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Modelling the ecological, behavioural and perceptual dimensions of outdoor recreation, using Loch Lomond as a case study.

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MA (Hons)

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Abstract

The primary objective of this thesis is to study outdoor recreation within a broad theoretical and policy-relevant context. It is an investigation into the ecological, economic and behavioural-perceptual dimensions of recreation within relatively fragile environments, which are often claimed to be in need of conservation. The deep-seated conflicts between the differing demands placed on the Loch Lomond environment constitute a "capsule example" of similar conflicts played out in many recreationally-attractive environments the world over. World-wide issues are therefore explored through the case study of the Loch Lomond and Trossachs National Park, where field-work was carried out in 2003/2004. Qualitative and quantitative methods have been combined, namely: semi-structured interviews; a questionnaire survey; systematic observation (including a visual assessment of visitor-induced environmental damage survey); documentary evidence; and ecological surveys. A variety of econometric models have been created, including a travel cost model, contingent behaviour models and a contingent valuation model. Based on these models a "typical" day at Loch Lomond is valued at £20.53, with visitors willing to pay an <u>additional</u> £1.76 to fund environmental improvements. Looking at the particular environmental issues of noise, crowding and environmental damage, noise pollution appears to have the greatest influence on recreation enjoyment. Noise pollution is caused primarily by the use of personal watercraft ("jet-skis"). It was found that an asymmetrical conflict exists between jet-skiers and non jet-skiers.

The research project reveals that there is no simple relationship between the perception of and reality of environmental damage. Although visitor perception of environmental damage often differs from actual levels of environmental damage, the relationship is complex. In terms of "real" environmental impact around the loch area, the visitor-induced environmental damage survey estimates that just over 9% of the loch shore suffers from severe environmental impact. Ecological vegetation surveys also confirm that recreation pressure is a statistically significant influence on the presence/absence of plant communities, but that this ecological impact is spatially limited to specific sites around the loch.

Following on from both the perceptual and ecological results, policy and management implications are investigated and recommendations are provided – for example the implementation of a possible vehicle parking fee at various sites around Loch Lomond. It is suggested that recreational carrying capacity frameworks such as VERP should be applied, as they assimilate the ecological and social facets of outdoor recreation. An overall conclusion to the thesis is thus that a sustainable approach (framework) to recreation management, one that encompasses the perceptual and ecological dimensions of outdoor recreation, is the only way of maintaining the beauty and enjoyment of Loch Lomond – and, it is suggested, national parks world-wide – for present and future generations.

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Author's Declaration

This thesis embodies the results of original research carried out by the author between October 2001 and April 2006. References to existing works are made as appropriate. Any remaining errors or omissions are the responsibility of the author.

Gillian F. Dalrymple
April 2006

Chapter 1. Introduction

"Nothing is more striking than the first view of Loch Lomond: its spacious expanse of silvery water, its lovely islands, the rich meadows and trees by which it is bounded, and the distant scene of fading hills, among which Ben Lomond rears its broad and gigantic bulk, like an Atlas to the sky" (John MacCulloch (1824) in Mitchell 2001, 11).

1.1 General Introduction and Rationale

This thesis is concerned with the ecological and perceptual dimensions of outdoor recreation. Any study of outdoor recreation integrates a number of extensive issues. This thesis explores issues of recreation impact, in particular crowding, noise, environmental damage and visitor conflict. It investigates the potential use of the concept of recreational carrying capacity ("the level of recreation use an area can sustain without an unacceptable degree of deterioration to the character and quality of the resource or recreation experience." C.C.S., 1990), and the validity of a number of recreation management frameworks. It enters into the debate surrounding economic valuation of the environment (see for example Bennett and Blamey, 2001). In short, the thesis contributes to the ever expanding field of outdoor recreation and recreation management.

Although the notions of the thesis are transportable beyond the confines of a particular area, the specific purpose of this research project is to investigate the ecological, behavioural and perceptual aspects of outdoor recreation in the Loch Lomond area, Scotland. As seen in the above quote, Loch Lomond has long held a special place in the hearts of many Scottish people. It is an area of great scenic beauty and of much ecological importance. It is argued that in order to maintain the beauty, scientific significance and enjoyment of the Loch Lomond area for present and future generations, both the ecological and social impacts of outdoor recreation must be researched.

In July 2002 the Loch Lomond area was designated as part of Scotland's first National Park: the Loch Lomond and Trossachs National Park (LLTNP). This designation heralds an exciting and dynamic time for outdoor recreation in Scotland. As a consequence of National Park status there has been a rising demand for recreation activities in the Loch Lomond area, which may lead to two fundamental pressures: higher visitor numbers may lead to overcrowding and/or visitor conflict at certain sites, and hence reduced utility per visit; and secondly, higher visitor numbers may place more pressure on the natural environment. Sustainable environmental and recreation management is therefore a must: never has there been a greater need for recreation research to inform environmental policy. This thesis hopes to inform said policy for the National Park area, while at the same time expand academic knowledge through the integration of the ecological and social impacts of outdoor recreation.

Loch Lomond is set within the wider context of an often fraught and controversial Scottish environmental history. Scotland has, as a consequence of this history, the most concentrated pattern of private land ownership in the world (Warren 2002, 41), and countless debates have occurred, concerned with land management, policy, politics, environmental pressures and environmental conflict. Key historical events, such as the Highland Clearances[1] in the eighteenth and nineteenth centuries, and a long history of access controversy in both Scotland and the UK are only two of the many examples of historical debate (see Warren 2002). As Warren (2002, 36) notes, environmental management in Scotland was long criticised for being too sectoral in its approach and it was not until the 1990s that an integrated, and more hence more sustainable, approach was favoured. Scottish devolution from England in 1999 was salient here, leading to the creation of the Scottish Parliament and the Scottish Executive, and with the environment defined as a devolved issue, there is now a more integrated approach to environmental management in Scotland. Crucially, the 1949 National Parks and Access to Countryside Act established National Parks in England and Wales but not in Scotland. However, the devolved Scottish government created Scotland's first National Park. The National Park has allowed a substantial increase in resources devoted to integrated conservation, recreation, forestry, agriculture and socio-economic management. Striking a balance between the various land-uses and debates within environmental management remains a challenge for the future, where integration will remain paramount.

The rationale behind this research project is thus the belief that there is a need for an integrated multidisciplinary approach when studying outdoor recreation; little academic or policy-driven research currently exists to assimilate perceptual and ecological issues. The general research context in which the thesis is based is one of fragmentation. Whilst much research has been undertaken on the environmental impacts of outdoor recreation (see for example Liddle, 1997; Cole, 1995a&b; and Wall and Wright, 1977) and similarly many studies have been conducted on the social impacts of outdoor recreation such as crowding, noise and conflict (see for example Manning, 2001; Stankey, 1980; Graefe *et al*, 1984; and Lucas, 1964), little research attempts to combine methods and results from both the social and natural/biological sciences. This research project bridges this gap. It offers a unique perspective linking humanistic and scientific elements of recreation and its impacts. It is argued that in order to effectively manage the recreation resource, these social and natural science issues must be combined in a coherent whole and that this can be achieved through the adoption of relevant management frameworks. Recreational Carrying Capacity is an important conceptual framework within which to address these environmental and social aspects of outdoor recreation.

[1] The Highland Clearances were part of a process of agricultural change in Scotland when people were evicted from their homes to allow additional space for sheep, cattle and deer (Warren, 2002).

Thinking specifically about the Loch Lomond area, to date there is little research to understand how visitors perceive their environment and recreational experience, and how they feel about other visitors during their recreation experience. The thesis therefore develops outdoor recreation research in the Loch Lomond area. The social issues of crowding, noise and visitor conflict are investigated, as is the environmental issue of environmental damage, thinking in particular about recreation impact on vegetation. Following on from the statements of Phillips and Pugh (2001, 64), it is an original piece of work – i.e. it is empirical work that has not been conducted before. It is also cross-disciplinary, using different methodologies from the disciplines of Geography, Economics and Biology. Both qualitative and quantitative methods are combined.

The aim of this initial chapter is to set the context of the thesis and to orientate the reader with the writing to follow. To this end, the chapter states the aims and objectives of the research project; following on from this the study area (Loch Lomond, Scotland) is introduced; and finally the following thesis chapters are outlined.

1.2 Aims and Objectives of Research Project

The general aim of the thesis is to **analyse and synthesise the ecological, perceptual and behavioural dimensions of outdoor recreation in the Loch Lomond area**. Furthermore, the specific aims and objectives of the research project are as follows: (1) to study outdoor recreation in the Loch Lomond area, focussing on the water and associated lake margin environment; (2) to determine the more important factor to the "typical" Loch Lomond visitor, namely: perception and the social dimensions of recreation (crowding, noise, visitor conflict) or the actual environmental conditions of a site; (3) to investigate whether visitor perception of environmental damage differs from actual levels of environmental damage, again focussing on the water and associated lake margin environment; (4) to construct a model for perceived crowding and to assess whether the expectation of crowding impacts on recreation participation decisions; (5) to construct a model for perceived environmental damage and to assess whether the expectation of environmental damage impacts on recreation participation decisions; (6) to construct a model for perceived noise level and to assess whether the expectation of noise impacts on recreation participation decisions; and finally (7) to integrate perceptual and ecological findings in order to recommend future resource and recreation management options. Specific aims are identified for each individual methodology used, and are explored in following chapters.

In addition to the aims outlined above, it was decided that in order to focus the research project a set of research questions was required. These are as follows: (1) is it perception (crowding, numbers of people, visitor conflict) of recreation or actual/ "real" environment (environmental damage, vegetation, scenery) that affects recreation patterns/demand?; (2) do excessive levels of human encounter in recreation settings have adverse affects on recreation experience utility of a trip?; (3) does the expectation of crowding impact on recreation participation decisions?; (4) does the expectation of environmental damage impact on recreation participation decisions?; (5) does the expectation of high noise levels impact on recreation participation decisions?; and (6) what is the effectiveness of policy instruments for reducing noise/environmental damage/crowding?

Crowding, noise and environmental conditions are themes imperative to this thesis, and so four specific hypotheses have been created. These are:

- Crowding Hypothesis: high visitor numbers lead to overcrowding and reduced utility per visit.
- Noise Hypothesis: high noise levels result in reduced utility per visit.
- Environmental Hypothesis One: high visitor numbers place pressure on the natural environment.
- Environmental Hypothesis Two: visitor perception of the indicators of environmental damage differs from the actual level of environmental damage.

The following chapters will achieve the aims and objectives, and discuss the above hypotheses.

1.3 The Study Area: Loch Lomond, Scotland

1.3.1 Description of Loch Lomond area

Located in the central belt of Scotland (see figure 1.1), Loch Lomond is the largest inland waterbody and largest stretch of freshwater in Great Britain. The loch itself is twenty-three miles long and up to five miles wide and includes great physiographic, climatogical and biogeographical variation. This unique environmental setting can be attributed to the Highland Boundary Fault, which geologically divides the area. Mitchell (2001, 12) describes the loch as an "elongated triangle", with a narrow and deep northern half and a wide and relatively shallow southern end. Both these northern and southern basins differ in character – with different underlying geology, topography, soil, land uses and ecology (see box 1.1).

> *"The loch has two main basins... The northern basin is long, narrow and deep, with a mountainous, base-poor rocky catchment (mainly used for sheep-grazing), while the southern, in contrast, is shallower, with a lowland, base-rich, agricultural, more populated catchment. These catchment differences are reflected in both water chemistry and algal measurements, which indicate more nutrient poor, or oligotrophic, conditions in the northern basin compared to the more productive, mesotrophic, conditions found in the southern basin".*

Box 1.1: Description of Lomond basins (Eurolakes 2004, 8 and 9).

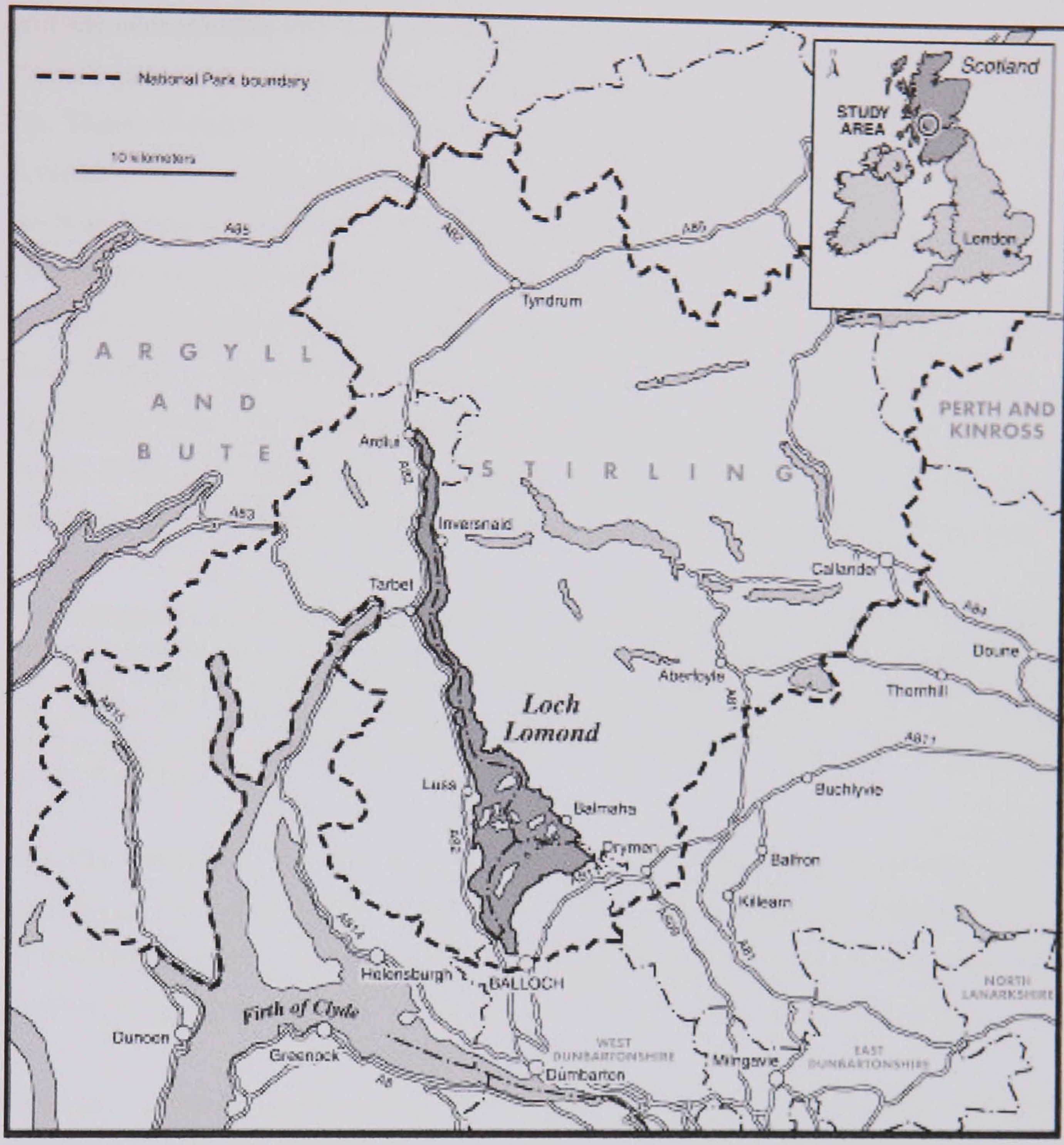


Figure 1.1: Location of Loch Lomond.

In terms of ecological significance, Loch Lomond has a high diversity of species, reflected in a wide range of habitat types and conditions (Eurolakes 2004, 2). There are a number of national and international conservation designations in the area including Sites of Special Scientific Interest (SSSIs), a National Nature Reserve (NNR) and a RAMSAR site. The area is, however, subject to a number of pressures including nutrient enrichment, invasive species (such as the alien wetland plant *Elodea nuttalli* Nuttall's Pondweed and fish species Ruffe), water level changes, and various land uses including agriculture, forestry and recreation. As a consequence of these pressures, coupled with the area being one of outstanding natural beauty, significant ecological interest and a vital scientific and economic resource, Loch Lomond was included in Scotland's first National Park "Loch Lomond and the Trossachs" – opened on July 24th 2002 by HRH Princess Anne.

The aims of the LLTNP are four-fold, namely: (1) to conserve and enhance the natural and cultural heritage of the area; (2) to promote sustainable use of the natural resources of the area; (3) to promote understanding and enjoyment of the special qualities of the area by the public: and (4) to promote sustainable economic and social development of the area's communities (LLTNPA 2003, 5.). These are ambitious aims and the integration of the various components is a challenging task. A National Park Plan, the first draft of which was issued for public consultation during May 2005, has been devised in an attempt to balance these four statutory aims. Although at time of writing the Plan is only available in draft form, a number of priority objectives have already been identified. In terms of aim three and the "National Park Experience" (and hence the concerns of this thesis), these include: "reviewing site management at places where anti-social behaviour occurs" (LLTNPA 2005a, 178); "monitoring noise from recreation activity on Loch Lomond" (LLTNPA 2005a, 198); and "promoting a comprehensive visitor monitoring framework with partner organisations" (LLTNPA 2005a, 183). It is also important to recognise that the Plan states:

"the designation of the National Park and the rise in leisure and recreation activity in society generally are likely to result in increases in the numbers of visitors to the area. The Plan is not, at this time, seeking to limit the numbers of visitors to the area as a whole. However, it is important that leisure and recreation activities are only promoted in locations where there is capacity *(researcher's emphasis)* to cope without damage to the local environment and its special qualities" (LLTNPA 2005a, 178).

The Plan recognised that the LLTNP must strive for sustainability, integrating conservation, recreation and the many other land-uses present in the area (see Ireland *et al* (1998) for a discussion of sustainable resource management in the Loch Lomond area). Research into the social and environmental impacts of recreation is one step towards achieving such sustainability[2].

Demand for outdoor recreation in the Loch Lomond area is high: visitors travel to the loch from not only the central belt of Scotland (at its closest point the loch is no more than thirty kilometres (eighteen miles) from Glasgow, the most populous city in Scotland), but also from elsewhere in the U.K. and abroad. The area's water and land resources contribute to this popularity. The main activities in the LLTNP are picnicking, hill-walking, sightseeing, angling, boating and jet-skiing. The current stance of the Loch Lomond and Trossachs National Park Authority (LLTNPA) towards boating and jet-skiing is that all motorised craft must be registered with the LLTNPA before they can be used on Loch Lomond, and registration is currently free. Craft can be launched from two primary sites at Lomond: Drumkinnon Bay (at the south end of the loch) and Milarrochy Bay (on the east shore), but no formal zoning is in place. Both slipways have rangers on-site and also launch all other boating craft. Currently all boaters and jet-skiers must adhere to the Loch Lomond Byelaws. The byelaws state that care should be taken when navigating the loch, and rules of

[2] Sustainability has environmental/ecological, social, economic, and political components, all of which overlap. There are many, often contested, definitions of sustainability in both academic and policy literature (see Mitchell, 2002). However, the most frequently quoted definition is that of sustainable development provided by the report *Our Common Future*, namely: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, 1987).

navigation are given, including speed limits. There is a statutory 11 kilometres per hour speed limit within 150 metres of all shores, both mainland and island. A "dead slow" speed limit is required in "the Narrows" and in all rivers. In addition, the byelaws state that "no person shall navigate a boat anywhere on the Loch at a speed in excess of 90 kilometres per hour or in excess of whatever lower speed is safe under the prevailing conditions, without the prior approval of the Authority" (Loch Lomond Regional Park Authority 1995, 15).

A favourable location, high accessibility and great scenic beauty make Loch Lomond one of the most popular areas for outdoor recreation in Scotland. Indeed, recreation and tourism have become the mainstay of the local economy. It has been suggested that up to three million recreational visits per year are made to the Loch Lomond area (*Pers. comm., Forestry Commission Employee*) and it is expected that as the National Park becomes increasingly well known, demand for recreation and tourism in the area will continue to increase. Dickinson (1996) suggests that recreation pressure on the environment is compounded by two factors: access issues and a concentration of leisure use in time. Approximately 75% of trips to Loch Lomond occur on Sundays, with a further 20% on Saturdays. Further, the period between mid-April and late September accounts for about 80% of all visits (Dickinson 1996, 25). Recreation is also spatially constrained, and so there is a clustering of activities where access is available. Dickinson (1996, 27) concludes, "the overall patterns of recreational impact on Loch Lomond can be summarised as being of limited spatial extent but of significant degree in affected sites". It is the levels of high use in a limited spatial area within a short time period that cause greatest environmental and social impact and hence must be of priority for the LLTNPA. The Loch Lomond area is fragile, requiring careful management. It is the "jewel in the crown" of the Loch Lomond and Trossachs National Park (Maitland *et al* 2000, 181). The following section introduces specific locations within the National Park boundaries. These locations are popular outdoor recreation sites.

1.3.2 Field Site Characterisation

Figure 1.2 indicates the location of the main field sites under study during the course of the research project, namely: Milarrochy Bay, Sallochy, Rowardennan, Firkin and Drumkinnon Bay. Milarrochy Bay, Sallochy and Rowardennan are located on the eastern shore of Loch Lomond, Firkin is located on the west, while Drumkinnon Bay is found to the South of the Loch. The east side of Loch Lomond is viewed by many as "quieter" than the west, primarily because of the termination of the eastern B-class road at Rowardennan and the continuous stretch of the main A82 road along the west shore of the loch. As a consequence of the main A82 road on the west shore, which is the main route to the highlands of Scotland, Firkin is very popular with tourists, while local visitors more often frequent Milarrochy Bay, Sallochy and Rowardennan.

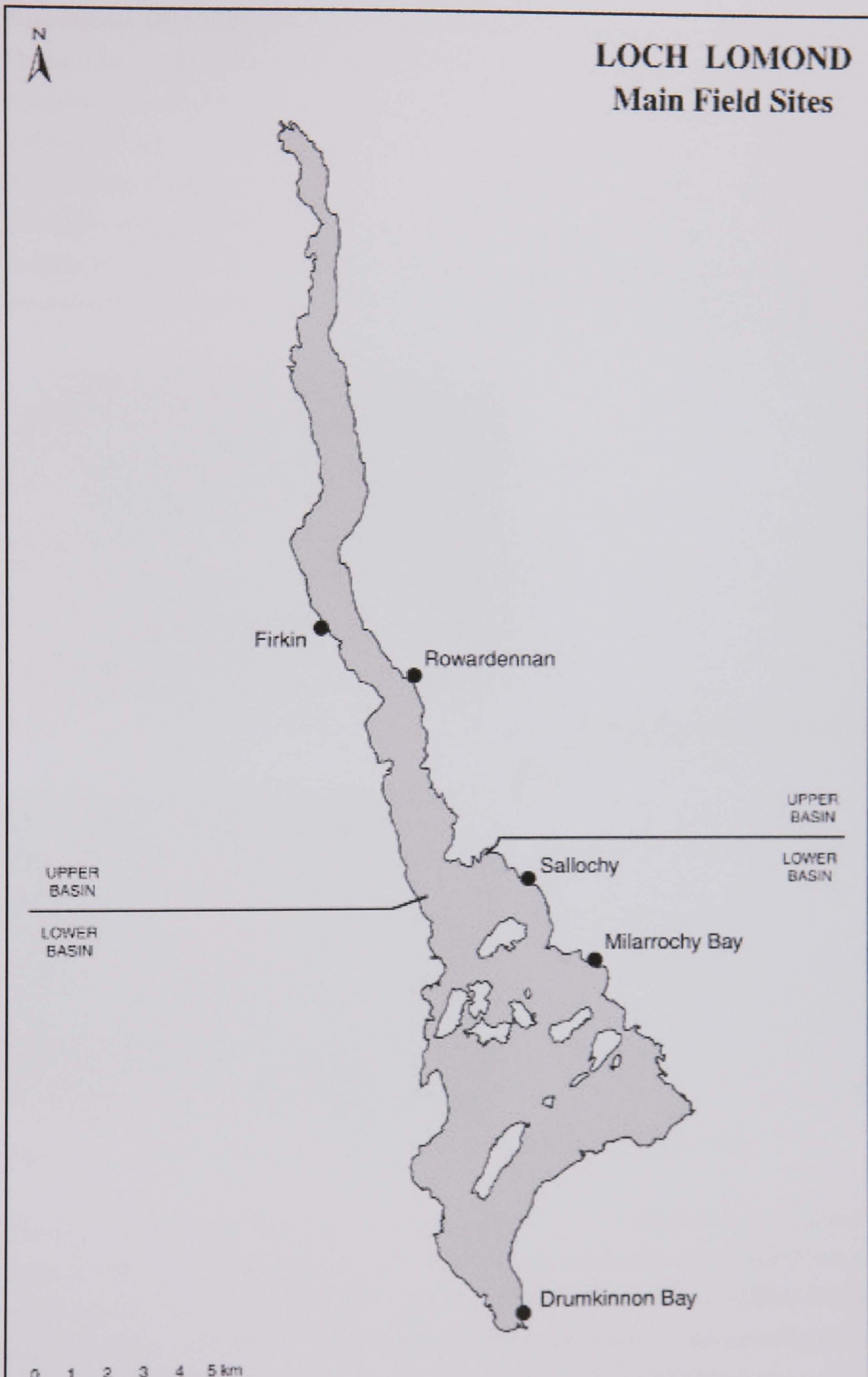


Figure 1.2: Location of main field sites, Loch Lomond, Scotland.

Rowardennan and Sallochy are both, although part of the LLTNP, partly managed by the Forestry Commission. Although a small beach is present at Rowardennan (see figure 1.3), it is a site primarily used as a base car park from which to climb Ben Lomond. Toilets and a small information hut, with information boards, a pier and some benches are also located at Rowardennan. Sallochy is a smaller site (see figure 1.4); it is home to both a beach and car park and is also the start of forest trails. The dominant recreation use here is therefore picnicking and walking of the forest trails. Boat launching is prohibited, however, some boat users are still determined to launch their craft, often causing degradation of the shoreline and the vegetation.

Figure 1.3: Beach at Rowardennan *(Photograph taken by author on Sunday 24th August 2003).*

Figure 1.4: Sallochy *(Photograph taken by author on Sunday 24th August 2003).*

Conversely, official boat launching facilities are present at both Milarrochy Bay and Drumkinnon Bay (see figures 1.5 and 1.6 respectively). Both sites are managed by the LLTNPA and provide secure parking, boating slip-ways, beach access, picnic areas and toilets (in addition Drumkinnon Bay has shower facilities). A range of activities are experienced on site including picnicking, boating, jet-skiing and walking. Wardens and/or rangers are to be found on both sites.

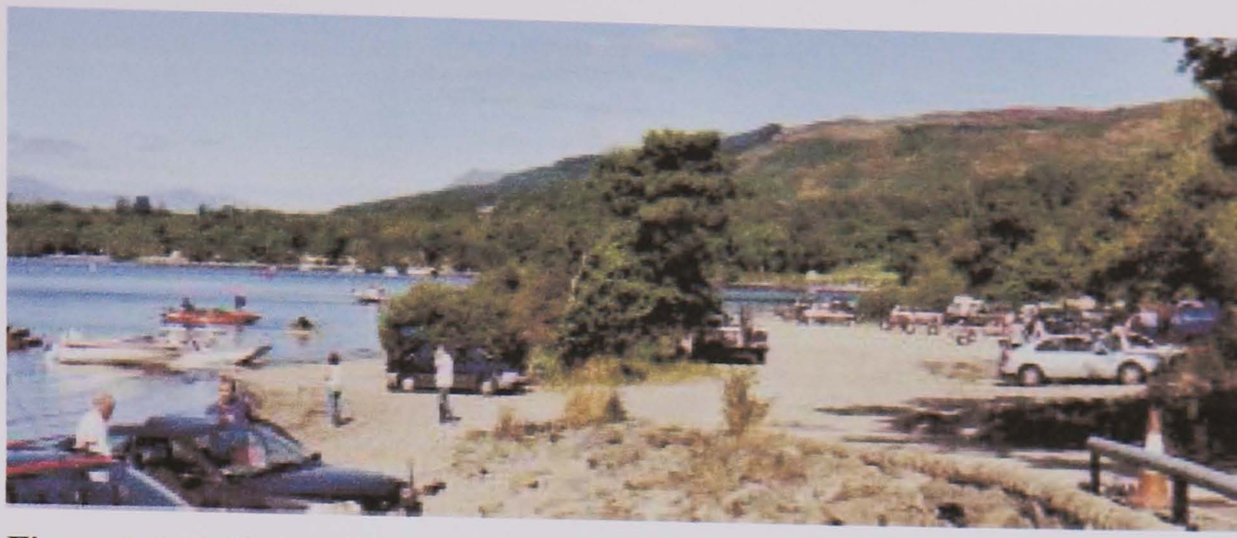


Figure 1.5: Milarrochy Bay – beach and boating slipway *(Photograph taken by author on Sunday 24th August 2003).*

Figure 1.6: Drumkinnon Bay - boating slipway *(Photograph taken by author on Sunday 3rd September 2000).*

Finally, Firkin (see figure 1.7) is a picnic area and car park located on the west shore of the Loch. Although there are no rangers located on site, there are toilet facilities and information boards. There is also access to loch shore walks from the picnic area (along a level surfaced path covering three miles). Subsequently, the main activities here are picnicking and gentle walks along the shore.

Figure 1.7: Firkin – car park *(Photograph taken by author on Sunday 4th July 2004).*

It is significant that at Rowardennan, Milarrochy Bay. Firkin and Drumkinnon Bay gates are present. This allows the LLNTPA to set opening hours for the sites (typically 8:30am until 10:30pm during the summer months) and to prohibit entry when the sites are deemed to be full. At Sallochy no gates are present, allowing access at all hours. Following chapters will explore the implications of this management practice and the geographical differences of each site in more detail.

1.3.3 Previous Loch Lomond Research

Several empirical studies have been concerned with the environmental impacts, or visitor perception, of outdoor recreation in the Loch Lomond area (see Dickinson, 1994; Dickinson. 2000a&b; Hansom and McGlashan, 2000a&b; Murphy *et al*, 1994b; Bannan, 1999; and Mitchell. 2001). In one of the first studies of recreation and tourism in the Loch Lomond area, Nicholls (1968) suggested that the recreational value of the area could be maximised without detriment to landscape, if demand was concentrated around the southern end of the loch and at Balloch in particular. Nicholls (1968) believed that this would remove pressures from other, more vulnerable areas. Since the new "gateway" to the National Park and the recreation site of Drumkinnon Bay are both located in Balloch, Nicholls' vision has been realised.

Brown (1974) provided a more general recreation study based on visitor perceptions, aiming to "study the different kinds of visitor and their patterns of activity in order to indicate the extent to which existing resources are used, the adequacy of various sites for visitor requirements and the existing conflicts between recreation and other land uses". From July to September 1972 detailed surveys of selected recreation sites around Loch Lomond included traffic movements, the supply of parking space and parked vehicle counts. Questionnaires were issued to a random sample of departing vehicles from the sites and photographs taken of the site's character and main recreational uses. A boating survey was also made in order to determine how the loch itself is used for recreation. Brown (1974, 131) found that 93% of visitors to the east shore came by car with an average vehicle occupancy of 3.5 persons. 64% of visitors were Scottish with 53% from counties surrounding Loch Lomond. Sunday was found to be the busiest day of the week and 75% of visitors were on a day trip. Brown (1974) concluded that on the east shore of Loch Lomond, demand occasionally exceeded supply but that the capacity of the parking areas was flexible enough to cope.

Tivy (1980) provided an ecological study on the effects of recreation on freshwater lochs and reservoirs in Scotland aiming "to carry out a systematic study of recreation relevant to lochsides in Scotland and to investigate the nature of the effects of recreation on selected lochsides". Tivy's report provided data on the ways in which lochsides are used for land and water-based recreational activities and assessed the vulnerability of the lochside to such activities. Loch Lomond, according to Tivy, was "the most intensively used loch in Scotland" with recreational impacts including pedestrian trampling, rolling by vehicles wheels, digging, construction, abrasion, burning and litter. She also noted the importance of non-recreational impacts such as natural wind-generated waves acting as agents of erosion, a feature noted with Dobson (1979). Tivy (1980) concluded a need to reduce lochside vulnerability by promoting community awareness of the effects of recreation via information and education.

Similar studies have focused on the impacts of water-based activities and boat use in Loch Lomond. Adams *et al* (1992) and Grant and Adams (1999) investigated temporal and spatial patterns of boat use on Loch Lomond, finding boat traffic to be greater in the south than in the north of the Loch. Recreational boating on Loch Lomond was becoming increasingly popular, especially in the summer months.

Dickinson (2000b), in a general study of recreation in the Loch Lomond area, defines both reality ("what do people actually see") and perception ("how do people react to what they see and experience through their senses"). He notes, "perception is an important element in the recreational experience" (Dickinson 2000b, 240) and that recreational carrying capacity varies from place to place. Thus recreation management has two main objectives: to sustain the recreational experience and to protect the internationally important ecosystems and landscapes of the area (Dickinson 2000b, 233). Dickinson (2000b) claims that the designation of the Loch Lomond and Trossachs National Park allows for integrated and holistic management to occur. Scepticism regarding the designation of Loch Lomond and the Trossachs as Scotland's first national park does, however, exist elsewhere (see Warren, 2002).

Warren (2002) discussed the background to National Park designation in the Loch Lomond area, noting that the road to the creation of Scotland's first national park has been "long and tortuous" and providing an excellent table of the key events in the Scottish National Park debate (see table 1.1). He offers an informative discussion on the background to National Park designation, and states, "the battle for national parks in Scotland has been won. Ahead now lies the challenge of making them realise their positive potential" (Warren 2002, 219). Key to realising this potential is the Park Authority aim of promoting public understanding and enjoyment of the special qualities of the area.

Date	***Event***
1928	The *Scots Magazine* campaigns for national parks.
1931	Addison Committee's recommendations for UK national parks include Scotland.
1945/1947	Ramsay Reports recommend five publicly-owned national parks; objectives included scenic and wildlife protection; development of public access and recreation; enhancement of rural life and industries.
1948	National Park Direction Areas introduced to provide development controls in Ramsay's five areas; existed in planning system until 1980 when replaced by National Scenic Areas (NSAs).
1949	National Parks and Access to the Countryside Act excludes Scotland.
1974	Countryside Commission for Scotland (CCS) publishes *A Park System for Scotland*, recommending 'Special Parks' not national parks.
1988	Loch Lomond Regional Park created, administered by a Park Authority.
1990	CCS publishes *The Mountain Areas of Scotland*, identifying pressures in the uplands and recommending wide-ranging solutions including national parks.
1991	Natural Heritage (Scotland) Act introduces Natural Heritage Areas (NHAs). Designation never used, but seen by some as a uniquely Scottish (and preferable) alternative to national parks.
1992	Scottish Office rejects CCS's call for national parks, but establishes working parties to identify solutions for Loch Lomond Trossachs (LLT) and Cairngorms areas; national parks specifically excluded as an option.
1993	Working parties publish their reports (LLT Working Party in 1993, Cairngorms Working Party in 1993).
1994-5	Secretary of State responds to working part reports; establishes the Cairngorms Partnership and the Loch Lomond Joint Committee.
1994	International Union for Conservation of Nature (IUCN) publishes the *Parks for Life*, identifies Scotland as an area where 'action is now urgently required'.
1996	Scottish Office review of natural heritage designations skirts round National Park issue; makes positive comments about NHAs.
1997	Scottish Wildlife and Countryside Link (SWCL) publishes *Protecting Scotland's Finest Landscapes*, a powerful case for a new 'top-tier' designation which should be entitled 'national park'.
1997	Secretary of State announces that the government is committed to a National Park for LLT, and probably for the Cairngorms.
1998	Scottish Natural Heritage (SNH) publishes a consultation document on the principle of national parks in Scotland.
1999	SNH publishes its Advice to Government, with detailed recommendations for national parks.
2000	Scottish Executive consults on the enabling legislation for national parks.
2000	The National Parks (Scotland) Bill is passed unanimously by the Scottish Parliament.
2000-1	Detailed consultation on the names, boundaries, functions, powers, authority, representation and operation of proposed national parks in LLT and Cairngorms. Boundary for LLT decided in June 2001.
2002-3	Creation of the first national parks in LLT and Cairngorms.

Table 1.1: A chronology of the key events in the Scottish National Park debate. Compiled by Warren from numerous sources. (Source: Warren 2002, 212.)

1.4 Thesis Outline and Concluding Comments

This chapter has set the context of the thesis. To reiterate, the aim of this thesis is to investigate the ecological and perceptual dimensions of outdoor recreation, using Loch Lomond, Scotland as a case study. In particular the themes of crowding, noise, visitor conflict and environmental damage are studied. Throughout this thesis it is maintained that there is a need for an integrated cross-disciplinary approach when studying outdoor recreation. Ecological and social impacts must be addressed in order to effectively manage an outdoor recreation area.

Following on from this initial introductory chapter, chapter two reviews the relevant recreation literature. Chapter three discusses research methods, while chapters four and five present the results of the research project. Chapter four is a crucial chapter, where perceptual data from the traffic survey, questionnaire survey and interviews are considered. Correspondingly, chapter five presents the ecological results, specifically the ecological survey and visitor damage survey findings. Chapter six then moves on to investigate these perceptual and ecological results through the examination of four themes: crowding, noise, environmental conditions and conflict (specifically the PWC debate as a case study). Chapter seven explores outdoor recreation and resource management by discussing management frameworks and strategies. It also offers some recommendations for the LLTNPA. Finally, chapter eight summarises all findings, suggests possibilities for future research, and indeed brings this thesis to a conclusion.

Chapter 2. Ecology, society and management: a multidisciplinary review of outdoor recreation literature.

"Robust theoretical links are important and necessary"
(Interviewee, Loch Lomond and Trossachs National Park Authority).

2.1 Introduction

The research project employs a multidisciplinary approach, seeking to bridge gaps between theoretical and empirical knowledge, and linking the ecological (environmental) and perceptual (social) aspects of outdoor recreation. It is recognised that while "recreation is a vital social issue and a rewarding form of human experience" (Pigram and Jenkins 2002, 1), it is also an environmental issue, with ecological impact and resource management implications. The purpose of this chapter is, therefore, to locate the research project within the relevant literature and theory.

As separate themes, literature on recreation and the environment, and conversely recreation and perception/social impact, is plentiful and many studies have been undertaken in the disciplines of Geography, Ecology, Economics and Psychology respectively. Lacking however is an integrated multidisciplinary approach; little research exists to integrate perceptual and ecological issues, either in the social or natural/biological sciences. Such an approach is attempted in the research project. Relevant literature is considered firstly by reference to the key concepts underlying the thesis. Embedded in this discussion is the concept of "recreational carrying capacity", which is seen as a way in which the various elements of the research may be linked. Theoretical background to the major themes of the thesis is then investigated: namely, crowding, noise, environmental impact, and management practices and frameworks. The sub-discipline of environmental economics is reviewed, and finally the chapter concludes by linking theoretical background to the current thesis.

2.2 Key Concepts

Before a consideration of the relevant literature and theory can be made, it is necessary to define the key concepts underlying this thesis. Perception, "the exercise of the human senses" (Warnock, 1967), is one of the many fundamental concepts investigated during this thesis and one which is highly relevant to any study of outdoor recreation. Indeed, for Driver and Tocher in Van Doren *et al* (1974, 95), "recreation itself is a state of mind". Research into perception began in the discipline of Psychology in the 1960s and gained much importance in the 1970s (see for example Barker, 1968; Proshansky *et al*, 1970; and Mussen *et al*, 1977) leading to the development of the sub-discipline of environmental psychology concerned primarily with peoples' relationship to the physical environment, and more particularly to the environment that they themselves have "created" (Proshanksy *et al*, 1970). The discipline of Geography, where research into human perception has become a popular element of study, is greatly influenced by environmental psychology. Studies of perception in the discipline of Geography were initially concerned with perception and place (see for example Watson (1975); and Lowenthal and Prince (1964) in their discussion of human perception of the English landscape). One of the most influential theorists concerned with human perception of the environment is Downs (1970). Downs claims that people behave depending on their image of the real world and that they are complex information-processing systems. He discusses "Geographic Space Perception", a conceptual schema for research into geographic space perception (see figure 2.1).

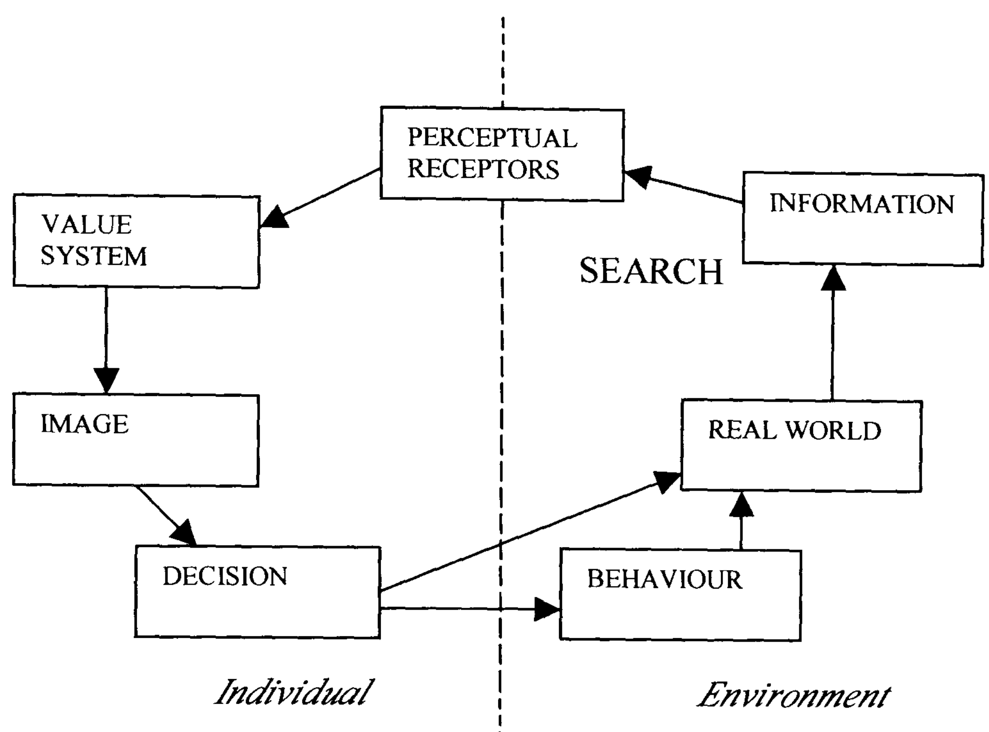


Figure 2.1: A Conceptual Schema for Research into "Geographic Space Perception" (Downs 1970, 85).

According to the Downs' schema, information enters the individual through a system of perceptual receptors and the meaning of the information is determined by an interaction between the individual's value system and their image of the real world (Downs 1970, 86). Such a schema could be applied to the notion of perception in outdoor recreation studies. Downs' paper is part of the wider "behavioural revolution" that occurred in human geography in the 1970s. For Downs (1970, 68) the "behavioural revolution" represents a "fundamental change in our conceptual approach to understanding human spatial behaviour, and is characterised by a more realistic view of man, in combination with the use of quantitative methods". The theoretical underpinning of behavioural geography (see Golledge and Rushton, 1976; and Cloke *et al*, 1991) influences the research project.

Behavioural geography developed as a consequence of dissatisfaction with the mechanistic models of people-environment interaction that existed prior to the 1960s, seen most notably in the case of environmental determinism (Walmsley and Lewis 1993, 1). The notion of a distinctive perceptual geography, concerned to elucidate the processes whereby individual human beings acquire, process and arrive at some conscious apprehension of spatial-environmental information, is hence associated with the rise of behavioural geography from the late 1960s onwards. An excellent general account of perceptual geography and its connections to behavioural geography is provided by Gold (1980), who states that behavioural geography is a study of human-environment relationships, which focuses on the way in which individuals interpret and assign meaning to the environment. Crucially those following a behavioural geography tradition argue that "the environmental cognitions upon which people act may well differ markedly from the true nature of the real world" (Gold 1980, 4). Further, Gold (1980) recognises that behavioural geography has a multidisciplinary outlook, often looking to environmental psychology for insight into behavioural processes. More generally the subdisciplines of humanistic geography (see Ley and Samuels, 1978) and the more recent cultural geography have addressed questions of perception (see, for example, Cloke *et al,* 1991). Overall, therefore, the issue of perception within the research project has a broad theoretical basis, encompassing elements of environmental psychology, behavioural geography, humanistic geography and cultural geography.

Within the theme of perception and outdoor recreation exists a further division in research to date. Often empirical research either involves studies of perception of other recreation participants (crowding and conflict studies) or perception of the environment. Wagar (1964) in his study of the effects of crowding on user satisfaction typifies the former research, while Lucas (1964) and his measurement of the environmental perception of recreational users in wilderness areas in the U.S.A. is an example of the latter premise. There is a need to integrate both of these perspectives on perception and recreation into a general model of perceptual carrying capacity.

Another key concept, and arguably one that deserves most attention to definition, is the concept of "recreation" itself. According to Burton (1971, 1) "recreation is not an easily defined, homogenous entity". However, a good attempt at definition is provided by Butler *et al* (1998, 3), who define recreation as "activity (or deliberate inactivity) that is voluntary and which is engaged in for the purposes of enjoyment and satisfaction during time which is free from obligations, i.e. during leisure time". Whilst there has always been an interest in recreation, serious academic research into outdoor recreation began in the post-war period and gained much importance in the 1960s and early 1970s – an era known as the "age of leisure" (Glyptis 1993, 4). Indeed, in the U.S.A. in 1962 a series of 27 official reports were published by the Outdoor Recreation Resources Review Commission (ORRRC) addressing issues such as wilderness, boating, predictions of participation levels and water pollution. Throughout the 1960s and 1970s there was the adoption of a spatial framework in the study of recreation patterns within the discipline of Geography (see Lavery, 1971; Taaffe and Gauthier, 1973; and Coppock *et al,* 1976). Undoubtedly recreation geography developed as a consequence of the increasing recognition of the importance of outdoor recreation for society; indeed today around 90% of those who live in Western countries participate in some form of outdoor recreation (Pigram and Jenkins 2002, 11).

The growth of outdoor recreation in the post-war period can be accounted for by a number of factors including increased leisure time, increased affluence and higher disposable income, increased holiday entitlements, and increased mobility (Pigram and Jenkins 2002, 13). As stated by Dickinson (1989, 1985) two important concepts underlie these factors, namely access and participation. Access is of significance because it determines the level of the depletion of the resource base as it implies "the ability of the recreationalist to get to and to use the natural resource base of the countryside – land, water, vegetation, scenery – for their activities" (Dickinson 1989, 90). Clearly if an area is accessible, particularly to car-borne visitors, recreational pressures can be considerable. Control of access to the countryside, through charging for car parking for example, can therefore be both environmentally and socially beneficial. Access is influenced by participation –"the rate at which particular activities are undertaken" (Dickinson 1989, 90). As expected, outdoor recreation trips in the U.K. are predominately taken at weekends and biased towards summer months (Patmore, 1983). Hence, at these times participation will be highest and environmental damage and/or social crowding/visitor conflict most likely.

A further key concept that deserves clarification is outdoor recreation "resource". O'Riordan (1971) in Pigram and Jenkins (2002, 57) defines a resource as "an attribute of the environment appraised by man to be of value over time within constraints imposed by his social, political, economic and institutional framework". In particular, recreation resources include vegetation, waterbodies, climate, landscape and so on. Thus, the "recreation resource base" (Pigram and Jenkins 2002, 59) describes the total natural values of the countryside. Recreation resources can vary in space and time. Clawson (1963) was one of the first theorists to recognise the importance of resource variability throughout space. For Clawson (1963, 13) outdoor recreation resources can be classified into three broad categories: user-orientated areas ("characterised by their close proximity to the residence of their users"); intermediate areas ("located further away from users' homes, but usually within a distance where they can be used for all-day outings, i.e. within two hours travel distance, for example water-based recreation"); and resource-based areas ("primary emphasis is upon the natural or human qualities of the site, much less emphasis upon the activities at the site, and almost none on the location factor", for example National Parks). Reality is of course more complicated than any of these three divisions and as such the area studied in this project appears to be defined as both an intermediate area (recognised by the importance of water-based recreation) and a resource-based area (Loch Lomond is part of Scotland's first National Park). Still, Clawson's classification of recreation resources has been influential in the development of resource management.

The final key concept of this thesis is "recreational carrying capacity", which is a valuable tool with which to integrate both the recreation experience and the ecological impacts of outdoor recreation. Initially derived from wildlife and livestock management, carrying capacity was first applied to the outdoor recreation field in the mid-1930s in the U.S.A. in a primarily ecological setting. Indeed, the concept of carrying capacity had previously been investigated in the discipline of ecology. A good example of this is the logistic population growth curve, in which carrying capacity is used to illustrate the equilibrium state of the growth of a population over time (see Krebs, 1978; Ricklefs, 1996; Jarvis, 2000; and Cherrett, 1989). According to the logistic curve, a population responds to the "maximum population size that the environment can sustain without degradation of that environment through overuse", i.e. the carrying capacity (Jarvis 2000, 149). Although the logistic equation, initially derived by Verhulst in 1838, has been criticised for being too simplistic in reality and only achievable in laboratory conditions (Krebs 1978, 204), in the context of outdoor recreation such curves, and the subsequent implication of ecological carrying capacity, do have value.

By the 1960s carrying capacity had obtained an additional social focus and it became a more integral part of the outdoor recreation field in the U.S.A. and later the U.K. Concerns of a rapidly increasing demand for recreation and the writings of the Outdoor Recreation Resource Review Commission (ORRRC) contributed to the expanse of carrying capacity studies (see for example Lucas, 1964). Today there are many interpretations of recreational carrying capacity in the literature (see Pigram, 1983; Patmore, 1983; Pearce, 1989; and Hall and Page, 1999). Most definitions attempt to combine both protection of the environmental resource base with the satisfaction, and behaviour, of visitors. One of the earliest definitions is provided by Wagar (1964) in which he states that recreational carrying capacity is "the level of recreational use an area can withstand while providing a sustained quality of recreation". This definition is inadequate, however, failing to explicitly state the four distinct facets of such a concept; namely the physical, ecological, perceptual and economic components. To this end the definition by the Countryside Commission has been widely accepted as reflecting the complexity and importance of such a concept: "recreational carrying capacity is the level of recreation use an area can sustain without an unacceptable degree of deterioration to the character and quality of the resource or recreation experience" (C.C.S. 1990, 2). More importantly, the Commission identified the four elements of recreation carrying capacity: physical capacity; economic capacity; ecological capacity; and social (perceptual) capacity.

Physical carrying capacity is defined by Pigram and Jenkins (2002, 91) as "the maximum number of people or equipment (boats or cars), which can be accommodated or handled comfortably and safely by a site". Here the capacity of car parks is crucial as this can modify visitor numbers and activities such as boat-use. An element of physical capacity may be imposed on an outdoor recreation site as an effective form of resource management – i.e. once a physical threshold has been reached the site is closed. Conversely, economic carrying capacity is traditionally defined as "the level of use of a site that is required to yield a given financial return" (Patmore 1983, 232). At the Loch Lomond sites under study, where no entry or user fee is charged, economic capacity does not, at first, appear significant. Further, for Pigram and Jenkins (2002) economic capacity relates to many different types of resource use, including non-recreational activity, and hence economic capacity will not be explicitly considered in the research project. It is argued that when addressing outdoor recreation, ecological and perceptual carrying capacity are of greater importance. It is important to realise, however, that perceptions are based on the utility of a visit, and as "utility" is an economic term with which to define enjoyment and satisfaction, perceptual carrying capacity is at least partly an "economic measure" of capacity.

Ecological carrying capacity is "the maximum level of recreational use, in terms of numbers and activities, that can be accommodated by an area or an ecosystem before an unacceptable or irreversible decline in ecological value occurs" (Pigram and Jenkins 2002, 91). This is a prime concern and is often site-specific, related directly to recreational impacts and environmental damage – illustrated by "scars of popularity" (Patmore 1983, 227) such as vegetation trampling. For Pigram and Jenkins (2002, 92) any study of ecological carrying capacity must take account of the nature of the plant and animal communities affected by recreation activity, and the nature of the recreation activity itself. In addition, Patmore (1983) notes that ecological carrying capacity is as much a matter of management objective as level of use. For Patmore (1983, 228) an analysis of the management of ecological carrying capacity must involve either recreational activities exerting a minimal modifying influence over the resource (retaining the ecological status quo); accepting some ecological change; creating an ecosystem suitable for intended use; or attempting a laissez-faire approach, effectively ignoring any management practices.

For the application of ecological carrying capacity to be viable and hence of practical use to resource managers, it must be combined with the establishment of a perceptual carrying capacity. Perceptual (social) carrying capacity is "the number of people a site can absorb before the latest arrivals perceive the area to be 'full' and seek satisfaction elsewhere" (Patmore 1983, 223). More than this, perceptual carrying capacity relates to "visitor's perception of the presence (or absence) of others … and the effect of crowding on their enjoyment and appreciation of the site" (Pigram 1983, 69). In an economic sense this is the utility per visit. Here three cases are possible: 1. crowding/visitor conflict is so high that visitors decide to visit somewhere else; 2. crowding/visitor conflict reduces utility per visit so one makes less visits (but still visit the site); or 3. there is no change in the number of visits (i.e. utility per visit does not change as a consequence of crowding/visitor conflict).

The term "perceptual" carrying capacity is often used interchangeably with the term "social" carrying capacity. Essentially both concepts are concerned with visitor tolerance levels (including crowding and conflict) <u>and</u> sensitivity to site characteristics (including perception of environmental damage). As Pigram and Jenkins (2002) note it is a subjective notion, linked to human psychological and behavioural characteristics. Moreover, it has cultural and temporal dimensions: it may change over space and time. Patmore (1983) believes that while perceptual carrying capacity is useful when addressing the overall impact of visitors at a recreation site, it is difficult to measure and has thus not been adopted by many academics or practitioners interested in recreation. For many, perceptual carrying capacity is difficult to adopt in practice and has no simple or absolute value (Tivy, 1972; Lime and Stankey in Van Doren *et al*, 1974; Wall, 1983; and Barkham, 1973). A major deterrent to the application of a perceptual carrying capacity model has been that the relationship between use and impact is affected by many factors including type of recreation activity; its timing and distribution; and the environment where use occurs (Pigram and Jenkins 2002, 96). It is maintained, however, that these problems can be eliminated through the application of a rigorous methodology, which integrates the perceptions of the user with the actual capacity of the environment to meet these demands.

Today it is widely agreed that no one carrying capacity for an outdoor recreation area exists (see for example Manning, 2001; Pigram and Jenkins, 2002; and Hall and Page, 1999). Rather, there are a number of different carrying capacities depending on an area's management objectives. Many maintain that there are many difficulties involved in establishing carrying capacities and the term "recreational carrying capacity" has been subject to a great deal of criticism. Shelby and Heberlein (1986, 4) recognise three primary difficulties when establishing carrying capacities: (1) people have different wants, leading to different carrying capacities for different situations; (2) any use produces some change, and it is difficult to recognise how much change is too much; and (3) the number of users is sometimes a poor predictor of impact; even low amounts of use, for example, can severely impact plant communities. A further critic of carrying capacity is Lindberg who argues that carrying capacity is complex, a multi-dimensional concept, of little practical use, subjective, and a "misguided simplicity" (Lindberg *et al*, 1997). His subjective claim in particular is adhered to by many including Sidaway (1994) who states that "capacity is after all what we care to make it". Whilst all of these criticisms are valid, this thesis advances the argument that when placed within an overall management framework, carrying capacity can become a valuable tool with which to assess recreation pressure. It is important to recognise that "one of the most important developments in our understanding of the carrying capacity concept over the past thirty years is that carrying capacities are the product of value judgements as well as science" (Hendee *et al* 1990, 218). The term "recreational carrying capacity" remains valuable today when addressing environmental and social issues in a recreation area and indeed "carrying capacity can be useful as an outdoor recreation management concept when viewed in proper perspective – as an organizational framework for determining and managing appropriate outdoor recreation opportunities" (Manning 2001, 78).

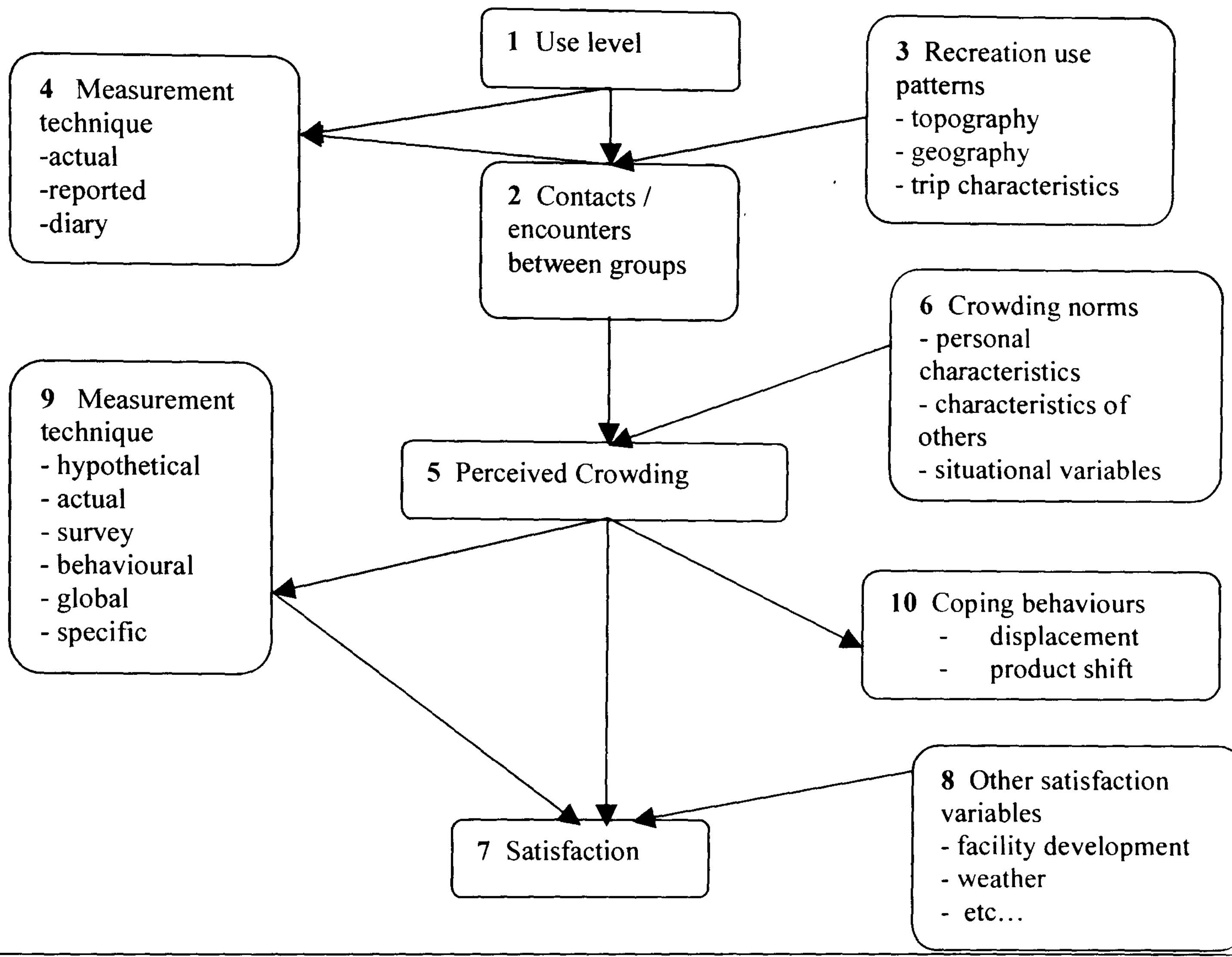
One of the few empirical academic studies which attempts to integrate perceptual and ecological carrying capacity into a general recreational carrying capacity is provided by Burton (1974). Based at Cannock Chase, Staffordshire, the main objectives of Burton's study were to test the hypotheses that the quality of the recreational experience is related to the prevailing conditions of crowding, and that different intensities of recreational use cause proportional degrees of ecological damage (Burton 1974, 33). Burton (1974) discovered that there is no evidence that the level of ecological damage as it exists at Cannock Chase was in any way unacceptable to the visitor. However, she believed that there was a need for management plans for recreational areas to consider ecological and perceptual capacity as an aid to policy. She also suggested that visitors organise themselves spatially on the basis of their sensitivity to crowding.

2.3 Crowding – theoretical background

There are many definitions of the term "crowding" in the social science literature. For Westover and Collins (1987, 87) crowding is "a negative affective response to high levels of social density". A similar, but more recent, definition is given by Lee and Graefe (2003, 1). They define crowding as "a psychological state characterised by stress and having motivational properties... Crowding can be defined as a negative assessment of a certain density level in a given area". Both definitions illustrate the importance of differentiating between crowding and density. Put simply, while crowding is subjective and has a negative psychological meaning, density is a physical construct, i.e. the number of people in a given area. Crowding is therefore a negative psychological evaluation of density (for a further discussion of this differentiation see Gramann, 1982; Manning, 2001; and Shelby and Heberlein, 1986).

The impact of crowding on the recreation experience has been documented by many social scientists. A number of different models have been created to conceptualise crowding in outdoor recreation settings (see for example Manning, 2001; Graefe *et al*, 1984; Gramann, 1982; and Hammitt, 1983). Many of these models are based on Wagar's (1964) notion of social carrying capacity. Wagar (1964) claims that too many people in an area result in overcrowding and reduced recreation enjoyment. For Graefe *et al* (1984) a social carrying capacity framework must determine why visitor enjoyment is reduced, and achieve this through building upon a basic understanding of recreationists' motivations. They argue that there is a need for a social carrying capacity conceptual framework, as this helps to explain the diversity and complexity inherent in visitors' experience evaluations. Social carrying capacity, then, states that there is a certain level of crowding beyond which the quality of the recreation experience diminishes. It is this notion that has contributed to a number of crowding models in the recreation literature and it is a suitable framework on which to base theoretical and empirical crowding research.

Manning (2001) provides one theoretical crowding model particularly relevant to social carrying capacity. He suggests that crowding is influenced by a number of issues and offers what he calls "an expanded crowding model", which is based on a number of previous theories of crowding as examined in following paragraphs. Manning's (2001) expanded crowding model is shown in figure 2.2.



"The expanded model recognises that recreation use level (box 1) results in contacts between groups (box 2), but that other variables affect contacts as well, including topography, geography, and the complexities of trip patterns (box 3). Moreover, the way in which contacts are measured will affect the ultimate number derived (box 4). Second, the model shows that contacts between groups affect perceived crowding (box 5), but so does the way in which these contacts are interpreted (box 6). Crowding norms based on personal characteristics of visitors, the characteristics of those encountered, and situational variables affect the point at which contacts are evaluated negatively. Third, perceived crowding affects overall satisfaction (box 7), but is only one of theoretically many variables to do so (box 8). Moreover, the relationship between perceived crowding and satisfaction depends on measurement techniques (box 9). Finally, feelings of perceived crowding can result in displacement of some users, so their satisfaction is not measured, or some users may simply redefine the type of recreation opportunity they experienced (box 10)" (Manning 2001, 118).

Figure 2.2: An expanded crowding model.
(Source: Manning 2001, 94 and 118.)

Manning's theoretical model offers a comprehensive and realistic model of crowding in outdoor recreation settings. It includes a number of previous crowding concepts including the satisfaction model, normative approach and perceived crowding model. The satisfaction model in particular is especially relevant to the current research project. It assumes an inverse relationship between use level and satisfaction; namely increased use causes decreased satisfaction. Figure 2.3 illustrates this relationship graphically.

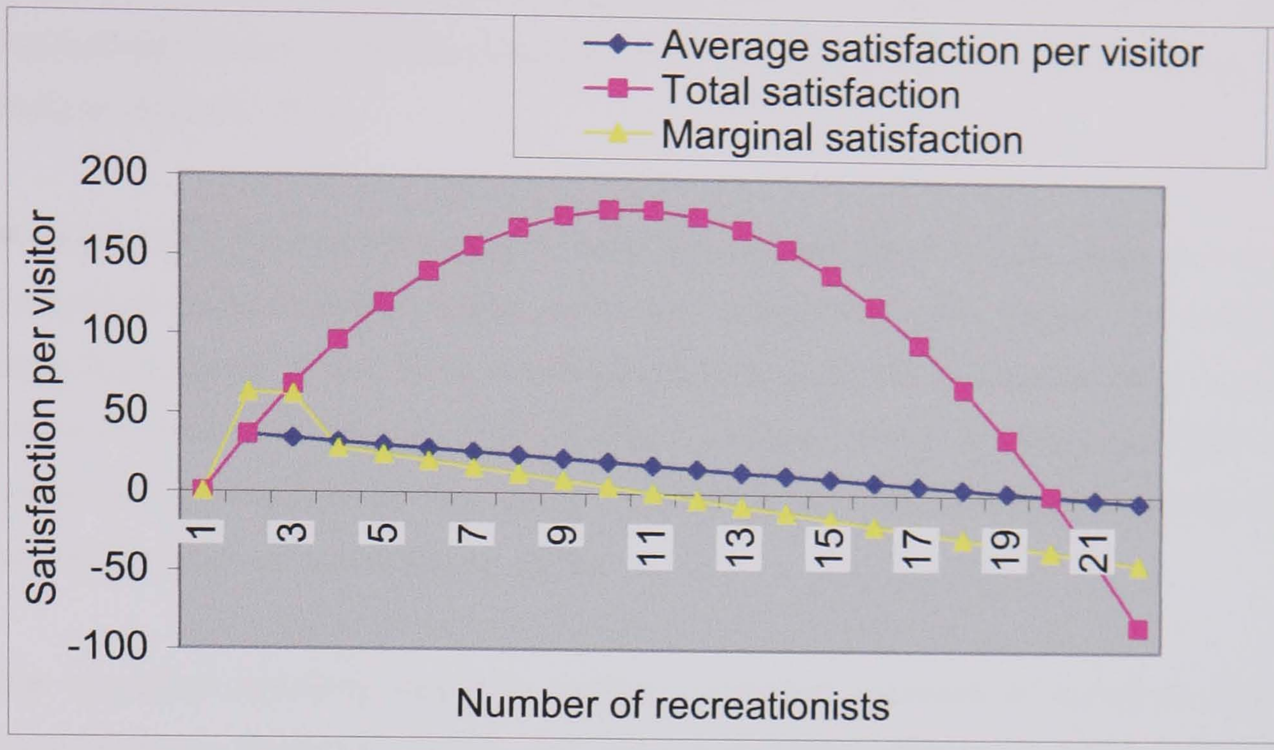


Figure 2.3: Hypothetical relationship between increasing visitor use and satisfaction. (Source: Manning 2001, 85.)

As seen in figure 2.3, the satisfaction model assumes that as the numbers of visitors to an area increase, satisfaction will eventually decrease. The graph differentiates between average, total and marginal satisfaction and, according to Alldredge (1973) in Manning (2001, 86), when total satisfaction is at its highest (i.e. the tenth visitor has been added in figure 6.2) social carrying capacity has been reached. At this point marginal satisfaction equals zero. The satisfaction model refers to the individual's perception of crowding and assumes that there is no level below which satisfaction increases, i.e. all visitors prefer no crowds. As shown in figure 2.4, and explained in later paragraphs, reality is more complex than this simple model. Nevertheless, the satisfaction model has been tested in a number of empirical situations (see for example Gramann and Burdge, 1981; Hammitt, 1983; and Westover and Collins, 1987). In the majority of these studies only a weak statistically significant relationship was found between use level and satisfaction. In many cases the crowding variables were not statistically significant at all. Findings such as this suggest that there are a number of other conceptual issues other than density to address when thinking about crowding levels and visitor enjoyment in recreation settings.

The normative approach is another means by which to think about crowding and is thus included within Manning's expanded crowding model. Normative theory distinguishes between the concepts of use level and crowding. Use level is related to the physical density of a recreation setting, i.e. the number of people per unit of space; while crowding is the negative, subjective psychological evaluation of use level (Stokols, 1972). Use level may increase to a point where it is perceived to interfere with one's activities or intentions, but only at this point does crowding occur.

Thus, crowding is a normative concept, dependent on a variety of circumstances. Use level is not interpreted negatively as crowding until it is perceived to interfere with or disrupt one's objectives or values: their social norms (Manning 2001, 100). Normative theory therefore offers a social-psychological theory of human crowding; it introduces personal and social variables into crowding analysis (Stokols, 1972).

Manning (2001) proposes a variety of these personal and social factors, which influence normative interpretations of crowding. These can be seen in figure 2.2. An example of a normative claim in crowding research is that many empirical studies support the notion that more experienced users are more sensitive to higher use levels (Hall and Page, 1999). In other words they have a lower social carrying capacity, or that "being crowded" is reception of excessive social stimulation and not merely a lack of space (Desor, 1972).

The perceived crowding model is another conceptual approach to crowding, and one that is included within Manning's model. Lee and Graefe (2003) offer good explanations for the theories of perceived crowding. For Lee and Graefe (2003) a perceived crowding model is related to the evaluative component of crowding. Crowding is complex; it is not necessarily "bad" and its effect depends on the particular set of social and psychological circumstances. Perceptions of crowding can be dependent on the area in question – for example in a wilderness area crowds are seen to be negative and destructive to the recreation goal of solitude, while at a fun fair crowds are necessary for recreation enjoyment (see figure 2.4) – and on personal preference. There are multiple social carrying capacities.

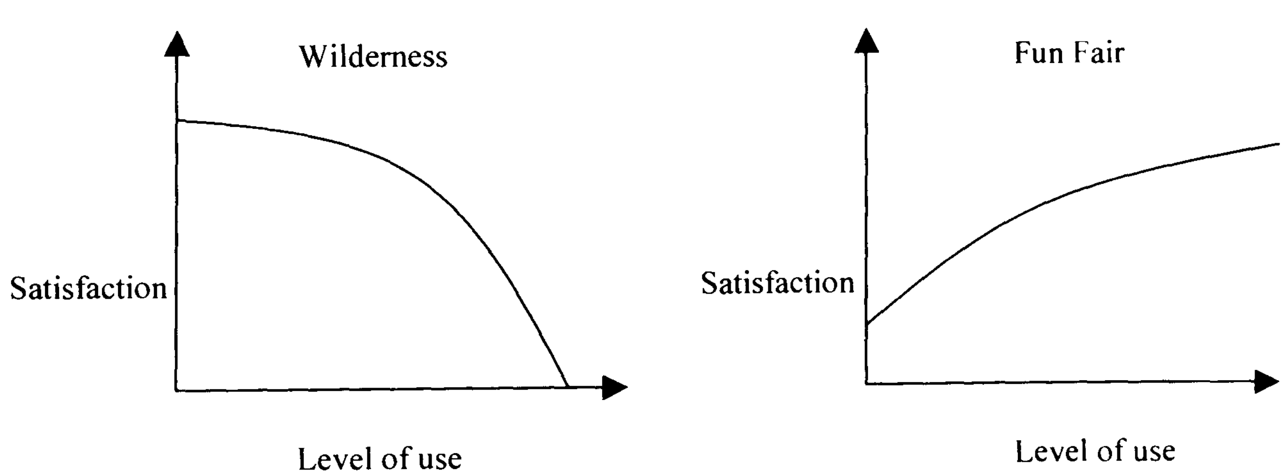


Figure 2.4: The effect of crowding on recreational satisfaction.
(Source: Pigram and Jenkins 2002, 94.)

There are also many theories of perceived crowding, three of which are addressed here. Firstly, there is expectancy theory, which advocates that people usually take part in recreational activities with the expectation of a particular reward, whether this be excitement, solitude, friendship, status and so on. It is a behavioural approach to crowding in recreation settings (see for example Gramann, 1982). A second theory of perceived crowding is stimulus overload theory. This states that high density can be unpleasant because it can overwhelm the senses. Finally, there exists social interference theory, which postulates that crowding occurs when the levels of density interfere with a visitor's activities and goals in a particular setting (Lee and Graefe, 2003). Regardless of which concept is used, all the perceived crowding theories assume that crowding perceptions are influenced by use densities, but this relationship is mediated by a variety of other locational and subjective variables (Graefe *et al* 1984, 409).

Shelby *et al* (1989) (in Hall and Page, 1999) identify four sources of variation in perceptions of crowding: temporal variation; resource availability; accessibility; and management strategies. As a consequence of perceived crowding a range of reactions or "coping strategies" are developed (see Hall and Page, 1999; and Freedman, 1975). For Hall and Page (1999) these are four-fold, namely: modifying behavioural patterns; changing time of visit or use; changing expectations and recreation priorities; and recreational displacement (where those who are more sensitive to recreational crowding seek alternative sites to achieve the desired outcomes). Again these strategies are incorporated into Manning's model, under box 10: coping behaviours.

2.4 Noise – theoretical background

In comparison with crowding studies, studies of noise levels have not received much attention in the theoretical or empirical recreation literature. Perhaps this is because actual measurement of noise is quite difficult and often controversial. Noise levels can have variable point sources, different intensities, and diverse patterns. The generic definition of "noise" is "unwanted sound" (RYA 1999, 5) and it is this definition that is adopted in the thesis. As Fay (1991) notes, like crowding, noise is subjective and evokes negative emotions and often strong reactions. Thus, a more complex definition of noise is "an audible acoustic energy that adversely affects the physiological or psychological well-being of people" (Kryter 1985 in Fay 1991, 1). All unwanted sounds are termed "noise" and this project is concerned with the psychological and behavioural impacts of noise, rather than any physiological reaction. In particular noise generated by personal watercraft (PWC) is examined. Other sources of noise are also investigated, including shouting and music played loudly on portable equipment and car stereos by groups of people on site.

Regardless of the source of noise, noise in an outdoor recreation setting can be identified as a "soundscape", which consists of sounds, the material objects which produce them, and "ultimately has more to do with civilisation than with nature" (Matless 2005, 749). Noise is often deemed to be out of place by those seeking to enjoy a quiet recreation experience (see sections 6.3 and 6.5). Technology is salient, and consequently the majority of studies of noise levels in outdoor recreation relate to PWC produced noise. The RYA (1999) state that there is a rise and fall in the pitch of PWC noise caused by the hull rising and falling on the water surface with the pump inlet and the exhaust alternately submerged and exposed. They argue that PWC noise is a problem for three main reasons: (1) the intermittent sound; (2) PWCs operate close to shore in company of other PWCs, resulting in a droning sound, which can be made worse by an onshore wind; and (3) it is a highly subjective issue – some visitors enjoy to watch the PWC and as spectators are not disturbed by the noise, while others prefer peace and quiet and find PWC highly disruptive to their recreation enjoyment (RYA, 1999). The latter point implies interesting links with the crowding model of Manning (2001), in that a variety of social and psychological factors influence visitor perception of noise. It is hence stated that "the offensiveness of noise is a function of not only its level, but also its context and the state of the mind or expectations of the listener" (Port Hacking Protection Society 2001, 7).

It is interesting that noise measurements suggest that the absolute (decibel) levels of PWC noise are not higher than other generally tolerated sources; it is therefore the intermittent noise that appears to "annoy" visitors. As such, those researching a person's perception of noise have long observed that varying noise is generally more disturbing than a steady noise – even when the steady noise is louder than the loudest of the varying noises (Komanoff and Shaw, 2000). The reason is that varying noise demands the hearer's continuous attention; it cannot be "tuned out". (For a good discussion of perception of noise see Komanoff and Shaw 2000, 21.) Boocock (2002) takes this argument further; he claims that as noise is measured on a logarithmic scale, small changes in decibel value (dBA) are equivalent to a substantial increase in energy levels which are perceived as noise. Using models of noise level he shows that a change in noise of 15 dBA results in an increase in noise intensity of 32 units, due in part to the craft's behaviour as it passes over waves or a choppy surface. Moreover the noise increase of 15 dBA is that for one craft, but on some days many PWC can be seen out on the water together, significantly multiplying the noise levels (Boocock 2002, 3).

Thinking about noise caused by factors other than PWC, more general theoretical statements concerning environmental acoustics can be made. Cowan (1994, 1) shows that problems with noise levels are often viewed as "a by-product of our technologically advancing and expanding society". Through a discussion of acoustics he shows that recreational activities may generate noise levels that can intrude on other people. Likewise, Fay (1991) states that noise is ambiguous and subjective; it evokes negative emotions. He argues, "sounds can influence our attitudes because of the information they convey" (Fay 1991, 94). In particular, when unpleasant information is being transmitted, such as loud music from an unwanted source, these sounds are perceived as annoying. For Fay (1991) there are a number of factors of annoyance in relation to high noise levels, i.e. a number of factors influence the unacceptability of certain sounds. These include: (1) feelings about the necessity or preventability of sound can determine its acceptability. When listeners feel that the propagators of an intruding sound are callous and indifferent to their presence/needs, the sound is more likely to be annoying, even at a fairly low level; (2) the type of activity affected determines how annoying a sound will be. Sensitivity to noise appears to be higher at those times when it interferes with sleep or relaxation. It is more difficult to accommodate a sound that interferes with relaxation (during passive recreation for example) than a sound that may be present during ordinary everyday activities; (3) feelings about the value of a sound source's primary function have a significant effect; (4) the liability to feel annoyance with noise exhibits individual differences; (5) the relationship between fear and sound is a significant factor; and (6) past experiences with sound will influence perception of noise. Again, then, as with perception of crowding, the human response to unwanted sound involves far more than just the simple assessment of its physical intensity, the perception of what is called "loudness", other factors also affect the undesirability of a sound (Fay 1991, 93).

2.5 Environmental Impacts – theoretical background

Unlike noise, but like crowding, the environmental impact of outdoor recreation has received much attention in the literature. Before a discussion of this literature, it is necessary to define both environmental impact and environmental damage, which together characterise environmental conditions. Like crowding and noise, damage suggests a subjective negative assessment of the environment. Environmental damage is consequently equated with environmental degradation. Conversely, impact implies a change to the environment, but one that is not necessarily negative. This claim is adapted from the thoughts of Pigram and Jenkins (2002). Thinking about impact is especially important when it is recognised that "recreation always disturbs natural conditions" (Hammitt and Cole 1998, 13), whether this be its influence on vegetation, soil, wildlife, water quality, the shore line, or fish.

Liddle (1997) provides an excellent general overview of the ecological impacts of outdoor recreation. Liddle (1997), along with Bayfield (1992), Cole (1995a&b), and Wall and Wright (1977) are some of the most influential ecologists in the field of outdoor recreation. Wall and Wright (1977), for example, summarise recreation impacts and divide them into four groups, namely impacts on plants, soils, wildlife and aquatic situations. Elaborating on their four themes, Wall and Wright (1977) show that certain forms of recreation affect soil, vegetation, water, wildlife, geology, and the air; and complex inter-relationships exist between different types of recreational impacts. They argue that an increasing number of participants in outdoor recreation are bringing about changes in their environment, and that this is particularly true with reference to the increasing number of mechanised activities such as power-boating. Interestingly, they believe that the environmental impact of outdoor recreation "merges imperceptibly into that on carrying capacity" (Wall and Wright 1977, 2). Wall and Wright (1977) conclude that although changes in the environment are inevitable, the concept of carrying capacity can help to manipulate the degree and direction of change. They hence provide an influential notion of environmental impact and its relation to ecological carrying capacity.

As reported by Dickinson *et al* (1998) interest in the ecological impacts of outdoor recreation first attracted scientific attention in the late 1960s. Again research began in the U.S.A. and by the mid-1970s there was an increasing number of scientists concerned with monitoring recreational impacts, often with the aim of assisting resource management. In the U.K. the development of the Recreation Ecology Research Group in the 1970s and 1980s contributed to an increasing understanding of the ecological impacts of outdoor recreation and today many studies exist which assess the relationship between recreation and the environment (see for example Liddle and Scorgie, 1980; Murphy and Eaton, 1983; Huxley, 1994; Hendee *et al*, 1990; and Bannan, 1999).

Overall, the environmental impact of outdoor recreation can be summarised as follows: trampling, burning and other damage of vegetation; reduced species abundance; species may be eliminated: new species may be introduced; disturbance to birds, animals and invertebrates; soil compaction; soil erosion; shore erosion; and water pollution (Lavery, 1971; and Glyptis, 1991). Liddle (1997) scientifically shows that recreation is an important influence on the water environment, the shore environment, vegetation, soils, animals, invertebrates, reptiles, birds, bears, deer, sheep, goats, gazelles, small mammals, large mammals, fish, and aquatic mammals. Clearly, however, listing the impacts in this way does not allow an accurate examination of recreational impacts; in order to do this it is useful to distinguish between the environmental impacts of shore-based activities and the environmental impacts of water-based recreation – as discussed by Liddle (1997).

Primarily, therefore, the environmental impacts of shore-based recreation activities are examined. As Edington and Edington (1986) recognise, terrestrial plants can suffer direct damage from the mechanical impacts of trampling feet or vehicle wheels, or may be indirectly affected by soil compaction or erosion. Taking the trampling of vegetation as an example of a shore-based impact, such pressure from walkers or vehicles can have three major effects: abrasion of the vegetation, abrasion of the surface soil organic layers, and compaction of soils. Plants can be crushed, sheared, bruised, and even uprooted by recreation trampling. Consistent trampling is likely to reduce the vigour and reproductive capacity of all but the most resistant species (Hendee *et al* 1990, 427). A conceptual model of trampling effects is shown in figure 2.5 and illustrates the complex nature of the trampling phenomenon. A variety of physiological and morphological changes occur when vegetation is trampled. Moreover, as figure 2.5 shows, there are numerous reciprocal and cyclic relationships between soil and vegetation impacts (Hendee *et al* 1990, 427).

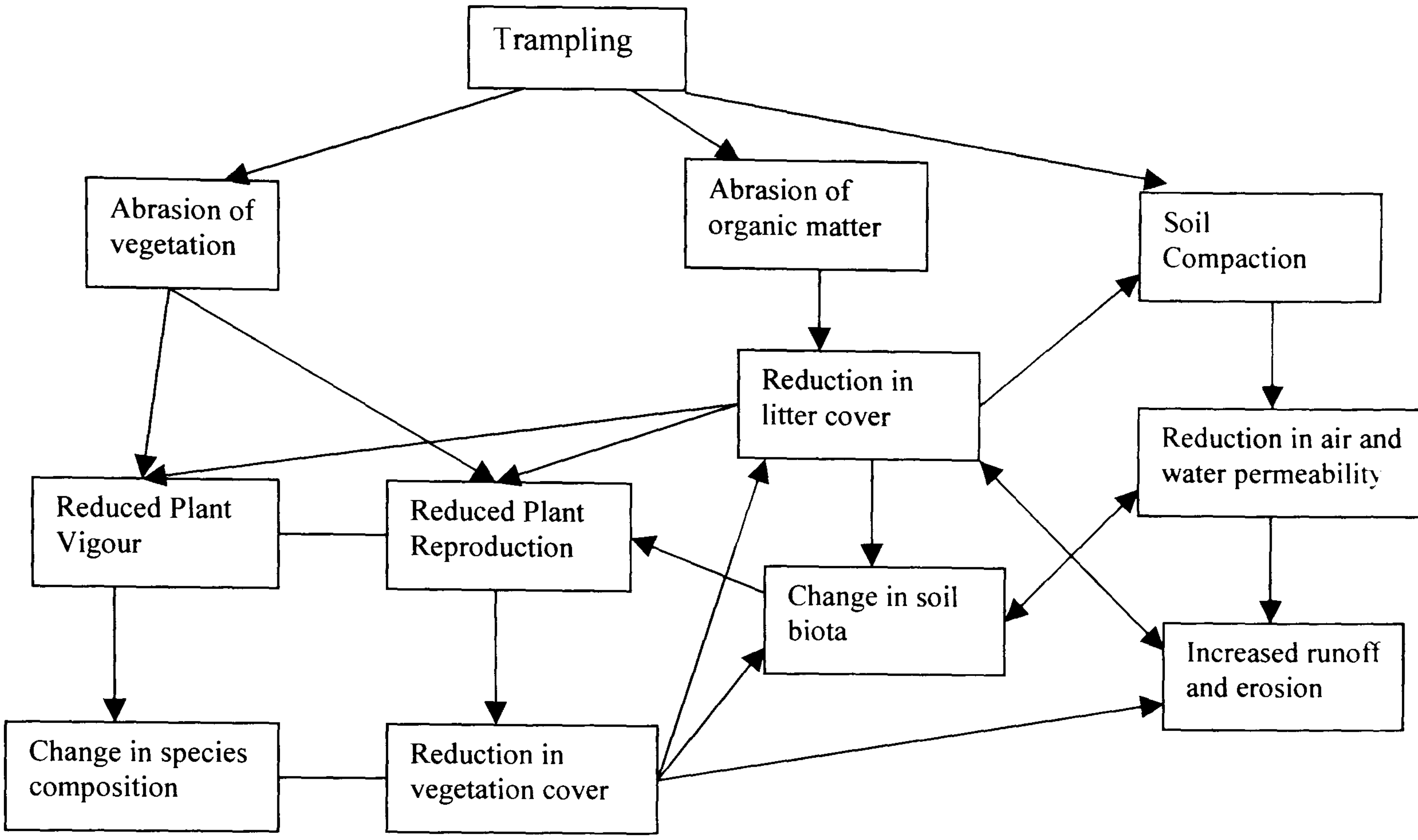


Figure 2.5: A conceptual model of trampling effects.
(Source: Hendee *et al* 1990, 427.)

Recreational pursuits not only damage individual plants and animal populations but they may affect entire ecosystems. Liddle and Scorgie (1980) provide a good example of the effects of shore-based activities on freshwater plants and animals. They claim that low levels of shore-based use increase the numbers of plants growing at particular sites (because of the increase in nutrients locally), but state that it is important to remember that certain plant species are more sensitive to mechanical damage than others (because of softness or brittleness). Liddle and Scorgie (1980) recognise, however, that recreation activity contributes not only to vegetation trampling and hence plant alteration, but also to sewage and changes in the chemical environment.

Moving on, then, to discuss the impacts of water-based recreation, boating can produce wash, turbulence and turbidity, damaging propeller action, disturbance to animals, pollution from outboard motors, and sewage (Liddle and Scorgie, 1980). All of these impacts interact and their relative importance depends upon the type of habitat involved. Wash is particularly relevant to the impacts of motor-boats, creating considerable erosion to plant roots, while propeller action can lead to "cutting" of vegetation, causing extensive damage (Liddle and Scorgie 1980, 189). Boating, as a specific recreation activity, can therefore have significant influence on the ecology of an area.

Despite the numerous ecological impacts possible as a consequence of the variety of forms of outdoor recreation, the current thesis concentrates on impact to vegetation. As such the theoretical background to recreation impact on vegetation is now discussed – first through general plant theory and then more specific plant impact, or trampling, theory.

As Liddle (1997) notes a general theory that summarises the effects of recreation and environmental management on species of high competitive index, species of high resistance to stresses imposed by recreation, and all other remaining species, was proposed by Grime in 1973. Grime related plant success to the balance of stress and disturbance pressures influencing an ecosystem. For the context of this thesis, recreation would be one such pressure. Part of the functional approach to ecology, Grime's theory is a powerful tool for predicting how plants respond to changes in their environment (Dickinson and Murphy 1998, 36) and became known as CSR theory (see figure 2.6).

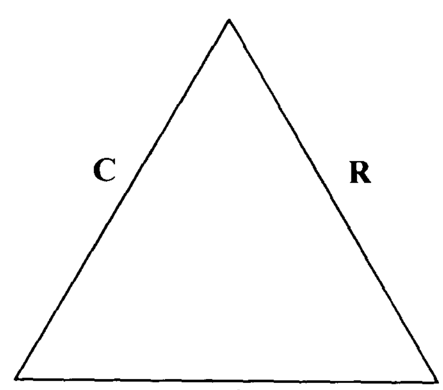
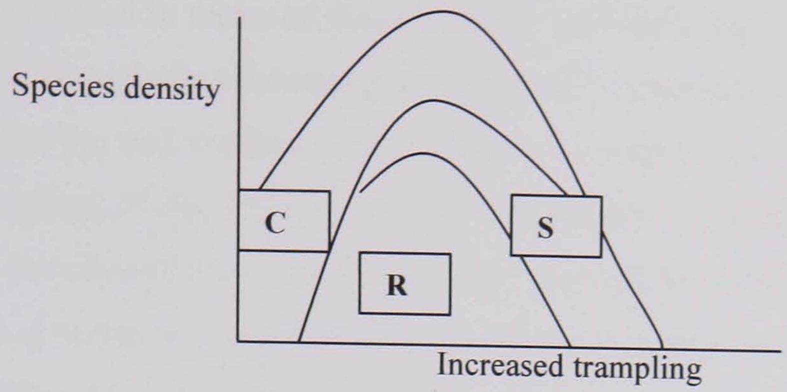


Figure 2.6: Triangular CSR model of Grime (1979).
(Source: Adapted from Dickinson and Murphy 1998, 38.)

As shown in figure 2.6, CSR is a theory of plant strategy, which suggests that species can be categorised according to their relative competitive ability (C), stress tolerance (S) and degree of ruderal characteristics (R). Competition includes the effects of other plants in competing for limiting factors such as water, light, nutrients and space; stress is any pressure that reduces productivity, such as shade; and the ruderal characteristics (or disturbance) is anything which damages or destroys the biomass of plants either directly (such as grazing) or indirectly (for example an unstable substrate). It is important to recognise that most plant species are intermediate, having a combination of traits to resist environmental pressure (Dickinson and Murphy 1998, 38). However, R-strategists, such as fescue grass (*Festuca* spp.) and rushes (e.g. *Juncus* spp.), are found in habitats where trampling and other disturbance is typically high. Figure 2.7 indicates how this theory can be adapted to recreation pressure.

Figure 2.7 illustrates that competitive species dominate at low levels of stress, to be replaced by stress-tolerant species when stress is intense, but, at intermediate levels of stress, large numbers of "remaining" species may join the community. Thus as the level of trampling, for example, increases, plant survival depends on the strategy that is adopted. Plant species vary in their resistance to trampling and, more generally, recreation impact. Hence, "recreation can set in train a series of processes leading to, at best, a more vigorous growing environment for plants and, at worse, ugly scars on a previously natural and undisturbed landscape" (Liddle 1997, 212).



"Where C is the distribution of competitive species, S is the distribution of stress-tolerant species, and R the distribution of remaining species (from Grime 1973)".

Figure 2.7: Species density with increased trampling according to CSR theory.
(Source: Liddle 1997, 70.)

Thinking specifically about trampling as a recreation impact on the ecology of an area, Cole provides one of the few attempts to provide a rigorous theoretical basis for investigating trampling impact. <u>Trampling theory</u> as discussed by Cole (1995a&b) is thus now addressed. A major claim of Cole (1995a&b, 1997, 2003) is that there is a curvilinear relationship between trampling intensity and surviving vegetation cover. It is hence widely agreed that the following graph (figure 2.8) represents the relationship between vegetation and trampling:

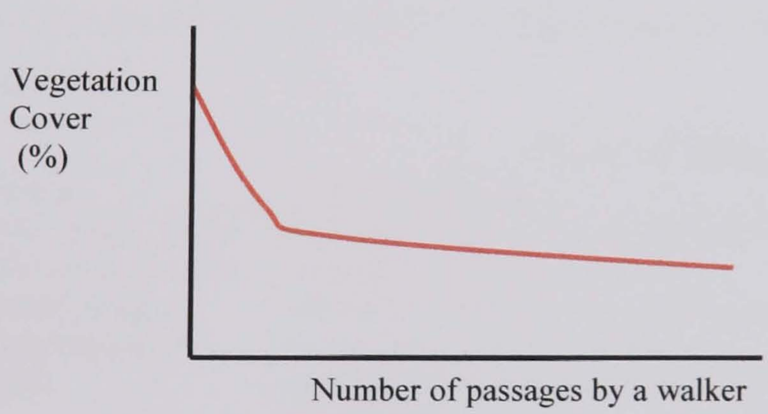


Figure 2.8: Trampling and vegetation.

Figure 2.8 shows that the relationship between wear and vegetation is generally curvilinear, i.e. as the level of trampling (either by walkers, animals or vehicles) increases the percentage of vegetation cover decreases until a point at which it begins to level off. The consequence of this is that after a certain level of trampling, damage to vegetation communities will cease to worsen. This relationship has many important implications for management as it indicates that recreation concentration, rather than recreation dispersal, may be the preferred management approach from an ecological perspective.

According to Cole (1995a) the curvilinear relationship between amount of use and amount of impact is explained by the tendency for recreation activities to become increasingly concentrated as amount of use increases. More specifically, he argues that the response of vegetation to trampling is expressed in terms of three indices: resistance (the ability of a vegetation type to resist change when trampled); tolerance (the ability of a vegetation type to tolerate a cycle of disturbance and recovery); and resilience (the ability of a vegetation type to recover following the cessation of trampling) (Cole, 1995b). Through a number of vegetation studies, Cole (1995a&b) concludes that the curvilinearity of the relationship between trampling intensity and surviving vegetation cover will decrease with increases in resistance, tolerance and species diversity of vegetation type. For Liddle (1997, 27), the curvilinear response is a consequence of the initial sharp decline in cover as the more vulnerable plants are eliminated by trampling, and then a slower attrition of those resistant individuals that are left, until at some point no living vegetation remains on the path or track. Regardless of the factors leading to the curvilinear response, it is widely agreed that such a relationship is present when looking at plant communities and their reaction to recreation trampling. The curvilinear relationship is expected to exist in the current research project: after a certain period of use, impact on vegetation will cease to cause further environmental damage.

Taking the relationship between trampling and plant species further, Liddle (1997) provides a useful discussion of the tolerance of different species to regular trampling. He suggests that certain plant species are known as "trampling communities", which are indicative of areas subject to high recreation pressure – see table 2.1. This theoretical background is related to empirical findings in section 6.4.

Degree of Tolerance		
Very low	**Low to moderate**	**Moderate to high**
Species which, on the whole, are only to be found growing on slightly trampled ground.	Species occurring first and foremost on slightly trampled ground but which can also be found growing on moderately trampled ground, although with a reduced biomass and low frequency.	Species with approximately the same frequency irrespective of whether the ground in question is trampled to a slight, moderate or intensive extent. Frequency begins to decrease only in case of intensive trampling. Species which are only or primarily to be found on moderately or intensively trampled ground.
Dryopteris filix-mas *Oxalis acetosella*	*Salix caprea* *Sorbus aucuparia* *Vaccinium myrtillus* *Taraxacum officinale* *Trifolium repens*	*Leontodon autumnalis* *Potentilla erecta* *Deschampsia cespitosa* *Festuca ovina* *Poa annua*

Table 2.1: The tolerance of different species to regular trampling.
(Source: Adapted from Liddle (1997, 54 and 55)).

2.6 Conflict – theoretical background

Conflict exists between different groups when differing views exist on how to use a recreation resource. This thesis focuses on the conflict generated between different recreationalists as a result of PWC use on Loch Lomond. According to the British Marine Industries Association (1999, 28), a PWC is a "small recreational boat propelled and steered by a directionally controlled water jet" – see figure 2.9.

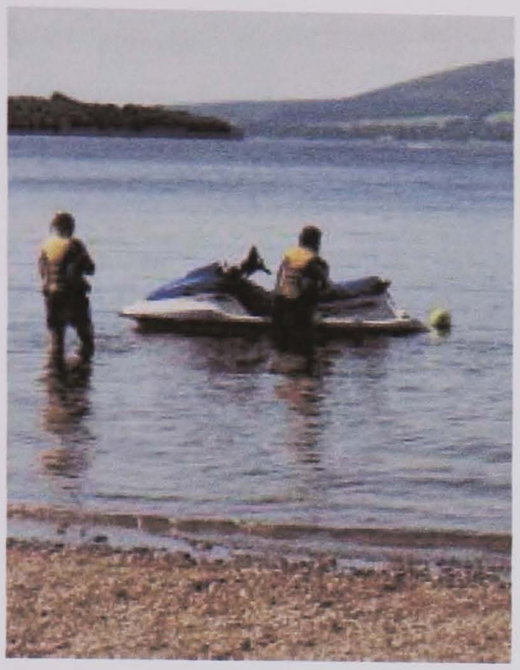


Figure 2.9: A PWC, Milarrochy Bay, Loch Lomond *(Photograph taken August 2003 by author).*

For the purposes of this thesis, the terms PWC, "jet-skis" and "jet-bikes" are all used interchangeably. The term "jet-ski", then, encompasses all personal watercraft. Boocock (2002) notes that PWC can carry from one to four persons and are capable of speeds of 65 mph. Such fast-moving craft has the potential to generate much recreation conflict.

The traditional definition of conflict is "goal interference attributed to others" (Manning 2001, 203)[3]. Conflict can be "out-group" (between different recreation activities) or "in-group" (within the same recreation activity) (see for example Vaske *et al*, 2000). Conflict literature has shown that recreationalists are more tolerant of individuals engaged in the same activity as themselves than they are with those engaged in a different activity (Vaske *et al*, 2000). In other words, "out-group" conflict is a greater issue for the majority of recreationalists. To this end, the current research concentrates on "out-group" conflict.

In addition to "out-group" and "in-group" conflict, there can occur interpersonal conflict or social values conflict. For the former to occur, the physical presence or behaviour of an individual or a group of recreationalists must directly interfere with the goals of another individual or group (including the goals of pleasure and enjoyment). Conversely, social values conflict can occur between groups who do not share the same norms and/or values, where norms are evaluative beliefs regarding acceptable behaviour in a given context (Carothers *et al*, 2001).

[3] There are many additional definitions of "conflict" in the social science literature (see for example Butler *et al*, 1998; Carothers *et al*, 2001; Devall and Harry, 1981; Gramann and Burdge, 1981; Ivy *et al*, 1992; Jacob and Schreyer, 1980; and Scheider, 2000). Many social science definitions include the notion of conflict being internalised, where there are two sides knowingly/deliberately opposing one another. In this thesis the term "conflict" is appropriated in a more specific, technical sense, i.e. interference with recreation goals, enjoyment and/or pleasure.

Regardless of the type of conflict found, conflicts that arise in connection with recreational uses of water are often more to do with friction between different forms of recreation than with environmental damage (Warren 2002, 134). Competing demands continue to cause numerous conflicts, and as such the rural landscape must now accommodate different types and styles of visitor use. For Tivy, looking specifically at conflict in the Loch Lomond area, this is known as the problem of "compatibility", where compatibility is "the extent to which two or more activities can be pursued in a given area; it is dependent on their ability to use either the same or adjoining sites at one and at the same time, or to use a given area at different times" (Tivy 1980, 67). Tivy (1980) notes that fishing and fast powerboat activities are, for example, often incompatible and consequently conflict results.

A final important point to recognise is that recreation conflict is often asymmetrical, where "the physical presence or actions of one group interferes with the goals (motivations) of another group, but the reverse does not hold true" (Vaske *et al* 2000, 297). Interestingly Vaske *et al* (2000) suggest that this phenomenon typically occurs when people engaged in traditional activities (for example sailors) interact with those using newer technologies (for example jet-skiers). Often traditional recreationalists are more negatively affected by the actions of other groups than those recreationalists using newer technologies, many of whom are not affected by the activities of others at all.

These important theoretical definitions of conflict are incorporated within a conceptual model developed by Jacob and Schreyer (1980). Jacob and Schreyer's model is based on expectancy theory (which states that people participate in recreation activities because they expect to achieve certain goals) and discrepancy theory (which defines satisfaction in outdoor recreation as the difference between desired and achieved goals) (Manning 2001, 196). Thus for Jacob and Schreyer, people participate in recreation activities because they expect, and wish, to achieve certain goals. If these goals are not achieved, and if, for example, pleasure and enjoyment are not obtained, conflict will result. More specifically Jacob and Schreyer (1980) argue that conflict is caused by four major factors: (1) activity style, which refers to the various personal meanings assigned to a recreation activity; (2) resource specificity, which refers to the significance attached to using a specific recreation resource for a given recreation experience; (3) mode of experience, which refers to varying expectations of how the natural environment will be perceived; and (4) lifestyle tolerance, which refers to the tendency to accept or reject lifestyles different from one's own (Manning 2001, 196). This theoretical model has been very influential in guiding empirical conflict research, and has been built upon by Vaske *et al* (2000). They contribute to the conceptual model through the addition of a safety factor, which includes all safety concerns generated by different recreation groups (see figure 2.10). Using the five relationships shown in figure 2.10, Vaske *et al* (2000, 301) define five formal hypotheses, as follows:

H1: As the importance attached to the activity increases, out-group beliefs about unacceptable behaviours (conflict) will increase.

H2: As the importance attached to the resource increases, out-group beliefs about unacceptable behaviours (conflict) will increase.

H3: As the mode of experience increases (becomes more focused), out-group beliefs about unacceptable behaviours (conflict) will increase.

H4: As tolerance for lifestyle diversity increases, out-group beliefs about unacceptable behaviours (conflict) will decrease.

H5: As perceptions of safety-related problems increase, awareness of out-group beliefs about unacceptable behaviour (conflict) will increase.

These formal hypotheses, and hence the conceptual model of Jacob and Schreyer (1980) and Vaske *et al* (2000), are investigated in chapter six with relevance to the PWC empirical findings of the research project.

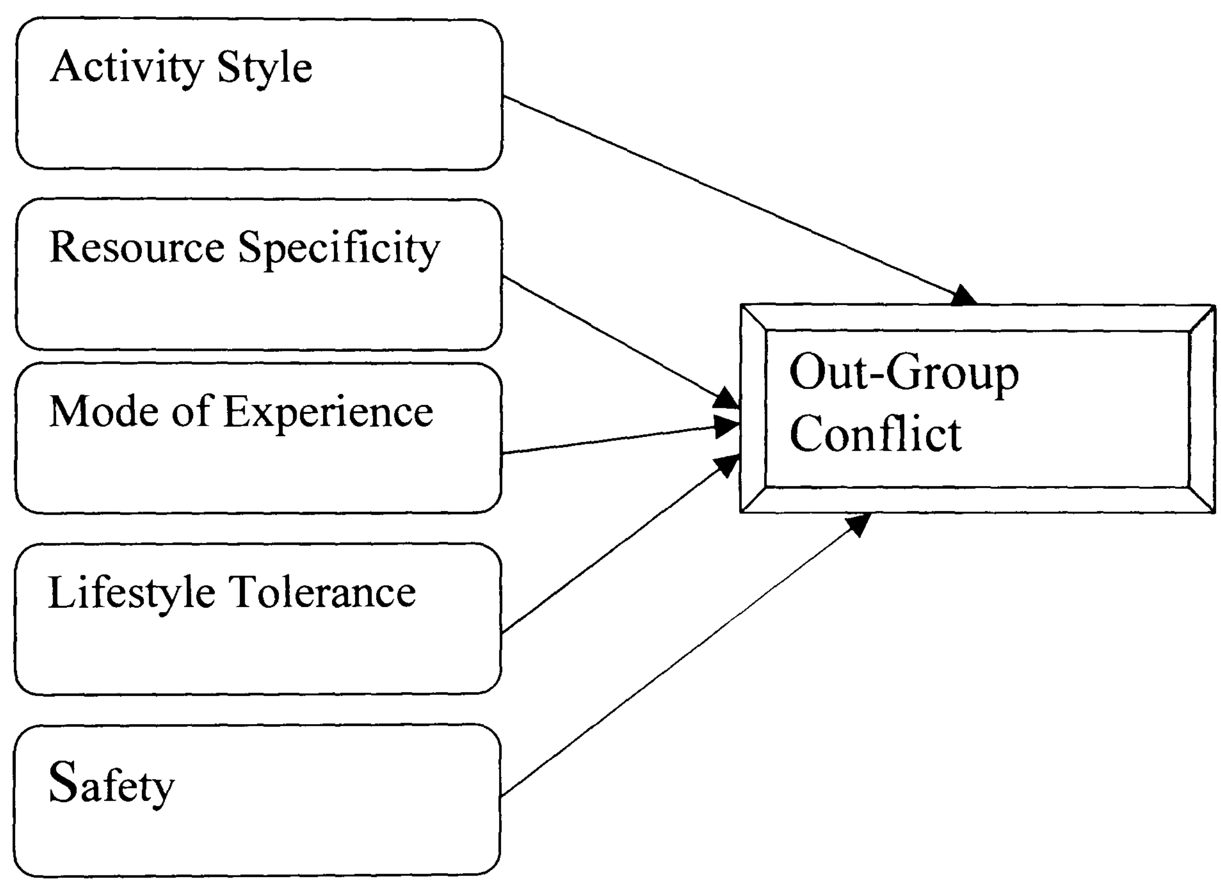


Figure 2.10: Expanded conflict model (Vaske *et al* 2000, 301).

2.7 Theory behind Management Practices and Frameworks

In the recreation management literature (see for example Dickinson, 2000b) it is generally agreed that there are two approaches to the management of outdoor recreation: management of people and/or management of the environment. Whilst management of people includes restrictions on vehicle entry into a National Park or recreation site, management of the environment includes the construction of tracks or boardwalks, i.e. hardening a site to make it less vulnerable to recreation use. The researcher believes that the LLTNPA should use a combination of both approaches, and indeed currently this is seen in the Loch Lomond area. Both management of people and management of the environment can be achieved through either direct or indirect management. Hendee *et al* (1990, 414) define direct management practices as those that emphasise regulation of behaviour, while indirect management is that which influences or modifies behaviour by managing factors that influence visitors' decisions. Put simply while direct management is the "hard" approach to managing recreation, through the regulation of visitor behaviour and by "controlling" visitors, indirect management is a more "soft" approach, allowing visitors more freedom and choice. Consequently, indirect management is often preferred as the more acceptable method of recreation management. For Manning (2001, 241) the reasons for the preference of indirect approaches are four-fold, namely: 1. management should not "confine" visitors; 2. recreation is a form of leisure activity and leisure by definition involves freedom of choice in thought and actions; 3. given the choice many visitors prefer indirect over direct management practices; and 4. less cost is often involved with indirect practices. Taking this further, Manning (2001) constructs a conceptual diagram of direct versus indirect management as illustrated in figure 2.11.

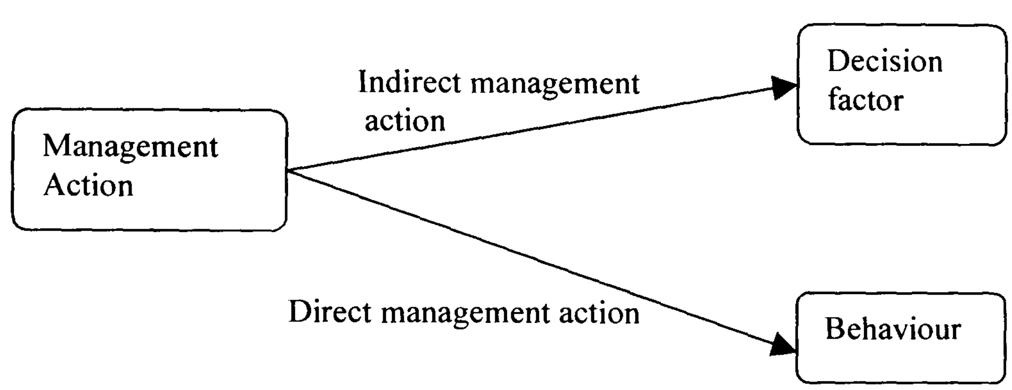


Figure 2.11: Diagram of direct versus indirect management tactics. (Source: Manning 2001, 241.)

Indirect Strategies	**Direct Strategies**
Physical alterations Improve or neglect access. Improve or neglect campsites.	Enforcement □ Increase surveillance. □ Impose fines.
Information dispersal Advertise area attributes. Identify surrounding opportunities. Provide minimum impact education.	Zoning □ Separate users by experience level. □ Separate incompatible uses.
Economic constraints Charge constant fees. Charge differential prices.	Rationing use intensity Limit use via access point. Limit use via campsite. Rotate use. Require reservations.
	Restricting activities Restrict type of use. Limit size of group. Limit length of stay. Restrict camping practices. Prohibit use at certain times.

Table 2.2: Classification of visitor management strategies.
(Source: Pigram & Jenkins 2002, 215.)

Good examples of direct and indirect management practices are provided by Pigram and Jenkins (2002, 215) and are shown in table 2.2. Direct and indirect management do not have to be mutually exclusive. They can complement each other. For example, a regulation banning campfires (a direct management practice) could be implemented in conjunction with an educational programme explaining the need for such a regulation (an indirect management practice) (Manning 2001, 243). Recreation management, then, moves along a continuum scale from direct to indirect strategies. For Manning (2001) these strategies are a basic conceptual approach to management that relates to the achievement of desirable objectives. Manning summarises this conceptual approach in the following diagram:

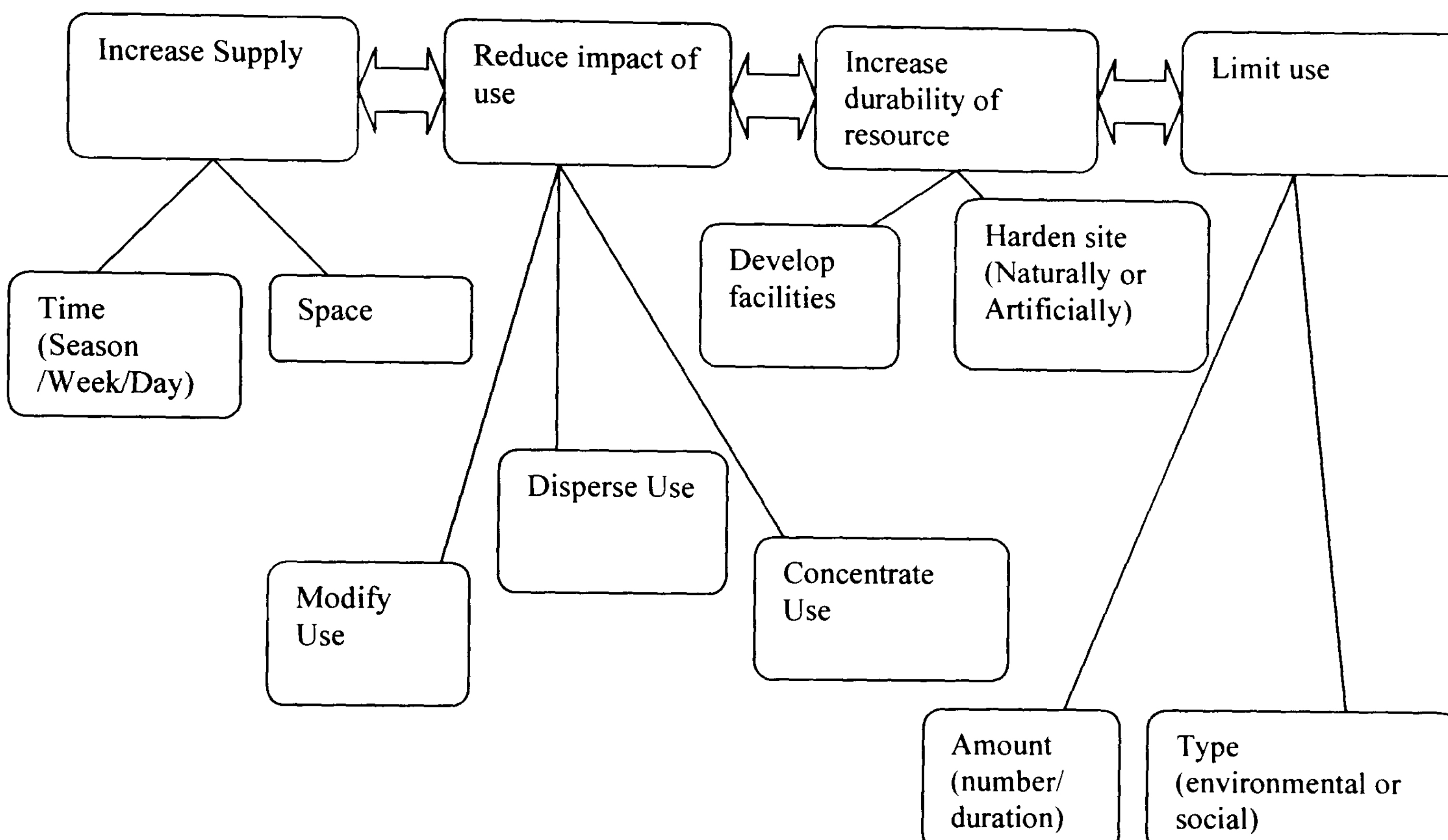


Figure 2.12: Strategies for managing outdoor recreation.
(Source: Adapted from Manning 2001, 239.)

The strategies in figure 2.12 are the basic conceptual approach to management. Regardless of what strategy is used "a careful balancing act by managers is always required" (Hendee *et al* 1990, 403). Furthermore, to achieve these various strategies, "tactics" are needed: the practical tools with which to implement the various strategies. Four common "tactics" of recreation management are zoning, pricing, education, and limiting access. The theoretical background to each practice is now examined in turn.

Zoning is a form of direct management that regulates visitor behaviour and offers a high degree of management control. It can be used to separate incompatible uses either spatially or temporally (Hendee *et al* 1990, 415). Spatial zoning would, for example, allow PWC in only one specified area of the loch. Temporal zoning would, for example, prohibit PWC use during times of high environmental damage potential. Different areas of the loch can therefore be zoned for different uses, for different levels of boating experience, or for use during specific time periods. On a larger scale National Parks themselves are a form of zoning (Pigram and Jenkins 2002, 218), while the Recreation Opportunity Spectrum (R.O.S.) is a good example of spatial zoning at a regional scale. The R.O.S. provides a wide variety of different recreation opportunities in different areas and as such "zones" different recreation activities (see Clark and Stankey (1979) for a good discussion of the R.O.S.).

Pricing is another tool that can be used as a strategy to manage outdoor recreation. Economic theory states that higher prices result in less consumption of a good or service[4], thus pricing may be an effective approach with which to limit the use of certain areas within a National Park (Manning 2001, 265). In addition to limiting use, charging creates revenue to fund, for example, environmental improvements. Charging a fee to enter a National Park area or to park at a specific site is one means by which pricing could be successful. Lundgren and Gregersen (1997) provide an interesting example of the use of fees in National Park Management and suggest that user fees can help National Park managers achieve their protection and enjoyment objectives by (1) generating revenues, and (2) helping to control or direct volume of use. A more complex approach to pricing in National Parks is one that differentiates between different times and/or locations. Pricing could perhaps be used to level out peak recreation times for example (Manning 2001, 265). Similarly the type of fee instituted is important and could include a daily use fee or an annual pass that allows unlimited use opportunities for a flat fee. Visitor willingness to pay for both Park services and the general National Park environment can be used to predict the success of possible fees and pricing.

Likewise provision of information and education is another tactic currently used by the LLTNPA and therefore addressed in this research project. An indirect and subsequently "light-handed" approach, providing information and education is a means by which to persuade visitors to adopt behaviours that are compatible with recreation management objectives while still allowing freedom of choice (Manning 2001, 245). The main aim of information and education is to communicate to Park users the objectives of management and the rationale for various measures undertaken. There are two functions of this management approach: (1) to provoke and stimulate interest and awareness among visitors to a recreation site; and (2) to assist in accomplishing management objectives (Pigram and Jenkins, 2002, 220). The latter function is based on the idea that the majority of destructive behaviour, chopping down a tree for firewood for example, results not from malicious intent but rather from ignorance. As Pigram and Jenkins (2002, 221) state "an informed public is a caring public". The key point is to show why and when certain norms of behaviour are required and this can be achieved by providing information before arrival at the site and when at the site (through leaflets, posters and so on).

[4] This is elasticity of demand in recreation, i.e. as the cost of recreation increases, demand declines. Outdoor recreation is "elastic" because it is not an "essential good" (as is food or shelter, for example).

From a more theoretical standpoint, information operates through three basic models (see Roggenbuck, 1992 in Manning 2001, 245): (1) applied behaviour analysis – a simple, short-term model of information and education. It focuses on visitor behaviour rather than attitudes and beliefs, for example visitors are given rewards or punishments depending on their behaviour; (2) central route to persuasion model, a less direct and more complex model which may result in more long-term behavioural modification. It manipulates the relevant beliefs of visitors through delivery of substantive messages, leading to new beliefs and desired changes in behaviour; and (3) peripheral route to persuasion model which emphasises non-substantive elements of information and education messages and is especially useful where it is difficult to attract and maintain the attention of visitors, such as at visitor centres. It may not have lasting long-term effects. All three models of information and education can be used to influence recreation use patterns, enhance visitor knowledge (especially knowledge related to minimising ecological and social impacts), influence visitor attitudes towards management policies, and address depreciative behaviour such as littering and vandalism (Manning 2001, 256). The box below shows the more practical guidelines that have been developed from these theoretical models and could be adopted by resource managers in their expansion of information and education.

1) "Use of multiple media to deliver messages is often more effective than use of a single medium.
2) Information and education programs are generally more effective with visitors who are less experienced and who are less knowledgeable. Young visitors may be an especially attractive target audience.
3) Brochures, personal messages, and audio-visual programs may be more effective than signs.
4) Messages may be more effective when delivered early in the recreation experience, such as during trip planning.
5) Messages from sources judged highly credible may be most effective.
6) Computer-based information systems can be an effective means of delivering information and education.
7) Training of volunteers, outfitters, and commercial guides can be an effective and efficient means of communicating information and education to visitors.
8) Information on the impacts, costs, and consequences of problem behaviours can be an effective information and education strategy.
9) Role modelling by park rangers and volunteers can be an effective information and education strategy.
10) Personal contact with visitors by rangers or other employees can be effective in communicating information and education.
11) Messages should be targeted at specific audiences to the extent possible. Target audiences that might be especially effective include those who request information in advance and those who are least knowledgeable."

Box 2.1: Guidelines according to Manning (2001, 256).

Limiting access is the final management tactic to be discussed and often the final management tool to be employed by recreation managers. This is partly because it is a direct approach: it is an approach of "last resort" (Manning 2001, 258). Limiting use and access is often very controversial and generally considered the antithesis to the basic objective of National Parks: to provide public access for all. However, limits on use may be necessary where park resources are increasingly vulnerable or where the quality of recreation experience must be maintained. Manning (2001) recognises that five basic management practices have been identified in the literature to ration and allocate recreation use. These include reservation systems; access lotteries; first-come, first-served or queuing; pricing; and merit. Each has advantages and disadvantages as shown in the following table. It is important to note that the information in the table that follows is based on the U.S.A.

	Reservation	Lottery	First come, first served	Pricing	Merit
Definition	Requires potential visitors to reserve a space or permit in advance of their visit.	Potential visitors request permit in advance, but permits allocated on a purely random basis.	Queuing system, requires potential visitors to "wait in line" for available permits.	Visitors pay a fee for a permit which may "filter out" those who are unable or unwilling to pay.	Potential visitors "earn" the right to a permit by virtue of demonstrated knowledge or skill.
Clientele group benefited by system	Those able and/or willing to plan ahead; i.e. persons with structured lifestyles.	No one identifiable group benefited. Those who examine probabilities of success at different areas have better chance.	Those with low opportunity cost for their time (e.g. unemployed). Also favours users who live nearby.	Those able or willing to pay entry costs.	Those able or willing to invest time and effort to meet requirements.
Clientele group adversely affected by system	Those unable or unwilling to plan ahead; e.g. persons with occupations that do not permit long-range planning, such as many professionals.	No one identifiable group discriminated against. Can discriminate against the unsuccessful application to whom the outcome is important.	Those persons with high opportunity costs of time. Also those persons who live some distance from areas. The cost of time is not recovered by anyone.	Those unwilling or unable to pay entry costs.	Those unable or unwilling to invest time and effort to meet requirements.
Experience to date with use of system	Main type of rationing system used in both National Forests and National Parks	Limited. However it is a common method for allocating big-game hunting permits.	Used in conjunction with reservation system in San Jacinto Wilderness. Also used in some National Park Wildernesses.	Little. Entrance fees sometimes charged, but not to limit use.	Little. Merit is used to allocate use for some specialised activities such as river running.
Acceptability of system to users	Generally high. Good acceptance in areas where used. Seen as best way to ration by users in areas not currently rationed.	Low.	Low to moderate.	Low to moderate.	Not clearly known. Could vary considerably depending on level of training required to attain necessary proficiency and knowledge level.
Difficulty for administrators	Moderately difficult. Requires extra staffing, expanded hours. Record keeping can be substantial.	Difficult to moderately difficult. Allocating permits over an entire use season could be very cumbersome.	Low difficultly to moderately difficult. Could require development of facilities to support visitors waiting in line.	Moderate difficulty. Possibly some legal questions about imposing a fee for wilderness entry.	Difficult to moderately difficult. Initial investments to establish licensing programme could be substantial.
Efficiency – extent to which system can minimise problems of suboptimisation	Low to moderate. Underutilisation can occur because of "no shows", denying entry to others. Allocation of permits has little relationship to value of the experience as judged by the applicant.	Low. Because permits are assigned randomly, persons who place little value on an opportunity stand as good a chance of gaining entry as those who place high value on it.	Moderate. Because system rations primarily through a cost of time, it requires some measure of worth by participants.	Moderate to high. Imposing a fee requires user to judge worth of experience against costs. Uncertain as to how well use could be "fine-tuned" with price.	Moderate to high. Requires user to make expenditures of time and effort (and maybe money) to gain entry.

	Reservation	Lottery	First come, first served	Pricing	Merit
Principal way in which use impact is controlled	Reducing visitor numbers. Controlling distribution of use in space and time by varying number of permits available at different trailheads or at different times.	Reducing visitor numbers. Controlling distribution of use in space and time by number of permits available at different places or times, thus varying probability of success.	Reducing visitor numbers. Controlling distribution of use in space and time by number of persons permitted to enter at different places or times.	Reducing visitor numbers. Controlling distribution of use in space and time by using differential prices.	Some reduction in numbers as well as shifts in time and space. Major reduction in per capita impact.
How system affects user behaviour	Affects both spatial and temporal behaviour.	Affects both spatial and temporal behaviour.	Affects both spatial and temporal behaviour. User must consider cost of time of waiting in line.	Affects both spatial and temporal behaviour. User must consider cost in monetary terms.	Affects style of user's behaviour.

Table 2.3: Evaluation of five recreation rationing practices.
Source: Adapted from Manning (2001, 259-261.)

For a further discussion on the benefits and drawbacks of permit systems or reservations more generally see Hendee *et al* (1990, 410-411).

In addition to the practices listed in table 2.3, access can also be limited by ensuring that visitors comply with rules and regulations. These could include group size limitations or length of stay limitations. Overall, however, when thinking about limiting access in a recreation area, emphasis should be placed on the environmental and social impacts of recreation use rather than the amount *per se* and, as Manning (2001, 258) realises, good research and information is required to implement successful use rationing and access limitations.

As the above discussion shows, a number of different management practices are available to the recreation manager, which can be used alone or together. Manning (2001, 273) provides a useful list of the most commonly used recreation management practices in the U.S.A. Actions that could be transferred to a U.K. context are as follows:

- Prohibit visitors from cutting dead wood for fires.
- Educate visitors about how to minimise their impacts.
- Remove litter left by visitors.
- Give verbal warnings to visitors who violate regulations.
- Require groups to limit their size.
- Inform visitors about potential crowding that they may encounter in selected areas.
- Inform visitors about managers' concerns with visitor use impacts at attraction areas.
- Perform regular trail maintenance.

Manning postulates that the most effective environmental approaches are maintaining and rehabilitating trails, monitoring use impact and implementing quotas on the amount of use. He claims that the most effective measures to reduce visitor crowding and conflict are implementing quotas on the amount of visitor use and providing information to, and education for, visitors to a recreation area (Manning 2001, 271). The effectiveness of these various approaches in the Loch Lomond and Trossachs National Park context are examined in chapter seven.

Regardless of the specific management practice adopted, it is useful to have an overall management framework within which to base management decisions. The idea of recreational carrying capacity should underpin such a framework, as it is a basis from which to integrate both the ecological and perceptual dimensions of outdoor recreation, and to relate the theoretical basis of recreation to the management of the recreation resource. Indeed, for Manning (2001) recreational carrying capacity is best applied as "an organizational framework" which contains both descriptive and evaluative components. This is a very useful way of thinking about the concept and its application to management frameworks. The descriptive component of carrying capacity addresses what is already present on the ground; it describes the current situation. Conversely the evaluative or prescriptive component of carrying capacity looks at what ought to be. Shelby and Heberlein (1984) show that the descriptive component includes management parameters – the factors that managers can manipulate – and impacts which describe the consequences of different management regimes, while the evaluative component involves value judgements regarding the type of experience to be offered and specific standards defining the important dimensions of that experience. Overall, then, carrying capacity can be defined as "the level of use beyond which impacts exceed acceptable levels specified by evaluative standards" (Shelby and Heberlein 1986, 7). The first step in setting a carrying capacity is to identify the important impacts (noise level, crowding, environmental damage for example), in other words the descriptive component; and the second step involves identifying how use levels and other management parameters affect these impacts, the evaluative component.

Based on these descriptive and evaluative ideas of recreational carrying capacity are many management frameworks including Limits of Acceptable Change (LAC), Visitor Impact Management (VIM), Visitor Experience and Resource Protection (VERP), and more recently and within a Scottish context, the Sustainable Visitor Management System (SVMS). The basic steps involved in these management frameworks are shown in table 2.4.

All of the frameworks in table 2.4 incorporate the concept of carrying capacity and provide a rational, structured process for making management decisions (Manning 2001, 74). Underlying all frameworks is the need to establish management objectives and indicators and standards of quality. According to Manning (2001, 72) a management objective is a "broad, narrative statement defining the type of visitor experience to be provided", while indicators of quality are "specific, measurable variables reflecting the essence or meaning of management objectives. They are quantifiable proxies or measures of management objectives... and may include elements of the biophysical, social and managerial environments that are important in determining the quality of the visitor experience" (Manning 2001, 72). Examples of indicators of quality include trail and camp encounters, vehicle counts, party size, presence of litter, noise, amount of exposed tree roots, and trampling of vegetation. Standards of quality are the minimum acceptable condition for each indicator variable, for example a maximum of five encounters each day with other groups along trails (Manning 2001, 72). Management objectives and indicators and standards of quality can therefore be formulated along natural resource, social and managerial considerations.

Limits of Acceptable Change	Visitor Impact Management	Visitor Experience and Resource Protection	Sustainable Visitor Management System
Step 1. Identify area concerns and issues.	Step 1. Preassessment database reviews.	Element 1. Assemble an interdisciplinary project team.	Step 1. Define the boundaries of the site.
Step 2. Define and describe opportunity classes.	Step 2. Review of management objectives.	Element 2. Develop a public involvement strategy.	Step 2. Undertake a baseline survey and assessment of the site.
Step 3. Select indicators of resource and social conditions.	Step 3. Selection of key impact indicators.	Element 3. Develop statements of primary park purpose, significance, and primary interpretative themes.	Step 3. Prepare a long-term vision statement for public enjoyment of the site.
Step 4. Inventory resource and social conditions.	Step 4. Selection of standards for key impact indicators.	Element 4. Analyse park resources and existing visitor use.	Step 4. Develop specific visitor management objectives and standards.
Step 5. Specify standards for resource and social indicators.	Step 5. Comparison of standards and existing conditions.	Element 5. Describe a potential range of visitor experiences and resource conditions.	Step 5. Identify management prescriptions to achieve these objectives and standards.
Step 6. Identify alternative opportunity class allocations.	Step 6. Identify probable causes of impacts.	Element 6. Allocate potential zones to specific locations.	Step 6. Prepare an action plan to deliver the management prescriptions.
Step 7. Identify management actions for each alternative.	Step 7. Identify management strategies.	Element 7. Select indicators and specify standards for each zone; develop a monitoring plan.	Step 7. Implement the action plan.
Step 8. Evaluation and selection of an alternative.	Step 8. Implementation.	Element 8. Monitor resource and social indicators.	Step 8. Monitor the key qualities of the site, its visitors and their experience.
Step 9. Implement actions and monitor conditions.		Element 9. Take management action.	Step 9. Evaluate the monitoring data and revise future management accordingly.

Table 2.4: Carrying Capacity Frameworks.
(Source: Manning (2001, 75) with an additional column for SVMS derived by the author.)

Table 2.5 provides an example of indicators and standards, as adapted from Newman *et al* (2001). Implementing a successful carrying capacity framework requires: (1) definition of recreation opportunities to be provided – through indicators and standards of quality; (2) monitoring of indicator variables to determine whether existing conditions meet standards of quality; and (3) management action where monitoring suggests that standards of quality have been violated. LAC, VIM, VERP and SVMS all contain such elements. They are a reformulation of the traditional carrying capacity model, and the validity of each framework is now investigated in turn.

Indicator	**Standard**	**Method of Measurement**
Visitor Satisfaction.	A drop in the satisfaction index by 10% should prompt action by site management.	Survey of visitors.
Number of people at one time in key locations.	Numbers of people exceeding standards for the site as a whole by 10% should prompt management action.	Sample numbers per hour.
Status of vegetation.	Reduction in grass vegetation by 10%.	2 by 2 metre quadrat surveys.

Table 2.5: Examples of Indicators and Standards.
(Source: Adapted from Newman *et al* 2001, 31.)

LAC was one of the first carrying capacity frameworks to be developed and was created by the U.S. Forest Service in an attempt to identify quality indicators and standards to which must be adhered (Pigram and Jenkins, 2002). If standards are violated then it can be said that carrying capacity has been exceeded. LAC places emphasis on the ecological and social attributes sought in an area rather than on how much use an area can tolerate. As shown in figure 2.13, LAC takes the natural variation in rate and character of change into consideration, allowing standards to be set for acceptable levels of impact (Pigram and Jenkins, 2002). Essentially, then, LAC asks how much impact or change should be allowed.

As shown in table 2.4, LAC is a nine-step process that focuses on identifying desired wilderness resource and social conditions and then prescribing management actions to preserve, restore, or enhance those conditions (McCool *et al*, 1988). Public participation is a crucial element of the LAC process and the framework has now been applied in both U.S.A. and U.K. contexts.

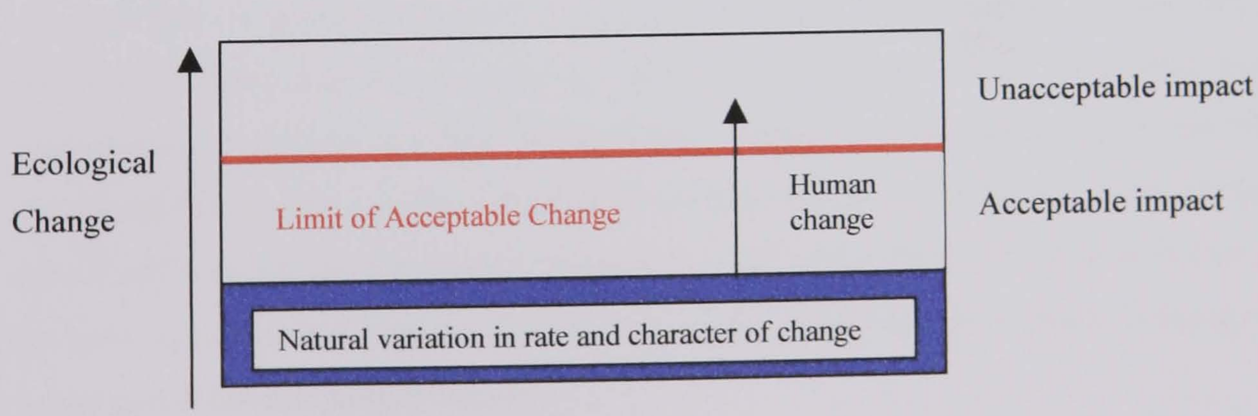


Figure 2.13: Limits of Acceptable Change. (Source: Pigram and Jenkins 2002, 97.)

Initially developed in the U.S.A., examples of the successful implementation of LAC are widespread. One of the earliest examples of the LAC process was in the Bob Marshall Wilderness Complex (BMWC), Montana, U.S.A. (see Hendee *et al*, 1990). More recently LAC has been adopted in the U.K., specifically in a Scottish context. The Cairngorms area (recently designated as Scotland's second National Park) is today subject to a LAC framework (see Bayfield and Conroy, 2000) and in particular the LAC approach has been modified and designated at the Aonach Mor ski development near Fort William (see McGowan, 2004; and Bayfield *et al.* 1991). Sidaway (1994) argues that the principal benefits of adopting the LAC framework at Aonach Mor are those of engaging the interested parties in a rational debate about assessing and managing change; and forcing managers to be specific about the objectives of management and the standards that are to be attained, using quantitative assessments wherever possible. He provides a (useful) table of the strengths and weaknesses of LAC; see table 2.6.

LAC combines:	**Strengths**	**Weaknesses**
THE RATIONAL PLANNING APPROACH which focuses on desirable future conditions.	Promotes a rational debate about assessing and managing change. Forces managers to be specific about objectives and standards.	The costs of specifying and collecting data on biological change and recreational use are high. May prove too elaborate a management system for simple impacts or widely dispersed activities.
QUALITY MANAGEMENT Qualities are assessed and quantitative indicators are selected and monitored.	Directs research and evaluation towards quality management. Monitoring can be selective; management can be directed to improving quality.	Qualities are difficult to define and routinely assess. Undue emphasis is given to those aspects of quality that are easily measured. There may be practical limits on the number of impacts and/or qualities that can be handled.
PUBLIC INVOLVEMENT throughout the process.	Improves acceptance and support for conservation and recreation management in contentious situations.	Difficult to find accountable representatives for informal activities that are not organised. Difficult to deal with new impacts if task force is not adaptable. Difficult to sustain public involvement over time.

Table 2.6: LAC Strengths and Weaknesses Analysis. (Source: Sidaway 1994, 13.)

As shown in table 2.6, LAC is unlikely to be a universal panacea for recreation management, but it does provide a possible management framework. In particular, the creation of a task force is one useful element for recreation research. Certainly the key to the success of the LAC process on Aonach Mor is public participation and the creation of stakeholder groups (McGowan, 2004). McGowan shows that the Aonach Mor ski resort provides a unique long-term study of the LAC management technique and that the indicators chosen for monitoring have been successful. The success of the scheme can be attributed to the fact that the indicators are relatively easy to measure, robust and address the key issues adequately. McGowan (2004) does nonetheless note that while the LAC approach has been flexible at Aonach Mor, there is still a need to integrate environmental, social and economic targets further.

LAC has also been considered in the Trossachs area, part of the LLTNP. Aitken *et al* (1994) recommend LAC as a framework for the Trossachs area and set out proposals for a monitoring system to address the issue of sustainability in tourism development in the Trossachs. They advocate the formulation and agreement of a system of LAC at an early stage in the planning process and argue that such a framework is needed to address the issues of environmental, social and economic impact as a consequence of tourism in the Trossachs area. Although management has not yet adopted these recommendations, and the study is concerned with tourism development rather than outdoor recreation, clearly such claims have many parallels with this research project.

More recently the LAC framework has been extended and altered to address visitor management concerns under the new principle of Visitor Impact Management (VIM). Again the VIM framework aims to identify current conditions, establish indicators and standards, select potential management strategies for the amelioration of unacceptable impacts, and provide continuous monitoring and evaluation. In comparison with other carrying capacity frameworks VIM is only an eight (rather than nine) stage process (table 2.4). It has been applied in many areas including Australia (at Jenolan Caves), Canada (for example, Prince Edward Island) and in the U.S.A. (at Icewater Spring Shelter in the Great Smoky Mountains National Park). Monz *et al* (2003) provide a good example of VIM in action at the Coastal and Barrier Island Network in the eastern U.S.A. For Pigram and Jenkins (2002) the VIM process is primarily concerned with a market-sensitive approach: the manager is encouraged to be strategic in marketing a visitor experience that will appeal to specific market segments. As a consequence of this emphasis on "marketing" VIM is not the author's preferred framework to be adopted in the Loch Lomond area.

Of greater relevance to the Loch Lomond area is the Visitor Experience and Resource Protection framework (VERP). Investigated further in chapter seven, VERP is the U.S. National Park Service's equivalent of the Forest Service's LAC and has been implemented in a number of areas throughout the U.S.A., most notably the Arches National Park in Utah and Yosemite National Park in California. It is an on-going framework that addresses both visitor impacts and visitor perceptions through defining desired conditions, indicators and standards and monitoring protocols. Again it is a nine-step process (see table 2.4). VERP has been a useful tool in the implementation of user capacities; further it illustrates that the conceptual background of recreational carrying capacity can be applied in a practical context as is shown in section 7.2 with reference to the Arches National Park. The Arches was the first National Park to pilot and later introduce VERP.

The final framework, and the only framework to be developed exclusively in Scotland, is SVMS. Also known as Management for People (MfP), SVMS is a cyclical, iterative planning and management process, which is presented as a menu of procedures, processes and tools that can be used at a range of visitor sites according to their management (Masters *et al*, 2004). It has been piloted at eight sites around Scotland (Glentress Forest; Falls of Clyde; St. Abbs Head; Flanders Moss; Mar Lodge; Fife Coastal Path; Ruby Bay, Elie; and Lochore Meadows Country Park) and focuses on small areas, and therefore differs from the larger scale focus of VERP, LAC and VIM. SVMS helps to secure, enhance and maintain both the quality of the environment and/or cultural heritage values of the resource and the visitor experience (Masters *et al*, 2004). Central to SVMS is the concept of sustainability (defined in section 1.3.1). Mitchell (2002) outlines a number of interesting perspectives on sustainability and recognises that the concept contains paradoxes, tensions and conflicts (for example, intergenerational versus intragenerational equity: and individual versus collective interests). He suggests that these conflicts deserve attention if sustainability is to be transformed from concept to action. Though controversy exists regarding the meaning and utility of sustainability, it is at least a stated aspiration of the SVMS framework. The SVMS cycle is shown in figure 2.14 and is critically examined further in chapter seven with specific reference to the Loch Lomond area.

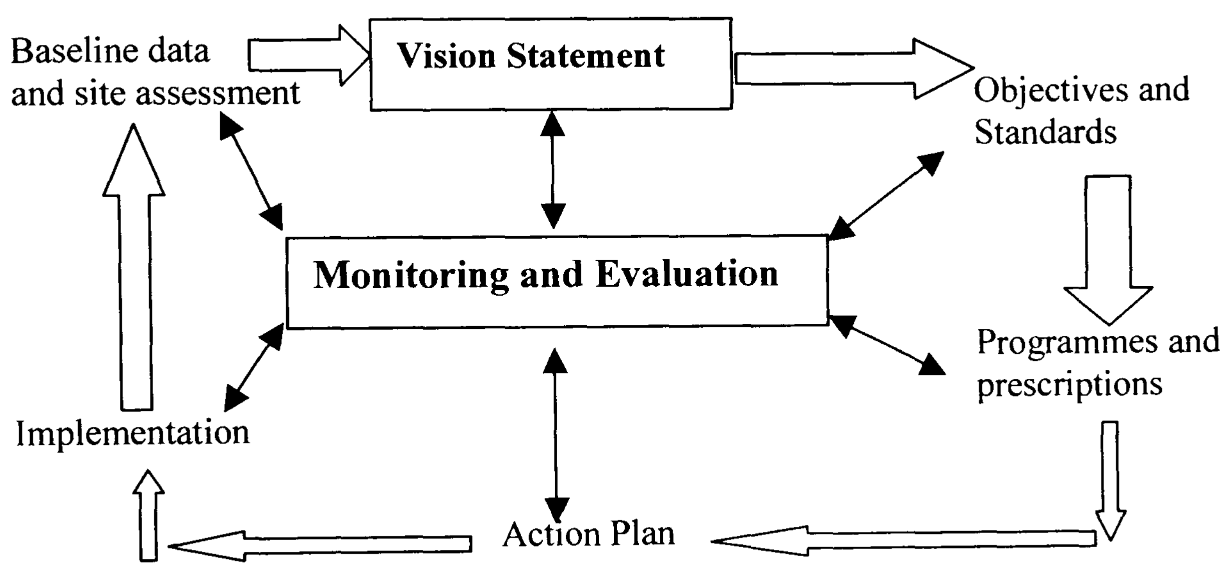


Figure 2.14: The sustainable visitor management cycle. (Source: Adapted from Masters *et al* 2004, 7.)

2.8 Environmental Economics

According to Costanza (1997) in Moffatt and Hanley (2001, 7), environmental economics is a "branch of economics designed to address the relationships between ecosystems and economic systems in the broadest sense". During the early development of this sub-discipline, in the 1960s, outdoor recreation emerged as a major concern for the environmental economist. Outdoor recreation offered a productive link between people (their preferences and behaviour) and the environment (Hanley *et al*, 2003). More specifically, economic valuation has been developed in the sub-discipline of environmental economics and – as discussed by Dalrymple and Hanley (2005) – is a valuable tool for management of recreation resources such as national parks. To this end, this section outlines the importance of recreation research for environmental economists through an initial discussion on the history of recreation demand, followed by a review of the methods economists have used to value outdoor recreation and environmental impacts. Primarily, therefore, the history of recreation demand is examined.

2.8.1 History of recreation demand

For many academics, such as Pearce (1989) and Lavery (1971), determining the level of consumption of recreation resources requires the assessment and modelling of recreation demand. The demand for recreation is defined as "the use of existing facilities and the desire to use recreation facilities either now or in the future" (Lavery 1971, 21), and in the case of the current project, demand is also a function of site attributes, specifically crowding levels, noise levels and environmental conditions. According to Clawson and Knetsch (1966) the major factors involved in the growing demand for outdoor recreation include a steady increase in population; an increase in leisure time; increased mobility; and an increase in income (and consequently disposable income). With this growing demand for outdoor recreation developed economic approaches to measure and estimate recreation demand curves[5]. One of the most common approaches for estimating outdoor recreation demand is based upon the research of Clawson (Brown and Nawas, 1973). For Clawson (1963, 64) economic demand is a "schedule of volume (visits, user-days etc.) in relation to a price (the cost of the recreation experience)". Clawson and Knetsch (1966) claim that the concept of a demand curve is applicable to each of the three major types of outdoor recreation – user-orientated, intermediate and resource-based – and in particular outdoor recreation involves three kinds of cost: money, time and travel. Further, Clawson and Knetsch (1966) recognised that perception and past recreation experience strongly influence demand for an outdoor recreation area. More recently Smith (1989, 203) has echoed this claim in his statement that "recreation demand models should be based on perception". It is argued that visitor perception of outdoor recreation should be an integral part of any recreation demand model and, as noted by Train (1998), through integrating perception into recreation demand models they can be used not only to forecast demand for recreational activities (see for example Morey, 1981), but they can also determine the value that recreationalists place on the various factors that affect their choices (Train, 1998).

Hanley *et al*(2000) provide a good example of the demand concept in a recreation study. Here the demand for rock-climbing in Scotland was modelled using nested and non-nested models. The perceptions and preferences of climbers were investigated, and the underlying rationality of respondents' behaviour was analysed. A study such as this can then be used to model public perception, recreation demand, and predict recreation behaviour. As exemplified by Hanley *et al's* (2000) study, and the research of others such as Morey and Rowe (1993), a number of empirical methods are available to economists for estimating recreational demand and, more generally, environmental values.

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[5] A demand curve is "a statement of the amount of a particular good or service that will be purchased in a given period of time at specified prices per unit" (Clawson and Knetsch 1966, 46).

2.8.2 Methodological options for recreation economics.

Conventionally the methods available to environmental economists for the estimation of recreation demand can be divided into revealed preference and stated preference approaches. Whilst the former tries to infer the value people place on environmental goods from their actual behaviour; the latter asks respondents about their willingness to pay for the option to use recreational resources, or for a quality change to these resources, thus is based on people's intentions (Hanley *et al*, 2003).

The revealed preference (RP) approach is based on pioneering theoretical work by Maler (1974) (in Hanley *et al*, 2003) and involves "the exploitation of people's preferences as revealed through their actions". Revealed preference methods can thus only measure use values (not non-use), and they aim to use observed behaviour in real markets (including outdoor recreation) to determine the value of an environmental good. Any revealed preference technique assumes a relationship between the environmental good and marketed good – *ceteris paribus*. Using the revealed preference approach economists can show how behaviour in related markets can be used to estimate values for non-market goods. Of greatest relevance for outdoor recreation is travel expenditure and visitation rates, which can be used to estimate demand curves for recreation sites. Here the travel-cost method is one of most valued tools in the estimation of recreation demand.

Originating in the U.S.A. in the context of planning and management of outdoor recreation in national parks, the travel-cost method recognises that expenditure is typically necessary to undertake recreational activities, where expenditure includes money <u>and</u> time spent in travelling to recreational sites (Hanley *et al* 2001b, 55). Recommended to National Parks by Harold Hotelling and developed further by Clawson and Knetsch, the travel-cost technique uses the total number of visitors from some zone of origin as the dependent variable and the travel cost from the zone to the area as the key explanatory variable. Thus the travel-cost method focuses on the cost of getting to a site (Mendelsohn and Brown, 1985). According to Hanley *et al* (2003) the travel-cost method has two basic approaches: "count models", originating from the methods used by Clawson and Knetsch; and Random Utility Models (RUMs), based upon the allocation of a fixed quantity of trips across substitute sites as site qualities change (for a good example of RUM see Smith, 1989). More generally, the travel-cost method is based on the following assumptions: (1) recreationists travel purely for the pleasure of travelling; (2) the only purpose of the trip is to visit the specified site; (3) individual sites are evaluated in their entirety; and (4) the prices of substitutes are independent of the travel cost of the site (Mendelsohn and Brown 1985, 612). As recognised by Mendelsohn and Brown (1985) the underlying of rationale of the travel-cost method is that people from different origins bear different travel costs when visiting a site and thus visit a site at different rates. The central element of the TCM is to identify the number of trips a recreationalist has made to a site in the past twelve months. This is then statistically modelled and can be used to inform resource management. As it is a revealed preference technique, it infers the value that people place on environmental goods from their actual behaviour. The TCM is subsequently extremely useful when measuring recreational use values (Bishop *et al* in Bromley, 1995) and it is a highly relevant and well-used revealed preference technique (see for example Willis and Benson, 1989). As a revealed preference method it is relatively uncontroversial, because it is modelled on standard economic techniques for measuring value and it uses information on actual behaviour rather than verbal responses to hypothetical scenarios (King and Mazzotta, 2002). It is based on the simple and well-founded assumption that travel costs reflect recreational value.

Whilst revealed preference techniques such as the travel-cost method estimate actual behaviour, stated preference techniques address hypothetical, stated, behaviour and "refer to a wide array of possible ways of asking consumers about preferences, choices, ways of using options, frequencies of use, and so forth" (Louviere and Street 2000, 131). As Hanley *et al* (2001b) note, stated preference (SP) methods are either based on surveys in which the public is directly questioned about its willingness to pay (WTP) or willingness to accept compensation (WTAC) for certain hypothetical changes in environmental quality; or they are based on respondent choice, where the public is asked to choose between different "packages", which vary according to price and/or the environmental quality studied. According to Louviere *et al* (2000) stated preference data typically describe hypothetical decision contexts and can control relationships between attributes, which seems to be reliable when respondents fully understand the questions being asked.

Again there are two types of stated preference method: contingent valuation method (CVM) and choice modelling (CM). CVM is the most common approach in practice and is based on is based on hypothetical prices, where survey respondents are asked about their monetary values for non-market goods contingent upon the creation of a market or other means of payment (Bishop *et al* in Bromley, 1995). Hence CVM asks respondents to explain how they would behave if a market existed (Hanley *et al*, 2003). The first application of the CVM was by Davis (1963) in his questionnaire-based study of deer hunting in a Maine backwoods area; and since the early 1970s the CVM has been widely used by economists to measure the benefits of a variety of goods, including recreation. It is capable of yielding both use and non-use values and produces plausible measures of environmental preference (Turner in Bateman and Willis, 1999). Indeed, Mitchell and Carson (1993) argue that the CVM offers the most promising approach yet developed for determining the public's willingness to pay for public goods.

Like the CVM, choice modelling (CM) is a stated preference method, however, here the environmental resource is described in terms of its attributes. Choice experiments are "samples of choice sets or choice scenarios drawn from the universe of all possible choice sets" (Bennett and Blamey 2001, 13). CM therefore uses a questionnaire that presents the respondent with different sets of options; by accepting a specific option the respondent reveals the marginal utility they place on each attribute. Although CM has been criticised for creating a "cognitive burden" on respondents, its complex questioning provides a rich data set based on people's preferences that can be used to generate statistically robust models of choice (Bennett and Blamey, 2001). Further, it can be stated that choice modelling is more efficient if one's main focus is the relative value of attributes/characteristics. Thus, although CVM is still a technique favoured by many economists, CM is growing in its acceptance and validity.

A final stated preference method is the contingent behaviour method (CBM). To date the literature surrounding use of the CBM is limited, and indeed few studies implement the technique. CB questions are used to measure intended behaviour within the contingent recreation market; actual behaviour is not measured. In contrast to the CVM, CB questions focus on hypothetical behaviour rather than hypothetical prices/transactions. The justification for the use of this method is that many respondents may find it easier to predict a change in recreation behaviour, rather than estimate a payment for the recreation resource (Englin and Cameron, 1996). However, the CB methodology has many of the same concerns as CVM: they are both based on hypothetical markets. Indeed, there are many issues surrounding the use of these methods within the economics literature. These critiques are now deliberated.

Although the TCM has gained much credibility within the discipline of economics (see for example Bockstael in Bromley, 1995; and Kling and Crooker in Jeroen, 1999), there are some concerns surrounding its use as a methodological, and indeed analytical, technique. According to Englin and Cameron (1996) of primary importance is the failure to include the prices or qualities of relevant substitute or complementary goods. This can lead to omitted variable bias in travel cost estimates of recreation demand. More generally, the TCM has been criticised because of its assumption that people perceive and respond to changes in travel costs the same way that they would respond to changes in admission price (King and Mazzotta, 2002): they are not providing a true value of travel cost. For King and Mazzotta (2002) a further issue surrounding the TCM is that it is difficult to define and measure the value of time spent travelling. This could be over or underestimated, again leading to erroneous results. Following on from this King and Mazzotta (2002) suggest that often those who value certain sites highly may choose to live nearby, and will therefore have lower travel costs, leading to problems of misrepresentation. A final criticism of the TCM is that it provides information about current conditions, but not about gains or losses from anticipated changes in resource conditions (King and Mazzotta, 2002).

Stated preference approaches, such as the CVM and CBM, have received a great deal more criticism than traditional revealed preference approaches (see for example Sagoff, 1988)[6]. Much of this criticism is levelled at the hypothetical nature of the survey design. Indeed Smith (1992) claims that hypothetical questions yield hypothetical answers, giving numbers that "may often be worse than having no numbers at all" (Bateman & Willis 1999, 4). As Bateman and Willis (1999) note, however, often many of these observed problems are the consequence of poor or inadequate design or execution. To compensate for the hypothetical survey design, many assert that stated preference techniques need to be applied rigorously and with great care if they are to be of any practical value.

To date, the CVM has been more controversial than the CBM, in part as a consequence of the latter's limited application within economic survey research. A good example of criticism of the CVM is provided by Bowers (1993), who argues that CV is "not a satisfactory method": he offers a critique of putting monetary values on the environment. A basic concern with CVM is that money is not actually exchanged. For Bishop *et al* (1995) the validity issue is central to any discussion concerning CVM. They recognise that in order for CVM to yield valid economic values, study participants must be both willing and able to reveal their values. They develop a theoretical framework for assessing the validity of CVM, which defines three types of validity: content, construct and criterion (Bishop *et al*, 1995). Content validity is centred on the assertion that the questionnaire scenario provides the participants with all the information they need to value the amenity in question. Here the main problem is the limit on the amount of information that participants can or are able to absorb and process at one time – the psychological problems of boredom, confusion or "information overload" must be overcome (Bishop *et al* in Bromley, 1995). Construct validity is concerned with "the degree to which the measure under scrutiny is related to other measures as predicted by theory" (Bishop *et al* 1995, 642). It is the claim of some that many CVM studies fail to meet theoretical expectations. Finally, for Bishop *et al* (1995), criterion validity is a significant element of the CVM; again this is concerned with the extent to which the criterion used is related to the theoretical background. As Bishop *et al* (1995) state, if adequate guidelines are followed in the implementation of the questionnaire, CV studies will have criterion validity and will hence convey useful information.

Bateman and Willis (1999) echo Bishop *et al's* (1995) claims for validity in their assertion that one of the key problems faced by the CVM researcher is the problem of cognition, namely the participant can have difficulties in observing, understanding a particular environmental system, and/or weighing up the attribute of the good. Furthermore, Bateman and Willis (1999) suggest that incongruity (individuals being unable to accept that price can capture all the relevant information

[6] For a more general discussion of the critique surrounding the use of economics to value the environment, see chapter eight.

about a good and its value) and composition (the inability of individuals to accept that an environmental good can be "commodified") are pertinent criticisms of the method. Concerns regarding the validity of contingent valuation questionnaire results are also expressed through claims of strategic bias (respondents deliberately misrepresent their preferences in order to influence the decision making process); yea-saying (respondents agree to pay not because of the strength of their preferences for the environmental impact but because of a desire to make themselves look good); insensitivity to scope variations (respondents' values are invariant to the extent of the environmental impacts involved); and framing (respondents' values do not reflect the availability of substitute goods) (Bennett and Blamey, 2001). It is not disputed that these criticisms are difficult to overcome; nonetheless, many environmental economists (see for example Lee and Han, 2002; Carson, 1992; and Hanley and Kristrom, 2002) have successfully employed the CVM (Hanley *et al*, 2001b). It is suggested that with a rigorous questionnaire design and effective explanation to the respondents, many of the potential problems can be eradicated.

One fundamental approach to overcome the above difficulties of the CVM and indeed the CBM is to combine these stated preference approaches with revealed preference techniques. Through combining stated and revealed preference techniques it is possible to observe both intended <u>and</u> actual behaviour respectively (see Englin and Cameron, 1996; Eiswerth *et al*, 2000; and Hanley *et al*, 2002). As recognised by Hanley *et al* (2003), a useful approach is to combine travel cost models of site visits with questions on how respondents' behaviour would change should site characteristics change – allowing improved development of the basic revealed preference technique. Louviere *et al* (2000) examine the value in combining stated preference and revealed preference analysis and conclude that the major strength lies in an enhanced ability to add robustness to valuation and prediction, which provides data enrichment. Similarly, Adamowicz *et al* (1994) encourage joint model estimation and argue that the underlying preferences reflected in stated and revealed preference models are similar. For Adamowicz *et al* (1997) the advantages in combining revealed and stated data include an increase in the amount of information available, the possibility of modelling "new goods", and reduction in the collinearity offered by the stated preference statistical designs. Such a combination of revealed and stated preference methods has much validity in the field of environmental economics and outdoor recreation, providing statistically useful econometric models.

2.9 Conclusion

The research project is related to a wide range of literature and theory. Of primary importance is the concept of "recreational carrying capacity", which contains both ecological and perceptual dimensions. The main academic purpose of this research project is to contribute to the existing literature by linking the ecological and perceptual components of recreation. For example, Gold

(1980, 4) argues that "the environmental cognitions upon which people act may well differ markedly from the true nature of the real world", while Pigram (1983, 68) states, "the environment impacts on users, who in turn, have an impact on the environment". The research project aims to analyse these statements, determining the level of environmental impact at a recreation site and whether visitor perception of this environmental impact differs from the actual environmental impact present.

It has been argued that there is a clear need to adopt a multidisciplinary outlook, both theoretically and empirically, and there must be an attempt to link the ecological and perceptual (social) aspects of recreation – this is an obvious gap in research and knowledge that must be filled and is consequently addressed in this thesis. This central claim has been developed through examination of key concepts; and a discussion of the main themes of the research project. There has also been consideration of the importance of environmental economics to the thesis.

Therefore, thinking about the literature reviewed in this chapter and relating each theme to the current research, the following should be achieved:

- While Liddle (1997) provides a general overview of recreation impact from a natural science, ecological perspective, Manning (2001) provides the social science/social impact equivalent. Although both texts provide a thorough examination of ecological and social impact, neither one attempts to thoroughly combine the ecological and perceptual aspects of outdoor recreation. The current thesis attempts to achieve this combination.
- Ecological conditions must be linked to social impact/perception. This will be achieved through the development of a TCM, CVM and CBMs. Recreational carrying capacity, and its subsequent management frameworks (for example, LAC, VERP), also integrates ecological and social conditions, and relates theory to the management of recreation.
- Implementing a successful carrying capacity framework requires the setting of indicators and standards of quality.
- Any study of ecological carrying capacity must take account of the nature of the plant communities affected by recreation activity (Pigram and Jenkins, 2002).
- Perceptual carrying capacity should include both visitor tolerance levels (crowding and visitor conflict) and perception of environmental conditions.
- Incorporating the theory behind management practices, specific management practices can be recommended for the Loch Lomond area.
- Manning's (2001) crowding model can be applied to the factors influencing crowding in the Loch Lomond area. Using this model, the following **crowding hypothesis** has been created: **high visitor numbers lead to overcrowding and reduced utility per visit.** In particular the hypothesis is equivalent to the satisfaction model, i.e. it assumes an inverse relationship

between use level and recreation satisfaction. Chapter six tests this crowding hypothesis with reference to the research findings.

- There is a need to investigate whether high noise levels result in reduced utility per trip. Using the theoretical background discussed above the following **noise hypothesis** has been created: **high noise levels result in reduced utility per visit.** This hypothesis is investigated in section 6.3.
- Using theoretical background from Liddle (1997), Grime (1973) and Cole (1995a&b). the impact of recreation on vegetation and recreation pressures in aquatic situations can be investigated.
- Ecological theoretical background has contributed to the creation of two environmental hypotheses: **(1) high visitor numbers place pressure on the natural environment**; and **(2) visitor perception of the indicators of environmental damage differs from the actual level of environmental damage**. These hypotheses are explored with reference to the research findings in section 6.4.
- Vaske *et al's* (2000) conflict conceptual model can be adapted to represent conflict as it is experienced at Loch Lomond.
- The most appropriate methodological options available to environmental economists should be implemented in the current research project. There is validity in combining revealed and stated preference approaches.

Each of the above statements is what follows. Furthermore, the literature reviewed here has influenced the research methods adopted in the research project. Chapter three, research methods, illustrates how gaps in the current literature will be addressed.

Chapter 3. Research Methods

"The time is ripe for some reconsideration of the 'quantity and quality' distinction, and for some attempt to reopen the channels of communication between quantitative and qualitative geographers" (Philo 1998, 192).

3.1 Introduction

The aim of this chapter is to describe and explain the various methods employed throughout the research project, and to justify the reasons for applying such methods. The research methods are as follows: a questionnaire survey; an ecological survey; systematic observation including a visual assessment of visitor-induced environmental damage; semi-structured interviews; and documentary evidence. It is desirable, and possible, to combine and synthesise these qualitative and quantitative methods in order to obtain a holistic and thorough approach to investigating the research aims. Such a combined approach also allows a comprehensive assessment of an area previously neglected by the social and natural sciences. Further, as realised by Philip (1998, 271), the use of more than one method for data collection reduces the risk of generating erroneous results. Combining methods is therefore advantageous for this research project.

3.2 Questionnaire Survey

A questionnaire was issued to visitors at various sites around Loch Lomond on each survey day. Questionnaires are accurate, generalisable and allow rapid statistical analysis (Marshall and Rossman 1999, 130). As Denscombe (1998, 105) recognises, on a practical level, questionnaires are also economical as they can supply a considerable amount of research data for a relatively low cost in terms of materials, money and time. There are of course limitations to the use of the questionnaire survey as a research method. Marshall and Rossman (1999, 191) suggest that not only is there often seen to be an invasion of the privacy of respondents, but also that sample size is crucial in order to ensure generalisability. The research project overcomes the former problem by ensuring that visitors were questioned on-site, not within the privacy of their own homes, and the purpose of the survey was clearly explained to respondents before it was implemented. Respondents could refuse to answer the questions if they wished. The latter problem is eradicated through issuing a large number of questionnaires on each of the allocated survey days. Moreover, as statistical analysis is an integral part of modelling recreation, questionnaires are a relevant and crucial component of the research project. Indeed, as the relevant visitor survey information did not previously exist, a questionnaire survey to be issued to land-based visitors was a necessity.

The aim of the questionnaire survey is to produce data that can be statistically analysed and used to produce various econometric models. To this end methodologies from the discipline of economics were used to produce the final questionnaire. These methods are three fold: the Travel Cost Method (TCM), Contingent Valuation Method (CVM), and Contingent Behaviour Method (CBM) (section 2.8.2). The design of the questionnaire survey reflected the need to combine these revealed and stated preference approaches. Initially it was decided to implement one single questionnaire, which would include the travel-cost questions, contingent valuation questions (WTP) and contingent behaviour questions. However, following construction of this questionnaire, it was decided that such a design was too long and could lead to boredom and perhaps non-response from the respondents. It was consequently decided that two questionnaires would be implemented: one including the TCM and CV questions, the other the TCM and CB questions. While the TCM and CV questionnaire proved to be acceptable with respect to length, the TCM and CB questionnaire remained unacceptable (it was too long). To this end, two TCM/CB questionnaires were created: termed CBa (perceived crowding) and CBb (perceived environmental damage).

To obtain data to satisfy the TCM, questions – in all three questionnaires – related to the number of visits the respondent had made to the site in the last twelve months and the origins of the visitor. The CV (WTP) question asked respondents if they would be willing to pay a parking fee to help towards the cost of environmental improvement at the site (the environmental improvement was previously explained to the respondent). If the respondent answered "yes" to this question, a payment set card was shown (see appendix B), which included eight car parking fees options – ranging from a minimum of 50p to a maximum of £8 for one day's parking. The respondent was then asked to choose one of the options. If the respondent answered "no", they were asked to give reasons for their refusal to pay.

The questionnaire termed CBa again included the relevant TC questions, but in place of the WTP question it included questions on expected behaviour change as a consequence of a jet-ski ban, along with expected behaviour change if twice as many people than at present visited the site. Similarly, the questionnaire entitled CBb included the TC questions along with a question asking how many trips the respondents would make if jet-skis were banned. Here a question was also asked about whether the respondent's number of trips would change if there were a reduction in environmental damage in place of the crowding question. In summary, therefore, three questionnaires were issued to Loch Lomond visitors (see appendix A). These questionnaires included the following methods: 1. questionnaire one: TCM and CVM; 2. questionnaire two: TCM and CBa (perceived crowding); and 3. questionnaire three: TCM and CBb (perceived environmental damage).

A pilot survey of all three questionnaires was undertaken in the summer of 2002 at two sites on east Loch Lomond: Milarrochy Bay and Sallochy. In total 60 questionnaires (30 TCM/CVM and 30

TCM/CB) were issued over four survey days. The questionnaires were then revised before the main survey was undertaken in the summer of 2003 at four sites around Loch Lomond, namely Rowardennan, Milarrochy Bay and Sallochy on the east shore of the loch and Firkin on the west (Figure 1.2). A total of 548 responses (260 TCM/CVM, 144 TCM/CBa, 144 TCM/CBb) were obtained over twenty-four days and two evenings. As the questionnaire was issued by the researcher as an intercept survey (i.e. in person on site) there was a 98% response rate; those refusing to answer the questionnaire did so primarily due to lack of time. A random sample was used to allow the maximum number of respondents possible, and a conscious attempt was made to interview an equal number of men and women and to distribute the questionnaire respondents throughout all age groups. This has achieved an accurate representation of recreation use on Loch Lomond and avoided any sex or age bias. Respondents were asked questions relating to their socio-economic characteristics (including their income, see appendix B); their origins and the number of trips made in the past twelve months (satisfying the TCM); their recreation activities; their perception of the presence (or absence) of crowding at a site; their perception of noise pollution; their perception of jet-skis; and their perception of the environmental conditions (specifically litter, dead trees, water pollution, exposed tree roots, broken branches, shore erosion and vegetation trampling and then environmental damage in general). Either a CV question, asking respondents whether they would be willing to pay a parking fee in order to fund environmental improvements, or the CBa or CBb questions were included.

Before a discussion of the procedure employed to analyse the questionnaire, it is necessary to briefly discuss an additional method that was considered for questionnaire inclusion. This is the choice experiment or choice modelling (CM) method, again a stated preference technique, which was introduced in chapter two. Many advocate the use of CM as an alternative to CB or CV (Hanley *et al*, 2003). In CM a sample of choice sets is provided to the respondent and by selecting a specific scenario the interviewee reveals the utility that they place on each attribute. The following attributes were considered for inclusion in a questionnaire survey: noise, expected number of people on site, and expected environmental damage. Three choice scenarios were then considered. Each scenario had a different level of payment along with two different payment mechanisms: car parking fees and higher local taxes. Following discussion with various managers and economists, however, it was decided that the latter payment mechanism may not be feasible. Further, the choice experiment appeared to add complexity to the questionnaire, creating a cognitive burden on respondents. Choice experiments are also often implemented in focus group situations, not on-site as was desirable for the current research. Thus, although CM is an approach favoured by many economists (see for example Bennett and Blamey, 2001), it was rejected as a method in this research project. The TCM used in conjunction with CV and CB was the favoured technique, as it is believed that, by providing data on both actual and intended behaviour, such a methodology provides a reliable and robust economic model and addresses the initial research questions.

Whilst the qualitative data generated by open questions allowed visitor perception to be studied (through coding and quotes as with the interview data – see section 3.5), the quantitative data of the closed questions was statistically analysed in order to determine whether any significant relationships exist between the different sections of data. Statistical analysis of the closed questions of the questionnaire was a four-stage process. Primarily an S.P.S.S. (Statistical Package for Social Sciences) spreadsheet was set up and included all the quantitative results from the questionnaire survey. Data from each respondent was coded and entered into S.P.S.S., which enables the data from the questionnaire to be rigorously analysed. After all the quantitative questionnaire data were entered, descriptive statistics and frequency tests were conducted in order to answer some basic questions on the characteristics, origins and recreation patterns of the respondents. The third stage involved inferential statistics: carrying out statistical tests of association, relating variables such as activity to either perception of crowding, perception of environmental damage, or perception of high noise levels, and establishing relationships between the data to investigate various statistical hypotheses (see chapter four). Chi-square was the statistical test of association used to conduct this analysis.

According to Owen and Jones (1990, 399) chi-square is the most widely used significance test. Although often criticised as a weak test of association, it was chosen because the questionnaire survey had generated a lot of data; it had provided a large sample, which is necessary to use this test. Moreover, the chi-square test can be easily and quickly computed using S.P.S.S. and many options (for example three way variable tables such as Age/Activity/Perception of environmental damage) are possible with chi-square. Alternative tests of association were considered (for a good discussion of the alternatives to the chi-square test see Agresti, 1996): these tests included Fisher Exact Test, Kruskal-Wallis test and Mann-Whitney test. These tests are, however, more difficult to perform using S.P.S.S. and further are more appropriate where the aim is to test whether two independent samples come from the same population. It also appears that chi-square has a number of advantages not found with the alternative options. Chi-square statistics have a reproductive property, they are easily repeated by other researchers elsewhere (Agresti, 1996). They are also easily broken down into components to show certain aspects of the association. Agresti (1996, 36) also shows that chi-square is a very general test, designed to detect any type of relationship/pattern. In achieving this generality, it allows an overview of any relationships existing in the data. The TCM, CVM and CBM, along with the descriptive statistics, allow a more specific look at the data and as such the chi-square test is a good means by which to look at the general statistical results. All alternative tests were therefore rejected on the basis that the chi-square test provides the researcher with all the information required to answer the research sub-questions – for example: is there a statistically significant relationship between length of stay on site and perception of crowding?

Regression analysis was the fourth and final stage of analysis and was used as a means of predicting future trends in recreation activity when thinking about crowding, noise levels and environmental damage. Whilst the previous three stages were conducted using S.P.S.S., this final stage, i.e. setting up and analysis of the travel cost model, contingent valuation model and contingent behaviour models, was conducted using the statistical computing packages Limdep and Stata (as they offer more procedures for regression analysis than does S.P.S.S.).

As an aside, it is relevant to note that in addition to the land-based questionnaire constructed and issued by the researcher, additional questions (created by the researcher) were added to the Loch Lomond Boat User Survey undertaken by the Loch Lomond and Trossachs National Park Authority in 2001. These questions elicited the perceptions of boat-users. Responses to the questions were analysed, in the form of basic descriptive statistics using S.P.S.S., as an integral part of the research project, the results of which are integrated into following chapters.

3.3 Ecological (Vegetation) Surveys

To supplement the primarily perceptual data obtained from the questionnaire survey, ecological surveys were undertaken with the intent of providing information on the "real" ecological/environmental impacts of recreation. Eight ecological survey sites were selected on the basis of a preliminary visit to multiple sites in the summer of 2002. In total sixteen sites were considered (ten sites in the south and central basin, and six sites in the north basin). Eight sites were chosen, on the principle that they provided the most appropriate geographical representation of plant distribution on the loch side[7], providing representation of both the north and south basin of the loch and the east and west shores. The eight sites selected were: Ardlui (north); Inverbeg (north-west); West Highland Way site (north-east); Kenmore Bay (north control); Narrows site (south); Bay at Loch Lomond Golf Course (south-west); Milarrochy Bay (south-east); and Camas an Losguinn (south control)[8] (see Figure 3.1). Each site was sampled at six-week intervals on the following days during 2003: Thursday 1st May; Wednesday 11th June; Wednesday 23rd July; and Tuesday 2nd September. There were therefore thirty-two samples for analysis.

[7] During the 2002 pilot survey, the researcher's supervisor identified the different plant species of Lomond, and the sites where these different species were represented. From this species identification the eight final sites were chosen.

[8] Grid references (GR) for all sites are as follows: Ardlui GR 231715; Inverbeg GR 234700; West Highland Way GR 235699; Kenmore Bay GR 234698; Narrows GR 237691; Bay at Golf Course GR 236688; Milarrochy Bay GR 240692; and Camas an Losguinn GR 237695.

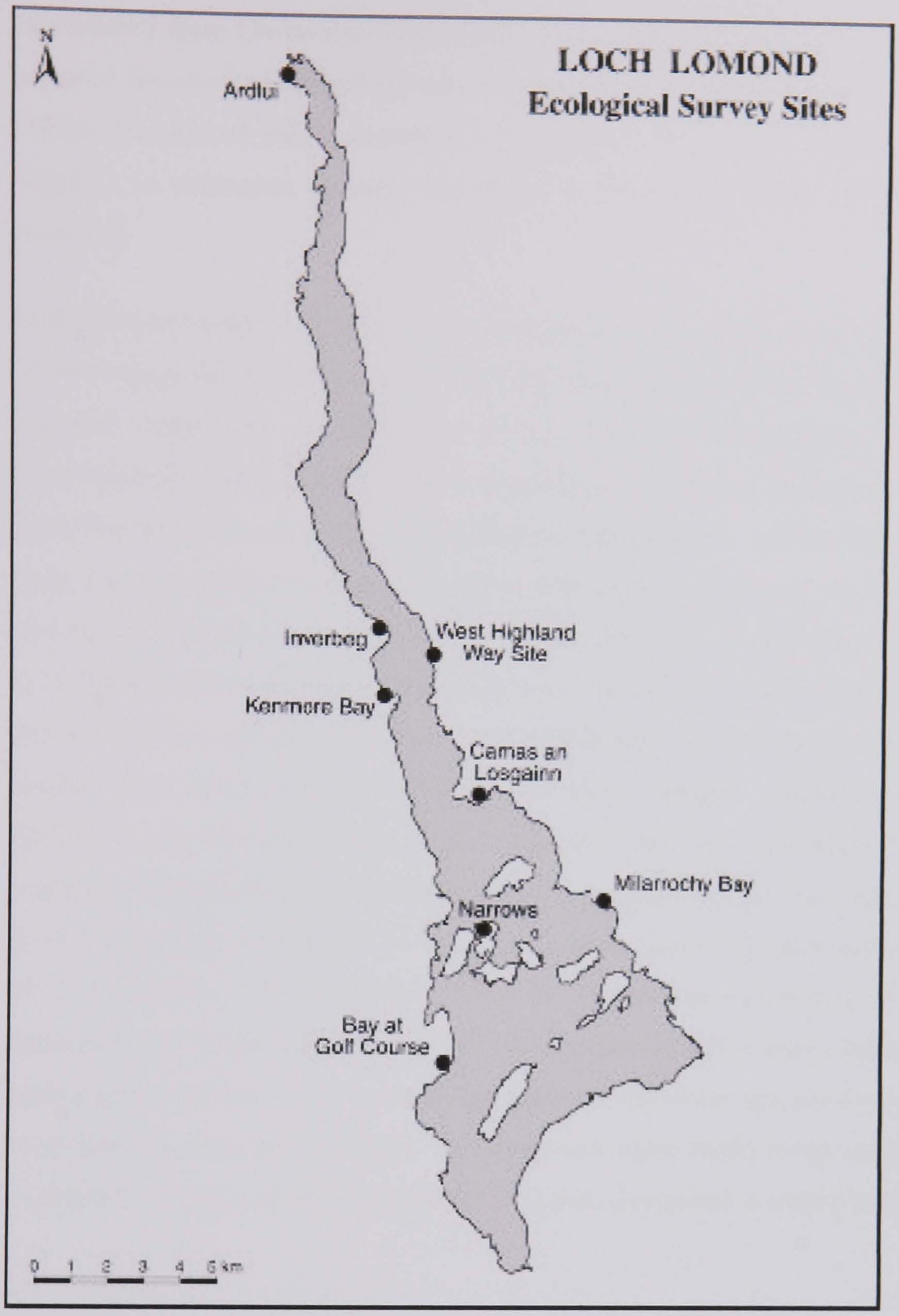

Figure 3.1: Location of ecological survey sites, Loch Lomond.

All sites were sampled in the following way: primarily an overall site assessment was made, namely the overall conditions of the site was observed using a quantitative checklist similar to that employed at Loch Venacher by Dickinson *et al* (1998). The quantitative checklist included the percentage of bare ground, from level 1 'little bare ground' to level 3 'mostly bare ground'; level of shade, from 1 'green' to 3 'heavy shade'; grazing intensity, from 1 'very low' to 3 'high'; artificial structures, from 1 'none' to 3 'major works'; presence of recreation, from 1 'no' to 5 'yes'; and the overall visitor damage (trampling) level, from 1 'No discernible damage' to 5 'substantial damage' (see appendix C). Any further observations relating to visitor use and site condition were recorded. The environmental variables measured at each site included soil redox (using a soil redox metre), underwater light availability (using a light sensor metre), substrate type, wind speed, wind direction and wave exposure. Wind speed and direction, along with the wave exposure index, were constructed from University field station data. Ecological variables were measured at each site sampled because the abundance and distribution of all plants are determined to some extent by abiotic features of the environment (Sutherland 1996, 281). Moreover, ecological data were required to determine whether vegetation is influenced by its environment and/or recreation pressures.

Following this ecological assessment, macrophyte data were collected using a probability measure of percentage frequency method. The following types of plants were studied using the standard National Vegetation Classification (NVC) sampling methodology (Rodwell, 1991a-1991e): submerged plants, emergent shoreline vegetation and vegetation observed one field from the shore. Sampling was achieved using both quadrats and grapnels. Whilst the submerged aquatic plants were sampled using a grapnel, the emergent shoreline vegetation was surveyed using a quadrat of one square metre (so as to produce a probability measure of percentage frequency of plant cover – for a detailed discussion of this technique see section 3.3.1). More specifically, three quadrats were thrown in the transition to field zone, or the backshore. In each quadrat the names and frequency of species were noted, dominant species were then recorded. Similarly three quadrats were then thrown in the shoreline zone where again the shoreline vegetation within each quadrat was recorded and frequency was counted. Finally, grapnel samples were taken either from the boat or from wading into the water from the shore. Three grapnel samples were obtained in total for each site (each sample consisting of five throws in order to obtain an average in correspondence with the quadrat data). Water depth was noted before grapnel samples were obtained. The species found in each grapnel sample were recorded and again the dominant species was noted. Where no species were found a zero was recorded. Records were again made using the data recording sheets (an example of which is attached in appendix C) and, if required, a waterproof notebook.

3.3.1 The Frequency Method.

The technique used to sample vegetation at the key sites is the probability measure of frequency method. According to Kershaw and Looney (1985, 14) the frequency of a species is "a measure of the chance of finding it with any one throw of a quadrat in a given area". The measure is obtained by recording whether a species is present or not in a series of randomly placed quadrats. The primary justification for using this method is the ease and rapidity by which an area can be sampled. Greig-Smith (1983) recognises further that the frequency method provides consistent results that are easily determined (in comparison with alternative methods such as density and cover). However, the primary rationale for the adoption of the percentage frequency method was the ease and speed by which an area can be sampled. This was important since the ecological surveys were only one of many methods implemented during this research project and hence time availability was a significant issue.

As is to be expected, there are many issues surrounding the use of the frequency method in field ecology (for a good discussion of these see Kershaw and Looney, 1985; Greig-Smith, 1983; Sutherland, 1996; McLean and Cook, 1968; and Bennett and Humphries, 1976). One of the most prominent issues is the influence of quadrat size on the results obtained. Put simply, larger quadrats will usually be more likely to provide a higher frequency estimate than smaller quadrats (Sutherland, 1996). Kershaw and Looney (1985) state that frequency is dependent on quadrat size and it is therefore important to state the size of quadrat used in an estimate of percentage frequency. It is thus stated that a one square metre quadrat was used to sample the emergent shoreline vegetation and the vegetation one field from the shore. Although it is often argued that a larger quadrat size yields more accurate results, for the purposes of answering the research question it was decided that a one square metre quadrat would provide sufficiently accurate results. The limitations of such an approach are nevertheless recognised.

For Kershaw and Looney (1985) a further issue surrounding the use of the percentage frequency method is the influence of plant size. Markedly different frequency values can be obtained between alternative species if they vary in size. For example, if species A is significantly larger than species B it is more likely to be obtained in a quadrat, hence species A will have a larger percentage frequency than species B, albeit both species A and B have the same overall density in the total area. Here percentage frequency would be an inadequate representation. Again this limitation is recognised, however, it is maintained that frequency is a useful measure of abundance as comparisons are made on a large scale and hence speed and rapidity are essential.

A final limitation of the percentage frequency method recognised by Kershaw and Looney (1985) is the effect of the spatial distribution of individuals. Frequency is dependent partly on density and partly on pattern. In essence, "patchiness" in species distribution will reduce the likelihood of a randomly placed quadrat finding the species and will therefore also reduce the frequency estimate (Sutherland 1996, 116). Sutherland (1996) realises that frequency can be biased against species with a more clumped distribution. Still, the accuracy of the frequency estimate can be increased to any desired extent by increasing the number of samples (Greig-Smith 1983, 9).

Sample size is certainly an important issue to address with reference to the ecological surveys. Eight sites were selected for analysis and each site was sampled four times. This provided thirty-two samples for analysis. Greig-Smith (1983, 20) explains that sampling may be placed in four ways: (1) by selecting sites considered typical of the area as a whole; (2) by placing samples randomly; (3) by placing them systematically in some regular pattern; or (4) some combination of these methods. The first method of sampling is inappropriate as it is based on the researcher's preconceived notions; the latter three methods are more advantageous. In particular random sampling allows more rigorous statistical analysis and is likely to give a good estimate of plant frequency (Greig-Smith, 1983). Random sampling was used in this research project. For Kershaw and Looney (1985) an important issue in any discussion of sample size is the size of the sample necessary. They recognise that it is impossible to make a general rule as to the number of sample quadrats needed to provide an accurate representation of an area, but they suggest that it is possible to obtain a subjective assessment of the size of sample necessary for any given area (Kershaw and Looney 1985, 26). They state that as the number of samples is increased, variations in the value of the mean for a given number of samples are reduced, and eventually the value of the mean will become stable, allowing an estimate of the number of samples preferred. In general, Kershaw and Looney recommend that it is appropriate to take as large a sample as time will permit. This has been implemented in the research project. The rejection of regular sampling avoids the problem of biased results, because the sampling should not coincide with any natural regularity in the distribution of the vegetation (Sutherland, 1996).

For Greig-Smith (1983, 19) "the value of quantitative data on the composition of vegetation depends on the sampling procedure used to obtain them"; it is important to be familiar with the alternative sampling methods available. These are primarily measures of density and cover. Density is "a count of the number of individuals within an area" (Kershaw and Looney 1985, 12) and it is an accurate method, allowing direct comparison of different areas and different species in an absolute measure of plant abundance. Regardless of its accuracy, this method was rejected because of the time involved in counting what would be a very large number of individuals. A further rejected method was a measure of plant cover. Kershaw and Looney (1985, 12) define cover as "the proportion of ground occupied by perpendicular projection on to it of the aerial parts of individuals of the species under consideration" and this is usually expressed as a percentage, which can be estimated or measured. Although plant cover is a widely used measure of plant abundance it was rejected in this research project primarily as a consequence of the slow sampling involved and the high chance of human error. Specifically, repeated measurement of the same plant species tends to be high (Kershaw and Looney 1985, 13). Frequency, with its speed and ease in measuring vegetation, was therefore adopted as the preferred method for the ecological survey.

3.3.2 Ecological (Vegetation) Survey Analysis.

To reiterate, a total of thirty-two samples were available for analysis. The aim of analysis of the ecological surveys was to assess whether any pattern had arisen between the vegetation community and environmental factors or recreational pressure/impact. The analysis was undertaken in two stages: (1) TWINSPAN classification into species groups and (2) statistical analysis of environmental factors (including recreation pressure) using descriptive statistics and parametric and non-parametric tests of association.

Primarily all the data from the ecological survey days were gathered together and entered into an Excel spreadsheet. In Excel three spreadsheets were created, containing the following: (1) a species list for all those plants found within the field and shoreline zone: (2) a species list for all aquatic plants; and (3) all environmental factors for all sites. Both the field/shore and aquatics species lists were then transferred from Excel into TWINSPAN (a computer package that classifies samples and species into groups). TWINSPAN then ran the analysis and classified all species into the appropriate groups. Using these groups and the eigenvalues found, final groups were defined for all species. These groups were then compared with previous findings, namely the results of Murphy *et al* (1994a) and McLeod and Murphy (2003) – see section 6.4.1.

The TWINSPAN groups were then related back to the environmental factors and recreation pressure variables. Again this was a two-stage process. Primarily all the environmental variables were classified into the TWINSPAN groups within the Excel spreadsheet. Group classification was based on site and group as identified by TWINSPAN. Secondly, the groups of environmental variables were imported into a Minitab spreadsheet. Using Minitab descriptive statistics were run on all variables. Histograms of frequencies were then run for each variable, to ensure that a normal distribution was present. If it was decided that the data were skewed, and hence not normally distributed, the variables were transformed, using logbase10. Two forms of statistical test were then used. For the environmental variables water clarity (represented by *k* and *Zeu*), soil redox and exposure, and one-way analysis of variance (ANOVA) tests were employed. For the bare ground, shade, grazing pressure, artificial structures, recreation pressure and visitor damage variables, the Kruskal-Wallis non-parametric test was used. Both were run within the Minitab spreadsheet. Finally, for each environmental factor, Minitab was used to graph the mean value against each group, indicating the standard error on each bar within the chart.

As an additional technique, the programme 'Tablefit' was used to classify each of the sites into species communities based on the NVC (National Vegetation Classification) method of classification. For each site a species list was entered into the 'Tablefit' programme and this produced the NVC grouping for each site. This was cross-referenced with Rodwell's (1991a-1991e) *British Plant Communities* books and the classifications derived by TWINSPAN (see chapter five).

3.4 Observation (including visual assessment of visitor-induced environmental damage survey).

For Marshall and Rossman (1999, 107) observation entails the "systematic noting and recording of events, behaviour and artefacts in the social setting chosen for study", the main advantage of which is that the observer can document and describe complex actions and interactions in natural settings.

Observation has been adopted in this research project from three different perspectives: (1) systematic observation on-site on the days the questionnaire survey was issued; (2) visual assessment of visitor-induced environmental damage survey; and (3) systematic observation in the Arches National Park.

On the questionnaire survey days, observation was made of visitor behaviour, appearance of the site and recreation activities, and recorded in the form of field notes. As Denscombe (1998, 141) notes, direct data collection was implemented through recording what people do, as distinct from that that they say they do. Further, boat count surveys and traffic surveys were carried out at each site. Specifically, on each questionnaire survey day on each hour, every hour from approximately 10am until 6pm, the number of vehicles in the site car park and the number of boats visible on the water were counted and recorded in a field-note book. Photographs were taken on each site, with the basic purpose of establishing the visual use and character of an area. Systematic observation of environmental damage at the site was also made using a quantitative checklist, for example: are exposed tree roots present?

Analysis of the systematic observation undertaken in the field again involved a combination of qualitative and quantitative procedures. With data obtained from the boat, traffic and environmental surveys, simple summary descriptive statistics were used to determine the physical (actual) carrying capacity of the area. Descriptive statistics were again computed using the statistical package S.P.S.S. Qualitative data obtained from personal observation of visitor behaviour, appearance of the site and recreation activities, were analysed by identifying key themes and using visitor quotes from field-notes collected (a field diary was written every day that a site was visited, which included comments made by recreationalists to the researcher).

A visual assessment of environmental impact on the loch shore area was undertaken during July 2004. This followed a pilot systematic observation survey carried out by the author, her supervisor and a research fellow on Thursday 13th December 2001. Visitor impact on the loch shore was observed using a basic quantitative scale, which recorded environmental impact from zero (no impact) to three (serious impact). Sites visited included Ardlui, Luss, Tarbet and Inveruglus, all on the west shore of Loch Lomond. It was discovered that such a quantitative method is a useful way by which to record a general picture of visitor-induced environmental damage. To expand this method a more detailed visual assessment of visitor damage was made where the aim was to establish the level of visitor damage and grazing pressure around the shore zone of Loch Lomond, including all major islands. The survey was carried out from the university field station boat. Using the University of Glasgow's field station (located on the central, east shore of Lomond) as a starting point, the survey was conducted clock-wise around the loch (south-east, south, south-west, islands, north-west, north, north-east shore), allowing continuous monitoring to occur. The south basin was surveyed and following on from this the north basin was then surveyed.

Consequently, visitor damage and grazing pressure were semi-quantitatively assessed and mapped for the entire shore zone of the loch. Visitor impact was observed using a six-point scale as shown in box 3.1.

1. No evidence of visitor impact.
2. Evidence of low visitor impact.
3. Evidence of moderate visitor impact (e.g. some litter, some shore erosion, some trampling of vegetation, some evidence of water pollution).
4. Evidence of high visitor impact.
5. Evidence of very high visitor impact (e.g. complete erosion of top soil, massive littering etc.).
6. Substantially altered (i.e. artificial/armoured shoreline) or rock (natural outcrop) shoreline.

Box 3.1: Visitor Impact Scale.

An area registering as '5' was seen to be the most significant in terms of visitor impact; this is because '6' is not susceptible shoreline (i.e. visitor impact is prevented). Grazing impact was similarly assessed using the scale presented in box 3.2.

1. No grazing.
2. Low grazing pressure.
3. Moderate grazing pressure.
4. High grazing pressure.
5. Very high grazing pressure.

Box 3.2: Grazing Impact Scale.

In addition to visitor impact and grazing impact scales, general observation was used. This was qualitative and involved noting the general uses of various impact areas and definition of these impacts, such as trampling of vegetation or burning of broken branches. Degrees from the shore (using a compass) and grid reference (using GPS) were also noted.

More specifically, implementing the survey involved a team of four, including the author. The tasks were divided as follows: (1) the boatman ran the boat steadily along as close inshore as was safe; (2) the author observed (with binoculars as necessary) the shoreline, calling out visitor damage and grazing impact scores and other information (for example, a convenient landmark) at each "start" point for a type of shoreline condition; (3) at each start point the recorder wrote down the visitor and grazing impact scores on pre-printed record sheets from the author (see appendix D) and also recorded the grid reference position of the boat for each start point (using a GPS attached to the clipboard); and (4) as each start point was called, a fourth person took a compass bearing from the boat to the start point on shore and marked the approximate position of the start point on the map. Thus, a start point was defined as any change in shoreline condition. The "end point" of a given set of conditions was not recorded. Whenever at least one survey criterion changed this indicated a new start point, which provided a continuous record of visitor impact and grazing pressure along the shore and islands.

As the visual assessment of visitor damage survey is based on personal observation by the researcher, the survey could be criticised as biased and subjective. In response to this criticism it is asserted that the researcher's observation was validated by at least two other professional researchers/academics. For example, on the days the visual assessment of visitor damage survey was undertaken the researcher was accompanied by her supervisor and a fellow Ph.D. candidate, allowing a reliable and robust survey to be implemented. The basic systematic observational method could be easily replicated by researchers outwith the Loch Lomond area.

Using the obtained record of visitor impact and grazing pressure, along with the GPS coordinates and compass readings, environmental damage along the shoreline was mapped. Initially this analysis process was conducted by hand. Using the GPS coordinates and the compass bearings all start points were marked onto 1:10,000 maps of Loch Lomond (there were twelve 1:10,000 maps in total). Following on from this each visitor damage level was allocated a different colour, these colours were then drawn on each map. Similarly grazing pressure levels were coloured in for each compartment on every 1:10,000 map. The distance of shoreline for each visitor damage and grazing pressure compartment was then measured by hand. Distance in centimetres was then converted to metres on the ground, which was then converted to kilometres. Using these data, along with the total length of shoreline covered, percentage of visitor damage and grazing pressure for each compartment was calculated and presented in tabular and chart form using the spreadsheet Excel. The final stage in the analysis process was to digitise the data. The G.I.S. programs of ArcCatalog and ArcMap were used for this illustrative purpose and the final map was produced on the 1:50,000 scale.

The quantitative and mapping results provide evidence of "real" environmental damage compared to the perceived environmental impact elicited by the questionnaire surveys, and allows the author to determine how much of the Loch Lomond shoreline area actually experiences environmental damage. In particular, areas experiencing severe visitor impact (i.e. 'five' on the visitor impact scale) can be identified. It was therefore a valuable exercise.

The final adoption of systematic observation is seen through a research visit to the Arches National Park (Utah, USA), which was undertaken by the author during October and November 2003. The aim of the visit was two-fold: (1) to carry out interviews and observation with employees of the Arches National Park management team; and (2) to find out more about the VERP framework (section 2.7) as it has been applied to National Parks in the U.S.A., and to determine whether it could be successfully applied in the Loch Lomond and Trossachs area. The author's research trip to Utah also involved time at Utah State University, Logan, where possible econometric models were discussed with Professors within the Economics department, and the theoretical side of recreational carrying capacity was researched in the University library and through attending graduate school classes in the School of Natural Resources. The research trip consequently had both practical and theoretical dimensions. Methods employed while in the Arches included personal observation. On the first day of the research visit a Park ranger heavily involved in the VERP process took the author on a drive around the entire area of the Park, explaining the main issues/problems/challenges for each area and how these have been dealt with within the National Park management programme. The author visited the Arches' three main impact areas: Delicate Arch, The Windows and Devil's Garden, and each area's relationship to the VERP process was explained. The researcher observed conditions in each area and systematically recorded crowding, environmental damage and noise levels. Photographs were also taken throughout the Arches National Park.

The main justification for the adoption of observation as a research method is not only that it allows a quantitative assessment of "real" environmental conditions, but also that it permits visitor behaviour to be documented, which can endorse the interview and questionnaire data. It is also suggested that systematic observation allows efficient, reliable and rigorous data collection (Denscombe 1998, 141). Denscombe (1998, 142) does, however, note the issues surrounding the use of systematic observation, namely an oversimplification of the situation can occur (subtleties are ignored) and behaviour not intentions are studied (what happens not why it happens). While the former problem is overcome through the implementation of interviews, the latter is eradicated by the use of the questionnaire survey, which includes questions of visitor intent and the reasons for their recreation visit. Again, therefore, systematic observation is an appropriate method to use in the research project as it complements the interviews, the questionnaire survey and the ecological survey. It provides relevant data on levels of recreation use, environmental conditions and the general characteristics of the sites studied.

Denscombe (1998, 140) differentiates between systematic observation and participant observation; whilst the former is primarily quantitative, the latter is qualitative. The research project uses systematic observation. It was decided that participant observation was not a relevant method to employ: it was not required to answer the research questions. Bryman and Burgess (1999, xvi) state that participant observation is "a research method in which a researcher immerses him-or herself in a social context with the aim of uncovering through an empathetic understanding the meaning systems of participants in that social context and hence to see the world from their point of view". While participant observation undeniably allows unique insights into the subjects' point of view, access can be difficult. Further, ethical problems can arise while reliability of the data can be questioned. As Denscombe (1998) states there is a "dependence on the 'Self'". To this end it was decided that overt systematic observation would be used; participant observation as a research method was not seen as applicable and was rejected.

3.5 Interviews

To complement these observational data, semi-structured qualitative interviews were carried out with managers from the Loch Lomond and Trossachs National Park Authority, along with Forestry Commission managers, policy-makers, Arches National Park staff, members of the sailing club, anglers, jet-skiers and local business people. According to Kahn and Cannell (1987) in Marshall and Rossman (1999, 108), interviews are "conversation with a purpose", they allow the researcher to uncover the participant's view and perception of a topic, allowing in-depth analysis and exploration. Put simply, people are speaking for themselves (Winchester 1996, 125). Opinion and perception are fundamental elements of the thesis and therefore interview implementation is justified, and, it is argued, an essential part of the research project.

Of course, as stated by Denzin and Lincoln (2000, 667), "researchers must be aware of the implications, pitfalls and problems of the types of interviews they choose". Hoggart *et al* (2002, 202) recognise that critics of interviewing commonly raise the issues of researcher bias, contamination, subjectivity, reliability, validity, data analysis is difficult, they are time-consuming, and it is not easy to generalise findings. It is important to remember that "there is always a gap between lived experience and communication" (Hoggart *et al* 2002, 210). Intensive interviewing will always be selective: some information will be unseen, some forgotten and some omitted (Ball 1984, 78). Whilst these serious problems are recognised, it is maintained that the inclusion of combined methods within the research project in part eradicates these limitations and strengthens any conclusions made; in particular the observation data (what people do) complements the interview data (what people say they do / plan to do). Overall, therefore, while the limitations of qualitative interviewing are recognised, interviews are an appropriate means by which to investigate the research aims as they provide rich, in-depth data.

Interviewing was also implemented because of its suitability for answering the research questions. A focus group was considered as an alternative method. It was rejected, for the following reasons. Hoggart *et al* (2002) believe that interviews and focus groups are both qualitative methods based on "close encounters", and both allow depth of insight, where the beliefs and actions are explored in terms used by those under investigation. In contrast to interviews, which are usually implemented on a one-to-one basis, focus groups consist of a small group of people, usually between six and nine in number, who are brought together by the researcher to explore attitudes, feelings and ideas about a topic (Denscombe, 1998). While focus groups can produce rich data, they may be dominated by one person and the emerging group culture may interfere with individual expression (Denzin and Lincoln, 2000). A focus group consisting of boat-users was considered (to determine their perception of each other), while a focus group of anglers was also considered (to discover their feelings towards jet-skiers and their perception of environmental damage). However, not only was it decided that such a topic may be difficult to research in a group situation (as many may be hesitant to discuss conflict with other recreation users) but time and cost (of planning and carrying out the group) were also important factors, as were the logistics of bringing together these different groups of people in the one place at the one time.

The interview study was designed through the creation of a basic interview schedule. Initially the key points to be discussed were listed and, using this structure as a starting point, questions were created around these themes. In general, each interview schedule contained around ten to twelve questions. As a semi-structured approach was adopted, the researcher was careful not to be constrained by these questions and questions were added if necessary throughout the interview process. All face-to-face interviews were recorded using a cassette/tape player and the researcher also made written notes during each meeting. For the manager and policy-maker interviews current management practice and management priorities were considered, as were any management strategies undertaken to reduce either environmental damage or crowding, and to alleviate visitor conflict. Questions on the manager's perception of recreation were included to compare the perceptual differences of managers and visitors. The management and policy interviews were qualitative, in-depth and lasted approximately one hour.

Interviews were also undertaken with sailors, anglers, jet-skiers and local business people. Twelve face-to-face qualitative, semi-structured interviews were carried out on the 9th of February 2003 at the Loch Lomond Sailing club. Each interview lasted from ten to thirty minutes. The National Park Authority provided the researcher with the phone number of a known Loch Lomond angler, a member of the Loch Lomond Angling Association, and using this phone number contact was made with the possible respondent. Following on from this primary phone interview, the angler then provided the researcher with the telephone numbers of other fishers, whom he said might agree to answer the interview questions. All possible respondents agreed to take part. Hence, using a "snowball" method, a number of telephone interviews were carried out with various Loch Lomond anglers. In total five semi-structured phone interviews were undertaken, each lasting approximately fifteen to twenty minutes. The Loch Lomond and Trossachs National Park Authority also provided contact telephone numbers for two local businesses: "Can you Experience Loch Lomond? Canoe hire" and "Mayles Watersports". Both businesses are located in Balloch at the southern end of Loch Lomond, a popular tourist area. The interviews were semi-structured telephone interviews, lasting approximately thirty minutes. A brief telephone conversation (lasting approximately five minutes) was also conducted with an employee of the "TayJet Personal Watercraft Club". It was anticipated that the researcher would be able to interview members of the

"TayJet Watercraft Club", eliciting the opinions of jet-skiers on the East Coast of Scotland. This would provide a comparison with Loch Lomond users. However, although contact was made with the "TayJet" association, the club did not maintain contact and as such interviews were not carried out.

Again the National Park Authority provided the researcher with telephone numbers for a number of jet-skiers. Three telephone numbers were given, but only one respondent was willing to answer the interview questions. The semi-structured telephone interview lasted approximately twenty minutes. As the remaining two respondents were unwilling to answer the questions (no explanation was given for this refusal), it was decided to visit Drumkinnon Bay, a popular site for jet-skiing at Loch Lomond, located at the south end of the loch, where face-to-face interviews with jet-skiers were implemented. A National Park ranger accompanied the researcher while jet-skiers were questioned, to ensure that respondents were more likely to answer the interview questions. In total twelve face-to-face semi-structured interviews were undertaken at Drumkinnon Bay on Sunday 23rd May 2004. Each interview lasted approximately ten minutes. Therefore the total jet-ski sample consisted of one telephone interview and twelve face-to-face interviews with jet-skiers at Drumkinnon Bay.

Perhaps one of the most significant problems with overall research method arose during the interview process, in particular with the telephone interviews. Often interviewees spoke fast; it was difficult for the researcher to write down all of the information they were providing. This could have resulted in important information being overlooked. Unlike the face-to-face interviews, a tape recorder could not be used for the telephone interviews[9]; this made it more difficult in the transcription stage, during which the researcher had to comprehend her notes made during the telephone conversation. However, as telephone interviewees did not have time to meet with the researcher in person, such interview form was necessary.

All interviews were transcribed and coded. After the interviews were fully transcribed, common themes were isolated and sub-categories created. A qualitative data analysis computing package, such as NVivo, was not used to identify these themes and codes, primarily because of the length of time it would have taken the researcher to learn this new programme. Thus, by hand, various codes were used relating to environmental damage, environmental perception, crowding, conflict, management objectives and recreational activities. For the manager and policy-maker interviews, the researcher identified ten codes. These were: (1) crowding; (2) noise; (3) environmental damage / resources impacts; (4) "recreational carrying capacity" (sub-theme: multiple carrying capacities); (5) information / education; (6) facilities; (7) visitor behaviour and activities (including

[9] The tape recorder did not register the telephone respondents' comments. Money was not available to purchase more sophisticated equipment (which would record those on the other end of the telephone line).

visitor conflict); (8) national park management actions; (9) natural features of the park; and (10) miscellaneous. Themes five to ten were adapted from the codes identified by the Arches National Park during the Visitor Experience and Resource Protection (VERP) trial in 1996 (*Pers. comm., Arches National Park Ranger*), codes one to four were identified as important by the interviewees. The coding categories were then discussed, compared and linked, while of course remaining open to any new categories that arose while analysing the data. Following on from identifying the code categories, each interview was re-read and interesting, revealing and/or relevant quotes highlighted. The main points from each interview were summarised. Open, qualitative questions from the questionnaire survey, such as "what did you most enjoy at this site?", were analysed (coded) in a similar way.

3.6 Documentary Evidence

Outdoor recreation relies on public participation. Participation of the public in outdoor recreation is determined, in part, by the availability of information, both through recreation management and by external sources. External sources include documentary evidence and consequently documentary evidence was analysed as an integral part of this research project. Documentary evidence, as used here, includes newspaper articles, information booklets, visitor leaflets and e-mail correspondence.

Methods employed while in the Arches National Park included analysis of documentary evidence, specifically Arches National Park information booklets, visitor guides and leaflets (see, for example, Arches NPS, 2003). As with the interviews, common themes were identified and revealing quotes were harnessed.

Newspapers were investigated as part of the "jet-ski debate" case study (section 6.5). Using the search engine "NewsBank", provided by the University of Glasgow's library, a search was carried out into newspaper articles concerned with jet-skis. Specifically, the phrase "Jet-ski or Jet-skiing" was entered into the search engine and "NewsBank" then automatically searched ten newspapers for articles discussing jet-skis. The dates were limited to all articles in the last twelve months (14/6/03 to 14/6/04). The ten newspapers included within "NewsBank's" search were: "The Times", "The Guardian", "The Independent", "The Independent on Sunday", "The Observer", "The Sunday Times", "The Herald", "The Sunday Herald", "The Scotsman", and "Scotland on Sunday". In addition, the researcher carried out an independent Internet search of the "Daily Telegraph" newspaper, looking at articles including the word "jet-ski" or "jet-skiing". Again only articles within a one-year period were included in the search (June 2003 until June 2004).

To elicit a general and then geographically specific view of jet-ski use, documentary evidence was also analysed from "The Bluewater Network", "the Personal Watercraft Industry Association" (PWIA), and "Friends of Loch Lomond". As with the Arches National Park documentary evidence, common themes and useful quotes were identified. This documentary evidence provides further depth to the research project.

3.7 Conclusion

Successfully addressing the project's research aims requires a combination of both qualitative and quantitative methods. The following methods were thus implemented: a questionnaire survey; an ecological survey; systematic observation; semi-structured interviews; and documentary evidence. This chapter has addressed each of these methods in turn, and justification for each method has been presented. The following two chapters present the results obtained as a consequence of the adopted combined methods approach.

Chapter 4. Results – the perceptual dimension

"Where methods have been integrated, the whole can be greater than the sum of its parts"
(Barbour 1999, 40).

4.1 Introduction

The integration of qualitative and quantitative methods, along with techniques from both the social and natural sciences, has provided a multitude of available data. The following two findings chapters demonstrate that such a combination of methods has produced a "whole that is greater than the sum of its parts" (Barbour 1999, 40). The aim of this chapter is to present the empirical perceptual results, and from these the general social impact findings, of the research project. The outline of this chapter is as follows: firstly data from the traffic survey are examined; and following on from this the results of the questionnaire survey are presented – using both descriptive statistics and statistical tests of association. The findings from the econometric models are then considered, and following this the interview results are outlined. Finally, the findings from the PWC debate are deliberated.

4.2 Traffic Counts

As introduced in chapter three, systematic observation is one of the many methods adopted in this research project. Traffic counts are one facet of such a method. The aim of the traffic counts is to establish a physical carrying capacity (section 2.4), as defined by Patmore (1983), at each site and to determine whether this is being met or exceeded.

4.2.1 Milarrochy Bay

Estimated physical carrying capacity of site:

If physical carrying capacity is not to be exceeded, the maximum number of vehicles that the site can contain is **134** (site warden, Milarrochy Bay). The site warden also reported that the maximum number of cars allowed on the beach at any one time is 56 (this is the maximum beach capacity).

As shown in table 4.1, a daily pattern developed throughout the period from 10am until 6pm. In general a peak was reached at around 2pm, after which time the number of vehicles fell, reflecting the picnic use of the site and the fact that much activity was water-based. Water-based activity often requires a morning start in order to fulfil an ample time on the water. Although a traffic count was not taken after 6pm, a site warden reported that after 7pm Milarrochy could once again attract visitors:

"After 7pm it can get busy again, if the weather is good. Local people like to visit in the evenings, after work – it's definitely a site that has various busy spells" (Site warden, Milarrochy Bay. Loch Lomond and Trossachs National Park Authority (LLTNPA)).

Time	**Number of Vehicles**					
	Date					
	Sun. 27/4/03	**Sun. 18/5/03**	**Sun. 8/6/03**	**Thurs. 17/7/03**	**Sat. 9/8/03**	**Fri.12/9/03**
10am	3 (0)	4 (1)	6 (1)	2 (0)	48 (25)	3 (1)
11am	12 (0)	7 (1)	17 (3)	5 (0)	83 (30)	6 (1)
12 noon	17 (1)	10 (1)	22 (5)	13 (0)	87 (32)	13 (2)
1pm	20 (1)	16 (2)	35 (8)	13 (0)	139* (32)	25 (3)
2pm	24 (1)	21 (2)	35 (8)	16 (0)	145* (35)	28 (3)
3pm	20 (2)	23 (4)	26 (8)	15 (0)	145 * (40) #	22 (3)
4pm	20 (2)	17 (2)	25 (7)	11 (0)	145* (40)	17 (2)
5pm	11 (2)	13 (2)	25 (6)	10 (0)	145* (40)	18 (2)
6pm	7 (1)	6 (1)	20 (5)	5 (1)	128 (32)	17 (1)

NB. Number of vehicles on beach is in parenthesis, i.e. total number of vehicles (number on beach).
* Physical carrying capacity exceeded. # Gates closed.

Table 4.1: Daily Pattern (Milarrochy Bay).

An example of a "busy spell" is Saturday 9th August 2003. On this day, from 1pm until 5pm, physical carrying capacity was met and exceeded (see table 4.1). Saturday 9th of August was a sunny, clear day with temperatures averaging 28 °C – indeed it was part of the "heat wave" of summer 2003. The site appeared physically (densely) crowded and a high number of PWC and speed boats were found on the water. At 3pm the gates to the boating area of Milarrochy Bay were closed; the physical car park threshold had been met. However the gates to the picnic area remained open, explaining the higher than capacity numbers on site. With the boating gates closed at this time it can be said that the physical capacity of the beach was not exceeded, neither was physical capacity of the boating car park. Clearly good management practice prevents excess vehicles in these areas.

The site intensity index is a quantitative measurement of site use based on the number of cars present and the number of cars possible. From table 4.2 it is seen that on Saturday 9/8/03 there was a site intensity index of 1.08 from 2pm until 5pm. In other words, 108% of the site was occupied during this time, clearly exceeding capacity. During the remaining five days, however, an average of only 12% of the site was used (site intensity index of 0.12), within capacity limit. Periods of peak use do still remain cause for concern: it is during these times that the environmental and social sustainability of the site is most threatened and should be addressed by management.

Weekly Pattern:

The mean number of cars on a weekday at any one hour was 13; on Saturdays a mean of 118 vehicles was obtained; while on Sundays the recorded mean was 18. These results suggest that Saturdays are the busiest day of the week at Milarrochy Bay, contradicting previous studies, particularly the work of Brown (1974) who found Sundays to be the busiest day of the week. The explanation for this lies primarily with weather conditions: Saturday, as previously mentioned, had higher than average temperatures for the time of year and consequently high vehicle numbers on site. It is also important to remember that Milarrochy Bay was only visited on one Saturday throughout the tourist season; more research is needed to verify weekly patterns.

Time	**Site Intensity Index**					
	(No. of cars present/No. of cars possible, i.e. 134)					
/Date	**Sun. 27/4/03**	**Sun. 18/5/03**	**Sun. 8/6/03**	**Thurs. 17/7/03**	**Sat. 9/8/03**	**Fri. 12/9/03**
10am	0.02	0.03	0.04	0.01	0.36	0.02
11am	0.09	0.05	0.13	0.04	0.62	0.04
12 noon	0.13	0.07	0.16	0.10	0.65	0.10
1pm	0.15	0.12	0.26	0.10	1.04*	0.19
2pm	0.18	0.16	0.26	0.12	1.08*	0.21
3pm	0.15	0.17	0.19	0.11	1.08*	0.16
4pm	0.15	0.13	0.19	0.08	1.08*	0.13
5pm	0.08	0.10	0.19	0.07	1.08*	0.13
6pm	0.05	0.04	0.15	0.04	0.96	0.13

* Physical carrying capacity exceeded.

Table 4.2: Site Intensity Index (Milarrochy Bay) (Site intensity index after Dickinson *et al* (1998), for example, 0.02 = 2% of car park occupied).

4.2.2 Sallochy

<u>Estimated physical carrying capacity of site:</u>

Personal observation established a physical carrying capacity (as defined by Patmore, 1983) at a maximum of **sixty** vehicles.

Time	**Number of Vehicles**					
	Date					
	Sat. 5/4/03	**Fri. 23/5/03**	**Sun. 1/6/03**	**Sun. 27/7/03**	**Sun. 17/8/03**	**Sat. 13/9/03**
10am	1	1	7	3	18	3
11am	1	1	12	7	32	5
12 noon	3	1	20	25	50	11
1pm	5	5	29	29	63*	20
2pm	5	7	35	27	84*	18
3pm	5	8	33	17	103*	16
4pm	6	4	28	20	95*	14
5pm	7	8	28	18	84*	15
6pm	5	10	20	15	69*	17

* Physical carrying capacity exceeded.

Table 4.3: Daily Pattern (Sallochy).

Time	**Number of Vehicles**	
	Date	
	Sun. 3/8/03	**Mon. 4/8/03**
7pm	17	20
8pm	7	11
9pm	4	16

Table 4.4: Night Surveys (Sallochy).

Again a daily pattern arose throughout the time period of 10am until 6pm (see table 4.3). In general a maximum was reached from around 1pm until 3pm, after which the number of vehicles began to fall. The nature of recreation at the site explains this pattern: both picnics and forest walks that commenced in late morning and early afternoon are popular activities.

On only one of the study days was the estimated physical capacity of the site met and exceeded: Sunday 17th August 2003. Here again the temperature was high (ranging from 22°C to 25°C throughout the day) with sunny, clear, blue skies; and it was not surprising that the car park was full by 12:30pm. The lack of on-site management was clearly evident; by 1pm 63 vehicles were present and by 3pm a daily (and indeed study) maximum of 103 was reached (see table 4.3). Many cars were parked on "grassy" areas and music was played by a group of youths on-site, destroying the peaceful character for the other visitors. Indeed one visitor commented:

"The bloody neds[10] shouldn't be here destroying the peace and quiet. That music is getting on my nerves! Five years ago no-one would come to this site, now anyone can come and everyone uses it. It's really messy here today as well, there's a lot of crap lying about. They need bins and a patroller to get rid of the neds" (Male, 35-44 years, West Lothian).

Another visitor echoed these concerns:

"Music is blaring from that camper over there. That shouldn't be allowed. We're leaving early." (Female, 45-54 years, Milngavie).

A lot of litter was also seen on the site, as were broken branches and fire circles (see figures 4.1 and 4.2). A German visitor commented:

"There's a lot of litter here. There should be toilets; I've even seen a few "dirty spots" lying about! There's a tree over there with a lot of plastic bags lying underneath it where people must be collecting their rubbish. I've already picked up a lot of litter that was lying about the site. They need bins" (Female, 35-44 years, Germany).

These revealing perceptual (social) and environmental issues will be investigated further in the following chapters – in particular chapters six and seven.

[10] 'Ned' (plural 'neds'): "Scottish derogatory slang for a person, usually a youth, of low social standing and education, a violent disposition and with a particular style of dress (typically sportswear or Burberry), speech and behaviour. Also known as chavs" (Wiktionary, 2006).

Figure 4.1: Litter at Sallochy *(Photograph taken August 2003 by author).*

Figure 4.2: Fire circle, Sallochy *(Photograph taken August 2003 by author).*

To gain a thorough understanding of site use at Sallochy, and to ensure that the questionnaire sample was not biased toward day-time visitors, Sallochy was also visited at night. While the remaining three sites are not often used late at night (the gates at these remaining sites are closed after a certain time preventing further visitation), Sallochy, with no gates to limit visitors, is very popular with local visitors after 7pm. Local youths frequent Sallochy often during the summer months and have become a cause of concern for many, threatening the perceptual carrying capacity of the area (interview with Manager, Forestry Commission). With respects to physical carrying capacity, however, the limit of sixty vehicles is not met nor exceeded at Sallochy on either of the two survey nights (see table 4.4). This is confirmed further by night surveys undertaken by the Forestry Commission (see appendix E) during August 2003. A maximum of 36 vehicles were recorded on site on at 10:35pm on Saturday 9th August 2003, during all other nights vehicle numbers were in the range from 8 to 31, well within the physical carrying capacity limit.

Revealingly, the site intensity index for Sallochy (as shown in tables 4.5 and 4.6) ranges from 0.02 to 1.72, i.e. from only 2% of the site in use to 172% of Sallochy occupied. This large range reflects the popularity of the site during periods of good weather, and is indicative of the peaks of recreation demand common throughout the entire Loch Lomond area. Management must take these peaks into account.

Time	Site Intensity Index (No. of cars present/No. of cars possible, i.e. 60)					
\Date	Sat. 5/4/03	Fri. 23/5/03	Sun. 1/6/03	Sun. 27/7/03	Sun. 17/8/03	Sat. 13/9/03
10am	0.02	0.02	0.12	0.05	0.3	0.05
11am	0.02	0.02	0.2	0.12	0.53	0.08
12 noon	0.05	0.02	0.33	0.42	0.83	0.18
1pm	0.08	0.08	0.48	0.48	1.05*	0.33
2pm	0.08	0.12	0.58	0.45	1.4*	0.3
3pm	0.08	0.13	0.55	0.28	1.72*	0.27
4pm	0.1	0.07	0.47	0.33	1.58*	0.23
5pm	0.02	0.13	0.47	0.3	1.4*	0.25
6pm	0.08	0.17	0.33	0.25	1.15*	0.28

* Physical carrying capacity exceeded.

Table 4.5: Site Intensity Index (Sallochy).

Time	Site Intensity Index (No. of cars present/No. of cars possible, i.e. 60)	
	Sun. 3/8/03	Mon. 4/8/03
7pm	0.28	0.33
8pm	0.12	0.18
9pm	0.07	0.27

Table 4.6: Site Intensity Index for Night Surveys (Sallochy).

Weekly Pattern:

The mean number of vehicles at any one-hour on a week-day was seven, on Saturdays a mean of nine vehicles was reached, while on Sundays the mean number of vehicles was thirty-six. In general, therefore, Sunday was the busiest day of the week. This pattern is indicative of the high numbers of day-trippers who have most opportunity to visit Loch Lomond at weekends. As Brown (1974) states, Saturday is not a leisure day for all, many work and have duties to fulfil at home. Thus Sunday – as the traditional "day of rest" – is the most popular day for outdoor recreation at Sallochy.

4.2.3 Rowardennan

Estimated physical carrying capacity of site:

According to a Forestry Commission employee, **100** vehicles is the maximum physical capacity of Rowardennan.

As with the previous two sites, a daily pattern developed at Rowardennan (table 4.7). Again a peak was reached between 1pm and 2pm. A primary function of the Rowardennan car park is as a base for visitors hiking Ben Lomond, and "turn-over" of hikers would therefore explain the busy 1pm/2pm period. During this time the morning walkers are completing their hike, while the afternoon walkers are beginning their hike. Numbers on site are consequently high.

Time	Number of Vehicles					
	Date					
	Wed. 23/4/03	Sun. 25/5/03	Sat. 14/6/03	Sat. 19/7/03	Sun. 10/8/03	Sun. 7/9/03
10am	7	73	20	19	17	10
11am	22	80	27	29	37	30
12 noon	35	100 *	33	48	67	45
1pm	38	100 *	35	64	100 *	55
2pm	37	100 *	33	81	108 **	57
3pm	35	92	31	77	100 *	47
4pm	28	86	39	65	89	39
5pm	26	78	40	65	88	33
6pm	18	52	35	55	85	25

* Car park full. ** Site full but people parking on grassy verges, i.e. physical capacity of site exceeded.

Table 4.7: Daily Pattern (Rowardennan).

Interestingly, Rowardennan is the site at which physical carrying capacity is met and exceeded on two days throughout the survey season: Sunday 25th May 2003 and Sunday 10th August 2003. On Sunday 10/8/03 especially, physical carrying capacity is exceeded, with 108 vehicles recorded in the car park at 2pm. Cars were parked in non-designated spaces, for example on the grassy verge (see figure 4.3), and a lot of visitors unable to find a parking space decided to park in the Rowardennan hotel car park. Physical sustainability was threatened on this day.

Figure 4.3: Physical carrying capacity, Rowardennan *(Photograph taken August 2003 by author).*

Physical capacity is also met in May at Rowardennan, even though this is not the height of the tourist season and at the remaining three sites the threshold site level is not met during this time of year. At Rowardennan the capacity is met primarily because of its importance as a car park site from which to hike Ben Lomond. Hiking Ben Lomond is a popular activity throughout the year. Predominantly as a result of this activity, on Sunday 25/5/03 from 12 noon until 2pm 100% of the car park is occupied (site intensity index 1 – see table 4.8). By 3pm this falls to 92% (site intensity index of 0.92). Perhaps more importantly on Sunday 10/8/03 at 2pm 108% of the car park area is used (site intensity index of 1.08), during this period environmental sustainability is compromised. Despite these peaks, on Wednesday 23/4/03 at 10am only 7% of the car park is used, again showing the fluctuating nature of recreation demand at this site and the need for this site-use trend to be understood by management.

Time	Site Intensity Index (No. of cars present/No. of cars possible, i.e. 100)					
/Date	Wed. 23/4/03	Sun. 25/5/03	Sat. 14/6/03	Sat. 19/7/03	Sun. 10/8/03	Sun. 7/9/03
10am	0.07	0.73	0.20	0.19	0.17	0.1
11am	0.22	0.80	0.27	0.29	0.37	0.30
12 noon	0.35	1	0.33	0.48	0.67	0.45
1pm	0.38	1	0.35	0.64	1	0.55
2pm	0.37	1	0.33	0.81	1.08 *	0.57
3pm	0.35	0.92	0.31	0.77	1	0.47
4pm	0.28	0.86	0.39	0.65	0.89	0.39
5pm	0.26	0.78	0.40	0.65	0.88	0.33
6pm	0.18	0.52	0.35	0.55	0.85	0.25

* Physical carrying capacity exceeded.

Table 4.8: Site Intensity Index (Rowardennan).

Weekly Pattern:

Weekly pattern at Rowardennan confirms the findings of many previous recreation and tourism-orientated studies (see for example Brown, 1974; and Dickinson *et al*, 1998). Weekdays are the least popular, with a mean of 27 vehicles, Saturday is busier with a mean of 44 vehicles and finally Sunday is the most popular day with a mean of 68 vehicles. Again the high Sunday average represents the many day-trippers who have the opportunity to visit Rowardennan at weekends.

4.2.4 Firkin

Estimated physical carrying capacity of site:

From personal observation physical capacity is estimated at **fifty** vehicles.

Time	Number of Vehicles					
	Date					
	Sun. 13/4/03	Sat. 10/5/03	Tues. 10/6/03	Sun. 20/7/03	Mon. 11/8/03	Sun. 14/9/03
10am	12	5	5	6	6	5
11am	22	12	10	9	14	12
12 noon	25	13	21	12	19	15
1pm	20	20	30	10	28	16
2pm	30	21	29	18	31	14
3pm	27	17	25	17	27	12
4pm	23	15	20	16	27	9
5pm	19	13	12	15	21	9
6pm	5	8	6	13	17	3

Table 4.9: Daily Pattern (Firkin).

As table 4.9 demonstrates, the physical carrying capacity of fifty vehicles is not met at Firkin during the six days under study. Perhaps this is because of good management practice at the site: the gates are closed when the physical capacity is reached preventing further visitation. The daily pattern is also less pronounced than at the remaining three sites. For example, on Sunday 13/4/03 twenty-five vehicles were recorded at 12 noon and by 1pm this had fallen to twenty vehicles, rising again to a daily maximum of thirty at 2pm. Again on Sunday 20/7/03 twelve vehicles were recorded at 12 noon, falling to ten at 1pm and rising to eighteen at 2pm. Weather conditions almost certainly explain this pattern: heavy rainfall at 1pm on Sunday 20/7/03 caused many visitors to return to their cars. In addition to the toilet facilities on site, Firkin (with a number of picnic benches and tables) is also a picnic area (see figure 4.4). The daily peak around lunch time, then, is to be expected.

Figure 4.4: Firkin Picnic Area *(Photograph taken August 2003 by author).*

0.58 is the maximum site intensity at Firkin (see table 4.10). During the busiest time period only 58% of the car parking area is occupied, 42% remains available. Physical capacity is never exceeded at Firkin. Perhaps this is because many people stop at Firkin for a short period of time, either to view Loch Lomond or to use the toilet facilities, before continuing on the A82 road to a destination further north.

Time	**Site Intensity Index (No. of cars present/No. of cars possible, i.e. 50)**					
/Date	**Sun. 13/4/03**	**Sat. 10/5/03**	**Tues. 10/6/03**	**Sun. 20/7/03**	**Mon. 11/8/03**	**Sun. 14/9/03**
10am	0.24	0.1	0.1	0.12	0.12	0.1
11am	0.44	0.24	0.2	0.18	0.28	0.24
12 noon	0.5	0.26	0.42	0.24	0.38	0.3
1pm	0.4	0.4	0.6	0.2	0.56	0.32
2pm	0.6	0.42	0.58	0.36	0.62	0.28
3pm	0.54	0.34	0.5	0.34	0.54	0.24
4pm	0.46	0.3	0.4	0.32	0.54	0.18
5pm	0.38	0.26	0.24	0.3	0.42	0.18
6pm	0.1	0.16	0.12	0.26	0.34	0.06

Table 4.10: Site Intensity Index (Firkin).

<u>Weekly Pattern:</u>

The mean number of cars on a weekday at any one hour was 19; on Saturdays a mean of 14 vehicles was obtained; while on Sundays the recorded mean was 15. These are interesting results; previous research suggests that weekends are always busier than weekdays. Again the nature of Firkin can explain this anomaly. Firkin is very much a tourist-orientated site and, in comparison to the three remaining study sites, local use is very low. Hence tourists, many holidaying during the week, contribute to the larger numbers on week days. Again, however, further research is needed to validate this pattern.

Overall, then, is the physical carrying capacity – as defined by Patmore (1983) – being met or exceeded at any of the four sites?

Milarrochy Bay: Physical carrying capacity was exceeded during one of the six days of the field study. However, as a result of good management practice, this was not to a detrimental level with regards to environmental conditions.
Sallochy: On one day during the survey physical carrying capacity was exceeded. Although perhaps an extreme case, it is clearly cause for environmental and social concern.
Rowardennan: Physical carrying capacity was met and exceeded on two of the survey days (both Sundays). These peaks in recreation use are clearly cause for management concern – both environmentally and socially.
Firkin: Management restrictions prevent physical capacity from being exceeded at Firkin. Physical carrying capacity was not met nor exceeded on any of the six survey days.

Box 4.1: Physical carrying capacity conclusions.

As shown in box 4.1, it is only at Firkin where physical carrying capacity is not met nor exceeded on any of the survey days. At the remaining sites – Milarrochy Bay, Sallochy and Rowardennan – physical carrying is exceeded on at least one survey day.

In addition to the researcher's own counts, traffic counts have also been undertaken by Forestry Commission rangers at a number of sites around the east shore of Loch Lomond. This information was made available to the researcher and data for Sallochy and Rowardennan have been modified as appropriate and are presented in appendix E.

On the days the researcher carried out the traffic counts, a questionnaire survey was also distributed to visitors. The quantitative results of this survey are now reported.

4.3 Questionnaire Surveys

4.3.1 Descriptive Statistics

This section presents the results found for all questions for the three questionnaire surveys: CV (contingent valuation question regarding visitor willingness to pay for environmental improvements), CBa (contingent behaviour questions regarding perceived crowding) and CBb (contingent behaviour questions regarding perceived environmental damage). 548 questionnaires were issued in total (specifically, 260 TCM/WTP(CV); 144 TCM/CBa; and 144 TCM/CBb). All relevant descriptive statistics will be discussed further in the following chapters. In this section tables are presented, but not analysed.

Site	Number of respondents	Percent of all respondents (%)
Sallochy	152	27.7
Firkin	132	24.1
Rowardennan	132	24.1
Milarrochy Bay	132	24.1
Total	548	100

Table 4.11: Site.

Date	Number of respondents	Percent of all respondents (%)
Sat. 5/4/03	22	4.0
Sun. 13/4/03	22	4.0
Wed. 23/4/03	22	4.0
Sun. 27/4/03	22	4.0
Sat. 10/5/03	22	4.0
Sun. 18/5/03	22	4.0
Fri. 23/5/03	22	4.0
Sun. 25/5/03	22	4.0
Sun. 1/6/03	22	4.0
Sun. 8/6/03	22	4.0
Tues. 10/6/03	22	4.0
Sat. 14/6/03	22	4.0
Thurs. 17/7/03	22	4.0
Sat. 19/7/03	22	4.0
Sun. 20/7/03	22	4.0
Sun. 27/7/03	22	4.0
Sat. 9/8/03	22	4.0
Sun. 10/8/03	22	4.0
Mon. 11/8/03	22	4.0
Sun. 17/8/03	22	4.0
Sun. 7/9/03	22	4.0
Fri. 12/9/03	22	4.0
Sat. 13/9/03	22	4.0
Sun. 14/9/03	22	4.0
Sun. 3/8/03	10	1.8
Mon. 4/8/03	10	1.8
Total	548	100

Table 4.12: Date.

Time period	Number of respondents	Percent of all respondents (%)
Before 10am	5	0.9
10:05am – 12 noon	146	26.6
12:05pm – 2pm	253	46.2
2:05pm – 4pm	108	19.7
4:05pm – 6pm	16	2.9
6:05pm – 8pm	14	2.6
After 8pm	6	1.1
Total	548	100

Table 4.13: Time.

Weather conditions	Number of respondents	Percent of all respondents (%)
Poor	66	12.0
Moderate	274	50.0
Good	208	38.0
Total	548	100

Table 4.14: Weather.

Sex of respondent	Number of respondents	Percent of all respondents (%)
Female	283	51.6
Male	265	48.4
Total	548	100

Table 4.15: Sex of respondent.

Age of respondent	Number of respondents	Percent of all respondents (%)
16-24 yrs	66	12.0
25-34 yrs	94	17.2
35-44 yrs	168	30.7
45-54 yrs	122	22.3
55-64 yrs	54	9.9
65 + yrs	44	8.0
Total	548	100

Table 4.16: Age of respondent.

Car travel? ("CAR")	Number of respondents	Percent of all respondents (%)
No	44	8.0
Yes	504	92.0
Total	548	100

Table 4.17: Mode of transport *(Q.1a: Did you travel to this site by car today?).*

No car ("NOCAR")	Number of respondents	Percent of all respondents (%)
Bike	2	0.4
Motorcycle	2	0.4
Boat	1	0.2
Camper Van	3	0.5
Van	1	0.2
Minibus	2	0.4
Walk	33	6.0
Arrived on site by car	504	92.0
Total	548	100

Table 4.18: Mode of transport *(Q1b: If No, how did you get here?).*

Been before?	Number of respondents	Percent of all respondents (%)
No	202	36.9
Yes	346	63.1
Total	548	100

Table 4.19: Frequency of visits *(Q.2a: Have you visited this site before?).*

"LAST YEAR"	Number of respondents	Percent of all respondents (%)	Percent of valid respondents (345) (%)
None	16	2.9	4.6
1-5	196	35.8	56.8
6-10	74	13.5	21.4
11-15	23	4.2	6.7
16-20	23	4.2	6.7
21-25	3	0.5	0.9
26 and over	10	1.8	2.9
First time site visitors	203	37.1	0
Total	548	100	100

Table 4.20: Frequency of visits *(Q2b: If yes, how many times in the last twelve months?).*

Length of stay	Number of respondents	Percent of all respondents (%)
½ and hour or less	110	20.1
½ to 1 hour	68	12.4
1 to 2 hours	106	19.3
2 to 4 hours	134	24.5
4 to 6 hours	98	17.9
Over 6 hours	32	5.8
Total	548	100

Table 4.21: Length of stay on site *(Q.3: How long are you planning to spend here today?).*

Travel from home?	Number of respondents	Percent of all respondents (%)
No	189	34.5
Yes	359	65.5
Total	548	100

Table 4.22: Travel origins *(Q.4a: Did you travel from home today?).*

Postcode district / area	Number of respondents	Percent of all respondents (%)	Percent of Valid YES respondents (%)
G (Glasgow)	235	42.9	65.6
EH (Edinburgh)	16	2.9	4.5
FK (Falkirk = north-central Scotland)	38	6.9	10.6
PA (Paisley = west Scotland)	23	4.2	6.4
ML (Motherwell = south-central Scotland)	15	2.7	4.2
Other post codes	31	5.7	8.7
Total	358	65.3	100

Table 4.23: Place of residence, identified by postcode district *(Q4b: If yes, what is your postcode?).*

Home	Number of respondents	Percent of all respondents (%)	Percent of valid NO respondents (%)
Scotland	25	4.6	13.2
England	90	16.4	47.6
Wales	4	0.7	2.1
Ireland	4	0.7	2.1
Rest of Europe	57	10.4	30.2
U.S.A. & Canada	6	1.1	3.2
Other	3	0.5	1.6
Total	189	34.4	100

Table 4.24: Home *(Q.4c: If no, where is your home?).*

Type of Visit	Number of respondents	Percent of all respondents (%)
Holiday	151	27.6
Weekend trip	64	11.7
Day Visit	333	60.8
Total	548	100

Table 4.25: Type of Visit *(Q5a: Are you on a holiday, a weekend trip or is this a day visit?).*

Accommodation	Number of respondents	Percent of all respondents (%)	Percent of valid respondents (%)
West Loch Lomond	13	2.4	6.0
East Loch Lomond	82	15.0	38.1
Balloch	19	3.5	8.8
Ardlui	3	0.5	1.4
Trossachs	10	1.8	4.7
Stirling area	18	3.3	8.4
Glasgow area	28	5.1	13.0
Edinburgh area	6	1.1	2.8
Fort William	11	2.0	5.1
Oban	16	2.9	7.4
Other	9	1.6	4.2
Total	215	39.2	100

Table 4.26: Accommodation *(Q.5b: If on holiday or a weekend trip, where are you staying?).*

Length of stay in area	Number of respondents	Percent of all respondents (%)	Percent of valid respondents (%)
One night	13	2.4	6.1
2 to 3 nights	72	13.1	33.8
4 to 7 nights	32	5.8	15.0
Over 7 nights	6	1.1	2.8
1 day only	92	16.8	42.3
Total	215	39.2	100

Table 4.27: Length of stay in area *(Q.5c: How long are you planning to stay in the Loch Lomond area?).*

Activity undertaken	Number of respondents	Percent of all respondents (%)
Picnicking	130	23.7
Sitting or walking near the shore	240	43.8
Cycling	12	2.2
Climbing or hill-walking	98	17.9
Fishing	4	0.7
Boating or sailing	15	2.7
Canoeing	4	0.7
Jet-skiing	4	0.7
Swimming	11	2.0
Other	30	5.5
Total	548	100

Table 4.28: Activity *(Q.6: Have you undertaken, or are you planning to undertake, any of the following activities today?)*[11].

Category of activity	Number of respondents	Percent of all respondents (%)
Water	38	6.9
Land (active)	113	20.6
Land (passive)	397	72.4
Total	548	100

Table 4.29: Category of Activity.

Reduce enjoyment?	Number of respondents	Percent of all respondents (%)
No	262	47.8
Yes	280	51.1
Don't know	6	1.1
Total	548	100

Table 4.30: Enjoyment and Activity *(Q7a: Do any of these activities, if undertaken by other people, typically reduce your enjoyment of a day out on Loch Lomond?).*

[11] Respondents stated only one activity undertaken.

Activity and enjoyment	Number of respondents	Percent of all respondents (%)	Percent of valid YES respondents (280) (%)
"Jet-skis annoy me"	265	48.4	94.6
"'Neds' annoy me"	9	1.6	3.2
Something else	12	2.2	4.3
Total	286	52.2	102.1*

* Total percent is over 100 as respondents could give more than one factor that reduces their enjoyment.

Table 4.31: Enjoyment and Activity *(Q.7b: If yes, which of these activities?).*

Perception of jet-skis	Number of respondents	Percent of all respondents (%)
Nice to look at	50	9.1
Fun/Enjoyable	62	11.3
Causing noise pollution	346	63.1
Causing air pollution	12	2.2
Causing water pollution	36	6.6
Don't care	32	5.8
Other	10	1.8
Total	548	100

Table 4.32: Perception of jet-skis *(Q.8: Do you think that the jet-skis on Loch Lomond are:....?).*

Rating of noise level	Number of respondents	Percent of all respondents (%)
1	261	47.6
2	186	33.9
3	77	14.1
4	19	3.5
5	5	0.9
Total	548	100

Table 4.33: Rating of noise on site *(Q.9: How would you rate the noise level on this site today (with 1 = little noise, 5 = too noisy?).*

Enjoyment	Number of respondents	Percent of all respondents (%)
No	102	18.6
Yes	446	81.4
Total	548	100

Table 4.34: Noise and enjoyment of visits *(Q10a: Does the presence of noise pollution affect the enjoyment of your visit?).*

Frequency of visits	Number of respondents	Percent of all respondents (%)
No	199	36.3
Yes	349	63.7
Total	548	100

Table 4.35: Noise and frequency of visits *(Q.10b: Does it affect the frequency of visits?).*

Preferred Company	Number of respondents	Percent of all respondents (%)	Percent of valid respondents excl. CBb (total = 404) %
Lots of other people (c. 100)	2	0.4	0.5
A moderate amount of people (c.30)	18	3.3	4.5
A few people (c.10)	95	17.3	23.5
Family and friends only	181	33.0	44.8
On your own	57	10.4	14.1
Don't care	51	9.3	12.6
Total	404	73.7	100

Table 4.36: Preferred Company *(Q.11: When you visit a site like this one, do you prefer to spend your time with....?).*

Anticipated Crowding	Number of respondents	Percent of all respondents (%)	Percent of valid respondents excl. CBb (total = 404) %
1	46	8.4	11.4
2	132	24.1	32.7
3	143	26.1	35.4
4	72	13.1	17.8
5	11	2.0	2.7
Total	404	73.7	100

Table 4.37: Anticipated Crowding *(Q.12: Before you set out today, how crowded did you expect it to be once you got here (with 1 = no crowding and 5 = overcrowded?).*

Perceived Crowding	Number of respondents	Percent of all respondents (%)	Percent of respondents excl. CBb (total = 404) %
1	158	28.8	39.1
2	119	21.7	29.5
3	90	16.4	22.3
4	33	6.0	8.2
5	4	0.7	0.9
Total	404	73.6	100

Table 4.38: Perceived Crowding *(Q13: Now you are here, how would you rate the crowding level of this site today (with 1=no crowding and 5 = overcrowded?).*

Enjoyment	Number of respondents	Percent of all respondents (%)	Percent of valid respondents excl. CBb (total = 404) %
No	82	15	20.3
Yes	322	58.8	79.7
Total	404	73.8	100

Table 4.39: Crowding and enjoyment of visits *(Q14a: Does the presence of crowding affect the enjoyment of your visit?).*

Frequency	Number of respondents	Percent of all respondents (%)	Percent of valid respondents excl. CBb (total = 404) %
No	150	27.4	37.1
Yes	254	46.4	62.9
Total	404	73.8	100

Table 4.40: Crowding and frequency of visits *(Q.14b: Does it affect the frequency of visits?).*

Environmental damage	Number of respondents	Percent of all respondents (%) (total = 548)	Percent of valid respondents excl. CBa (total = 404) %
Litter	142	25.9	35.1
Dead trees	97	17.7	24.0
Water pollution	43	7.8	10.6
Exposed tree roots	111	20.3	27.5
Broken branches	134	24.5	33.2
Damage to ground vegetation	116	21.2	28.7
Wearing away of the beach	95	17.3	23.5
Does it worry you to see any of these things?	302	55.1	74.8
Total	1040	189.8	257.4

Table 4.41: Perception of environmental damage *(Q.15: Did you notice any of the following kinds of environmental impact on the site?)*[12].

[12] The total percent in table 4.41 is greater than 100%, because respondents could report more than one sign of environmental damage, i.e. they could notice litter along with exposed tree roots and shore erosion.

Rating of environmental damage	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (404) i.e. excl. CBa (%)
1	140	25.5	34.7
2	162	29.6	40.1
3	73	13.3	18.1
4	22	4.0	5.4
5	7	1.3	1.7
Total	404	73.7	100

Table 4.42: Rating of environmental damage on site *(Q.16: Again on a scale from one to five (one=no damage, five = severe damage), how would you rate environmental damage at this site?).*

Enjoyment	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (404) i.e. excl. CBa (%)
No	85	15.5	21.0
Yes	319	58.2	79.0
Total	404	73.7	100

Table 4.43: Environmental damage and enjoyment of visits *(Q.17a: Does the presence of environmental damage affect the enjoyment of your visit?).*

Frequency	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (404) i.e. excl. CBa (%)
No	190	34.7	47.0
Yes	214	39.1	53.0
Total	404	73.8	100

Table 4.44: Environmental damage and frequency of visits *(Q.17b: Does it affect the frequency of visits?).*

WTP	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (260) i.e. excl. CBa&b (%)
No	49	8.9	18.8
Yes	211	38.5	81.2
Total	260	47.4	100

Table 4.45: Willingness to pay for environmental improvements *(Q.18a: [Explanation of environmental improvements funded through an on-site car parking fee] ... would you be willing to pay such a fee to visit the site?).*

Amount	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (260) i.e. excl. CBa&b%)	Percent of valid YES respondents (%)
50p	16	2.9	6.2	7.6
£1.00	71	13.0	27.3	33.8
£1.50	21	3.8	8.1	10.0
£2.00	63	11.5	24.2	30.0
£3.00	28	5.1	10.8	13.3
£4.00	5	0.9	1.9	2.4
£5.00	6	1.1	2.3	2.9
Total	210	38.3	80.8	100

Table 4.46: Willingness-to-pay *(Q.18b: If yes, which amount on the card shows the MOST you would be willing to pay to visit this site with environmental improvements?).*

Type of bid	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (260) i.e. excl. CBa&b%)	Percent of valid NO respondents (%)
Protest bids (won't pay)	22	4.0	8.5	42.3
Genuine zeros	30	5.5	11.5	57.7
Total	52	9.5	20	100

Table 4.47: Willingness-to-pay *(Q.18c: If no, why not?).*

Reasons for stopping at site	Number of respondents	Percent of all respondents (%)
Convenient	142	25.9
Scenery of area	111	20.3
Peace and quiet	42	7.7
Been before/know it well	181	33.0
Other	72	13.1
Total	548	100

Table 4.48: Reasons for stopping at site today *(Q.19: Why did you stop at this site today?).*

Improvements	Number of respondents	Percent of all respondents (%)
No	388	70.8
Yes	160	29.2
Total	548	100

Table 4.49: Improvements *(Q.20a: Are there any ways in which you think that this particular site could be improved?).*

How?	Number of respondents	Percent of all respondents (548) (%)	Percent of valid YES respondents (%)
Toilets	50	9.1	31.2
(More) Bins	51	9.3	31.9
No more facilities, keep it natural.	16	2.9	10
Total	117	21.3	73.1

Table 4.50: Improvements *(Q.20b: If yes in what ways?).*

Group Size	Number of respondents	Percent of all respondents (%)
1	58	10.6
2	244	44.5
3	68	12.4
4	101	18.4
5	37	6.8
6	15	2.7
7	8	1.5
8	5	0.9
9	3	0.5
10	2	0.4
11	3	0.5
12	3	0.5
13	1	0.2
Total	548	100

Table 4.51: Group size *(Q.21: How many people are in your "party"?).*

Income	Number of respondents	Percent of all respondents (%)
Refused to answer	39	7.1
£4,001-£8,000	6	1.1
£8,001-£12,000	34	6.2
£12,001-£16,000	33	6.0
£16,001-£24,000	39	7.1
£24,001-£32,000	57	10.4
£32,001-£40,000	85	15.5
£40,001-£48,000	85	15.5
More than £48,000	170	31.0
Total	548	100

Table 4.52: Income *(Q.22: Which letter best represents your current level of household income (p.a.)* *show card* – see appendix B).

The following questions are from the contingent behaviour questionnaires (CBa and CBb) only.

Number of trips	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (288) i.e. CBa&b (%)
1-5	172	31.4	59.7
6-10	62	11.3	21.5
11-15	28	5.1	9.7
16-20	8	1.5	2.8
21-25	12	2.2	4.2
26-30	2	0.4	0.7
31+	4	0.7	1.4
Total	288	52.6	100

Table 4.53: Ban of jet-skis and number of trips *(Q.11(CBa&b): Last year you made X trips, thinking about this and your feelings towards the presence of jet-skis, could you tell me how this number of trips would change if the National Park Authority banned jet-skis? I would make ___ trips next year).*

Recreation Experience	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (288) i.e. CBa&b (%)
1	1	0.2	0.3
2	2	0.4	0.7
3	17	3.1	5.9
4	26	4.7	9.0
5	74	13.5	25.7
6	88	16.1	30.6
7	63	11.5	21.9
8	10	1.8	3.5
9	6	1.1	2.1
10	1	0.2	0.3
Total	288	52.6	100

Table 4.54: Jet-skis and the recreation experience (*Q.12 (CBa&CBb only) Taking the jet-skis into account, how would you rate your recreation experience at this site (with 1=poor and 10=excellent)?).*

Recreation Experience	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (288) i.e. CBa&b (%)
2	1	0.2	0.3
5	23	4.2	8.0
6	28	5.1	9.7
7	87	15.9	30.2
8	87	15.9	30.2
9	35	6.4	12.2
10	27	4.9	9.4
Total	288	52.6	100

Table 4.55: Jet-skis and the recreation experience *(Q.13 (CBa&CBb only) If jet-skis were banned at this site, how would you rate your recreation experience (again 1=poor and 10=excellent)?)*[13].

Number of trips	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (144) i.e. excl. WTP & CBb (%)
0	16	2.9	11.1
1-5	110	20.1	76.4
6-10	14	2.6	9.7
11-15	2	0.4	1.4
16-20	1	0.2	0.7
21	1	0.2	0.7
Total	144	26.4	100

Table 4.56: Overcrowding and number of trips *(Q.18 (CBa only) Again thinking of the X trips that you made last year, could you tell me how this number of trips would change if twice as many people than at present visited this site?).*

[13] There were no responses for values '1', '3' and '4'.

Recreation Experience	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (144) i.e. excl. CBb & WTP (%)
3	1	0.2	0.7
4	2	0.4	1.4
5	4	0.7	2.8
6	26	4.7	18.1
7	49	8.9	34.0
8	37	6.8	25.7
9	15	2.7	10.4
10	10	1.8	6.9
Total	144	26.2	100

Table 4.57: Crowding and its influence on recreation experience *(Q.19 (CBa only): Taking the number of people into account, how would you rate the recreation experience at this site (with 1=poor and 10=excellent)?)* [14].

Recreation Experience	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (144) i.e. excl. CBb & WTP (%)
A lot lot worse	34	6.2	23.6
A lot worse	48	8.8	33.3
Worse	43	7.8	29.9
The same	18	3.3	12.5
A lot lot better	1	0.2	0.7
Total	144	26.3	100

Table 4.58: Crowding and recreation experience *(Q.20 (CBa only): If there were twice as many people at this site, how would you rate the recreation experience?).*

Crowding action	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (144) i.e. excl. CBb & WTP (%)
Relocate within the loch	107	19.5	74.3
Relocate to another loch	5	0.9	3.5
Stay at this site	16	2.9	11.1
Return home	16	2.9	11.1
Total	144	26.2	100

Table 4.59: Crowding and displacement *(Q.21 (CBa only): If faced with overcrowding at a site, would you...).*

Number of trips	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (144) i.e. excl. CBa & WTP (%)
1-5	95	17.3	66.0
6-10	29	5.3	20.1
11-15	10	1.8	6.9
16-20	4	0.7	2.8
21-25	2	0.4	1.4
26-30	1	0.2	0.7
31+	3	0.6	2.1
Total	144	26.3	100

Table 4.60: Reduction in environmental damage and number of trips *(Q.17 (CBb only): Again thinking of the X trips that you made last year, could you tell me how this number of trips would change if the National Park Authority reduced environmental damage at this site?... I would make ___ trips next year).*

[14] There were no responses for values '1', and '2'.

Recreation Experience	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (144) i.e. excl. CBa & WTP (%)
2	1	0.2	0.7
3	4	0.7	2.8
4	1	0.2	0.7
5	16	2.9	11.1
6	37	6.8	25.7
7	52	9.5	36.1
8	29	5.3	20.1
9	3	0.5	2.1
10	1	0.2	0.7
Total	144	26.3	100

Table 4.61: Environmental damage and its influence on recreation experience *(Q.18 (CBb only): Taking the level of environmental damage into account, how would you rate the recreation experience at this site (with 1=poor and 10=excellent)?)*[15].

Recreation Experience	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (144) i.e. excl. CBa & WTP (%)
5	4	0.7	2.8
6	2	0.4	1.4
7	25	4.6	17.4
8	68	12.4	47.2
9	33	6.0	22.9
10	12	2.2	8.3
Total	144	26.3	100

Table 4.62: Environmental damage and recreation experience *(Q.19 (CBb only): If the National Park Authority took measures to reduce environmental damage at this site, how would you rate the recreation experience (again 1=poor and 10=excellent)?)*[16].

Twenty questionnaires were also issued at night (i.e. after 7pm), over two evenings, at Sallochy. This questionnaire survey was equivalent to the TCM/WTP(CV) survey, but in addition to the questions asked during this day survey, the "Sallochy night surveys" also contained three extra questions. The following tables present the frequency statistics for these questions.

Return to Site?	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (20) (%)
No	0	0	0
Yes	20	3.6	100
Total	20	3.6	100

Table 4.63: Return to site *(Q.23a: Would you come back to this site?)*.

[15] There was no response value '1'.
[16] There were no responses for values '1', '2', '3' and '4'.

Main attraction	Number of respondents	Percent of all respondents (548) (%)	Percent of valid YES respondents (20) (%)
Forest Walks	4	0.7	20
Beautiful Scenery	2	0.4	10
Peace and Quiet	6	1.1	30
Good Beach	2	0.4	10
Good Car Park	3	0.5	15
Good access to water/loch	4	0.7	20
Lots of space (e.g. for kids to play)	4	0.7	20
Not overcrowded	2	0.4	10
Safe for children	1	0.2	5
Valley with water chute nearby	1	0.2	5
Somewhere to get away from it all	1	0.2	5
Total	30	5.5	150 *

* Total percent is greater than 100 as respondents could give more than one answer.

Table 4.64: Main attraction of site *(Q.23b: If yes what is the main attraction of this site?).*

Most enjoy	Number of respondents	Percent of all respondents (548) (%)	Percent of valid respondents (20) (%)
Spending time with family	1	0.2	5
Relaxation/Away from stress/Getting away from it all	6	1.1	30
Scenery	12	2.2	60
Open and clean	2	0.4	10
Peace and Quiet	2	0.4	10
Beach Area	3	0.5	15
Peace of mind, knowing that children are safe as they play	1	0.2	5
Forest walks	1	0.2	5
Total	28	5.2	140

* Again total percent is greater than 100 as respondents could give more than one answer.

Table 4.65: Enjoyment and Site *(Q.24: Finally, what did you most enjoy at this site?).*

In addition to the overall questionnaire survey descriptive statistics, each question was split by site. All site descriptives are presented in appendix F and discussed in chapters six and seven.

As stated in chapter three, the researcher added a question (question eighteen) to the Loch Lomond Boat User Survey, conducted in 2001 by the LLTNPA. Responses to this question along with additional relevant questions from the survey are as follows:

Loch Lomond Boat User Survey (2001):

Enjoyment level	Number of respondents	Percent of all respondents (%)
Not at all	359	43
A little	227	27.2
Moderate amount	141	16.9
Quite a lot	69	8.3
Very much	38	4.6
Total	834	100

Table 4.66: Presence of other boats and enjoyment (n = 834) *(Q. 18: How much is your enjoyment of a day on the Loch affected by the presence of other boats?).*

Caused change in activity	Number of respondents	Percent of all respondents (%)
Frequently	37	4.4
Occasionally	203	24.3
Never	519	62.2
Don't know	33	4.0
No reply	42	5.0
Total	834	100

Table 4.67: Change in activity (n = 834) (*Q.19: During 2001 did the presence or activities of other users change which activity you took part in?*).

Caused change in location	Number of respondents	Percent of all respondents (%)
Frequently	64	7.7
Occasionally	264	31.7
Never	409	49
Don't know	45	5.4
No reply	52	6.2
Total	834	100

Table 4.68: Change in part of Loch Lomond used (n = 834) (*Q. 20a: During 2001 did the presence or activities of other users change where on Loch Lomond you took part in your preferred activity?*).

Caused change to another water body	Number of respondents	Percent of all respondents (%)
Frequently	14	1.7
Occasionally	45	5.4
Never	702	84.2
Don't know	19	2.3
No reply	54	6.5
Total	834	100

Table 4.69: Change resulting in carrying out activity at another water body (n = 834) (*Q.20b: During 2001 did the presence or activities of other users on Loch Lomond move you to another water body to carry out your preferred activity?*).

All descriptive statistics – from both the researcher's questionnaire survey and the relevant Loch Lomond boat user survey questions – are discussed throughout subsequent chapters. The following section outlines the statistical hypotheses conducted on the researcher's own questionnaire survey data.

4.3.2 Statistical Tests of Association

Various statistical hypotheses were tested using the Chi-square test. The tests incorporate the three themes of noise, crowding and environmental conditions. Again the implications of these statistics are investigated in following chapters, particularly chapter six. Here the chi-square results are presented in tabular form.

Theme One. Noise:

Data Sets	Pearson Chi-Square Value	df	Level of Significance	Reject or do not reject Ho?	Is chi-square significant?
Perception of Noise and Site	22.173	12	.036	Reject	Yes at P>0.95
Perception of Noise and Age	28.844	20	.091	Reject	Yes at P>0.90
Perception of Noise and Sex	5.621	4	.229	Do not reject	No

Data Sets	Pearson Chi-Square Value	Df	Level of Significance	Reject or do not reject Ho?	Is chi-square significant?
Perception of Noise and Length of stay on site	52.986	20	.000	Reject	Yes at P>0.99
Perception of Noise and origin of visitors (tourist vs. local)	8.451	4	.076	Reject	Yes at P>0.90
Perception of Noise and Activity	45.732	36	.128	Do not reject	No
Perception of Noise and Date	407.007	100	.000	Reject	Yes at P>0.99
Perception of Noise and number in group	99.813	48	.000	Reject	Yes at P>0.99
Perception of Noise and Income	29.243	32	.607	Do not reject	No
Impact of noise on enjoyment and Site	6.892	3	.075	Reject	Yes at P>0.90
Impact of noise on enjoyment and Age	45.206	5	.000	Reject	Yes at P>0.99
Impact of noise on enjoyment and Sex	.972	1	.324	Do not reject	No
Impact of noise on enjoyment Length of stay on site	29.907	5	.000	Reject	Yes at P>0.99
Impact of noise on enjoyment and origin of visitors (tourist vs. local)	.077	1	.781	Do not reject	No
Impact of noise on enjoyment and Activity	29.100	9	.001	Reject	Yes at P>0.99
Impact of noise on enjoyment and Date	48.706	25	.003	Reject	Yes at P>0.99
Impact of noise on enjoyment and number in group	29.184	12	.004	Reject	Yes at P>0.99
Impact of noise on enjoyment and Income	56.355	8	.000	Reject	Yes at P>0.99
Impact of noise on frequency of trips and Site	3.946	3	.267	Do not reject	No
Impact of noise on frequency of trips and Age	24.838	5	.000	Reject	Yes at P>0.99
Impact of noise on frequency of trips and Sex	4.728	1	.030	Reject	Yes at P>0.95
Impact of noise on frequency of trips and Length of stay on site	27.902	5	.000	Reject	Yes at P>0.99
Impact of noise on frequency of trips and origin of visitors (tourist vs. local)	37.398	1	.000	Reject	Yes at P>0.99
Impact of noise on frequency of trips and Activity	22.218	9	.008	Reject	Yes at P>0.99
Impact of noise on frequency of trips and Date	62.986	25	.000	Reject	Yes at P>0.99
Impact of noise on frequency of trips and number in group	10.157	12	.602	Do not reject	No
Impact of noise on frequency of trips and Income	31.229	8	.000	Reject	Yes at P>0.99

Table 4.70: Chi-square tests relating to noise, where Ho = there is no relationship between data and HA = there is a relationship between data. The Chi-square value was computed using S.P.S.S. spreadsheet package.

Theme Two. Crowding:

Data Sets	Pearson Chi-Square Value	Df	Level of Significance	Reject or do not reject Ho?	Is chi-square significant?
Perception of crowding and Site	28.239	12	.005	Reject	Yes at P>0.99
Perception of crowding and Sex	.589	4	.964	Do not reject	No
Perception of crowding and Age	20.239	20	.443	Do not reject	No
Perception of crowding and Weather	47.793	8	.000	Reject	Yes at P>0.99
Perception of crowding and Length of stay on site	47.135	20	.001	Reject	Yes at P>0.99
Perception of crowding and origin of visitors (tourist vs. local)	10.253	4	.036	Reject	Yes at P>0.95
Perception of crowding and Activity	26.772	36	.868	Do not reject	No
Perception of crowding and Income	36.662	32	.261	Do not reject	No
Perception of crowding and number in group	68.702	48	.027	Reject	Yes at P>0.95
Preferred company and Site	12.114	15	.670	Do not reject	No
Preferred company and Sex	12.940	5	.024	Reject	Yes at P>0.95
Preferred company and Age	55.411	25	.000	Reject	Yes at P>0.99
Preferred company and Weather	13.470	10	.199	Do not reject	No
Preferred company and Length of stay on site	43.096	25	.014	Reject	Yes at P>0.95
Preferred company and origin of visitors (tourist vs. local)	5.676	5	.339	Do not reject	No
Preferred company and Activity	57.157	45	.106	Do not reject	No
Preferred company and Income	130.414	40	.000	Reject	Yes at P>0.99
Preferred company and number in group	206.192	60	.000	Reject	Yes at P>0.99
Impact of crowding on enjoyment and Sex	2.512	1	.113	Do not reject	No
Impact of crowding on enjoyment and Age	16.100	5	.007	Reject	Yes at P>0.99
Impact of crowding on enjoyment and Site	9.073	3	.028	Reject	Yes at P>0.95
Impact of crowding on enjoyment and number in group	29.316	12	.004	Reject	Yes at P>0.99
Impact of crowding on frequency of trips and Sex	.954	1	.329	Do not reject	No
Impact of crowding on frequency of trips and Age	10.377	5	.065	Reject	Yes at P>0.90
Impact of crowding on frequency of trips and Site	5.251	3	.154	Do not reject	No
Impact of crowding on frequency of trips and number in group	15.123	12	.235	Do not reject	No
Number in group and Site	49.530	36	.066	Reject	Yes at P>0.90

Table 4.71: Chi-square tests relating to crowding, where Ho = there is no relationship between data and HA = there is a relationship between data. Again Chi-square was computed using S.P.S.S.

Theme Three. Environmental Conditions:

Data Sets *	**Pearson Chi-Square Value**	**df**	**Level of Significance**	**Reject or do not reject Ho?**	**Is chi-square significant?**
Perception of environmental damage and Length of stay on site	7.759	5	.299	Do not reject	No
Perception of environmental damage and Site	110.712	3	.000	Reject	Yes at P>0.99
Perception of environmental damage and Age	8.635	5	.173	Do not reject	No
Perception of environmental damage and Activity	8.489	9	.505	Do not reject	No
Perception of environmental damage and origin of visitors (tourists vs. locals)	.210	1	.709	Do not reject	No
Perception of environmental damage and mode of transport	34.329	1	.000	Reject	Yes at P>0.99
Perception of environmental damage and Income	7.173	8	.619	Do not reject	No
Perception of environmental damage and Date	140.306	25	.000	Reject	Yes at P>0.99
Perception of environmental damage and Sex	.483	1	.615	Do not reject	No
Perception of environmental damage and experience of site (whether or not visitor has been before)	2.045	1	.243	Do not reject	No
Impact of environmental damage on enjoyment and Site	5.418	3	.144	Do not reject	No
Impact of environmental damage on enjoyment and Sex	1.045	1	.307	Do not reject	No
Impact of environmental damage on enjoyment and Age	13.204	5	.022	Reject	Yes at P>0.95
Impact of environmental damage on frequency of trips and Site	13.713	3	.003	Reject	Yes at P>0.99
Impact of environmental damage on frequency of trips and Sex	3.056	1	.080	Reject	Yes at P>0.90
Impact of environmental damage on frequency of trips and Age	7.419	5	.191	Do not reject	No

* Perception of environmental damage includes aggregated data from perception of litter, dead trees, water pollution, exposed tree roots, broken branches, damage to vegetation, and beach erosion.

Table 4.72: Chi-square tests relating to environmental conditions, where Ho = There is no relationship between data and HA = there is a relationship between data. Chi-square was computed using S.P.S.S.

To analyse the results of the researcher's questionnaire survey further, with greater detail, econometric models were created; namely a travel cost model (TCM), a contingent valuation model (CVM) and contingent behaviour models (CBMs). Each is now presented and explained in turn.

4.4 Econometric Models

4.4.1 Travel Cost Model (TCM)

The aim of this section is to present and discuss the negative binomial travel cost model, which was set up in order to predict recreation demand for visits to Loch Lomond and to estimate consumer surplus (CS) per trip under current site conditions.

The individual travel cost model, as used here, may be stated as the following equation:

$$V = f(TC,Q,D,Y)$$

where V is the number of visits made by an individual; TC is the travel cost incurred by the individual; Q is a vector of the perceived qualities of the recreation site; D is the demographics or visitor characteristics; and Y is the household income of the individual (Garrod and Willis, 1999). In this particular TCM, TC is defined as petrol (distance) costs and length of time on site; Q is the rating on site of noise level, environmental damage and crowding; and the visitor characteristics (D) include age and sex of respondent, whether the individual travelled by car, whether they travelled from home, and whether the activity that they undertook was passive or active. Passive activities include picnicking, and sitting or walking near the shore. Active activities include cycling, climbing, hill-walking, fishing, boating, sailing, canoeing, jet-skiing, and swimming. It is worth noting that travel time to site was omitted from the equation, as there was not enough data on the labour market circumstances of the respondents to accurately estimate a person-specific value of leisure-time.

The regression equation is specified as a negative binomial regression model, for which 443 observations are used. Using this estimation the following model was created:

TRIPSONE = (DISCOST, LENGTH, NOISE, ENDAMAGE, CROWDNOW, AGE, SEX, CAR, HOME, PASSIVE, INCOME).

As seen above, the variables in the model are as follows: TRIPSONE (the number of trips the visitor made in the last twelve months including the site survey day); DISCOST (travel cost using petrol only, calculated by the distance travelled to the site converted to pounds using a rate provided by the R.A.C., i.e. kms * 0.062); LENGTH (length of stay on site); NOISE (perceived noise or rating of noise level on site (scale 1-5)); ENDAMAGE (perceived environmental damage or rating of environmental damage on site (scale 1-5); CROWDNOW (perceived crowding or rating of crowding on site (scale 1-5)); INCOME (household income of interviewee); AGE (approximate age of interviewee); SEX (sex of interviewee); CAR (whether interviewee travelled to the site by car); HOME (whether visitor was a day-tripper or on holiday); and PASSIVE (whether visitor is undertaking either passive recreation activities or active recreation activities. The latter includes all water activities).

Table 4.73 shows the output, generated using the statistical package 'Limdep', for the preferred negative binomial model:

Variable Name	Coefficient	T statistic	P
DISCOST	-.0487	-11.508	.0000
LENGTH	.1616	5.874	.0000
NOISE	-.1001	-1.656	.0978
ENDAMAGE	.0002807	.270	.7875
CROWDNOW	-.000512	-.504	.6142
INCOME	.00783	.463	.6433
AGE	.14004	5.698	.0000
SEX	.1770	3.621	.0003
CAR	.4725	3.913	.0001
HOME	-.000347	-.456	.6487
PASSIVE	.6697268924	6.501	.0000
Observations		443	
Log likelihood		-1154.427	
Restricted log likelihood		-1547.612	
CS/trip under current site conditions		£20.53	

Table 4.73: Results for Negative Binomial Travel Cost Model.

<u>Selection of Negative Binomial Model</u>:

Economic theory does not suggest any particular functional form that can be derived for travel cost models (TCM) and hence the above model was selected based on a number of criteria. Crucially the data obtained for the dependent variable, TRIPSONE, are count data (of non-negative integer values) and therefore a count data model was preferred. The nature of the data dictated the use of a count data model. Count models are favoured by many and indeed for Hellerstein and Mendelsohn (1993, 7) they are highly flexible tools for analysing individual recreation data and "given their strong econometric properties and sound theoretical foundation, in many circumstances count models should become the model of choice". It has been suggested that the standard linear ordinary least squares regression framework is not nearly as rich and complex as is necessary to understand count data (Cameron and Trivedi, 1998).

The two most widely used count models are the poisson and the negative binomial. Poisson and negative binomial models were hence run with all possible variables, using a backward stepwise procedure to eliminate variables that were not statistically significant (see Field, 2000). The models were then modified according to economic theory. Many recreation demand economists (see for example Garrod and Willis, 1999) find it desirable to include time to site within the travel cost equation. Time should be considered an opportunity cost of recreation. However, time taken to travel to site was not asked when the questionnaire was issued and it would have been wrong to convert distance travelled to time to site, as this would be highly correlated with the DISCOST variable, leading to problems of multicollinearity. It was therefore decided to include only length of time on site (LENGTH) as the element of time for travel cost. Negative binomial and poisson models were run including the variable LENGTH and without the variable LENGTH and it was decided that as length on site was significant it would be included within the final model.

Two points are worth noting: firstly only those visitors from the U.K. are included in the model. Overseas visitors are excluded, as distance, and consequently travel cost, could not accurately be worked out from the data available. It was feared that including overseas visitors would bias the model coefficients (as blank values would be present for their travel cost). Poisson and negative binomial models that included all visitors were run and this theory was confirmed – there were unreliable results. Hence, the preferred model is for U.K. visitors only, with travel cost computed in pounds. Secondly, the dependent variable TRIPSONE is truncated in that only those individuals who make one or more visit are observed (see Garrod and Willis, 1999, 60). There are no zero or negative values for TRIPSONE, as the visitor answering the questionnaire is responding on-site and is reported as having at least one visit in the past twelve months.

It is known that a poisson regression model should be used if the mean and variance of the dependent variable are equal; if this is not the case and the variance of the dependent variable exceeds the mean, then the negative binomial model should be adopted. This is known as the problem of overdispersion. Assessing for overdispersion involved poisson and negative binomial models being run simultaneously, both of which included the preferred explanatory variables. The overdispersion statistic was found to be significant at the 0.000 level (for b/St.Er. = 10.914). The Poisson model was therefore rejected due to evidence of overdispersion in the data. The negative binomial model was then adopted as the preferred specification and it is justified on econometric grounds of efficiency and consistency.

Interpretation of variables:

In agreement with the majority of previous travel cost studies (see for example Shrestha *et al*, 2002; Willis and Garrod, 1991a&b; and Hanley, 1989), DISCOST (i.e. travel cost in pounds) is negative and significant at $P \leq 0.05$, suggesting a downward sloping demand curve. Individuals make fewer visits to Loch Lomond as travel costs increase.

LENGTH, as length of time spent on site, is again significant at the $P \leq 0.05$ level and the coefficient is positive, hence as the length of stay on site increases, the number of trips made increases. This relationship is related to the type of activity undertaken on Loch Lomond. Often those staying all day, to undertake boating for example, require a full day to satisfy their activity recreation requirements. From personal on-site interviews it is seen that many visitors undertaking full day activities are local people and those who make a high number of trips per year. Consequently the positive coefficient on the length variable is to be expected. Further, boat surveys conducted by the Loch Lomond and Trossachs National Park Authority confirm that boaters use Loch Lomond as a major focus of their recreation behaviour (Adams, 2001). Boats are seen to be a heavy financial investment and "a day out on Loch Lomond" becomes the norm, requiring a long stay on site and many visits in order to satisfy the expense of the boating equipment. Conversely non-local visitors visit Loch Lomond infrequently, stopping for short periods to experience the site. Firkin is a good example of such a pattern. In this case length of stay on site is short and the number of trips made in one year is low, again corresponding with the positive coefficient for the length variable.

The perceived level of noise (NOISE) has a negative impact on trips and the coefficient is significant at $P \leq 0.10$. This result suggests that as the noise level increases, the number of trips decrease. Again this corresponds with theory: it is expected that as a site becomes noisier, less people will want to visit. Visitor perception of their recreation experience and the site in general is negatively affected by noise.

The coefficients on the ENDAMAGE variable are not significant (P=0.7875), so the level of environmental damage does not have a significant impact on trip number. This implies that the majority of visitors do not view environmental damage as a problem at the Loch Lomond sites. Indeed it confirms on-site interviews and corresponds with the descriptive statistics, both of which show that the noise issue is seen as more important than level of site environmental damage.

As expected CROWDNOW, as the rating of crowding on site, has a negative coefficient. Thus, as the level of expected crowding decreases, the number of trips made increase. However, perhaps surprisingly, this is not to a significant extent, i.e. the CROWDNOW variable is not significant at either the 0.05 or 0.1 level (P=0.6142). It is rare for Loch Lomond to be extremely crowded (on only four survey days – from a total of twenty-six – could the sites be termed physically crowded, i.e. physical carrying capacity was exceeded) and in comparison with Lake Windermere, for example, levels of use are low.

The coefficients on the INCOME variable are not statistically significant in the negative binomial model. This result is often encountered in TCMs (see for example Shrestha *et al.* 2002; Creel and Loomis, 1990; and Grogger and Carson, 1991). People with a wide variety of incomes visit Loch Lomond. Many in the immediate local community have lower than average incomes and visit Loch Lomond often as it is conveniently close to their home (evidence from interviews with managers of the LLTNPA, and visitors on site at Loch Lomond). Likewise, many professionals from the prosperous suburbs of Glasgow spend their weekends at Loch Lomond. With this wide range of income it is not surprising that the INCOME variable is not significant in the model. Again this result corresponds with the boat survey undertaken by the Loch Lomond and Trossachs National Park (Adams, 2001).

The coefficients on the demographic/visitor characteristic variables AGE, SEX, CAR and PASSIVE are all statistically significant at $P \leq 0.05$. Therefore, age of visitor, sex of visitor, car travel and activity undertaken all affect number of trips. Interestingly, the coefficients for all demographic variables were positive, indicating that as these variables increase, the number of trips made increases. More specifically, it is inferred that older visitors make more trips than younger visitors; males make more trips than females (the variable SEX was coded '1' for males and '0' for females); visitors travelling by car make more trips than other non-car based visitors; and those undertaking passive activities make more trips than those undertaking active activities (the variable PASSIVE was coded '1' for passive activity and '0' for active activity). The only demographic variable found to be not significant is HOME (P=0.6487).

The log likelihood function for the negative binomial model is –1154.427. As Long (1997, 104) states, all else being equal, models with a larger value of the log likelihood are preferred but there is no clear interpretation of the values nor is there any standard by which to judge if the value is large enough. To this end a Pseudo R^2 was constructed after Louviere *et al* (2000) where

$$\text{Pseudo } R^2 = 1 - (\text{unrestricted log likelihood value} / \text{restricted log likelihood value})$$

and a Pseudo R^2 of 0.25 was obtained. Louviere *et al* (2000) suggest that values between 0.2 and 0.4 represent a good fit and are equivalent to a R^2 value of 0.7 and 0.9 in the ordinary least squares (OLS) model. Therefore the negative binomial model at 0.25 fits the data well, and the explanatory variables explain approximately 80% of the variation in the dependent variable: number of trips. The Pseudo R^2 is relatively high, implying that the model has good explanatory power and is valuable in real-life situations where determinants of visits and trip number are being analysed. To confirm the model's utility diagnostic tests were undertaken.

<u>Diagnostic tests</u>:

Diagnostic tests for outliers, omitted variables, multicollinearity and heteroskedasticity were run on the negative binomial model. The findings are as follows:

1. Outliers

According to Long (1997, 98) residuals measure the difference between a model's prediction for a given case and the observed value for that case, with observations that fit poorly thought of as outliers. Subsequently, one method used to assess for any outliers is to plot residuals against observation number. This according to Cameron and Trivedi (1998) is known as "visual residual analysis". Visual residual analysis was carried out on the questionnaire data. Residuals were plotted against number of observations, and in addition each explanatory variable was plotted against number of observations, both of which helped to determine whether any outliers were present in data. From visual analysis of residuals and independent variables, there are no outliers present in the data. A subjective look at the data and residuals was also made, using the data view editor in 'Limdep', along with analysis of descriptive statistics, confirming that no outliers were present.

2. Omitted Variables

An omitted variable is "an important explanatory variable that has been left out of a regression equation" (Studenmund 2001, 18) and, if it is correlated with an included variable, the bias caused by leaving a variable out of an equation is called omitted variable bias (or specification bias). Such bias forces the expected value of the estimated coefficient away from the true value of the population coefficient. The main consequence of omitted variables is that bias is found in the regression coefficients that remain in the equation. There are no obvious solutions for omitted variables. Still, it is claimed that there are no omitted variables in the TCM. The backward step method (as discussed by Field, 2000) was used to construct the initial model and so all variables were entered into the model and then removed one-by-one according to significance level. Theory was then used to compile the model and the most favourable (i.e. most significant) explanatory variables were used. A number of different models were run, testing for the effects of omitted variables. Indeed, variables which were not significant were left in the final model to avoid omitted variable bias, as in the case of INCOME and HOME. Therefore all relevant variables are included in the TCM; there are no obvious omitted variables.

3. Multicollinearity

According to Greene (1997, 418) multicollinearity occurs when the measured variables are too highly correlated to allow precise analysis for their individual effects. Collinearity exists when there is a functional relationship between two or more independent variables that is so strong it significantly affects the estimation of the coefficients in the variables. There is no generally accepted, true statistical test for multicollinearity (Studenmund 2001, 255), however, the Variance

Inflation Factor (VIF) can be used. The VIF takes into account all explanatory variables at once and is an estimate of how much multicollinearity has increased the variance of an estimated coefficient. A high VIF (for Lewis-Beck (1993) this is values over six) suggests that multicollinearity has increased the estimated variance of the estimated coefficient considerably, yielding a decreased t-score and a stability problem for the model. Similarly tolerance, again a method of detecting multicollinearity by looking at the extent to which a given explanatory variable can be explained by all the other explanatory variables in the model, can be used to assess any collinearity in the model. Tolerance is the inverse of VIF and values below 0.1 indicate that collinearity may be a problem (Studenmund 2001, 257).

Taking these considerations into account tests VIF and tolerance tests for multicollinearity were run on the model. The results are shown in table 4.74.

Model	**Tolerance**	**VIF**
DISCOST	0.376	2.657
LENGTH	0.546	1.832
NOISE	0.724	1.381
ENDAMAGE	0.861	1.161
CROWDNOW	0.712	1.405
INCOME	0.864	1.158
SEX	0.942	1.061
AGE	0.839	1.192
CAR	0.687	1.457
HOME	0.339	2.952
PASSIVE	0.684	1.461

Dependent Variable: TRIPSONE

Table 4.74: Collinearity Statistics.

Tests conclude that the VIF values are relatively close to one and the tolerance level statistics are all above 0.3. These are acceptable tolerance values and VIF scores, indicating that multicollinearity is not an issue for the TCM.

4. Heteroskedasticity

The final diagnostic check on the negative binomial TCM was that of heteroskedasticity. Heteroskedasticity occurs when the errors in the regression do not have constant variance, for example the variance increases as one of the independent variables increase. If the disturbance variance is not constant across observations, the regression is heteroskedastic.

There are several formal tests for heteroskedasticity that can be used. One such test is the Breusch-Pagan (B-P) test, a Lagrange multiplier test of the null hypothesis that there is homoskedasticity. To this end the B-P test was run on the model and a statistic of 0.31862 was found. This value was less than the tabulated value of 18.30704 and further it was significant at the 0.000 level, thus the null hypothesis of homoskedasticity fails to be rejected. Overall, then, heteroskedasticity was not found in the model to a significant extent.

To conclude, after completion of the diagnostic tests for outliers, omitted variables, multicollinearity and finally heteroskedasticity, the TCM appears to be robust and stable.

Consumer Surplus:

Using this robust negative binomial model, consumer surplus (CS) values can be estimated. Consumer surplus is the difference between the most a visitor would pay (per trip) and what they actually pay. By observing the relationship between visits and travel costs it is possible to infer the value (consumer surplus) which recreationalists enjoy (Hanley *et al*, 2001b). CS is a valuable tool in the valuation of the recreation experience and recreation resource.

Consumer surplus is estimated in principle through integrating under the demand curve between two prices: current access fees, and a "choke price" which drives visits to zero. This gives CS per visit under current site conditions. Following Shrestha *et al* (2002) and Creel and Loomis (1990), CS estimates were calculated using the negative inverse of the DISCOST coefficient (-1/betaC). From this equation, where betaC is the coefficient on travel costs, CS per trip is £20.53, with a 95% confidence interval of £17.52 to £24.72. This CS is relatively high and therefore in theory a parking fee could be put in place at various sites around Loch Lomond, since a visitor gets a high level of utility (enjoyment) per trip. Visitors to Loch Lomond do not currently pay as much as they would be willing-to-pay and enjoy this consumer surplus. The preferences revealed by this study are now compared to the stated results of the contingent valuation study through discussion of the contingent valuation model.

4.4.2 Contingent Valuation Model (CVM)

The purpose of this section is to present and discuss the contingent valuation model (CVM), which was created to complement the travel cost and environmental contingent behaviour models. More specifically, the aim of the CVM is to determine the factors that influence a visitor's willingness-to-pay for environmental improvements and to estimate this willingness-to-pay. In particular it is interesting to discover which socio-economic variables, if any, contribute to a person's willingness-to-pay under improved environmental conditions.

The willingness-to-pay question in the visitor survey is shown in box 4.2.

"Q.18 Imagine that the National Park Authority decided to undertake some environmental improvements at this site. These environmental improvements would consist of the protection of ground vegetation and trees, the prevention of shore erosion, and a reduction in the level of water pollution. Imagine that the only way to pay for this programme was to introduce an on-site parking fee. The parking fee options are shown on this card. *show card*. Thinking about how much extra pleasure you would get from such environmental improvements, would you be willing to pay such a fee to visit the site?

YES NO

If Yes, which amount on the card shows the MOST would you be willing to pay to visit this site with environmental improvements? ____________________

If No, why not? ____________________"

Box 4.2: Willingness-to-pay question.

The question refers exclusively to environmental improvements and as such noise and crowding are not included in the CVM. Indeed, the CVM, as used here, may be estimated as the following:

$$WTP = f(Y,D,EQ)$$

where WTP is the willingness-to-pay for improved environmental conditions; Y is the household income of the individual; D is the demographics or visitor characteristics; and EQ is the perceived environmental qualities of the recreation site. Using this estimation the following model was created:

$$WTP = (\text{Constant, INCOME, AGE, SEX, CAR, PASSIVE, ENDAMAGE}).$$

The reasons for this choice of CVM are outlined in following sections. The model is specified in two ways: first using ordinary least squares linear regression and secondly using a tobit specification. There are 216 observations in each model.

Before discussion of the CVM, as a background to the model, descriptive statistics for willingness-to-pay are examined. Following on from this the ordinary least squares model corrected for heteroskedasticity is presented and then the tobit model is investigated as a comparison. For each model the variables are defined and interpreted, while diagnostic tests confirm the robustness of the model.

Descriptive statistics for WTP:

Table 4.75 illustrates the descriptive statistics for the variables 'WTP' (defined as '1' if a visitor is willing-to-pay a car parking fee to fund environmental improvements and '0' if they are not willing to pay) and 'AMOUNT' (defined as the maximum amount the respondent would be willing-to-pay under improved environmental conditions).

Statistics	AMOUNT	WTP
Mean	1.7643	0.81
Standard Error of Mean	0.06794	0.024
Median	1.5000	1.00
Mode	1.00	1
Standard Deviation	0.98453	0.392
Variance	0.96929	0.154
Range	4.50	1
Minimum	0.50	0
Maximum	5.00	1

Table 4.75: Descriptive statistics for respondents' willingness-to-pay to fund environmental improvements.

The payment card, shown during issue of the questionnaire (see appendix B), consisted of the following pricing options (for daily parking under improved environmental conditions): 50p, £1, £1.50, £2, £3, £4, £5 and £8. These amounts were selected following an open-ended question in the pilot questionnaire survey that asked respondents the maximum amount they would be willing-to-pay for improved conditions. As shown in table 4.75, the mean value for the variable 'AMOUNT', i.e. the most visitors would be willing-to-pay to fund environmental improvements, is 1.7643. Hence, the average willingness-to-pay to fund environmental improvements is £1.76. This amount would be collected in the form of a daily car-parking fee. The median willingness-to-pay is £1.50; corresponding with previous contingent valuation studies in which median WTP is lower than mean WTP (see, for example, Garrod and Willis, 1999). The minimum willingness-to-pay is 50p, while the maximum willingness-to-pay is £5. It is notable that no respondent chose £8 (the maximum value given on the payment card) as a possible car parking charge.

81.2% of visitors who were asked the WTP question stated that they would be willing to pay a car parking fee to fund environmental improvements. Correspondingly only 18.8% said they would not be willing to pay a car parking fee. Figure 4.5 illustrates the distribution of the amount that visitors answering "yes" to the WTP question were willing to pay under improved environmental conditions.

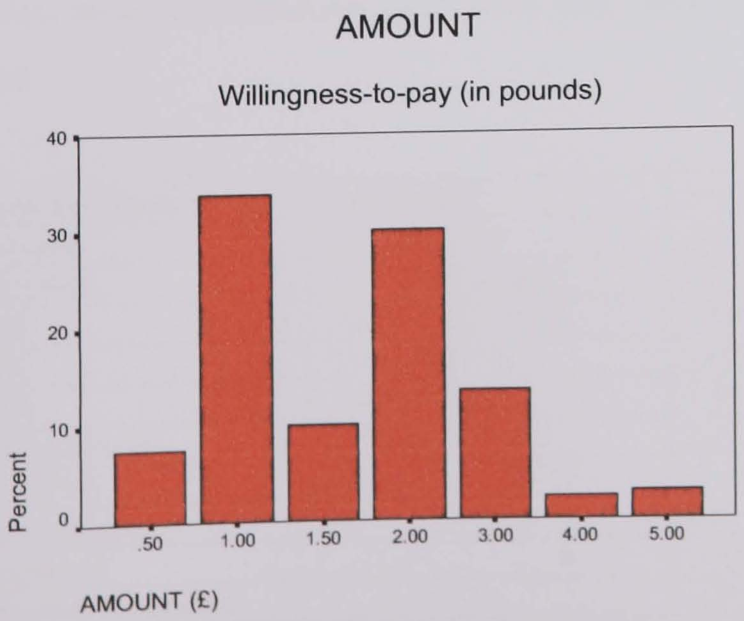

Figure 4.5: Distribution of the amount that respondents are willing to pay to fund environmental improvements (in pounds).

From figure 4.5 it is seen that both £1 and £2 were prevalent answers. Indeed, many reported that they believed one or two pounds to be the "typical" car parking fee and would have expected to pay this for a day's visit to Loch Lomond. Some even commented that this was a "typical" car parking fee in other outdoor recreation areas, such as the Lake District National Park in England.

Of those visitors not willing to pay for environmental improvements 8.5% did so out of protest, i.e. 8.5% of not willing-to-pay responses were protest bids. Examples of protest bids include "I shouldn't have to pay to go to loch as it's on my doorstep"; "this is part of a national park, enjoyment for all should be provided, not just for those who can afford it"; and "no, I already pay enough through taxes".

The remaining "no" responses to WTP are termed genuine zero bids, i.e. those visitors who refused to pay a car parking fee for a genuine reason. Examples of genuine zero bids include "I wouldn't pay, the environment's fine as it is"; "environmental improvement isn't a priority for me"; and "we can't afford to pay every time we come here".

The main findings of the descriptive statistics are, nevertheless, that 81.2% of visitors in the survey are willing to pay under improved conditions and the average visitor is willing to pay £1.76 (in the form of a daily car parking fee) to fund environmental improvements.

Ordinary Least Squares Regression:

Using these descriptive statistics as a starting point, the factors influencing a person's willingness to pay to fund environmental improvements were investigated. To this end a contingent valuation model was created. Table 4.76 presents the 'Limdep' output from the ordinary least squares (hereafter OLS) contingent valuation model (where the results have been corrected for heteroskedasticity). It was decided that as a high percentage of respondents were willing-to-pay under improved conditions (and hence there were few zero WTP replies), OLS regression could be used.

Variable Name	**Coefficient**	**t-ratio**	**P**
Constant	.4538312771	3.041	.0027
INCOME	.1937908782E-01	2.898	.0042
AGE	.1683494220E-01	.768	.4433
SEX	-.1640008146	-3.079	.0024
CAR	.1996610557	1.818	.0705
ENDAMAGE	.679848968E-01	2.637	.0090
PASSIVE	-.9669029702E-01	-1.743	.0828
Observations		216	
R-squared		.145578	
Adjusted R-squared		.12105	

Table 4.76: Results of Contingent Valuation Model (OLS) for willingness to pay for environmental improvements.

To reiterate, the model in table 4.76 includes WTP as the dependent variable and INCOME, AGE, SEX, CAR, ENDAMAGE and PASSIVE as the independent variables. Arriving at the final set of regressors required a number of steps. Primarily WTP was regressed against all possible independent variables. Then the backward step method (i.e. looking at the significance level of variables) and economic theories (for example, income should have a significant influence on visitor willingness-to-pay) were used to create the preferred model. All relevant socio-economic variables were included in the model, as the socio-economic status of the respondent was seen to be an important influence on their willingness-to-pay. The level of perceived environmental damage was also included in the model, as it was hypothesised that rating of environmental damage on the site would influence a visitor's willingness-to-pay to fund environmental improvements. In addition to these OLS models, variables were subject to the logarithm transformation in order to determine whether this improved the fit and significance of the model. It was then decided that the log transformation was not appropriate for the data (because the fit was already sufficiently good). Following on from the creation of these various models, the preferred model was found.

Interpretation of the above explanatory variables is crucial for understanding the reasons for visitor's willingness-to-pay under improved environmental conditions. Each variable in the OLS model (table 4.76) is now defined, described and interpreted.

As expected INCOME (household income of the interviewee) is significant and positive at $P \leq 0.01$, suggesting that income has a significant influence on the respondent's willingness-to-pay to fund environmental improvements. It can be said with 99% confidence that as a person's income increases, they are more willing-to-pay a parking fee under improved conditions.

Although the AGE coefficient is positive in the OLS model, implying that the older the respondent is, the more willing they are to pay a parking fee, the AGE of the respondent is not a significant influence on their willingness-to-pay to fund environmental improvements. It is therefore claimed that willingness-to-pay is not significantly influenced by respondent age group.

Correspondingly, the sex of the interviewee is significant and does explain willingness-to-pay to fund environmental improvements. The coefficient for SEX is negative and significant at the $P \leq 0.01$ level, indicating that females are more likely to be willing-to-pay than males. Frequency statistics confirm this trend: 88.6% of females said they were willing-to-pay to fund environmental improvements.

The variable termed 'CAR' is defined as whether or not the interviewee travelled to the site by car. The coefficient is positive and significant at the $P \leq 0.1$ level. In other words it is stated, with 90% confidence, that mode of transport is a significant influence on a person's willingness-to-pay to fund environmental improvements. For non-car users the introduction of a parking fee could derive benefits, as it expected that fewer car drivers would visit the site and therefore allow more space for the recreation activities of the non-car driver.

ENDAMAGE is defined as the perceived environmental damage of the site or the respondent's rating of environmental damage (on a scale from one to five). It was expected that perceived environmental damage would influence the respondent's willingness-to-pay to fund environmental improvements. The model met this expectation. ENDAMAGE was positive and significant at $P \leq 0.01$. Put simply, as the level of perceived environmental damage increases, people are more willing to pay a parking fee to fund environmental improvements.

The final variable PASSIVE is again only significant at the $P \leq 0.1$ level. PASSIVE is defined as whether the visitor is undertaking a passive recreation activity, and it has a negative coefficient, which suggests that those visitors undertaking non-passive activities (i.e. active land or water-based activities) are more likely to pay to fund environmental improvements.

Before discussion of the robustness of the OLS CVM, it is interesting to note that the R-squared value for the model is approximately 0.15 and the adjusted R-squared value (a more accurate representation of the strength of the model as it adjusts for the addition of explanatory variables) is 0.12. Together the independent variables of the OLS model therefore explain 12% of the variation in the dependent variable: visitor willingness-to-pay to fund environmental improvements. Although the adjusted R^2 is relatively low in explanatory power and the overall goodness of fit of the regression line is low, the model is robust as illustrated through the following diagnostic tests.

As with the travel cost model, four diagnostic tests were run on the OLS contingent valuation model. These were tests for heteroskedasticity, outliers, omitted variables and multicollinearity. The rationale for running these tests was to confirm that the model follows good modelling practice. Achieving good modelling practice for OLS regression requires that: (1) the equation is correctly specified; (2) the error term has a zero mean; (3) the error term has constant variance (homoskedasticity); (4) there is no autocorrelation; (5) the explanatory variables are fixed regressors; and (6) the data matrix has full rank, i.e. that there is no linear dependence between the right-hand side variables. If the above assumptions are met, OLS estimates are said to be BLUE (Best Linear Unbiased Estimates) (Kennedy, 1998).

Primarily, therefore, a test for heteroskedasticity was run on the OLS CV model. To test the hypothesis of homoskedasticity, the Breusch-Pagan (B-P) test was run on the initial OLS model and a statistic of 18.7211 was derived. It was thus found that the original OLS model did suffer from heteroskedasticity. As a consequence of this discovery the initial model was corrected for heteroskedasticity (using the 'het' command in statistical package 'Limdep'). and the statistics presented in table 4.76 are for the corrected OLS model. It can therefore be said that this model does not suffer from heteroskedasticity; the coefficients are robust and the assumption that the error term has constant variance is satisfied.

Following on from the test for heteroskedasticity, the assumption that there are no outliers in the data was tested. Residuals were plotted against each observation number, following the method of "visual residual analysis" as defined by Cameron and Trivedi (1998). Each explanatory variable was also plotted against the number of observations. Visual analysis of residuals, explanatory variables and observations showed no obvious outliers; thus outliers were not seen to be a significant problem in the CVM.

Likewise, the backward step method of comprising the CVM, along with the theory that was used to compile the model, ensured that all relevant variables were included. Looking at the significance levels and the overall strength of all possible models (through the adjusted R^2 value) made certain that no important variables were omitted from the final model; satisfying the first assumption that the equation is correctly specified and also including consideration of functional form.

To satisfy the assumptions that there is no autocorrelation and that the data matrix has full rank, tests for multicollinearity were undertaken. The results are shown in table 4.77.

Model	Tolerance	VIF
INCOME	0.920	1.086
AGE	0.874	1.144
SEX	0.943	1.061
CAR	0.866	1.155
ENDAMAGE	0.900	1.111
PASSIVE	0.978	1.023

Dependent Variable: WTP

Table 4.77: Collinearity Statistics.

As all the Tolerance values and the VIF levels in the regression are both close to one, it is concluded that there is no real problem of multicollinearity in the data. The assumptions of no multicollinearity in the CVM are satisfied and indeed, overall, the estimators are found to be BLUE. After completion of the diagnostic tests for outliers, omitted variables, multicollinearity and correcting for heteroskedasticity, the CVM – like the previous TCM – appears to be robust and stable.

Tobit Model:

Confirming the robustness and validity of the OLS CVM required the specification of a tobit CVM. To facilitate an accurate comparison, exactly the same explanatory variables from the OLS model were used in the tobit model. There were a number of reasons why this comparison was undertaken. Greene (1997) states that tobit analysis is more likely to render unbiased estimates and inferences than is ordinary least squares analysis where sample selection is an issue, although this is not likely in this data. More importantly, Greene (1997) shows that the tobit model is also known as the censored regression model as it can predict values of the dependent variable that are zero (or otherwise limited) and values that are nonzero (or otherwise unlimited). As the tobit estimator does not allow negative WTP values, and the dependent variable (WTP) is thus censored (i.e. blocked) at zero (respondents were not allowed to state negative WTP amounts), it is also appropriate for the questionnaire data. Moreover, many previous CVM studies use the tobit specification (see for example Grijavla and Berrens in Hanley *et al*, 2003).

In terms of the significance and direction of explanatory variables, the tobit specified CVM yields very similar results to the OLS CVM. The log likelihood value is -168.9262 and once again the number of observations is 216 (see table 4.78).

Variable Name	**Coefficient**	**T statistic**	**P**
Constant	.2965	1.60	.107
INCOME	.0255	3.38	.000
AGE	.0217	.87	.384
SEX	-.209	-3.06	.002
CAR	.2633	2.08	.037
ENDAMAGE	.0873	2.32	.020
PASSIVE	-.122	-1.60	.109
Observations		216	
Log likelihood		-168.9262	

Table 4.78: Results of Contingent Valuation Model (Tobit estimator).

More importantly all of the signs of the coefficients are in the same direction for both contingent valuation models, i.e. for only SEX and PASSIVE were the signs negative. Likewise INCOME and SEX were both again significant at the $P \leq 0.01$ level, while ENDAMAGE was significant at $P \leq 0.05$. As with the OLS CVM, AGE was not significant in the tobit CVM ($P = 0.384$). Mode of transport, i.e. CAR, was more significant in the tobit model than it was in the OLS model. While it was only significant at $P \leq 0.1$ level using an ordinary least squares specification, using a tobit specification it was significant at $P \leq 0.05$ level. Hence in the tobit model it is shown that mode of transport influences a visitor's willingness-to-pay for environmental improvements to a highly significant extent. Conversely while activity (PASSIVE) was significant at $P \leq 0.1$ for the OLS model, using a tobit specification it was not significant. It is important to note, however, that the value for the tobit coefficient was $P = 0.1091$. It was extremely close to the 90% confidence level.

Overall, the tobit CVM agrees with the results of the OLS CVM: namely that income, sex, perception of environmental damage, and mode of transport all significantly influence visitor willingness-to-pay under improved environmental conditions. Once again age of respondent is not a significant variable in the model and has therefore no impact on willingness-to-pay.

As with the OLS CVM diagnostic tests were run on the tobit model. Again no outliers, omitted variables or multicollinearity were present in the tobit CVM. Likewise correcting for heteroskedasticity in the tobit model provided the same, unchanged coefficients as the original model (both in terms of values and direction of signs). It is therefore reported that heteroskedasticity is not present in the tobit model. Consequently, the tobit CVM, like the OLS CVM, is robust and stable and it is a useful quantification of the variables influencing visitor willingness-to-pay for improved environmental conditions. Moreover, the stated preference findings of the CVM, along with the revealed preference findings of the TCM, can be strengthened through using a combined stated/revealed preference approach, as seen in the following section.

4.4.3 Contingent Behaviour Models (CBMs)

This section presents the results of the final set of econometric models, namely the contingent behaviour models (CBMs). Using the statistical package 'Stata' [17] three contingent behaviour models were specified. The aim of each CBM is to model the utility per trip of increases in crowding, a reduction in noise level and a reduction in environmental damage and therefore a separate CBM was specified for crowding, noise and environmental damage – each of the quality indictors of the travel cost model (TCM). Each CBM uses a combined stated/revealed preference approach and, again following on from the TCM, the models are specified as negative binomial count models.

Four points concerning model specification are worth noting. Firstly, the real and contingent behaviour data are combined using a random effects negative binomial panel model. A panel model uses a data set which contains more than one row for each individual for every variable (in this case two rows were used for each individual, one row for actual / real behaviour and one row for contingent behaviour). A panel model data set is typically wide but short (for a good example of the structure of panel data see Greene, 1997). One advantage of panel data is that it allows the researcher high flexibility in modelling differences in behaviour across individuals. The fixed effects model and the random effects model are two approaches to panel data. The random effects model, as opposed to a fixed estimator panel model, should be used when one or more variables are not changing across rows. For example, in the case of the current CBMs, the values for travel cost and length of time on site are the same for each individual's real and contingent answers; only the reply to the quality variable, for example crowding, changes across rows. If responses to all variables had varied across rows, and hence individual characteristics changed between

[17] 'Stata' rather than 'Limdep' was used because of its greater accuracy when working with panel data.

observations, then a fixed panel estimator would have been used. Fixed effects models are only preferred where the data includes the entire population. However if the data consist of observations from a large population (as with the current project), the random effects model is preferred. The random effects specification is consequently used for all three contingent behaviour models.

A second issue concerning model specification is that, as with the TCM, the overdispersion statistic was found to be significant for all CBMs at the 0.000 level and as such there is evidence of overdispersion in the data (the variance of the dependent variable exceeds the mean). As a consequence of this, a negative binomial model was preferred over a poisson model. Thirdly, a likelihood ratio test of the appropriateness of the random effects specification against a pooled (i.e. non-panel) alternative strongly rejects the pooled model (P = 0.000), suggesting that the random effects panel estimate is a better choice than a pooled model (for values see tables 4.79, 4.80 and 4.81). Finally, as panel data are used, the dependent variable for each CBM, termed TRIPS, has values for both actual behaviour and contingent behaviour (both values were given by respondents on site). For the actual/real data, TRIPS is defined as the number of trips made in the last twelve months and for the hypothetical/stated preference data, it is defined as the number of trips made if site conditions were to change (i.e. the site became overcrowded, noise was reduced as a consequence of a jet-ski ban, and environmental damage was reduced through on-site improvements). Taking these four points into consideration, the random effects negative binomial panel model is used to calculate the welfare values per trip (change in consumer surplus per visitor) and to predict the difference in trips should crowding, noise, and environmental damage change.

<u>Crowding Contingent Behaviour Model</u>:

The crowding contingent behaviour model is estimated as the following:

TRIPS = DISCOST, LENGTH, CROWDING, CONSTANT

where DISCOST is the travel cost using petrol only; LENGTH is the length of stay on site; and CROWDING is the perception of crowding on a scale from one to five, with one equal to no crowding and five equal to overcrowded. Using the panel data form, the revealed preference value for CROWDING is the actual perception of crowding value given by respondents on the one to five scale (39.1% of visitors rated crowding at level '1', i.e. low, and 0.9% rated crowding at level '5', i.e. high), while the stated preference value for CROWDING is automatically set to five, i.e. the site is overcrowded.

Arriving at the above model involved a number of steps. Primarily all relevant variables were included in the model and, using significance levels, theory and tests for collinearity, variables that did not contribute to the validity of the model were removed. Initially it was decided that the equation would address both perception of crowding and the recreation experience as a result of crowding. As such the variable NUMBERS, which was defined as a rating of the recreation experience with and without crowding, was included in the model. However, tests for multicollinearity showed that NUMBERS was highly correlated with CROWDING and so this variable was left out of the crowding CBM. Further tests for multicollinearity showed that the remaining variables – DISCOST, LENGTH and CROWDING – were not highly correlated (all explanatory variables were <0.6) and, moreover, inclusion of all relevant variables avoids the problem of omitted variable bias. Testing for any outliers involved visual analysis of residuals and the explanatory variables, and it is concluded that there are no significant outliers present in the data. Following diagnostic tests it is therefore found that the random effects negative binomial panel model is robust and stable.

Table 4.79 presents the results for the crowding negative binomial CBM – taking into consideration random effects.

Variable Name	**Coefficient**	**z statistic**	**P**	**[95% Conf. Interval]**	
DISCOST	-.043438	-6.65	.0000	-.0562347	-.0306413
LENGTH	-.1031997	-1.85	.064	-.2122498	.0058504
CROWDING	-.1938947	-10.85	.0000	-.2289216	-.1588679
Constant	4.506371	8.96	.0000	3.52043	5.492312
Observations		320			
Number of groups		160			
Observations per group		2			
Log likelihood		-759.82292			
Wald chi2 (3)		177.94			
Prob > chi2		.0000			
Likelihood ratio versus Pooled model		179.88 Prob. = 0.000			
CS/trip under current site conditions		£23.02			
CS/trip for 95% confidence interval		£17.78 to £32.64			

Table 4.79: Results for the Random Effects Negative Binomial Panel Model – Crowding.

As is seen in table 4.79, the log likelihood value is –759.82292 and there are 320 observations in total. As there are two observations per group, i.e. in the panel data each individual has a revealed and stated preference row, there are 160 groups representing 160 respondents. All variables are significant at $P \leq 0.10$ or better.

As expected DISCOST (i.e. travel cost in pounds) is negative and significant at $P \leq 0.01$, suggesting that as travel cost to a site increases, individuals make fewer trips. This result corresponds with the TCM and previous studies combining revealed and stated preference data (see for example Hanley *et al*, 2002). LENGTH (length of time on site) is also significant, but only at $P \leq 0.10$. Again the coefficient for length of time on site is negative and so as the length of time on site decreases, the number of trips made increase. This could be explained by the number of picnickers who were interviewed as part of the contingent behaviour survey (the activity given by 41.7 % of all respondents for the contingent behaviour surveys was picnicking). Many only stayed at the various Loch Lomond sites to eat and then returned home. More importantly, the quality variable CROWDING exerts a highly significant negative influence on trips (P = .000). Namely, as the level of anticipated / realised crowding decreases, the number of trips made increase. It is necessary to realise that this conclusion is based on an individual's perception of crowding. Accordingly, if a site is quiet during one visit (there are no crowds), an individual would believe it is a favourable (peaceful) location to visit and would travel to the site again. Their number of trips would increase.

The crowding CBM estimates a consumer surplus of £23.02 per person per trip. Using the 95% confidence interval (table 4.79), as much as £32.64 could be gained by the LLTNPA. Clearly this is a high consumer surplus and indicates that the LLTNPA is currently losing potential revenue. Furthermore, an increase in crowding to "overcrowded" would decrease the predicted number of trips by 9.04% (the average number of trips per year made by one individual at current crowding conditions is 3.140052 and with crowding increased to level '5' it decreases to 2.856481 trips). This change in trip number suggests that overcrowding has a detrimental influence on the recreation experience. The implications of all these findings are investigated in following chapters.

Noise Contingent Behaviour Model:

As with the crowding CBM, a random effects negative binomial panel model was also constructed for reduction in noise level. The following variables were included in the noise CBM:

TRIPS = DISCOST, LENGTH, NOISE, JETSKI, CONSTANT.

DISCOST and LENGTH are defined as in the crowding CBM. As with the variable CROWDING, a five-point Likert scale was used in the questionnaires for the variable NOISE (one equals "no or very little noise", five equals "very noisy"). For actual behaviour the respondent's own rating of noise level at the site where they were questioned was entered (again the majority of respondents gave actual noise level a '1' score (47.6%), while only 0.9% rated noise at '5'); for contingent behaviour the variable was set equal to one, its lowest value (i.e. "no or very little noise"). JETSKI was included in the equation as a rating of the recreation experience with and without jet-skis present. Previous interviews (during, for example, the pilot questionnaire survey) indicate that it is jet-ski noise that is most detrimental to the recreation experience and that many visitors believe that a ban in jet-skis to the area would reduce noise to a more acceptable level. For the variable JETSKI, actual behaviour is a rating of the recreation experience with jet-skis and hypothetical behaviour is a rating of the recreation experience if jet-skis were banned. Respondents stated both values at the time the questionnaire was issued in an attempt to capture the impact on utility per trip.

To ensure that there were acceptable levels of collinearity between the variables NOISE and JETSKI, a test for collinearity was carried out and a value of –0.31 was found. It was concluded that collinearity was not high enough for there to be a multicollinearity problem in the model and as both variables were significant they were left in the model. Leaving both variables in the model provides two factors of interest: (1) perception of noise, and (2) recreation experience/utility with and without jet-skis. More generally, as with the crowding CBM, all relevant variables were initially included in the model and those causing collinearity or those that were not significant were removed. Theory then dictated the final form of the model. Diagnostic tests confirmed that multicollinearity is not present in the noise CBM and likewise omitted variables and outliers are not present. The model seen in table 4.80 is therefore stable.

Variable Name	**Coefficient**	**z statistic**	**P**	**[95% Conf. Interval]**	
DISCOST	-.0437989	-10.05	.0000	-.0523417	-.0352556
LENGTH	-.0197722	-0.53	.597	-.0931462	.0536017
NOISE	-.0687576	-2.21	.027	-.1296972	-.0078179
JETSKI	.0570258	4.47	.0000	.03201	.0820416
Constant	16.98465	0.04	0.968	-824.9762	858.9455
Observations		516			
Number of groups		258			
Observations per group		2			
Log likelihood		-1239.288			
Wald chi2 (3)		141.60			
Prob > chi2		.0000			
Likelihood ratio versus Pooled model		333.61	Prob. = 0.000		
CS/trip under current site conditions		£22.83			
CS/trip for 95% confidence interval		£19.11 to £28.36			

Table 4.80: Results for the Random Effects Negative Binomial Panel Model – Noise.

Table 4.80 shows the results for the random effects negative binomial panel model for noise. One of the contingent behaviour questionnaires included the jet-ski (noise) question and the crowding question; the other included the jet-ski (noise) question and the environmental damage question. There are, therefore, 516 observations for the noise CBM, more than for both the crowding and environmental models. Again there are two observations per group, which gives 258 groups (or respondents) in total. The log likelihood value is –1239.288 and all variables, excluding LENGTH, are highly significant (at P<0.05 or better).

As with the crowding CBM, DISCOST is negative and significant at P<0.01 and as such travel cost has a negative impact on trips: as the cost of travelling to a site increases, the number of trips decrease. Although LENGTH is not significant in the noise CBM (P = 0.597), the two quality indicators of NOISE and JETSKI are highly significant (at P< 0.05 and P < 0.01 respectively). The coefficient on NOISE is negative. Thus as the level of noise at a site decreases, the number of trips made increases. The quieter a site is perceived to be, the more trips are made. Similarly JETSKI is positive and significant, suggesting that as the recreation experience improves (in particular if jet-skis were to be banned), more trips would be made.

The noise CBM also indicates that there is a consumer surplus per trip of £22.83. As with the crowding CBM, this consumer surplus represents revenue that could be used by the Park Authority. Using the 95% confidence interval a consumer surplus range of £19.11 to £28.36 is obtained.

Like the crowding CBM, predicted trips under current noise conditions and predicted trips under changed noise conditions were calculated. It was found that if noise level were reduced to '1' (no noise) through a ban of jet-skis, predicted trips to the study area would increase by 0.19% – from an average of 16.82547 trips made by an individual per year at current conditions to a value of 16.85718 trips per individual per year.

Environmental Damage Contingent Behaviour Model:

The final contingent behaviour model addresses environmental damage in the Loch Lomond area and again uses a random effects negative binomial panel model. The variables included in the environmental damage CBM are as follows:

TRIPS = DISCOST, LENGTH, ENDAMAGE, CONSTANT.

As with the previous two CBMs, DISCOST and LENGTH are defined as travel cost and length of time on site respectively. Responses to the variable ENDAMAGE were again on a one to five scale (with one equal to "no environmental damage" and five equal to "very high environmental damage") and consisted of the respondent's actual rating of environmental damage for the real behaviour data, and for the hypothetical/contingent behaviour the variable was set equal to one (i.e. "no environmental damage"). In terms of the actual rating of environmental damage, 34.7% of respondents perceived no environmental damage ('1'), while 1.7% rated environmental damage at a '5' or very high.

Diagnostic tests, theory and the backward step method were again used to derive the final model. As with the crowding model, initially it was hoped to include the variable 'ENVIRON', which would provide a measure of the recreation experience with and without environmental damage. However, following tests for collinearity it was found that ENVIRON was highly correlated with ENDAMAGE and, as a result of this collinearity, the former variable was left out of the equation. All other relevant variables are however included and outliers, along with multicollinearity, are not a significant problem for the model.

Variable Name	Coefficient	z statistic	P	[95% Conf. Interval]	
DISCOST	-.0500014	-7.54	.0000	-.0630018	-.037001
LENGTH	-.1005842	-2.11	.035	-.1941301	-.0070382
ENDAMAGE	-.0545234	-2.54	.011	-.0965748	-.012472
Constant	18.09255	0.05	.958	-657.9412	694.1263
Observations		320			
Number of groups		160			
Observations per group		2			
Log likelihood		-793.35546			
Wald chi2 (3)		65.13			
Prob > chi2		.0000			
Likelihood ratio versus Pooled model		260.74 Prob. = 0.000			
CS/trip under current site conditions		£20.00			
CS/trip for 95% confidence interval		£15.87 to £27.03			

Table 4.81: Results for the Random Effects Negative Binomial Panel Model – Environmental Damage.

As shown in table 4.81, the log likelihood value for the random effects negative binomial panel model for environmental damage is –793.35546 and, as in the crowding CBM, the number of observations is 320. Likewise, there are two observations per group for the panel data and there are 160 groups (individual respondents) in total. All variables are significant at $P \leq 0.05$ or better.

Once again increasing travel cost results in a reduction in the number of trips (DISCOST is negative and significant at $P \leq 0.01$) and as the length of time on site decreases, the number of trips made increase (LENGTH is negative and significant at $P \leq 0.05$). Perhaps more interesting is that the variable ENVIRON is negative and significant at $P \leq 0.05$. It is therefore reported, with 95% confidence, that as the level of environmental damage is reduced, the number of trips made will increase.

In terms of valuation, using the coefficient on travel cost, a consumer surplus per trip of £20 is obtained for the environmental damage CBM. Although lower than the welfare measure calculated for both the crowding and noise models, it is still a relatively high consumer surplus value. The 95% confidence level for this value is £15.87 to £27.03: at the 95% level of confidence, the Park Authority could gain £27.03 per person per trip. A car parking fee is only one way in which this surplus value could be obtained.

As with the noise CBM, percentage change in predicted trips with and without environmental improvements is relatively low, but it remains a significant change. Predicted trips under current environmental conditions were calculated, as was predicted trips if environmental damage was reduced to level '1' (i.e. "no environmental damage"). Predicted trips to the study area would increase by 0.21% from an average of 17.34098 trips made by an individual per year to 17.38471 trips per individual per year if environmental damage was decreased to level '1'. Thus environmental improvements would significantly increase trips and hence attract visitors to the

Loch Lomond area. A reduction in visible environmental damage would encourage more people to visit the area, as many believe their recreation environment would be improved.

4.5 Interviews

Complementing the quantitative data provided by the various econometric models are the qualitative interviews undertaken with managers and policy-makers. During these interviews the following themes became apparent:

- The need for management frameworks (e.g. recreational carrying capacity).
- Integrated planning and management.
- Information/education.
- Visitor behaviour and conflict (including anti-social behaviour).
- Park management actions.
- Sustainability.
- Resource impacts.
- Environmental damage.
- Conflict between land-uses, including conservation and recreation.

Many valuable quotes were derived from these interviews as discussed in following chapters. Supplementing the interviews undertaken with managers and policy-makers involved with the Loch Lomond and Trossachs National Park, additional interviews were conducted with Arches National Park (ANP) employees. Climatically the ANP and the LLTNP are very different environments and it was thus interesting to investigate whether the Arches suffered from the generic problems of crowding, noise, conflict and environmental damage, as are present in the LLTNP, and if so how these have been managed. An Arches National Park ranger reported that there are three main areas in the Arches where crowding is an issue: Delicate Arch (the most popular recreation site in the entire National Park), the Windows and Devil's Garden. Here it was reported that "crowding is leading to increased resource impact" (Ranger, Arches National Park) and, at Delicate Arch in particular, a Park Authority volunteer reported:

"Crowding is a pain in my ass. It pisses me off when you want to take a photo of Delicate Arch and a big group of people are standing in the way. I want to yell 'get out!'" (Volunteer Ranger, Arches National Park).

From the ANP interviews it was found that buses, cars, vans and four-wheel drive vehicles cause noise pollution. In terms of conflict, this exists in the guise of "vehicle conflict" (Ranger, Arches National Park), for example between off-road vehicles and walkers; buses, vans and cars in the parking lots; and snowmobilers and skiers in the winter months. Environmental impact was also a major concern for the Park Authority as the Arches has an ecology that when damaged finds it very difficult to recover. The cryptobiotic soils, vegetation, and threatened/endangered species were the prime concerns when looking at resource impacts. Threatened and endangered species include

Mustela nigripes (the black-footed ferret), *Haliaeetus leucocephalus* (the bald eagle), and *Strix occidentalis* (the Mexican spotted owl). When rangers were questioned about the strategies used to deal with crowding, noise, conflict and environmental damage, it was reported that all issues were managed through the integrated VERP framework (section 2.7).

A key element of the interviews with ranger staff was to investigate the success of VERP and the monitoring process, where monitoring provides periodic, systematic feedback to park managers to ensure that standards are not exceeded over the long term. Using three examples, one Arches National Park ranger closely involved with the development of the VERP process in Arches, explained the success or otherwise of VERP at specific sites: Delicate Arch, Windows and the Devil's Garden. Limits have been set in all three areas. In the terms of this thesis, a physical carrying capacity has been prescribed in these three areas. Each area and its relationship to the VERP process is now outlined in turn.

<u>Delicate Arch</u>:

Delicate Arch is the most famous arch in the ANP and hence a major visitor attraction. It was one of the first areas in the Park to implement the VERP process. Survey questionnaires, which included photographs representing a range of impact conditions (for example, number of visitors present at the Arch or amount of environmental impact on a path), were issued to visitors, and from this survey visitors reported that the number of people at an attraction at any one time was important in determining the quality of their experiences. Thus, the number of people at one time (PAOT) at Delicate Arch was selected as an indicator of quality. Findings from a series of sixteen photographs of Delicate Arch suggested that visitors generally find up to 30 PAOT to be acceptable (photographs showing 36 people were deemed to be too many, photographs showing 26 people were seen to be too few). Based on these visitor perceptions 30 PAOT was selected by the project team as the standard of quality for Delicate Arch. If there are more than thirty cars then Delicate Arch is outwith physical standard. The size of the parking lot (parking spaces are delineated on the ground – see figure 4.6) limits the number of people able to visit the area at any one time.

Figure 4.6: Delicate Arch car park with delineated spaces *(Photograph taken October 2003 by author)*.

Indicators and standards of quality were set for all zones of the ANP in this manner. Resource-based indicators and standards of quality were set based on a programme of ecological research (namely scientific measurements and systematic observation). The soil and biological community are very important to the health of the ecosystems and so most of the selected resource indicators measure the effects of visitor use on soils. The resource indicators are: cryptobiotic soil crust condition; density of social (unofficial trails); road widenings (by visitors driving cross-country or parking outwith designated spaces); relative soil compaction levels; cover and frequency of vascular plants; elemental tissue content of dominant plants; ground cover; and soil characteristics (Arches NPS 1995, 35). However, neither social nor ecological standards have been met at Delicate Arch throughout the 1998 to 2003 period.

Windows:

The "Windows" is one of the most popular areas in the Arches National Park. According to a National Park ranger a quarter of all visitors to the park congregate in this area where they hike to the "spectacles" arch (see figure 4.7).

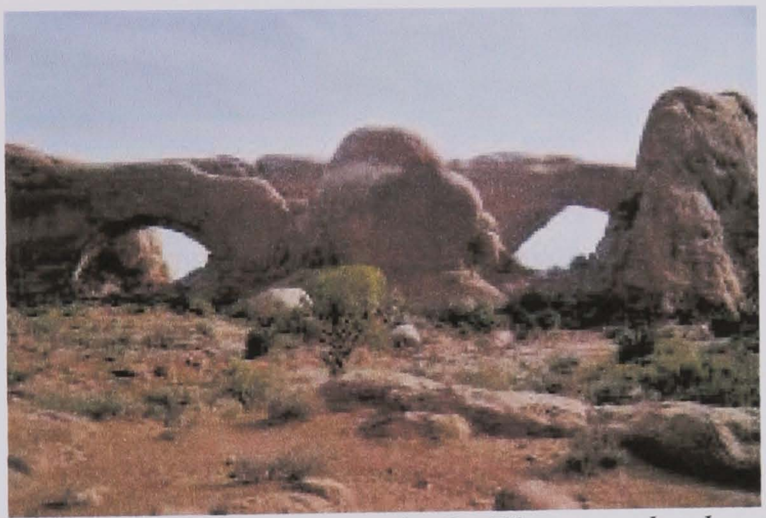

Figure 4.7: "The Spectacles" *(Photograph taken October 2003 by author).*

Direct management control is evident on site: there are "no parking" signs clearly seen on the road and fencing controls the flow of vehicle traffic. Steps on the walking paths also "funnel people into one area" (Ranger, Arches National Park). In 2002 and 2003 social standards were met at Windows. However, from 1998 to 2001 neither social nor ecological standards were met in this area.

Devil's Garden:

The final major impact area is Devil's Garden, illustrated in figure 4.8. Devil's Garden is a popular hiking and picnic area. The hiking trail to Landscape Arch is particularly popular, making monitoring of standards and indicators essential. Maximum capacity in the Devil's Garden car park is 150 cars and an Arches National Park ranger reported that this physical standard was always met (again as a consequence of the car parking spaces).

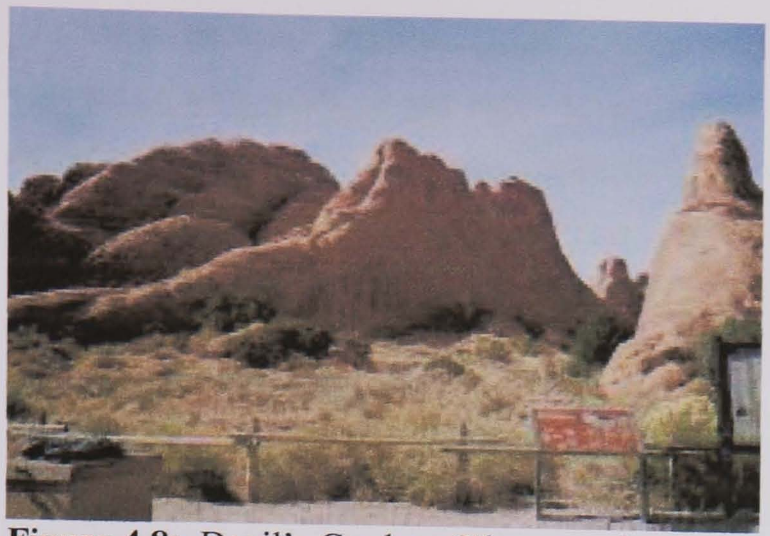

Figure 4.8: Devil's Garden *(Photograph taken October 2003 by author).*

Perceptual carrying capacity is, however, more difficult to maintain in this area. Assessing perceptual carrying capacity involved asking visitors to evaluate their experience along a section of a trail. From this survey it is seen that although social standards were met during the years 2002 and 2003, they were not met during the period 1998 to 2001. Again ecological standards were not met in this area. As a consequence of this, monitoring is again a fundamental part of the VERP process (see chapter seven).

4.6 PWC Debate Results

The following sub-section presents the results from an empirical study carried out into the conflicts between jet-skiers and other recreationalists using Loch Lomond.

4.6.1 General visitor perception of jet-skis

As discussed in chapter three, 548 questionnaire surveys were issued to visitors at four sites around Loch Lomond during the summer of 2003. Incorporated within this survey were questions regarding visitor perception of jet-skis. Only 0.7% of respondents (four individuals) were jet-skiing on the day when the questionnaire was issued. Therefore, the questionnaire survey was primarily answered by non jet-skiers and the results reflect this fact.

When asked if any activities undertaken by other people typically reduce enjoyment of a day out on Loch Lomond, 48.4% of questionnaire respondents stated that "Jet-skiers annoy me". Crucially, this answer was unconstrained; it was the reply to an open-ended, non-leading question. 9.1% believed that jet-skis were "nice to look at"; 11.3% thought that they looked "fun/enjoyable"; 63.1% believed that they caused noise pollution; 2.2% stated that air pollution was a problem caused by jet-skis; 6.6% were of the opinion that jet-skis caused water pollution; and only 5.8% said that they "didn't care" about jet-skis. Respondents were asked how many trips they made in the last year, and they were then asked how many trips they would make if the Park Authority banned jet-skis. The mean number of trips made in the last year was 5.02, while the mean number of trips to be made if jet-skis were banned rose to 7.11. In short, if jet-skis were banned, the number of trips made to the study area would increase by 29.4%. Similarly, respondents were asked to rate their recreation experience with and without jet-skis (on a scale from 1 to 10, with 1 equal to "poor" and 10 equal to an "excellent" experience). Mean values of 5.70 and 7.55 were found for the experience with and without jet-skis respectively. Using these figures it can be claimed that, if jet-skis were banned, the recreation experience would improve by 24.5%.

Using these descriptive statistics as a starting point, various statistical hypotheses were tested using the Chi-square test (see table 4.82). The tests address respondents' perception of jet-skis on-site and hence, from a theoretical perspective, are concerned with "interpersonal" conflict (section 2.6).

Data Sets	**Pearson Chi-Square Value**	**Df**	**Level of Significance**	**Reject or do not reject Ho?**	**Is chi-square significant?**	**Description (from descriptive statistics using "Crosstabs")**
Perception of Jet-skis and Site	31.005	18	.029	Reject	Yes at P>0.95	Perception of jet-skis varied between sites.
Perception of Jet-skis and Age	133.306	30	.000	Reject	Yes at P>0.99	The older the respondent, the more negative the perception of jet-skis.
Perception of Jet-skis and Sex	13.512	6	.036	Reject	Yes at P>0.95	Men were more likely than women to find jet-skis fun and enjoyable.
Perception of Jet-skis and Length of stay on site	59.600	30	.001	Reject	Yes at P>0.99	The longer the stay on site, the more negative the perception of jet-skis.
Perception of Jet-skis and origin of visitors (tourist vs. local)	27.318	6	.000	Reject	Yes at P>0.99	Locals have a more negative opinion of jet-skiers than tourists.
Perception of Jet-skis and Activity	203.745	54	.000	Reject	Yes at P>0.99	The more traditional and passive an activity, the greater the dislike towards jet-skiers.
Perception of Jet-skis and Date	184.695	150	.028	Reject	Yes at P>0.95	Perception of jet-skis varied according to time of year.
Perception of Jet-skis and number in group	143.161	72	.000	Reject	Yes at P>0.99	The larger the group, the greater the acceptance of jet-skiers.
Perception of Jet-skis and Income	126.828	48	.000	Reject	Yes at P>0.99	The higher the income, the more negative the perception of jet-skiers.
Perception of Jet-skis and Weather conditions	22.271	12	.035	Reject	Yes at P>0.95	The better the weather, the more negative the perception of jet-skiers.

Perception of Jet-skis and Experience ("visits" - visited before?)	27.071	6	.000	Reject	Yes at P>0.99	The more experienced the visitor, the more negative the perception of jet-skiers.
Perception of Jet-skis and enjoyment	206.800	6	.000	Reject	Yes at P>0.99	When a lot of jet-skis are present, the majority of respondents experience diminished enjoyment.
Perception of Jet-skis and perception of noise level	168.750	6	.000	Reject	Yes at P>0.99	As jet-skis increase, perception of noise increases.
Perception of Jet-skis and Ban jet-skis	125.171	102	.049	Reject	Yes at P>0.95	For those who perceive jet-skis negatively, a ban would improve their experience.
Perception of Jet-skis and experience with jet-skis	68.488	54	.089	Reject	Yes at P>0.90	Recreation experience is lower when jet-skis are present.
Perception of Jet-skis and experience without jet-skis	117.247	36	.000	Reject	Yes at P>0.99	Recreation experience is improved when jet-skis are banned.
Perception of Jet-skis and perception of water pollution	6.235	6	.397	Do not reject	No	No relationship (see explanation below).
Perception of Jet-skis and level of worry about environmental damage	37.983	6	.000	Reject	Yes at P>0.99	Visitors that worry about environmental damage perceive jet-skis negatively.
Perception of Jet-skis and perception of crowding	61.675	6	.000	Reject	Yes at P>0.99	The more crowded a site, the more negative the perception of jet-skis.
Perception of Jet-skis and perception of environmental damage.	42.356	6	.000	Reject	Yes at P>0.99	The more environmentally damaged a site, the more negative the perception of jet-skiers.

Table 4.82: Chi-square tests relating to jet-skis, where Ho = there is no relationship between data and HA = there is a relationship between data. (The Chi-square value was computed using S.P.S.S. spreadsheet package.)

As seen in table 4.82, all relationships are significant at at least the 0.05 level (giving 95% confidence in results), excluding the relationship between perception of jet-skis and perception of water pollution. Perhaps this is because those perceiving jet-skis as a problem believe this to be because of the noise factor, rather than the water pollution generated by them. Only 6.6% of all respondents recognised water pollution as a problem, while this figure rose to 63.1% for noise pollution.

In addition to the jet-ski questions asked as part of the on-site survey, qualitative, in-depth interviews were carried out with jet-skiers and non jet-skiers. The findings from these interviews neatly indicate the controversial debate between those "against" jet-skis and those "for" their use.

4.6.2 The jet-ski controversy: "Against"

Interviews were undertaken with two separate recreation groups: sailors and anglers[18]. "Social values" conflict (section 2.6) was investigated, at least in part over conflicting values regarding different activities.

Loch Lomond Sailing Club Members

All sailing club respondents were over thirty years of age. Two of the respondents were women, the remaining ten were men. The average number of years sailing on Loch Lomond was 27.5 years, with a number of sailors stating that they had sailed for over thirty. Overwhelmingly, responses to the interview questions were highly against jet-ski use on Loch Lomond. Only two out of the twelve respondents stated that they are not affected by the activities of jet-skiers. For the remaining ten members, PWC can be highly disruptive of a day's sailing on Loch Lomond. Specifically, the main issues for the sailing club members are:

- Disruption caused by PWC, especially the noise that they produce.
- Banning of PWC (three out of the twelve members wanted a ban on PWC, others implied a ban).
- Interference with other water users (visitor conflict/ irreconcilable differences between recreation activities).
- Safety concerns with PWC.
- Environmental issues caused by PWC use.
- Anti-social behaviour from PWC users.
- Importance of weather conditions.

Many respondents asserted that noise is their main concern, with one member stating that:

"I've heard them [PWC] *zooming from the top of Ben Lomond and I've had many complaints from people hearing the noise generated by the jet-bikes; hearing the noise from the top of the Ben!"* (Sailor).

Similarly, another respondent reported that he had heard the jet-skis from Conic Hill, a nearby hill which is popular with walkers, on more than one occasion, adding that he refused to sail on days when he knew the jet-ski numbers would be high.

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[18] Sailors and anglers, rather than canoeists for example, were chosen because they were already in organised groups – the Loch Lomond Sailing Club and the Loch Lomond Angling Association respectively – and hence an interview sample was easier to organise than with other activity groups.

Interestingly, weather conditions are an important factor for many respondents when thinking about the effects of jet-skis. One respondent stated that on calm, bright sunny days, "the noise and smell from those things [jet-skis] is awful". Environmental concerns are also relevant for many respondents, with many maintaining that PWC often cause staining on their boats. One sailor explained that "there's scum on my boat because of the oil from the jet-skis", while another stated that the jet-skis "cause disturbance in the water, creating unnecessary waves, which must contribute to shore erosion surely". Water pollution is often also of concern to the sailing club members. One member argued that:

"The jet-skis cause so much water pollution. I know that I wouldn't want to swim in the loch any more because of it" (Sailor).

Only one member suggested that, although there was a pollution factor as a result of jet-ski use on Loch Lomond, "just how much water pollution the jet-skis do contribute to is a matter of debate. It's probably not as much as people think". The remaining members claimed that the jet-skis "pump petrol fumes into the loch".

Concern with aggressive jet-ski users is another key problem, and a lack of respect was often cited as a reason behind such aggressive behaviour. One respondent insisted:

"The antics of jet-skiers are very alarming to other loch users. They are cowboys. They go round and round and round and round in the bay with their outlandish manners. It's the ones with the earrings and the shaved heads that you have to watch, they can be very aggressive... Jet-skiers don't have any respect for other loch users. They're bloody rude!" (Sailor).

The above quote appears to view jet-skiers as a particular social "type", perpetuating social stereotyping (i.e. jet-skiers are young, male and working-class). Those using PWC are seen to be an outsider group, demonised as "out-of-place" (Cresswell, 1996). The destructive behaviour of a small number of users is used by sailors to substantiate their claim that all jet-skiers are "out-of-place" and, more specifically, aggressive. Aggressive behaviour is often linked to a safety factor, and as such safety is an extremely important issue for many:

"Safety is so important. Disrespect and speed from jet-skiers towards other water users leads to an inherent danger. Juveniles often do 50/60 mph and pass close by my yacht, far too close for comfort. Last summer two jet-skis zoomed past me about 60mph, they were very, very close. I nearly capsized. I soon reported them to the National Park Authority. The jet-skiers in question were very aggressive, no respect whatsoever" (Sailor).

Interestingly, only two members had a "live and let live" attitude. One respondent stated: "the jet-bikes tend to get the blame for every little problem on the loch when this isn't always necessarily the case". When questioned about the possibility of zoning the loch into different areas for different recreation activities, only three of the twelve members thought that such a management policy would be a good idea. Many favoured a complete ban of jet-skis or charging for PWC use on Loch Lomond (currently it is free to use all powercraft, including PWC, on Loch Lomond). As one member forcibly argued:

"I don't want to look like I'm penalising the jet-skiers but I just don't like them. It's my freedom against their freedom. They spoil people's enjoyment of this beautiful area and should be banned!" (Sailor).

Loch Lomond Anglers

All the anglers interviewed were resoundingly against PWC use on Loch Lomond and more widely. All respondents were male and all were over 35 years of age (two men were of retirement age). The anglers had been fishing on Loch Lomond for an average of 30.6 years. Two of the five respondents (40%) believed that banning jet-skis would be a solution to their lasting impacts.

The main issues (themes) for the anglers are as follows:

- Noise caused by PWC.
- Disruptions to fish caused by PWC noise.
- The need to educate jet-skiers.
- Safety aspects of PWC use.
- Anti-social behaviour from jet-skiers.
- The need to police PWC.

Again, noise generated by PWC is a major concern. The "buzzing" of PWC is seen to disturb the fish and the ambience of the natural area. For example,

"I have two main causes for concern: noise and the fact that they go across shallow water. The shallow water is a good holding area for salmon and sea trout; quite often the jet-skis don't observe the 150 metre rule. They have no idea that they have this influence on other people. They fly through the area, pass you in two seconds, and then they're gone. They leave disruption, they've disrupted the fish and destroyed your loch experience and they have no idea" (Angler).

As with the sailors, anglers are also of the opinion that PWC present significant safety concerns. Again irresponsibility and a lack of respect fuel these concerns, as is seen in the following:

"There's a big safety issue. The jet-skiers don't consider anybody but themselves and that is very dangerous. They just don't care; all they care about is showing off to their friends. They have no respect for other loch users" (Angler).

Many of the anglers interviewed appear to believe that it is "young people" who are causing the jet-ski problem. They argue that the younger users of PWC show no respect towards their elders, and that education is an important tool by which the Park Authority can encourage improved relations between different recreation groups. Interviews with both sailors and anglers therefore demonstrate a highly anti jet-ski attitude. This anti jet-ski stance is perpetuated by the media and in particular newspapers.

The Media: Newspapers

A "NewsBank" search returned two hundred articles containing the words "Jet-ski" or "Jet-skiing". Clearly this illustrates the importance of the jet-ski debate within the media. For the "Daily Telegraph" only, 17 articles were found that were related to the jet-ski debate, for the last year. In total, therefore, in a one-year period and in eleven British newspapers, there were 217 articles concerned with the jet-ski controversy.

Whilst the jet-ski debate has popular media attention (see Anon., 2003a-f; and Anon, 2004a&b), the majority of the articles took an anti jet-ski stance. The anti jet-ski feeling was supported through the concept of safety. Indeed approximately 75% of the articles were concerned with safety issues, primarily jet-ski accidents and fatalities. Examples of headlines include:

"Jet-skiing father killed" ("The Times", 4th October 2003).

"Girl killed as uncle lost control of jet-ski" ("The Times", 28th August 2003).

"Two feared dead in jet-ski horror" ("The Scotsman", 14th June 2003).

In addition to safety issues, anti jet-ski articles were often concerned with supporting the ban of jet-skis in the U.K. and elsewhere. For example, an article in "The Times" discussed the banning of jet-skis in Greece and Cyprus, since the number of holiday makers involved in PWC accidents has risen in recent years. The same article stated that there have been 145 incidents involving jet-skis in the U.K. in the 18 months from June 1997. Hence, once again, safety issues are seen to warrant a "ban" of such craft. Overall it is apparent that the print media encourages the controversy surrounding jet-ski use on British waters.

Thinking more specifically about the Loch Lomond area, an article with the headline "Loch Lomond deters discerning tourists" ("The Herald", 12th August 2004) asked:

"Do the national park authority members and the political parties which appointed them seriously believe that tourists will come to Loch Lomond to watch literally thousands of fast speedboats, jet-skis and water-ski boats tear round and round, day in day out, at speeds of up to 60mph?... No discerning tourist in his right mind would risk taking a family out on the loch itself on any good summer weekend because of risk to life and limb from the speed which is now out of hand".

As with previous articles, this extract is concerned primarily with safety. A letter in reply to this article takes this argument further and brings the noise issue into the equation. Namely,

"The problem of noise pollution on Loch Lomond is even worse... the drone of jet-skis ruins what used to be a quiet and reflective time for visitors from near and far... No-one would tolerate a recreation which besmirched the loch with hectares of lurid, fluorescent paint. Why then put up with the audible equivalent of such a visual atrocity?" ("The Herald", 12th August 2004).

Clearly jet-skiers using Loch Lomond is an emotive issue for many. At no time was this more clearly seen than during December 2004 when "The Herald" started an investigation into the "state" of Scotland's first National Park. A variety of articles addressed a number of issues surrounding the use of the Loch Lomond and Trossachs National Park, including the use of PWC. Throughout this campaign the newspaper was clearly perpetuating a negative image of the National Park and jet-ski use therein. The public then responded to these articles through letters, leading to a controversial debate. Below are extracts from some of the more revealing articles and letters:

"The Fast Set: Jet-ski users are a particular bone of contention with people who live near Loch Lomond, anglers and other visitors who seek tranquillity... The whole leisure environment can be ruined by one noisy, fast machine" (Article, "The Herald", 6th December 2004).

"As a canoeist and dinghy sailor, I find the loch an unpleasant hell-hole on a hot summer's day, and stay away. Jet-skiing simply is an inappropriate activity for any national park worthy of the name" (Letter, "The Herald", 10th December 2004).

"Driving a jet-ski on Loch Lomond is like driving an unsilenced motorbike round and round the Botanic Gardens for hours on end. Would that be allowed? I suspect not" (Letter, "The Herald", 10th December 2004).

Not only did "The Herald" newspaper create a negative image of the Loch Lomond jet-skier, the majority of letters agreed with this image, congratulating the journalists on relevant and accurate articles. Evidence from this newspaper debate, and the earlier newspaper search, suggests that visitor conflict is a topical, newsworthy issue, both with relevance to the Loch Lomond and Trossachs National Park and for outdoor recreation more generally. Undeniably, the (biased) print media sustain the opinion that jet-skis are "bad".

The anti jet-ski stance is also forcibly seen through the analysis of documentary evidence.

Documentary Evidence

"The Bluewater Network" is an organisation based in the U.S.A. with the mission statement to "champion innovative solutions and inspire individuals to protect the earth's finite and vulnerable ecosystems" (Bluewater Network, 2004), and as such the Bluewater Network is extremely critical of jet-ski use and maintains the need for an outright ban of PWC use in the U.S.A. Regular "Bluewater" e-mails (at approximately fortnightly intervals) were received, with titles such as "Parks Prohibiting Jet-skis see significant increase in visitation, Parks that continue to allow the machines see decrease"; "Urge the National Park Service to protect the environment at Bighorn Canyon National Recreation Area from damaging jet-ski use!"; and "Bluewater announces the ten best places to avoid Jet-skis in 2004". All e-mails were extremely against PWC use and adamantly insisted on the need for a ban of such craft on all waters. Reasons for implementing such a ban included toxic emissions by jet-skis, disruption and displacement of wildlife, noise pollution and safety concerns. The following is an extract from the Bluewater Network website (accessed Wed. 28th May 2003):

"If you have ever heard their high-pitched whine or witnessed riders harass birds and marine animals, you understand the harm that personal watercraft, also known as jet-skis, can bring to our waterways and enjoyment of them. Nearly 100,000 of these so-called "thrillcraft" are sold each year, and more than one million jet-skis are currently in use in the United States. They move at speeds that can exceed 65 miles per hour, leaving in their wake a host of environmental and safety problems".

Similarly, the following extract neatly summarises the principle of the Network:

"More and more, those on and off the water see a need to recognise that thrills for a few should not become a safety and environmental hazard for the majority" (Bluewater Network 2002, 8).

The extracts above are testament as to how hostile the Bluewater Network is toward PWC, and therefore illustrate the primary goal of the network: to ban jet-ski use throughout the U.S.A. Indeed, the Bluewater Network (2004) state that "jet-ski bans have the added bonus of improving visitor enjoyment, public safety, air and water quality, and natural soundscapes" and claim that those U.S. National Parks which banned PWC welcomed an additional 1.45 million people during the first nine months of 2002. Parks that have already banned PWC include: Cape Cod (Massachusetts), Fire Island (New York) and Padre Island (Texas). Many e-mails received from the network encouraged members to write to the National Park Service to ensure support for further bans in many areas throughout the U.S. More generally, the claims of the "Bluewater Network" illustrate the generic arguments made against PWC throughout the developed world.

Closer to home, the "Friends of Loch Lomond" advocate a similar stance to the "Bluewater Network". In a positional paper to the LLTNPA, the "Friends of Loch Lomond" claim that jet-skis should be banned from Loch Lomond. They show that complaints against PWC have been raised in many parts of Scotland as well as in many parts of the U.K. and abroad, and argue that the main causes for concern are noise, safety, interference with other users and environmental issues (Boocock, 2002). "Friends of Loch Lomond" conclude that many Loch Lomond visitors and residents are concerned about the intrusion of jet-ski noise: this is the first mentioned concern of most of those consulted, and the belief is that jet-ski use interferes with the enjoyment of other Park users whether afloat or ashore. It is recommended that a total ban on the use of jet-skis on Loch Lomond be introduced. Therefore, many environmental organisations such as the "Bluewater Network" and "Friends of Loch Lomond" often adopt an anti PWC stance.

4.6.3 The jet-ski controversy: "For"

Examining both sides of the PWC controversy involved undertaking interviews with two further groups: jet-skiers and local businesses involved in water-based recreation.

Local Businesses (involved in water-based recreation)

Both respondents from the local businesses were male, and aged 30 and 50 years approximately. The main issues for the local businesses were:

- The Media: the controversy surrounding the jet-ski debate is perpetuated by the media.
- Communication: importance of communication between different recreation users and between recreationalists and the National Park Authority.
- Park Management Actions and the local economy: the importance of the National Park Authority in encouraging economic gain by local businesses.
- Perceived but not "real" PWC problem (particularly with respect to safety, noise and environmental pollution).
- Irresponsible behaviour.
- Safety.
- Information / Education.

It was a belief of the local businesses that the environmental lobby often unfairly target jet-skiers:

"The 'red sock brigade' [environmental groups] *as I call them are against me as a commercial operator of powered craft, their opinions are perpetuated by the media. What they don't seem to realise is that 320 days out of the year you don't see people out on the loch. Take today for example; there is no one out on the water at all. There can be over 100 craft out on a busy day on the water but that's to be expected. The jet-skiers and speed boats, and those who have businesses with them, are the unfair target of the environmental lobby"* (Employee, "Mayles Watersports").

With respect to noise pollution, one respondent argued that alterations to exhausts had reduced the noise level caused by PWCs considerably, as well as reducing the amount of water pollution generated:

"Noise and emissions have in part been addressed by the PWC manufacturers. There have been alterations to the exhausts and this had reduced the noise level. Noise pollution is a lot lower today than it ever was before. As I mentioned before, I live on the lochside and there is much more noise from the A82 than there ever is on the loch. There is noise pollution from the A82 twenty hours a day. There's nothing like that on the water; today is very quiet" (Employee, "Mayles Watersports").

Interestingly, the employee from "Mayles Watersports" suggested that safety was only a perceived problem and stated that "the problem exists in their mind". More specifically:

"The problem is with people who don't have a knowledge of the craft. They just assume that they are bad for the environment, when actually the environmental problems, water pollution and so on, are very few. The problem exists in their mind. They don't understand the real issue; they make assumptions. The jet-skiers get a bad press. A lot of it is due to the media, and the people who are against them don't understand the true facts. The media promote the opinion that the jet-skis are bad. They focus on the damage caused by powered craft, when really actual damage by watercraft is limited" (Employee, "Mayles Watersports").

Clearly the interviewee is arguing that there is not a real environmental problem as a consequence of jet-ski use. Any problem is a perceived one, existing only in the minds of the non jet-skiing recreationalist.

Conversely, the employee from "Can you Experience..." recognised that there was often a conflict between family activities such as picnicking and canoeing, and jet-skiing. For some, he said, "the jet-skis can be the bane of their lives" (Employee, "Can you Experience..."), as he demonstrated through the following example:

"The jet-skiers affect the enjoyment of our canoeists more often than not. For example, we had a family out in one of our canoes the other day. A jet-skier came roaring into the lagoon, turned suddenly and soaked the family. The family was petrified; thought the guy was coming for them. There's no problem with jet-skis if they are used responsibly, but it's the irresponsible jet-skiers that give the sport a bad name. Drinking can be a problem as well; a lot of the young lads drink and then go out on their skis. There's no law against it but clearly there should be. I mean as a means of transportation they [jet-skis] *are fine, but when they come into the lagoon and buzz the canoes they are not fine. The irresponsible ones are the problem, the ones that launch in the bay and travel in a straight line out to the Loch don't cause any problems, they're not even that noisy, cause they go far away, it's the ones that buzz around our bay that are a danger and cause a lot of noise, affecting the enjoyment of our customers. We've had lots of complaints about them"* (Employee, "Can you Experience...").

Both respondents recognised the importance of communication with the National Park Authority, education for jet-skiers, and the need for policing on the loch.

A brief telephone conversation (lasting approximately five minutes) was carried out with a "TayJet" employee, who stated that many people now jet-ski on the East Coast of Scotland because they believe that Loch Lomond is becoming too busy. He also suggested that jet-skiers are getting "a bad press" and that they had to accept that "there is a controversy element in everything you do". Overall, he asserted that "TayJet" was an organisation very much for the use of PWC on Scottish waters.

The interviews with the businesses involved in water sports provided a primarily balanced view of PWC use, but the respondent from "Mayles Watersports" was clearly for the use of jet-skis; this is not surprising as PWC generate the respondent's income.

<u>Jet-skiers</u>

It is not surprising that the important issues for the jet-skiers were not the same as the significant issues for those against jet-ski use. As expected, all jet-skiers were for the use of PWC on Loch Lomond. Of more interest is that the telephone interview (with a forty year old male jet-skier) derived the most information. The main themes arising from this interview were:

- Facilities (need for good facilities for jet-skiers).
- Park Management Actions (zoning and banning are "not good ideas").
- Interference with other loch users.

Interference with other loch users was acknowledged, but this conflict was seen to be one-sided. Although the respondent recognised that conflict and controversy is present on the loch, he did not believe that he was affected by the activities of other recreation users:

"There was a lot of controversy last year regarding jet-ski use on Loch Lomond, but the controversy is sorted out now.[19] *I know that a lot of recreation groups, fishermen for example, still complain about us; they say that we're too noisy and disturb the fish etc. but all the jet-skiers that I know are very considerate to other loch users. Like anything, it's just a small number of jet-skiers that make a bad name for the rest of us. The small minority are the worst of it. I mean, with any public area there will be disruptions. The bottom line is that there's always an element of people who don't show consideration for other users. It's the same whether you're jet-skiing or driving to 'Asda'... But there are no specific groups or sports that disrupt me* "(Jet-skier, phone interview).

With reference to Park management actions, the respondent felt very strongly that zoning and banning of jet-skis should not occur:

"Zoning can be an accident waiting to happen and as for banning jet-skis, no way! A ban is a bad idea. Everyone should be allowed to enjoy the loch in the way that they want... within reason of course" (Jet-skier, phone interview).

The conclusion to this sentence – "within reason of course" – is most telling. Crucially, one person's "within reason" is another person's wholly irregular activity, i.e. something they suppose is clearly not "within reason", such as jet-skiing on a quiet stretch of water.

Respondents from the face-to-face Drumkinnon Bay interviews were less forthcoming with their thoughts and opinions. Two jet-skiers refused to answer the questions (both due to "lack of time"), but twelve respondents were still interviewed in total. Ten of the respondents were male; two were female. The high percentage of male respondents reflects the apparent dominance of men in the jet-skiing sport. In terms of age group, all respondents were in the 25 to 54 year old age group: six respondents were aged 25 to 34 years (50%); four respondents were aged 35 to 44 years (33.3%); and two respondents were 45 to 54 years old (16.7% of sample). Although respondents were not asked for their income or their home town (it was decided that such questions would discourage jet-skiers from interview response), it was recognised that all accents (excluding one Irish man, now living in Scotland) were from Glasgow/West Central Scotland. With great hesitation it is also suggested that the individual accents indicated that respondents were from the lower income brackets. A number of jet-skiers were new to the Loch Lomond area, with 69.2% of respondents jet-skiing for two years or less. On average, respondents had been jet-skiing for only 6.3 years. A logical conclusion is, therefore, that the jet-skiers have a different level of personal "investment" in their activity (as compared to sailors and anglers).

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[19] As the controversial newspaper debate conducted in "The Herald" during the following December (2004) demonstrates, this was not the case.

The interviews carried out with the jet-skiers on site were very revealing. It appears that the main concern of the jet-skiers is to have fun and to enjoy their recreation activity. Discussions suggest that they have very little consideration for other recreation users, and only two people questioned mentioned being aware that there is controversy surrounding PWC use with dissatisfaction coming from other recreation users. None of the jet-skiers reported that any other activities disrupted their recreation enjoyment. The jet-ski conflict therefore appears to be very one-sided: namely from the side of the non jet-skier. In addition, many of the answers given by jet-skiers were very monosyllabic. Prompts were used for the majority of interviews, but many still only provided one-word answers and did not wish to engage in a dialogue. An impression was therefore given that the jet-skiers are very apathetic; they do not appear to care about other recreation users and the Loch Lomond environment in general.

On the day when the jet-skiers were interviewed, it was a warm, sunny weekend. The temperature reached a high of 21°C and interviews were undertaken between 2pm and 5pm. Drumkinnon Bay car park was very busy – it was full when the researcher arrived on site at 2pm and continued to be full throughout the day. The rangers reported that it was the busiest day of the season so far, with one ranger stating that it was "chaos out there". At Drumkinnon Bay lagoon, three PWCs, one speed boat, one rowing boat and two canoes were seen, all in the same area, close to the shore. There were also many picnickers sitting at the picnic benches around the lagoon. Moreover, there was a queue to launch boats and PWC, and this fact was commented on by many respondents. In general, however, the main themes from the face-to-face interviews with jet-skiers were:

- Fun/Enjoyment: Importance of "Play".
- Openness of water, large loch with lots of space.
- Facilities.
- Safety.
- Crowding.
- Visitor Conflict / Complaints.
- Park Management Actions (particularly zoning).

Of the themes listed above, the most important issue for all on-site jet-skiers was the importance of "play": the need for recreation enjoyment. This was especially true for the ten male respondents, one of whom stated:

"It's a lot more fun to ride in the shallow water, and it's warmer than out in the middle of the loch. The loch is a lot of fun; there are safe bits and daring bits. I can match my mood to the different stretches of water. It's great fun, you should try it!" (On-site jet-skier, Male).

Worryingly, the jet-skier's claim that it is "a lot more fun to ride in the shallow water" indicates a lack of awareness of the 150 metre rule (i.e. the statutory 11 kilometre per hour speed limit 150 metres off all shores). Furthermore, where visitor conflict is recognised, it is the belief that other people complain about the jet-skiers, rather than the jet-skiers themselves complaining about other people, as is shown in the quotes below:

"The loch is big enough for everyone to enjoy. Look at it; it's huge out there. I know that the canoes don't like us[20] *but we stay away from them. They've got no right to complain, we don't do anything wrong. It's fun to be out on the water with the other boats. It's fun to jump over the waves generated by the really big boats. Excellent times!"* (On-site jet-skier).

"I always make allowances for everyone. We're all here to enjoy the Loch. I love it here. It's ideal really" (On-site jet-skier).

To reiterate, therefore, the jet-skiers do not appear to be negatively affected by other loch users. Conflict appears one-sided, arising from the point of view of the non jet-skiers, such as the anglers and sailors. The jet-skiers appear to believe that fun is more important than eradicating any conflict.

Gender roles appear to be a prominent and significant influence on the opinions of jet-skiers. Women appear to be more concerned with safety and facilities than do men, who are more concerned with fun and enjoyment. Namely:

"It can get really busy and dangerous when all of the bigger boats are launching at the slip way and it can take ages to get my bike down there. Congestion can be bad and there's got to be a safety issue there. Having said that, I know that if my jet-bike were to break down there would be a ranger nearby to help, and that's important" (On-site jet-skier, Female).

Despite these comments, the majority of jet-skiers reported that "things are fine the way they are" (On-site jet-skier), and did not recognise any visitor conflict that was detrimental to their recreation experience. They are clearly for the use of PWC on Loch Lomond, and argue that a jet-skiing ban would be unfair and unjust:

"It's fun, you can't ban us! We bring good business to the area. Just think how much money we spend every time we come here... You can't take away our fun" (On site jet-skier).

The sentiment that the Loch should be for the enjoyment of all was thus echoed in the interviews with jet-skiers and local businesses involved with water-based recreation on Loch Lomond.

The Media: Newspapers

Approximately 25% of the newspaper articles analysed were for the use of PWCs. Those articles supporting the use of PWC were often found in the travel supplements of newspapers, and they were consequently not part of the main newspaper as were the anti jet-ski stories. Articles "for" jet-ski use primarily illustrated the fun and enjoyment of jet-skiing. Examples of such headlines

[20] If more time had been available, canoeists would have been interviewed to investigate this statement.

include: "A Truly exhilarating spin on beautiful Loch Lomond" ("The Herald", 8th September 2003) and "The jet-ski: a spine tingling thrill" ("The Scotsman", 26th June 2003). An interesting article titled "Record-setter aims to take yobbery out of jet-skiing" ("The Times", 18th September 2003) recognised that jet-skiers had a reputation of being "irresponsible, noisy lunatics", but the reporter argued that "jet-skis can be thrilling without being antisocial" and discussed the jet-ski controversy from a pro jet-skiing stance. It is important to reiterate, though, that the majority of articles adopt an anti jet-ski attitude.

Documentary Evidence

Analysis of documentary evidence indicated the existence of many organisations that support the use of PWC in waterbodies. One such organisation is the Personal Watercraft Industry Association (PWIA), founded in 1987 in the U.S.A. to represent all PWC manufacturers; and to promote safe and responsible operation of PWC (PWIA, 2004). The mission statement of the PWIA is to "ensure that personal watercraft and personal watercraft users are treated fairly when local, state and federal government officials consider boating regulations" (PWIA, 2004). Interestingly the PWIA recognise the existence of the Bluewater Network and suggest that:

"Personal watercraft manufacturers have made amazing technological advances to make their vessels cleaner and quieter – a fact acknowledged by National Park Service scientists and others, but ignored by Bluewater because it doesn't fit with their extreme agenda" (PWIA, 2003).

The Bluewater Network and the Personal Watercraft Industry Association therefore represent the two extreme sides of the jet-ski debate. The latter is for jet-ski use, the former against their use. Like the Bluewater Network, the PWIA address the environmental, safety and noise issues that surround PWC use. They argue that, with the introduction of "new-technology" engine improvements such as catalysts, direct injection, and four-strokes, marine engine manufacturers have achieved a 75% reduction in hydrocarbon and other emissions in recent years and hence state that PWC are "among the most environmentally friendly motorboats on the water today" (PWIA, 2004). Similarly, they maintain that more than 99% of PWCs are enjoyed accident-free every year and that "there is little data or evidence to suggest that PWC are inherently more dangerous than other recreational vessels" (PWIA, 2004). With respect to noise pollution, PWIA state that:

"PWC have always complied with every state and federal sound regulation, and are well within the sound range of other motorboats. Thanks to industry investments in hull insulation and other technologies, today's PWC are up to 70% quieter than 1998 models, and manufacturers are working to bring their customers even quieter vessels in the future" (PWIA, 2004).

The PWIA's website regularly issue news releases with titles such as: "Studies affirm PWC are Cleaner and Quieter"; and "Proposal to Ban Personal Watercraft on Keoka Lake Denied". These news articles and many more like them all argue against the "unfair ban" of PWC on many of the

U.S.A.'s waters. They maintain that the industry must "continue to clean up emissions and fight unfair bans" (PWIA, 2004).

The arguments of the PWIA, including those against banning PWC on waterbodies, are generally based on scientific evidence, and perception of recreation – and in particular conflict between recreation users – is dismissed as being a "non-real" issue. Environmental impact is thus seen to be the crucial factor, and anti jet-ski public opinion is seen to be "wrong": "we were confident that science would once again rule over bias, and confirm that PWC have no unique impact that justifies singling them out for discriminatory bans" (PWIA, 2004). Although the PWIA claim that jet-skis do not cause significant environmental damage, the fact that visitors perceive conflict to be present should be of concern for jet-skiers, manufacturers and resource management. In short, perception of the recreation environment should be as important as actual environmental impact for such groups. Analysis of the opinions of the PWIA shows that this is not always the case: "scientific fact" is seen to be more important in all the arguments of the PWIA. Perception should, nevertheless, be crucial if a National Park Authority wishes to encourage recreation enjoyment and harmony between different recreation groups, and hence it is a crucial motivation for the current research.

4.7 Conclusion

This perceptual results chapter has generated a number of interesting and revealing social findings. The traffic counts show that physical carrying capacity varies throughout the Loch Lomond area, depending on site visited. Descriptive statistics illustrate that the mean household income of the 548 questionnaire respondents is around £37,000 (somewhat higher than the Scottish mean of £26,988 – Scottish Household Survey, 2004) and that a very large percentage of respondents, 92%, arrive at the loch by car. In terms of participation, the mean number of trips made in the previous twelve months was six (with a maximum of thirty trips) and 72% of respondents undertake "passive" as opposed to "active" activities. The mean group size is relatively small at 3.02. The econometric models developed these descriptive statistics. Of the three site quality variables under study in the travel cost model (noise, crowding, environmental damage) only noise is statistically significant, suggesting that perceived noise has a negative impact on number of trips. Based on the estimated travel cost model a consumer surplus per trip estimate of £20.53 was calculated. Furthermore while a typical day at Loch Lomond is valued at this £20.53, from the contingent valuation study it is seen that visitors would be willing to pay an <u>additional</u> £1.76 per trip to fund specific environmental improvements. 81.2% of interviewees would be willing to pay a car parking fee to fund these environmental improvements. Through the CVM it can be inferred that such visitors are influenced by not only their socio-economic characteristics of income, sex, mode of transport and recreation activity, but also by their perception of environmental damage at a site.

The final set of econometric models, the contingent behaviour models, illustrate that hypothetical increases in crowding, decreases in noise level and a reduction in level of environmental damage would all increase predicted trips by 9.04%, 0.19%, 0.21% respectively. Supplementing this quantitative data are the qualitative findings of the interviews and PWC debate. The interviews identified a number of important themes and issues for managers and policy-makers, while the PWC debate illustrated that asymmetrical conflict currently exists in the Loch Lomond area.

These quantitative and qualitative results provide information on the perceptual (social) impacts of outdoor recreation. Ecological evidence is required to complement these perceptual findings, as presented in the following chapter.

Chapter 5. Results – the ecological dimension

"Modern technology Owes ecology An apology"
(Alan M. Eddison).

5.1 Introduction

Chapter five presents the empirical ecological results. It conveys evidence of any "real" environmental impact that exists as a consequence of outdoor recreation. Specifically, the findings from the visual assessment of visitor-induced environmental damage survey are considered, and then the (vegetation) ecological survey results are examined.

5.2 Visual Assessment of visitor-induced environmental damage survey

This section presents the results from the visual assessment of visitor-induced environmental impact survey. As explained in chapter three, the purpose of the environmental impact survey is to establish the level of visitor damage and grazing pressure around the entire perimeter of Loch Lomond, including all major islands. Visitor damage is defined as evidence of negative anthropogenic environmental impact such as litter, dead trees, water pollution, exposed tree roots, broken branches, vegetation trampling, shore erosion, and remnants of barbeques. The following tables and graphs illustrate the quantitative results of the visitor impact and grazing pressure surveys.

Visitor Impact Level	1 (no V.I.)	2 (low V.I.)	3 (moderate V.I.)	4 (high V.I.)	5 (very high V.I.)	6 (Artificial/Rock shoreline)
Total Distance (kms)	51.81	19.03	15.38	10.8	11.93	21.68
% of total shoreline *	39.67	14.57	11.77	8.27	9.13	16.59

Table 5.1: Six-point scale of Visitor Impact (V.I.) around Loch Lomond perimeter *(*total shoreline = 130.63 kms)*

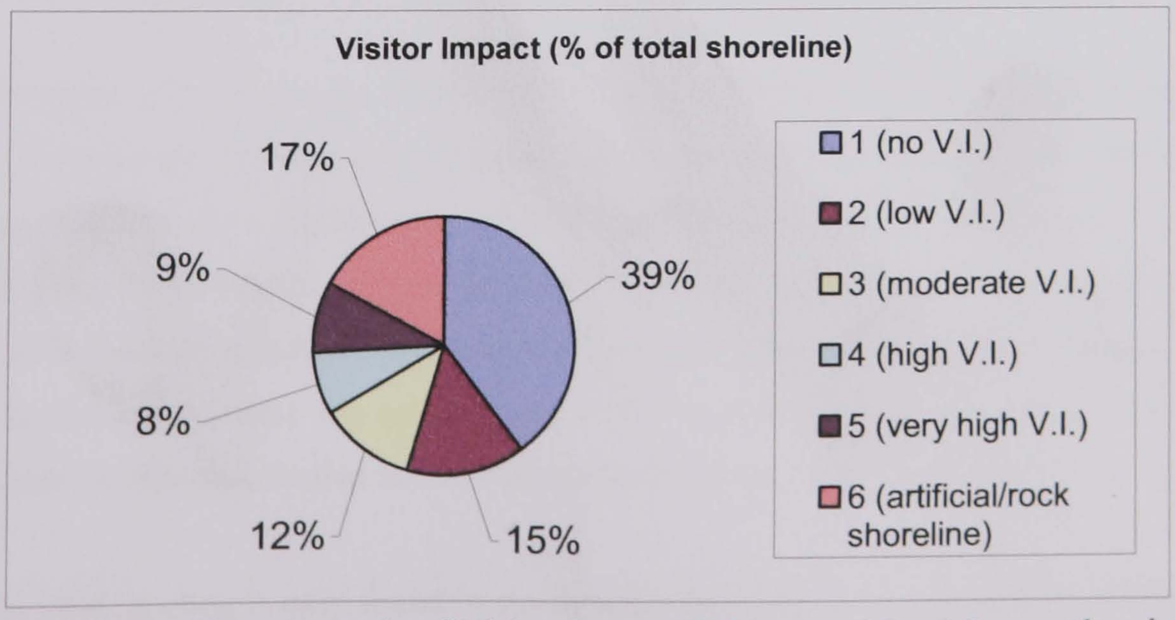


Figure 5.1: Six-point scale of Visitor Impact (V.I.) around Loch Lomond perimeter.

Overall, 56% of shoreline has no visible visitor impact (however 17% of this is artificial/rock shoreline, where visitor impact is impossible). 44% of the shore zone therefore experiences some level of visitor impact, with just over 9% experiencing very high visitor impact levels (see table 5.1 and figure 5.1).

With regard to grazing, the majority of the loch shore zone (93%) experiences no grazing pressure (see table 5.2). High or very high grazing impact is not encountered in the shore area (see figure 5.2).

Grazing Impact Level	1 (no grazing)	2 (low grazing)	3 (moderate grazing)	4 (high grazing.)	5 (very high grazing)
Total Distance (kms)	121.76	0.98	7.89	0	0
% of total shoreline *	93.21	0.75	6.04	0	0

Table 5.2: Five-point scale of Grazing Impact around Loch Lomond perimeter *(*total shoreline = 130.63 kms).*

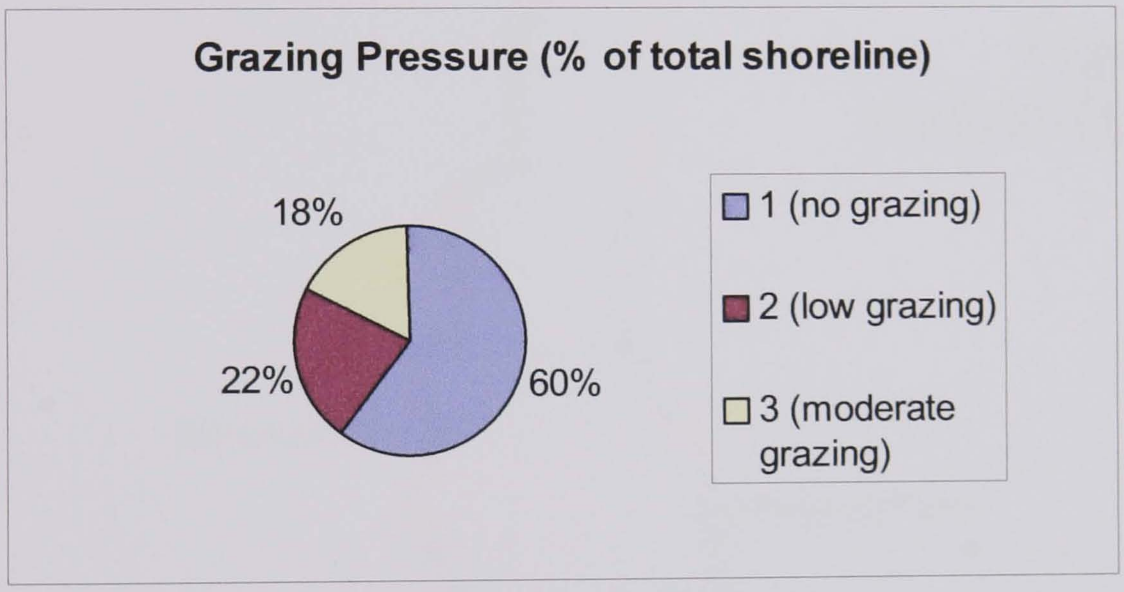


Figure 5.2: Grazing Pressure on Loch Lomond shoreline.

Figures 5.3 (visitor damage), 5.4 (grazing pressure) and 5.5 (high and low visitor damage) illustrate these results in pictorial form.

In terms of grazing pressure, there are no areas of high or very high grazing pressure (rated '4' and '5' on the quantitative scale respectively). Only 6.8% of the shoreline experiences grazing, either by sheep or cattle, but this grazing is termed 'low' or 'moderate' pressure ('2' and '3' respectively). Figure 5.4 shows the main areas of this low and moderate grazing pressure, primarily in the far north-east of the loch (around Ardlui); the north-eastern shore south of smugglers cave and north of the Inversnaid hotel; the area just north of Inveruglus on the west shore; south-east near the River Endrick area and, further south, Portnellan farm; and in the northern corner of Inchmurrin.

In total, grazing is only found in six separate locations, covering approximately 9 kms of the shore zone. Very few areas of the loch are thus subject to grazing pressure and for the majority of the

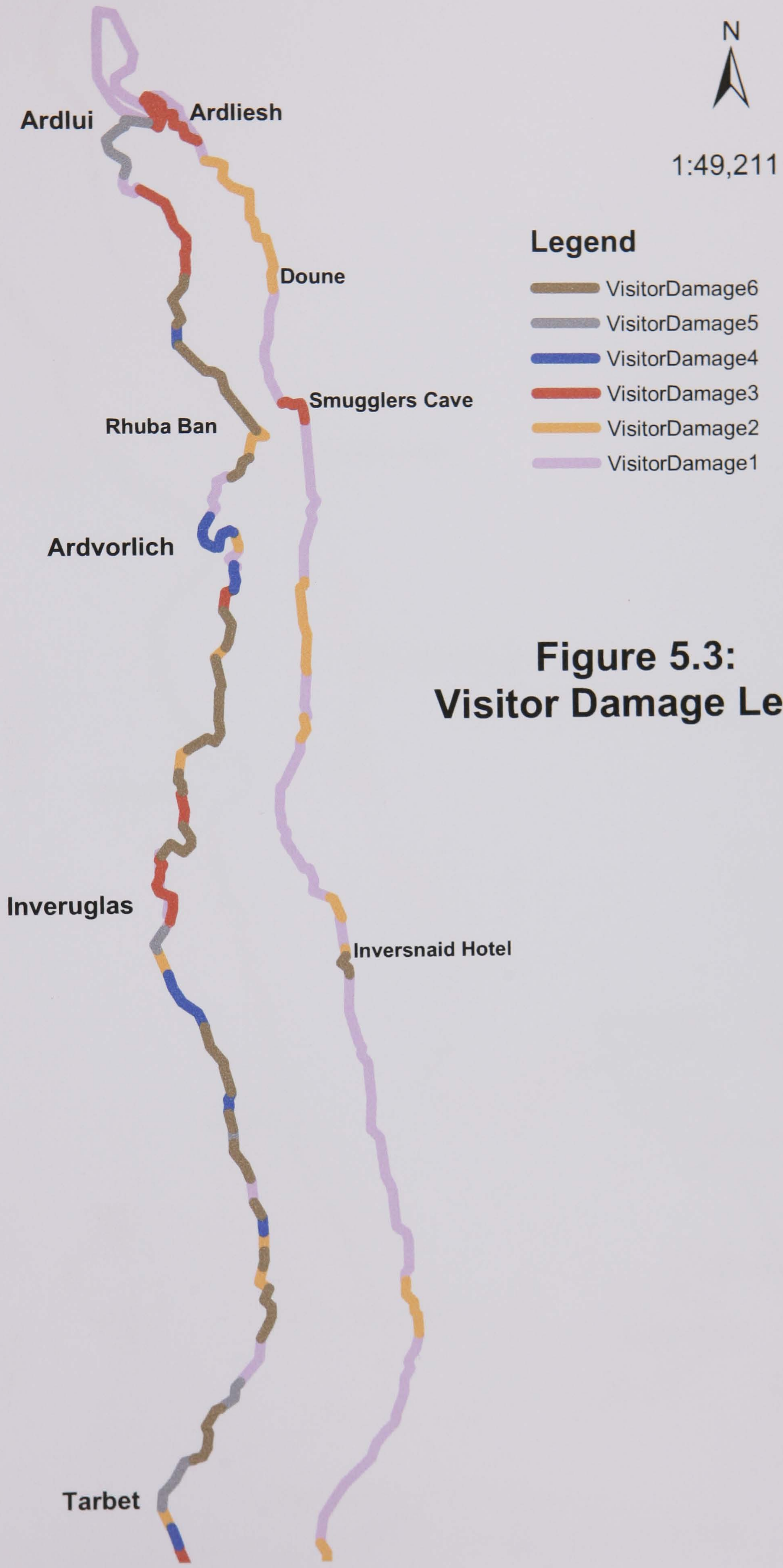


Figure 5.3: Visitor Damage Level


Tarbet
Ptarmigan Lodge
Firkin
Rowardennan
Inverbeg
University
Field Station
Carraig
Culag
Sallochy
Cashel
Luss Campsite
Inchlonaig
Luss
Camstradden Peninsula
Inchconnachan

Figure 5.3: Visitor-induced Environmental Damage.

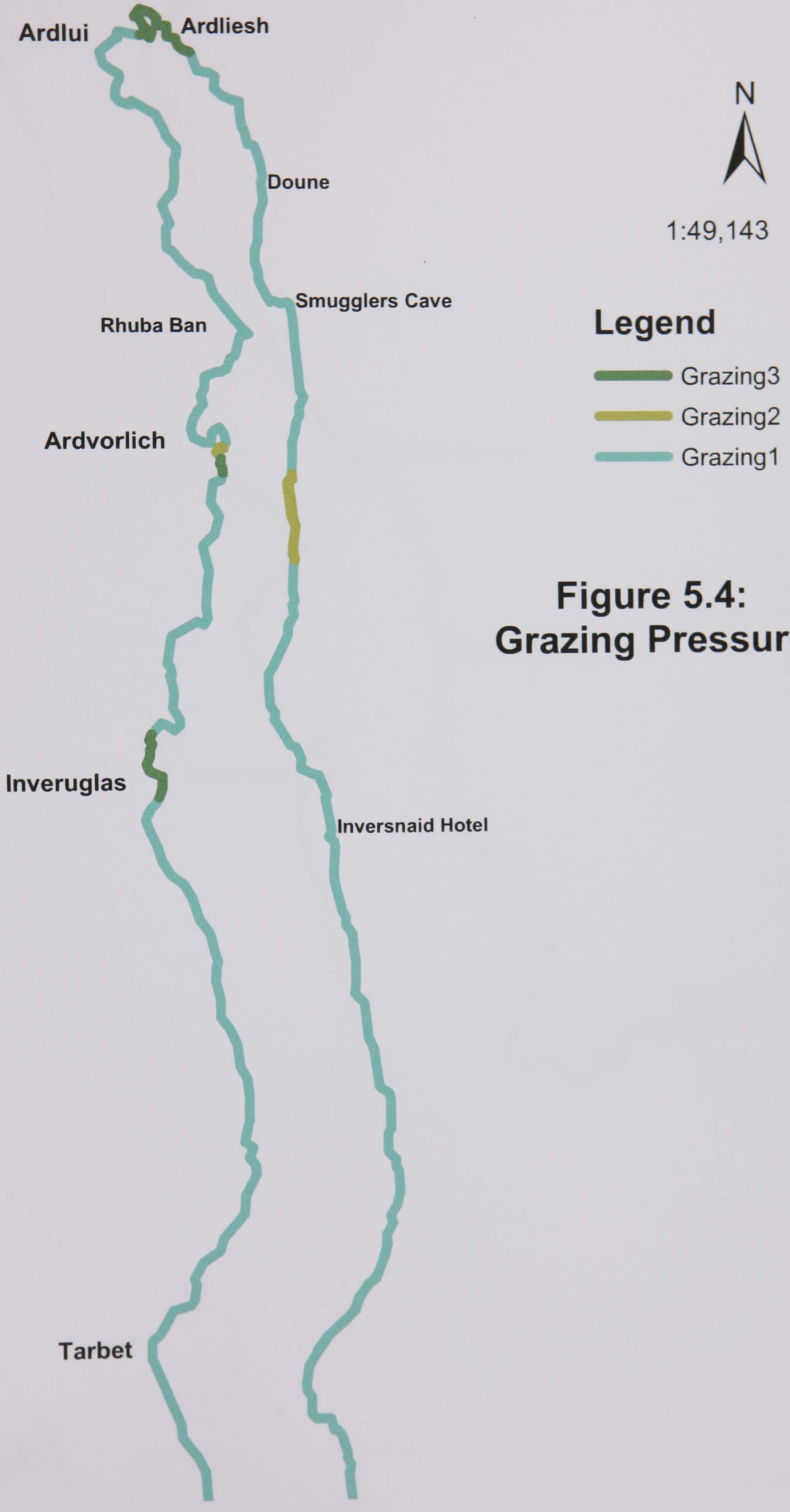


Figure 5.4: Grazing Pressure


Tarbet
Firkin
Ptarmigan Lodge
Rowardennan
Inverbeg
University
Field Station
Carraig
Culag
Sallochy
Cashel
Luss Campsite
Inchlonaig
Luss
Camstradden Peninsula
Inchconnachan

Figure 5.4: Grazing Pressure.

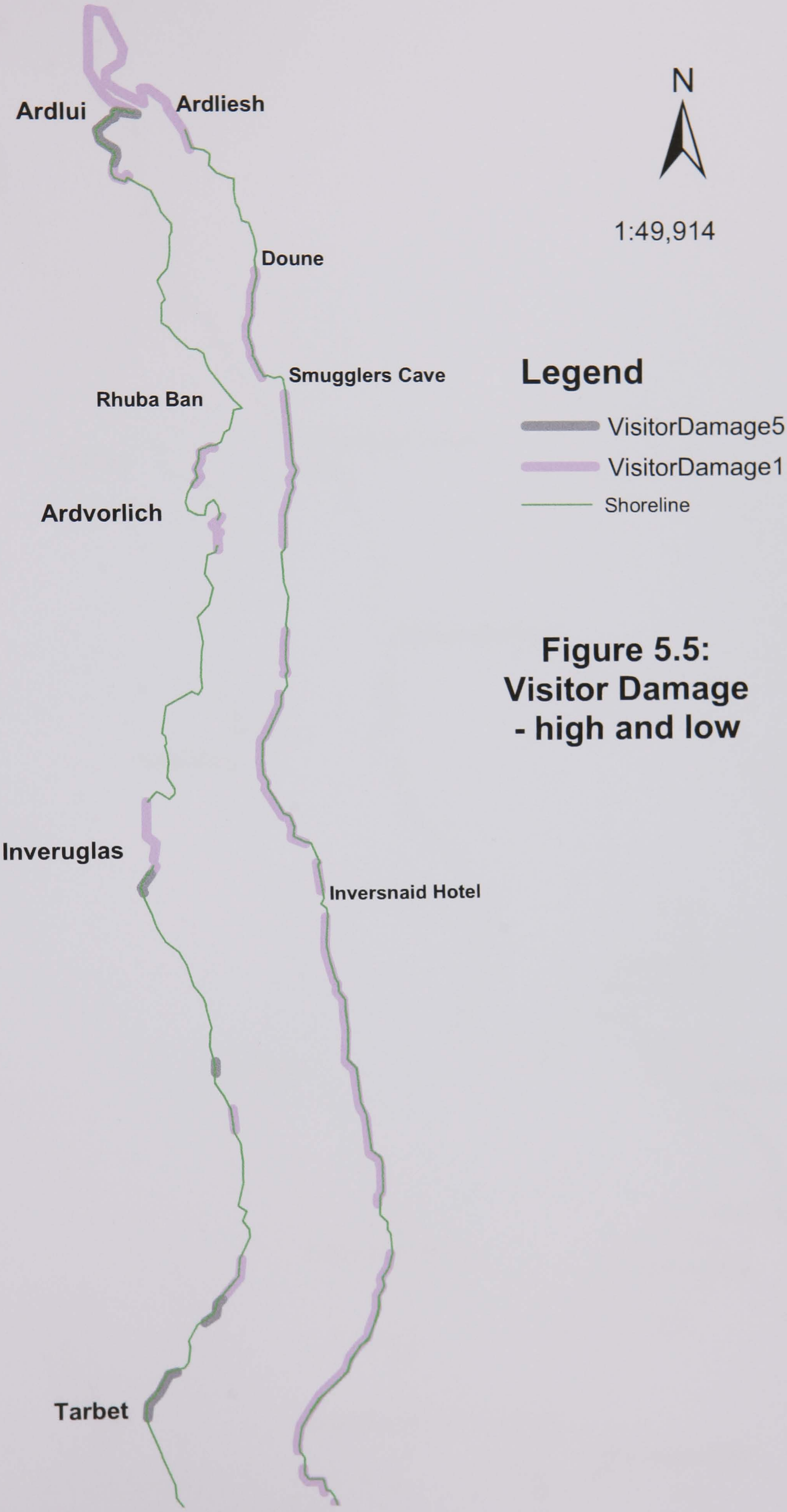


Figure 5.5: Visitor Damage - high and low


Tarbet
Ptarmigan Lodge
Firkin
Rowardennan
Inverbeg
University
Field Station
Carraig
Sallochy
Culag
Cashel
Luss Campsite
Inchlonaig
Luss
Camstradden Peninsula
Inchconnachan

Figure 5.5: Visitor Damage at high ('5') and low ('1') levels.

loch shore zone there is no grazing impact at all. There are therefore no areas of grazing concern for the LLTNPA.

Figure 5.3 illustrates visitor impact around the loch. Generally, it appears that the west shore of the loch suffers from more visitor pressure than the east. Indeed, very few areas of the western shore have no visitor impact; there are only small "pockets" with no visible visitor damage, for example just south of Ardvorlich and just south of Rhuba Ban in the north-west section of the loch, or near Findlas water in the south-west basin of the loch. Much of the remaining western shore consists of either rock or artificial/armoured shoreline interchanged with pockets of highly damaged, highly localised visitor pressure. Perhaps this is a consequence of the A82 main road, which runs parallel to the west shore of the loch and from which access to the loch shore is possible. Conversely road access to the eastern shore of the loch halts at Rowardennan. Car access is then denied. It is also noticeable that many areas of high impact and very high impact are present around popular recreation sites, such as Sallochy and Rowardennan. As a consequence of good access a high number of visitors congregate in these areas. This significant impact is consequently not surprising.

39.7% of the loch shore has no visible evidence of visitor impact. As figure 5.5 illustrates, these areas include:

- The majority of the north-east shore, excluding "pockets" of highly localised damage around visitor "hotspots" such as Rowardennan.
- The majority of the south-east shore, which is part of the National Nature Reserve.
- A number of the islands including Creinch, Clarinch and Inchcruin. The north shore of Inchmurrin, the majority of Torrinch (excluding the spit in the north-east corner of the island), the majority of Inchcailloch (excluding the area around Port Bawn and the north-east corner), the majority of Inchfad (excluding the eastern corner), the majority of Inchlonaig (excluding parts of the southern shore), and small areas of Inchonnachan and Inchmoan also experience no visitor damage.

17.4% of the loch shore has visitor impact levels rated at '4' (high visitor impact) and '5' (very high visitor impact). Figure 5.3 indicates these areas in their entirety. They include Rowardennan, the Sallochy area (from Carraig to Cashel), Balmaha, the southern corner around Drumkinnon Bay, small zones south of Milarrochy Bay and Milarrochy Bay campsite (Milarrochy Bay itself is rated '6', i.e. substantially modified shoreline), Firkin Point, Tarbet and the Narrows. In addition, there are localised "pockets" of high and very high visitor damage along the west shore, often surrounded by artificial/armoured or rock shoreline.

Only 9.3% of the shoreline experiences very high visitor impact levels. Areas prone to high visitor impact levels include the following (see figure 5.5):

- Sallochy (east shore).
- Southern corner of loch (near Balloch Castle and north-west of Drumkinnon Bay).
- The Narrows (i.e. eastern shore of Inchtavannach; western and southern shore of Inchconnachan; north, west and south-west of Inchmoan). Camping, barbeque remnants, litter, erosion of the shoreline, damage to the trees/branches and trampling of the vegetation are all present here.
- Inverbeg.
- Rowardennan.
- Ardlui.
- Southern corner of Inchmurrin.
- North-east corner of Inchcailloch and Port Bawn (Inchcailloch).
- East shore area near to Milarrochy Bay campsite.
- The area just south of Milarrochy Bay (here there are small "pockets" of visitor damage where access to the shore is possible).

In addition there are many localised areas of environmental impact along the west shore including a site that contained the worst level of observed visitor damage. Located just north of Luss, near the Luss campsite, there were present high levels of litter (including empty glass bottles), dogs' mess, make-shift swings, old tyres, exposed tree roots, broken branches, remnants of barbeques and much trampling of the ground vegetation. Path access was seen from the main road, but only from the survey boat was the true level of visitor damage observed.

The areas listed above are termed the "hotspots" of visitor damage. It is recommended that these areas should be of concern for the LLTNPA. In particular it is suggested that Sallochy, the Narrows and localised areas on the west shore should be a priority for environmental improvement (see chapter seven for further information). Here visitor damage should be reduced/minimised as such areas are potentially at risk from further environmental degradation (if visitor use continues at the current, or an increased, rate).

Interestingly, only one area of Loch Lomond suffers from both grazing pressure and visitor pressure. This area is located at the northern corner of Inchmurrin, where tents (and in addition litter and broken branches) are located near to cattle. Nevertheless, areas with a combination of grazing and visitor pressure do not appear to be an issue for the LLTNPA. The major issue should be access, as it is areas with easy access that appear to experience the most recreation pressure and, as a consequence, environmental damage.

5.3 Ecological Surveys

The aim of section 5.3 is to present the results obtained from the (vegetation) ecological survey. The results of the survey were manipulated in two ways: community groups for each vegetation species were developed using TWINSPAN and 'Tablefit' computer programmes and then statistical analysis was conducted for each vegetation group, based on ANOVA and Kruskal-Wallis tests. The overriding aim of such analysis was to determine whether any significant relationship exists between different vegetation groups and whether this can be attributed to environmental factors or recreation pressure. This section initially addresses the interpretation of the TWINSPAN and 'Tablefit' communities, and then presents the statistical results.

5.3.1 TWINSPAN Interpretation

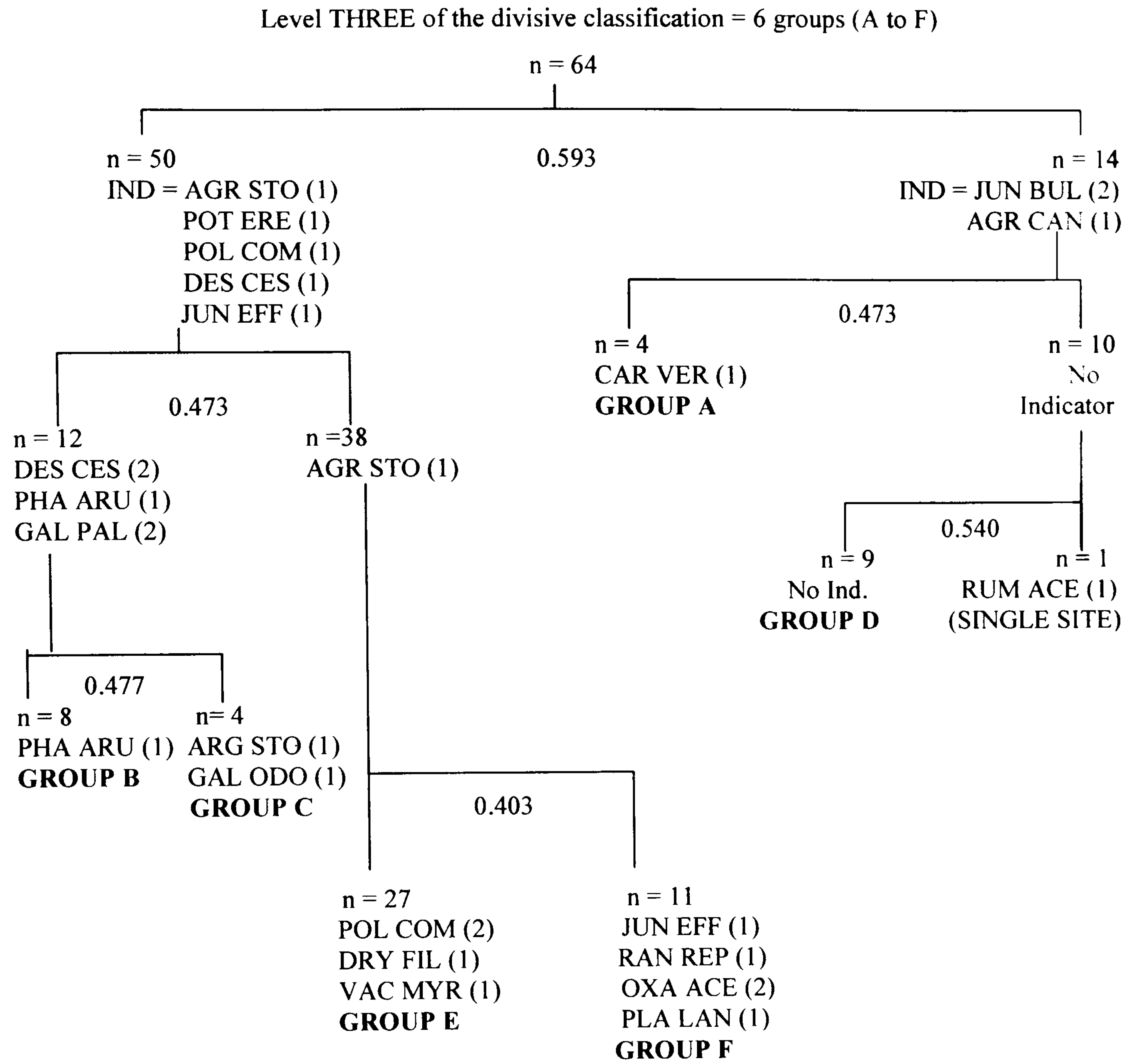
TWINSPAN analysis, as described in chapter three, was run on all species for all samples obtained throughout summer 2004. As a consequence of the data selection process, the TWINSPAN analysis was conducted on field/shore species and Lomond aquatics separately. The following results were obtained:

<u>Field and Shore species:</u>

Six groups of field and shore communities were identified by TWINSPAN, at the third level of the divisive classification. These are termed groups A through to F (see figure 5.6). Group A is characterised by *Carum verticillatum* as its indicator species[21]. It is found at the West Highland Way site, located in the north-east of Loch Lomond (see section 3.3 for all ecological survey sites' grid references), for all sample days (i.e. May, June, July and September). Group A is characterised by shoreline sites only.

Group B is identified by the indicator species of *Phalaris arundinacea*. Camas an Losguinn and the bay at the Loch Lomond golf course, for all four dates under study, are the only sites found

[21] An indicator species is a plant species that characterises an assemblage (i.e. a community) of plants. It is nearly always a constant presence in the samples taken from vegetation containing that particular group of species. TWINSPAN identifies an indicator species for sets of samples using an objective iterative algorithm, in which every sample is compared with every other sample for similarity of their species. Samples are grouped so that most similar ones are together, the process is then repeated down the hierarchy. TWINSPAN thus defines what an indicator for the sets of samples is, using pre-defined rules. If the rules cannot be met no indicator will be identified for a particular set of samples. Therefore, an indicator for a given assemblage represents that a particular vegetation type is present, because that indicator is characteristically associated with many other species. Gauch (1982) provides further information on TWINSPAN and the identification of indicator species.



Indicator species for final groups: *Carum verticillatum, Phalaris arundinacea, Agrostis stolonifera, Galium odoratum, Polytrichum commune, Dryopteris filix-mas, Vaccinium myrtillus, Juncus effusus, Ranunculus repens, Plantago lanceolata* and *Oxalis acetosella.*

(Species codes are for indicator species only. Pseudospecies level is in brackets. Number seen for each division is the eigenvalue at each iteration.)

Figure 5.6: Lomond Field and Shore Vegetation.

within this group. Again all sites are found within the shoreline zone and more generally within the southern/central basin of the loch. May, June, July and September are all included within this group for both sites.

For group C two indicator species are found, namely *Agrostis stolonifera* and *Galium odoratum.* All of the golf course survey days are incorporated within this group, for the field zone only. Hence here again the division is one of geographical location, specifically in the field zone and more generally within the south/central basin of the loch. All of the survey days are found within this group, namely: May, June, July and September.

For the following group, group D. no indicator species is found. There are, however, a number of preferred species including other mosses, *Galium palustre, Carex nigra, Juncus bufonius, Hydrocotyle vulgaris* and *Agrostis canina*. Ardlui and Kenmore Bay are found within this group, again for all sample dates. Inverbeg is also present, but this is for September only. All sites are again for the shore zone only.

For group E there are three indicator species present, namely: *Polytrichum commune, Dryopteris filix-mas* and *Vaccinium myrtillus*. Geographically this group is more extensive than the previous groups with Camas an Losguinn, the Narrows, Milarrochy Bay, Kenmore Bay and the West Highland Way sites all incorporated within this division. These sites are found within the north and south basin. Twenty of these sites are found within the field zone, the remaining seven are shoreline samples. Group E is hence the most wide spread group geographically, both with reference to the site-specific zone (field or shore) and more general loch location (north or south basin).

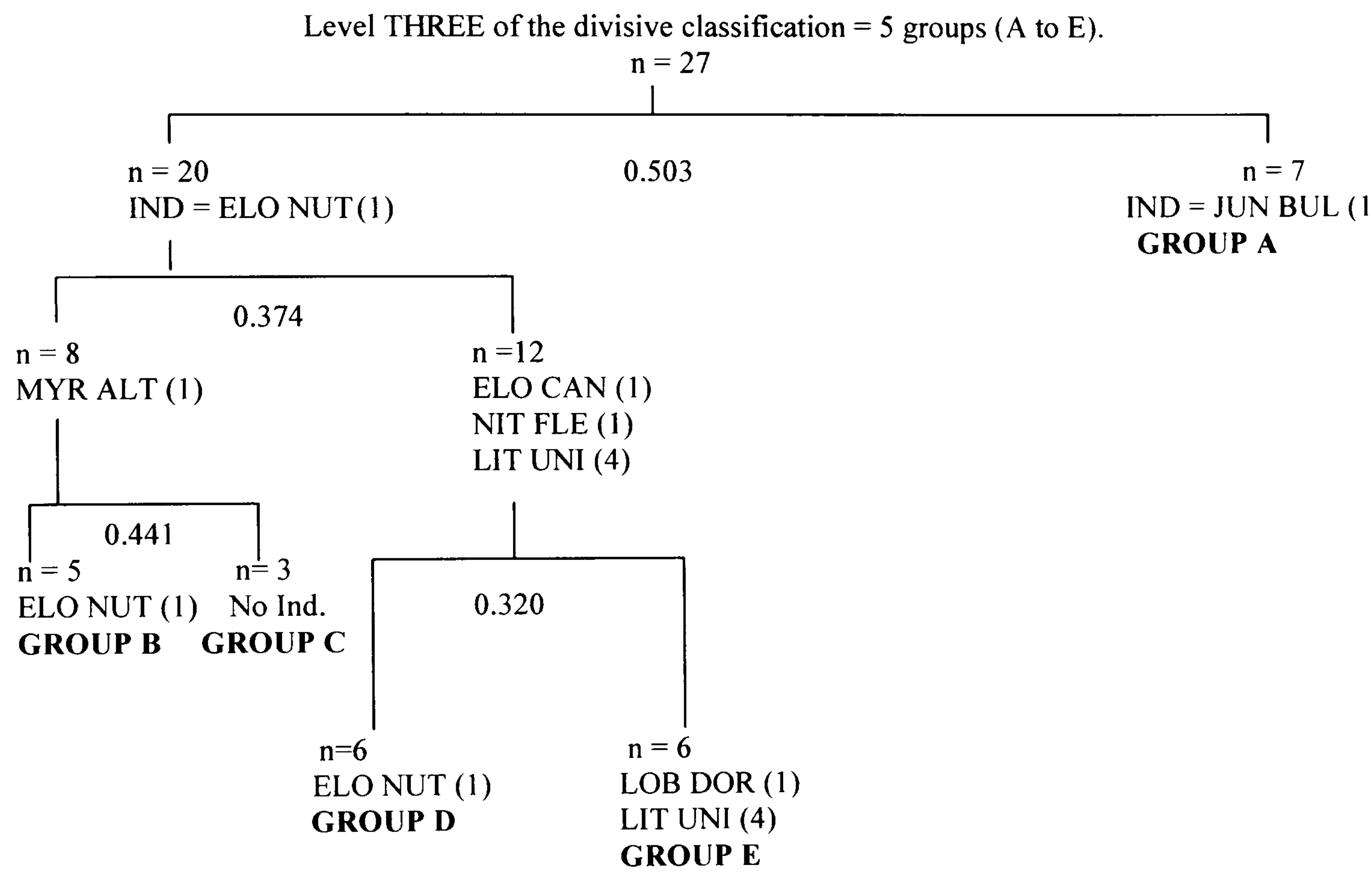
Group F, as the final group in the divisive classification, has four indicator species, namely *Juncus effusus, Ranunculus repens, Oxalis acetosella* and *Plantago lanceolata*. The Narrows, Ardlui and Inverbeg are all included within this group, encompassing both the south and north basins of the loch. Three of the samples are from the shore zone. The remaining eight are from the field zone. For the Narrows shore zone, September is the only month included within this group. May, June, July and September for the field zone are present for Ardlui and Inverbeg. May and June at Inverbeg for the shore zone are also included within this group. Like group E, this group is therefore less differentiated geographically than the previous groups.

In addition to the six groups found, a singleton site was also identified by TWINSPAN. *Rumex acetosa* is the indicator species for this site, where only Inverbeg, sampled during the month of July, is included. For the field and shoreline zones, there are thus six groups plus a singleton site, which for the purpose of analysis is retained in Group D.

Overall, it appears that a clear geographical division has arisen between community groups of the field and shoreline communities, primarily between the north and south basin of Loch Lomond. Where there is a combination of field and shore sites, such as at group E and group F, it can perhaps be attributed to sampling procedure. It was often difficult to differentiate between the shore and the field zone at certain sites. Still, from the very first TWINSPAN level a shore/field division was apparent. The primary, level one, division was between the shoreline plants of *Juncus bulbosus* and *Agrostis canina* and the more field zone plants of *Agrostis stolonifera, Potentilla erecta* and *Polytrichum commune*. This shore/field, and more generally north/south, divisive pattern continued throughout the majority of the TWINSPAN classification procedure. The majority of groups incorporated all sample dates (May, June, July and September).

Lomond Aquatic Vegetation:

For the Lomond aquatics, TWINSPAN analysis identified, at level three of the divisive classification, five main community types (A through to E) – see figure 5.7.



Indicator Species for final groups: *Juncus bulbosus*, *Elodea nuttalli*, *Littorella uniflora* and *Lobelia dortmanna*.

(Species codes are for indicator species only. Pseudospecies level is in brackets. Number seen for each division is the eigenvalue at each iteration.)

Figure 5.7: Lomond Aquatic Vegetation.

Group A comprises the West Highland Way and Kenmore Bay sites, hence sites occupying the north basin. The indicator species for group A is *Juncus bulbosus*, a non-invasive species. For Kenmore Bay all survey dates are included within this group, however, only May, June and July are included for the West Highland Way site.

Group B has *Elodea nuttalli* as its indicator species. Camas an Losguinn is included in this group, as is Inverbeg. This suggests that this invasive species is present throughout Loch Lomond, as the sites found are located in the north and central basin. Whilst group B is found in May, June, July and September at Camas, Inverbeg is only present for this group during the month of July.

No indicator species is found for group C, although *Myriophyllum alterniflorum* and *Isoetes lacustris* are preferred (both non-invasive species). Group C comprises the site of Inverbeg, found in the north basin, during the months of May, June and September only. A high level of algae was also found in group C. This is perhaps not surprising since the Inverbeg site is heavily used by those boating to the nearby chalets – as such algae may be caused by water pollution.

The indicator species for group D is *Elodea nuttalli*, found in the Golf course site, Milarrochy Bay and Ardlui. Widespread geographically (throughout the south and north basin), this group includes all four months for the Golf course, July for Milarrochy Bay and May for Ardlui. Again these results imply that this invasive species has spread to the far north of Loch Lomond.

For group E the indicator species are *Lobelia dortmanna* and *Littorella uniflora*. Group E encompasses the Narrows sites on all survey days and Ardlui during the months of July and September only. This non-invasive group is therefore located in the north and south basins. It is also revealing that the pseudospecies number for *Littorella uniflora* is four, in comparison with a value of one for *Lobelia dortmanna* (figure 5.7), suggesting that *Littorella uniflora* is greater in abundance than *Lobelia dortmanna* for this specific group.

In comparison with the geographical division of the field and shore vegetation, the results for Lomond macrophytes appear to illustrate an invasive/non-invasive species division. Two groups have an invasive species as their indicator; two groups have non-invasive species as their indicator. The final group has no indicator species. Evidence of geographical variation suggests that the invasive species of *Elodea nuttalli* has spread throughout certain areas of Loch Lomond. Although *Elodea canadensis* was not found to be an indicator species in any of the final groups, it was an indicator species at level two of the TWINSPAN division. It often occurred in a separate location to *Elodea nuttalli*, suggesting that both invasive species are present throughout the loch to a large extent. However, as an invasive/non-invasive division as arisen, results do imply that there is a habitat in Loch Lomond not yet invaded by either *Elodea canadensis* or *Elodea nuttalli*.

In summary, the field and shore species appear to have a geographical (north/south and more specifically field/shore) division, while the aquatic species are separated according to whether they are invasives or not. It is worthwhile determining whether this division arises when classifying species into communities using the computer programme 'Tablefit' along with the National Vegetation Classification (NVC) system.

5.3.2 Classification of species into communities using 'Tablefit'.

The computer software package 'Tablefit' is another method by which species can be classified into vegetation communities. Communities are based on those specified by the National Vegetation Classification system (hereafter NVC), which are presented and explained in Rodwell's (1991) *British Plant Communities* books, volumes one through to five. In order to compare and validate TWINSPAN's community findings, 'Tablefit' was used along with the *British Plant Communities* books (Rodwell, 1991a-1991e) to classify species into communities for each site studied (see table 5.3). 'Tablefit' analysis allows the results of the ecological survey to be applied more widely outwith the Loch Lomond area, as it identifies classifications of vegetation on a national scale. It not only represents community association, but also illustrates wider NVC implications. The 'Tablefit' identified NVC communities can be cross-referenced with statistical analysis, illustrating those NVC groups affected by recreation pressure and visitor damage. The aim of this section is thus to present the findings from the 'Tablefit' analysis.

From table 5.3 it can be seen that, in general, the TWINSPAN results correspond with the site NVCs as classified by 'Tablefit'. Importantly, species community is differentiated by site and hence a clear geographical division has arisen. This is particularly true for the field and shoreline zones. However, for the aquatics communities the same community type occurs frequently, regardless of location. In particular NVC community A22 (comprising of non-invasive species) is present for five out of the eight sites sampled. The remaining NVC groups contain invasive species (in particular *Elodea canadensis* and *Elodea nuttalli*), reinforcing the TWINSPAN invasive/non-invasive division. Both the TWINSPAN and 'Tablefit' results suggest that *Elodea* vegetation is different to non-invasive plants, i.e. it is found in different areas of Lomond.

Using the 'Tablefit' and site information generated, NVC communities can be established for each TWINSPAN group, these are now discussed in turn. Again field/shore zone and aquatics groups are discussed separately.

Field and shore group A includes all of the survey dates for the West Highland Way shore zone site only. For the field and shore group A, where the indicator species as identified by TWINSPAN is *Carum verticillatum*, the NVC type corresponding with the 'Tablefit' analysis initially appears to be SD17 *Potentilla anserine-Carex nigra* dune-slack community. Indeed the *Potentilla-Carex* community, dominated by mixtures of grasses and sedges, is characteristic of the moist climate of northern Britain (Rodwell 1991e, 237). However, on closer examination it was decided that a "dune-slack community" was not an accurate representation of group A, which does in fact contain marginal NVC vegetation types. Specifically, according to TWINSPAN output, group A includes the following preferred species: *Agrostis stolonifera, Ranunculus repens, Hydrocotyle vulgaris* and *Juncus bufonius*. In addition the species of *Deschampsia cespitosa, Agrostis canina* and *Galium*

Site	NVC Type	NVC Community	Corine	Goodness of Fit *
Camas an Losguinn – Field	U16	*Luzula sylvatica-Vaccinium myrtillus* tall-herb community	Tall herbs and bushes	37 – very poor
Camas an Losguinn – Shore	W7	*Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland	Ash - Alder woodland	31 – very poor
Camas an Losguinn – Aquatics	A22	*Littorella uniflora-Lobelia dortmanna* community	*Isoet, Lobel, Littorel*	64 – fair
Narrows – Field	M23	*Juncus effusus/acutiflorus-Galium palustre* rush-pasture	*Juncus effusus* meadow	25 – very poor
Narrows - Shore	OV28	*Agrostis stolonifera-Ranunculus repens* community	Flood-sward, wet grass, muddy grass	44 – very poor
Narrows – Aquatics	A22	*Littorella uniflora-Lobelia dortmanna* community	*Isoet, Lobel, Littorel*	87 – very good
Golf Course Bay – Field	U17	*Luzula sylvatica-Geum rivale* tall-herb community	Cliff-ledge, tall herb	36 – very poor
Golf Course Bay – Shore	M27	*Filipendula ulmaria-Angelica sylvestris* mire	Meadowsweet grassland	35 – very poor
Golf Course Bay – Aquatics	A13	*Potamogeton perfoliatus-Myriophyllum alterniflorum* community	Rooted submerged	62 –fair
Milarrochy Bay – Field	MG9	*Holcus lanatus-Deschampsia cespitosa* grassland	*Deschampsia cespitosa* meadow	41 –very poor
Milarrochy Bay – Shore	OV28	*Agrostis stolonifera-Ranunculus repens* community	Flood-sward, wet grass, muddy grass	15 – very poor
Milarrochy Bay - Aquatics	A15	*Elodea canadensis* community	Rooted submerged	52 – poor
Ardlui – Field	W7	*Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland	Ash - Alder woodland	34 – very poor
Ardlui – Shore	M6	*Carex echinata-Sphagnum recurvum/auriculatum* mire	Acid small-sedge 'fen'	23 – very poor
Ardlui – Aquatics	A22	*Littorella uniflora-Lobelia dortmanna* community	*Isoet, Lobel, Littorel*	68 - fair
Kenmore Bay – Field	SD17	*Potentilla anserine-Carex nigra* dune-slack community	Moist slack grass/rush	32 – very poor
Kenmore Bay – Shore	M23	*Juncus effusus/acutiflorus-Galium palustre* rush-pasture	*Juncus effusus* meadow	18 – very poor
Kenmore Bay – Aquatics	A22	*Littorella uniflora-Lobelia dortmanna* community	*Isoet, Lobel, Littorel*	75 – good
West Highland Way – Field	MG10	*Holcus lanatus-Juncus effusus* rush-pasture	Tall rush pastures	29 – very poor
West Highland Way – Shore	SD17	*Potentilla anserine-Carex nigra* dune-slack community	Moist slack grass/rush	37 – very poor
West Highland Way – Aquatics	A22	*Littorella uniflora-Lobelia dortmanna* community	*Isoet, Lobel, Littorel*	72 – good
Inverbeg – Field	OV21	*Poa annua-Plantago major* community	Roadsides and waste	49 – very poor
Inverbeg – Shore	OV19	*Poa annua-Matricaria perforata* community	Roadsides and waste	17 – very poor
Inverbeg – Aquatics	A23	*Isoetes lacustris/setacea* community	*Isoet, Lobel, Littorel*	70 - good

* A goodness of fit 'very poor' result is the consequence of few species in each group.

Table 5.3: 'Tablefit' NVC Classifications.

palustre were also found. As such it is suggested that field and shore group A can be described as S23/OV28, a mixed lake-margin/muddy grass community. The species found within group A correspond with both the S23 and OV28 floristic tables, where S23 is termed *other water-margin* *vegetation* and OV28 is the *Agrostis stolonifera-Ranunculus repens* community. Indeed, field and shore group A demonstrates elements of these two communities, one truly amphibious (for example with *Juncus bufonius*) and one running down to the water's edge (i.e. including flood-tolerant terrestrial plants, such as *Agrostis stolonifera*), and consequently it is claimed that S23/OV28 *Other water-margin vegetation/Agrostis stolonifera-Ranunculus repens* community is an accurate representation for field and shore group A (see table 5.4).

The NVC type for group B is M27 *Filipendula ulmaria-Angelica sylvestris* mire. Group B includes *Filipendula ulmaria* as a preferred species and this corresponds with M27, meadowsweet grassland. It is interesting that Rodwell (1991b, 293) states that community M27 occurs widely in artificial habitats and along stream edges right down to the water side. All of the sites within group B are shoreline sites and furthermore the golf course site, clearly influenced by artificial modification, is found within this community group.

For group C, the NVC community is U17 *Luzula sylvatica-Geum rivale* tall-herb community. This TWINSPAN group comprises the golf course field site only and includes *Deschampsia cespitosa*, *Luzula sylvatica* and *Festuca ovina* as preferred species. Consequently, it is compatible with NVC community U17, which finds the wet conditions of the west of Scotland favourable (Rodwell 1991c, 465).

Group D is composed of three sites: Ardlui, Kenmore Bay and Inverbeg. All of these sites are found within the north basin of Loch Lomond. As such goodness of fit, as well as location, was taken into account when allocating an NVC community to group D. The preferred NVC community is M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture: a *Juncus effusus* meadow. Again this TWINSPAN group includes *Galium palustre* as a preferred species, which corresponds with the floristic table for M23. Likewise, Rodwell (1991b, 247) shows that the *Juncus-Galium* rush-pasture occurs over a variety of moist, moderately acid to neutral, peaty and mineral soils in the cool and rainy areas of western Britain, which matches the characteristics of the Loch Lomond study sites. Furthermore, Rodwell (1991b) suggests that it is grazing that ultimately maintains this vegetation against progression to woodland, and which controls much of its floristic and structural character. It is therefore highly relevant to note that at Ardlui, Kenmore Bay and Inverbeg, the sites in which group D is found, grazing level was found to be high.

Again group E has a variety of sites encompassed within its TWINSPAN classification and, as a consequence, goodness-of-fit was used to help determine the most appropriate NVC community. OV28 *Agrostis stolonifera-Ranunculus repens* community – a flood-sward, wet grass, and muddy grass – is seen to be the best community fit to the species found within this group, containing many of the preferred species identified by TWINSPAN. Rodwell (1991e, 425) demonstrates that

Agrostis-Ranunculetum is characteristic of damp silts and clays on river islands and banks, in and around sluggish streams, ditches, pastures, arable fields and river flood plains. It is a community where trampling by livestock and humans is common and this clearly has important consequences for recreation pressures in the area. Interestingly, the West Highland Way site is incorporated within this group, a site where vegetation trampling level is high.

The final field and shore TWINSPAN group, group F, contains four separate geographical locations. Cross-referencing with the 'Tablefit' communities obtained for each site, once again provides OV28 *Agrostis stolonifera-Ranunculus repens* as the preferred NVC community. *Ranunculus repens, Juncus effusus* and *Poa annua* are all included as preferred species by TWINSPAN, and again these correspond with the preferred species for OV28 in the NVC system.

Moving on to the NVC communities for the aquatics, there is less differentiation between TWINSPAN groups. NVC community A22 *Littorella uniflora-Lobelia dortmanna* community is indicative of groups A and E. These groups include *Juncus bulbosus, Littorella uniflora, Lobelia dortmanna* and *Isoetes lacustris* as preferred species, which are found within A22's floristic table. Rodwell (1991d) recognises that the *Littorella-Lobelia* community is characteristic of the barren, stony shallows of clear waters. It is also strongly associated with the north and west of Britain, where it is a widespread and common feature of lakes and pools. The A22 community is often found around more exposed shores, where there is some wave disturbance (Rodwell 1991d, 96), supporting the high exposure indexes found for the sites within this group.

For groups B and C A23 *Isoetes lacustris/setacea* community is the favoured national vegetation classification. *Isoetes lacustris, Myriophyllum alterniflorum* and *Lobelia dortmanna* are the preferred species for these groups, again corresponding with the floristic table for NVC A23. Rodwell (1991d, 102) notes that the substrates of this community group are often sands or gravels, both of which support the findings of this project.

An NVC community characterised by invasive species identifies the remaining group, group D. For group D *Elodea canadensis* and *Elodea nuttalli* are amongst the preferred species and these are equivalent to the species identified by NVC community A13 *Potamogeton perfoliatus-Myriophyllum alterniflorum*, a rooted-submerged community. *Elodea canadensis* is native to most of the U.S.A. and parts of Canada and was first authentically reported from England in 1850. By 1880 it had entered southern Scotland. *Elodea nuttalli* was a much later arrival, first noted in Great Britain in 1966 (Rodwell, 1991d). Site and goodness-of-fit analysis does, however, determine that A13 is an accurate representation of the NVC community for aquatics group D.

Table 5.4 summarises the NVC communities for each TWINSPAN group, based on site, goodness-of-fit and preferred species.

TWINSPAN Group	NVC community
Field/Shore Group A	S23/OV28 *Other water-margin vegetation/Agrostis stolonifera-Ranunculus repens* community (a mixed lake-margin/muddy grass community)
Field/Shore Group B	M27 *Filipendula ulmaria-Angelica sylvestris* mire
Field/Shore Group C	U17 *Luzula sylvatica-Geum rivale* tall-herb community
Field/Shore Group D	M23 *Juncus effuses/acutiflorus-Galium palustre* rush-pasture
Field/Shore Group E	OV28 *Agrostis stolonifera-Ranunculus repens* community
Field/Shore Group F	OV28 *Agrostis stolonifera-Ranunculus repens* community
Aquatics Group A	A22 *Littorella uniflora-Lobelia dortmanna* community
Aquatics Group B	A23 *Isoetes lacustris/setacea* community
Aquatics Group C	A23 *Isoetes lacustris/setacea* community
Aquatics Group D	A13 *Potamogeton perfoliatus-Myriophyllum alterniflorum* community
Aquatics Group E	A22 *Littorella uniflora-Lobelia dortmanna* community

Table 5.4: NVC communities for each group as identified by TWINSPAN.

Overall the TWINSPAN groups do correspond with the NVC communities as identified by 'Tablefit'. For the field and shoreline communities a geographical division has again arisen, between the field and shore zone and the more general north and south basin. For the aquatic plants, there appears to be an invasive/non-invasive separation for NVC communities. Again this supports the findings of the TWINSPAN classification. This community division can be used to determine whether any differences exist between vegetation group and the environmental and recreational factors that influence these communities, and so has important consequences for the statistical analysis.

5.3.3 Ecological Statistical (ANOVA) Analysis – Results

Analysis of variance (ANOVA) statistical analysis was run for each environmental variable with the aim of determining any significant differences between the vegetation groups identified by TWINSPAN. The environmental variables include: water clarity or the light attenuation coefficient k (m^{-1}); euphotic depth *Zeu* (m); sediment redox (mV); exposure; level of shade; level of bare ground; level of grazing intensity; level of artificial structures; recreation pressure (i.e. whether or not recreation is present to a high extent in the site under study); and visitor damage (the level of visible evidence as a consequence of visitor impacts). Any patterns within the vegetation data that could be related to either environmental factors or recreation aspects were of interest. The overall null hypothesis is that there is no significant difference between each environmental variable for group A versus group B and so on. Testing this hypothesis involved adopting two statistical tests: one-way analysis of variance (ANOVA) and the Kruskal-Wallis Test.

One-way analysis of variance is used on the following variables: light attenuation coefficient k (m^{-1}), euphotic depth *Zeu* (m), sediment redox (mV), exposure, recreation pressure and visitor damage. Analysis of variance is a very general technique for which the objective is to provide statistics that are useful in comparing population means. The method can only be used with normal variables (Campbell 1974, 177). Campbell (1974) notes that the general procedure is to determine how much of the variation in observations is due to population differences and how much to random variability. The importance of population differences can then be determined. In particular one-way ANOVA is adopted because it is appropriate if there are three or more samples, as in the current study.

The null hypothesis for an ANOVA test is that the population means are the same, i.e.

$$Ho: \mu a = \mu b = \mu c = \mu d = \mu e = \mu f.$$

Thus, the alternative hypothesis is that at least two of the population means differ, where the μ are the unknown population means.

The Kruskal-Wallis Test is used for the following variables: level of shade, level of bare ground, level of grazing intensity, level of artificial structures, recreation pressure and visitor damage. This is because data for these variables are measured on an ordered scale of integral numbers from one to three or one to five. ANOVA analysis could not be performed using data in this form. It was therefore decided that a non-parametric test was the most appropriate statistical tool to employ. Furthermore, the Kruskal-Wallis test is appropriate for testing whether several samples could be drawn from populations with the same median and is the non-parametric alternative to one-way analysis of variance. Indeed the formal name for this test is the "Kruskal-Wallis analysis of variance ranks" (Campbell 1974, 61). The Kruskal-Wallis test allows the same conclusions to be drawn as if one-way ANOVA was used (Minitab Help file, 2004). A further advantage of this type of analysis is that non-parametric tests make fewer assumptions about the population distribution and are thus more robust for ranked data than are parametric tests. Formally the null hypothesis for the Kruskal-Wallis Test is that the population medians, rather than the means, are equal, i.e. the populations are identical.

An assumption of ANOVA is that the data are normally distributed. Therefore, after plotting normal distribution curves, skewed datasets requiring normalisation were log10 or square-root transformed as appropriate. The following variables are preferred: Log10 k, Log10 *Zeu*, Log10 redox, Square root Exposure, Log10 Recreation Pressure, Log10 Visitor damage, shade, bare ground, grazing intensity and artificial structures. Figures 5.8 to 5.25 illustrate the standard error for each TWINSPAN group for all preferred variables. The smaller the standard error bar, the more likely it is that the data are normally distributed.

Field and Shore Groups:

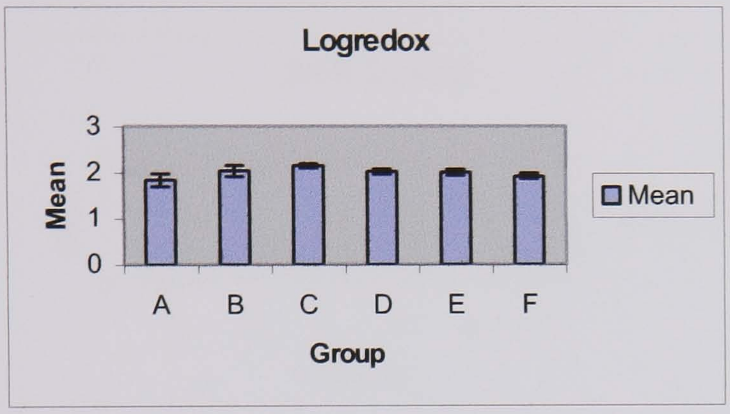


Figure 5.8: Log10 redox

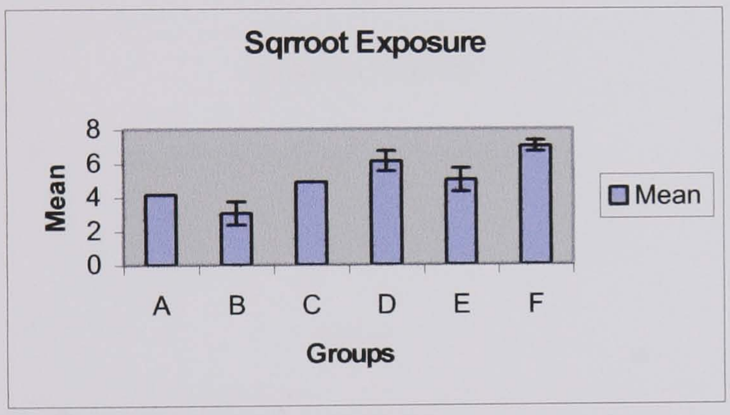


Figure 5.9: Square root Exposure

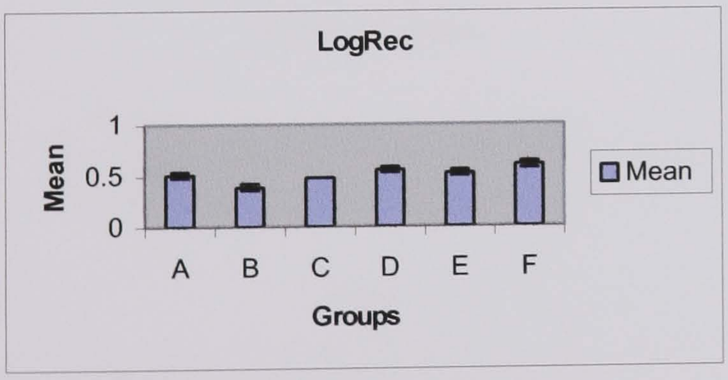


Figure 5.10: Log10 Recreation Pressure

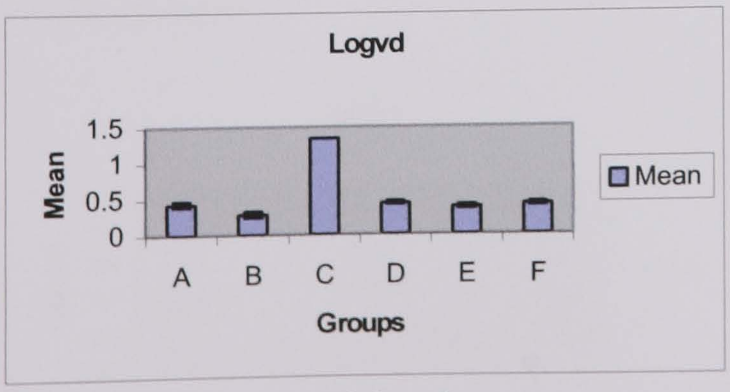


Figure 5.11: Log10 Visitor damage

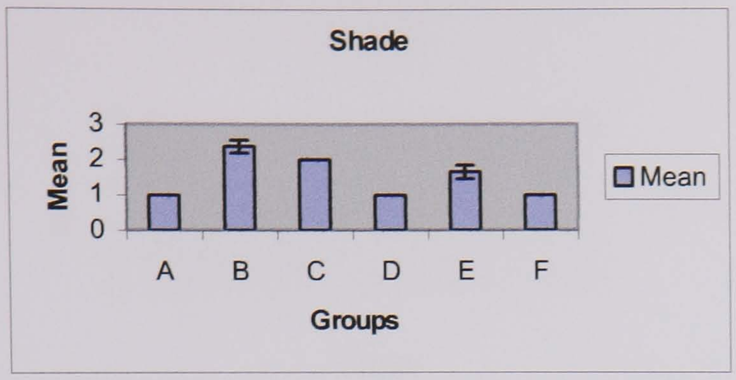


Figure 5.12: Shade

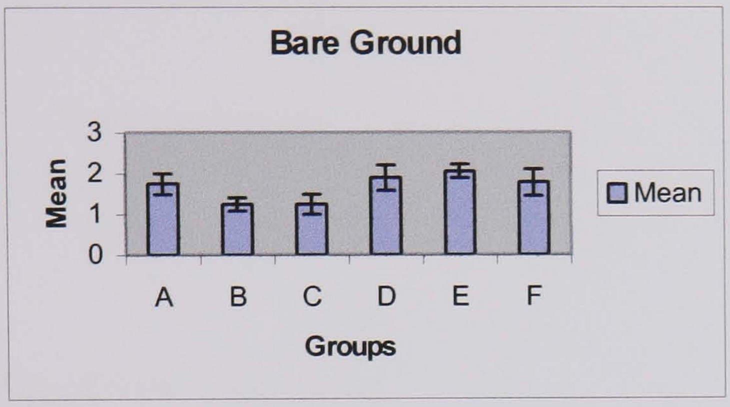


Figure 5.13: Bare Ground

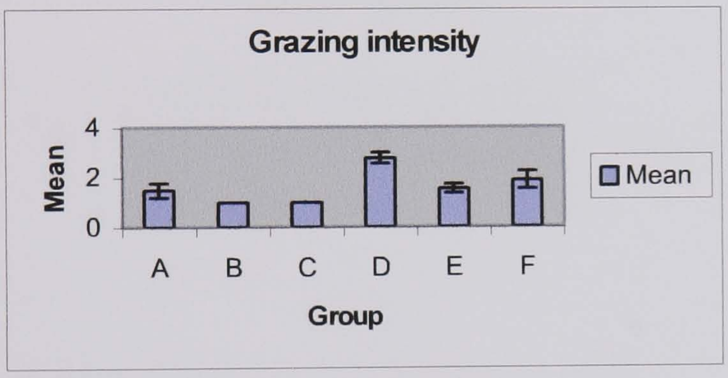


Figure 5.14: Grazing Intensity

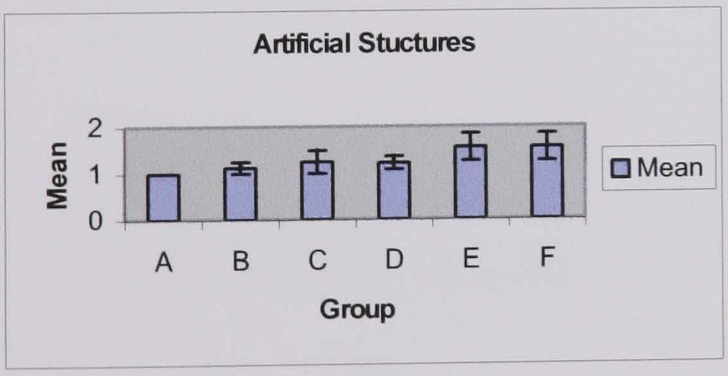


Figure 5.15: Artificial Structures

<u>Aquatic Groups:</u>

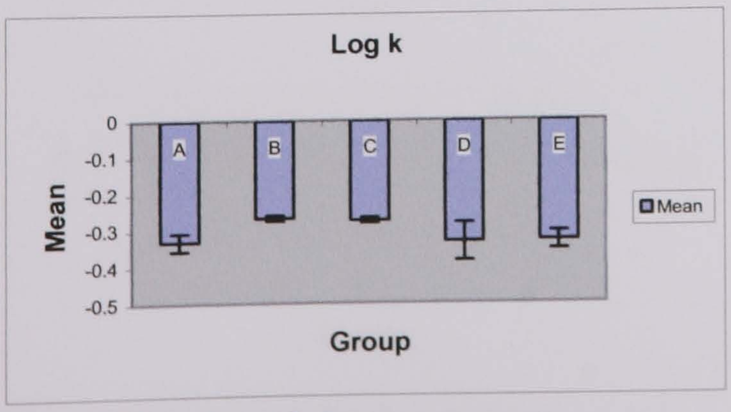


Figure 5.16: Log10 *k*

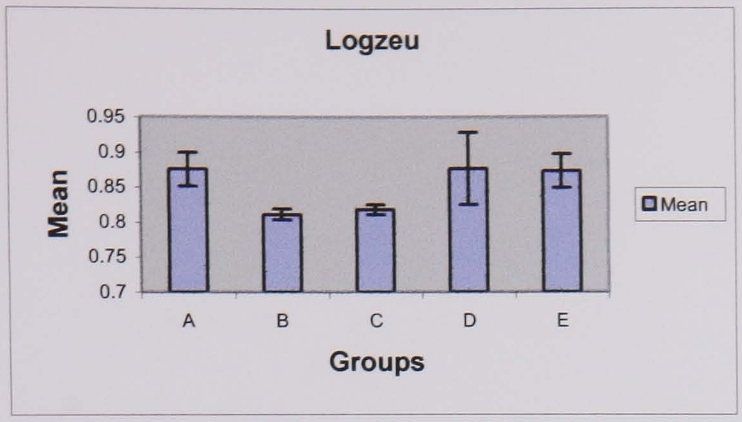


Figure 5.17: Log10 *Zeu*

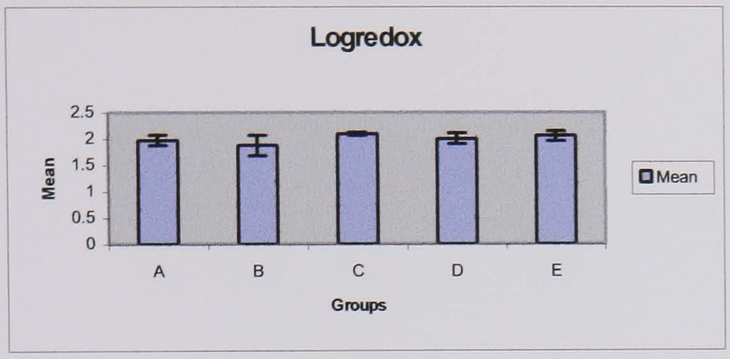


Figure 5.18: Log10 redox

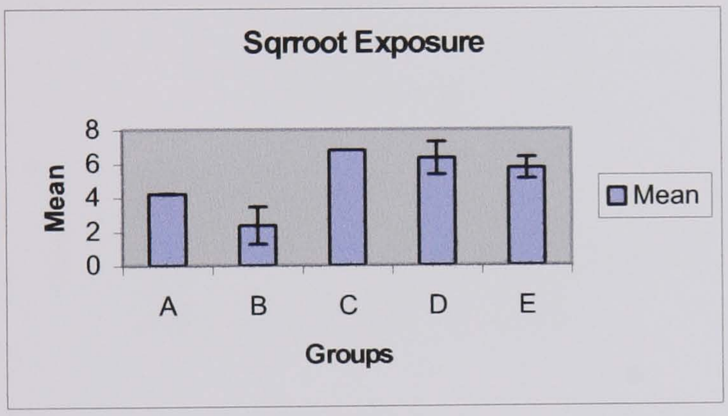


Figure 5.19: Square root Exposure

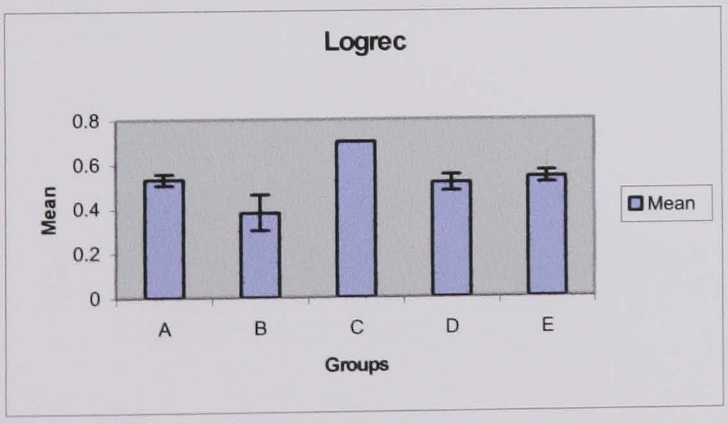


Figure 5.20: Log10 Recreation Pressure

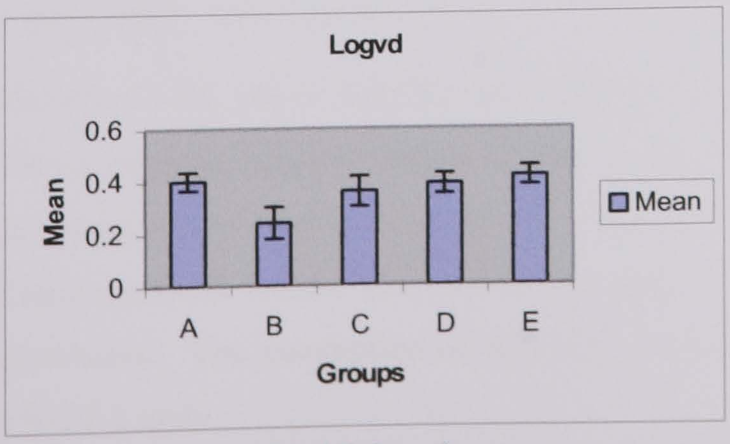


Figure 5.21: Log10 Visitor damage

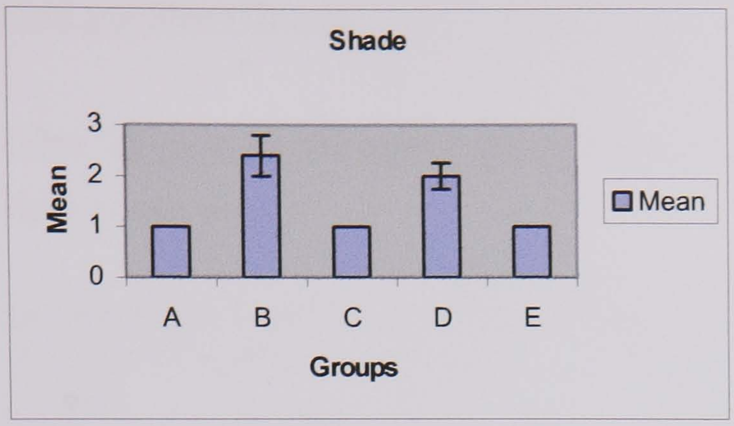


Figure 5.22: Shade

Figure 5.23: Bare Ground

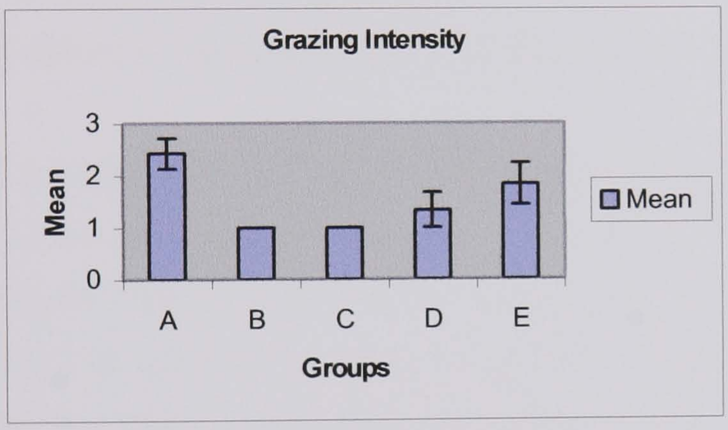


Figure 5.24: Grazing Intensity

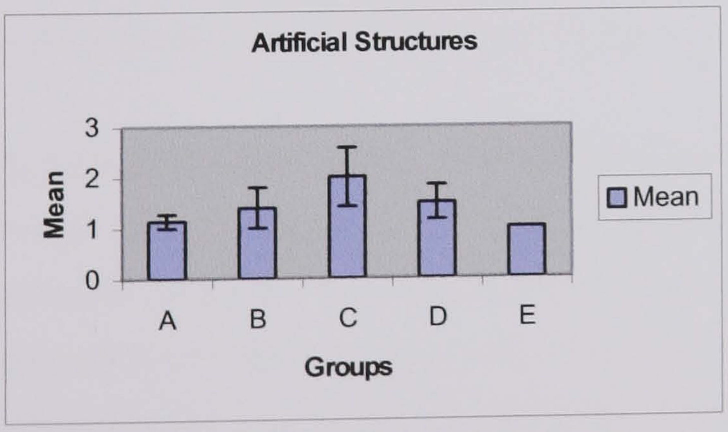


Figure 5.25: Artificial Structures.

Variables with larger standard errors are analysed using the non-parametric Kruskal-Wallis test. This is because Kruskall-Wallis is a less "demanding" test, in a similar way to chi-square tests of association (see section 3.2). For the variables subject to ANOVA testing, log and square root transformations reduce the size of the standard error and allow the data to become normally distributed. The assumption of normality is therefore met where appropriate, i.e. for the one-way ANOVA tests.

Field and Shore Groups

Table 5.5 provides the results of the statistical tests performed on all variables for the field and shore groups only.

Environmental Variables	ANOVA *P* Value	Kruskal – Wallis Test (adjusted for ties)
Sediment redox (mV)	0.534	-
Exposure	0.095	-
Shade	-	H = 28.41, Df = 5, P = 0.000 ***
Bare Ground	-	H = 8.05, Df = 5, P = 0.153
Grazing intensity	-	H = 19.92, Df = 5, P = 0.001 **
Artificial structures	-	H = 2.67, Df = 5, P = 0.750
Recreation pressure	0.013 *	H = 14.39, Df = 5, P = 0.013 *
Visitor damage	0.055	H = 10.50, Df = 5, P = 0.062
Log10 redox	0.584	-
Log10 Exposure	0.006 **	-
Square root Exposure	0.017 *	-
Log10 Recreation Pressure	0.007 **	-
Log10 Visitor damage	0.000 ***	-

* Significant at P<0.05 level.
** Significant at P<0.01 level.
*** Significant at P<0.001 level.

Table 5.5: Statistical tests for all field and shore variables.

To reiterate, following the assumptions of the statistical tests, the following variables are preferred for the field and shore groups: Log10 redox, Square root Exposure, Log10 Recreation Pressure, Log10 Visitor damage, shade, bare ground, grazing intensity and artificial structures. From table 5.5 it is seen that the following preferred environmental variables are significant at P = 0.05 or better: Sqrroot Exposure, log recreation pressure, log visitor damage, level of shade, grazing pressure and recreation pressure (the latter was statistically significant using both ANOVA and Kruskal-Wallis tests). Each of these variables is now discussed.

As table 5.5 shows, square root Exposure is significant at p <0.05. Thus, the mean exposure rates in each group are highly significantly different from one another. Exposure, then, is an important influence on the development of species communities throughout Loch Lomond. Communities associated with high exposure include field and shore groups D and F (see figure 5.9), where group D includes the shore zones of Ardlui and Kenmore Bay and, for one survey date, Inverbeg; and group F includes the Narrows, Ardlui and Inverbeg (for both the field and shore zones).

Similarly, log recreation pressure is significant at the p <0.01 level, suggesting that recreation pressure has a significant influence on the vegetation communities of Loch Lomond. More specifically, the level of recreation pressure differs between sites in the field and shore zone. The Kruskal-Wallis test confirmed the result obtained by the ANOVA test as it provided the following statistics: H = 14.39, Df = 5, P = 0.013, again indicating that there are significant differences in recreation pressure for the field and shore community groups. These results are very valuable for the underlying nature of the thesis, as they show that recreation is an important factor that influences the vegetation of the area. It is again community groups D and F that both experience the highest levels of recreation pressure[22].

The ANOVA test for Log visitor damage showed significance at $P<0.001$, implying that the level of visitor damage at a site has a highly significant impact on the surrounding field and shore plant communities of Loch Lomond. As seen in figure 5.11, group C has significantly higher visitor damage pressure than any of the remaining five field and shore groups. Group C has two indictor species *Agrostis stolonifera* and *Galium odaratum*, and includes the golf course site for the field zone only[23].

To assess level of shade the Kruskal–Wallis Test (adjusted for ties) was adopted. As seen in table 5.5 the results found are as follows: $H = 28.41$, $Df = 5$, $P = 0.00$. The null hypothesis that the population medians are equal is therefore rejected. The populations are not identical with reference to level of shade. Shade is an important influence on the development of plant communities in the field and shore zone. Shade influences community groups B and C to the greatest extent (where group B is identified by the indicator species of *Phalaris arundinacea* and includes the shoreline zone of Camas an Losguinn and the bay at the golf course).

A similar pattern arises for the level of grazing pressure. The Kruskal-Wallis Test (adjusted for ties) revealed a result of: $H = 19.92$, $Df = 5$, $P = 0.001$. Grazing pressure hence varies for the different field and shore groups, having greatest influence on community group D.

As Log10 redox, bare ground, and artificial structures are not significant it can be said that these factors do not differ between plant communities. They do not influence differences between vegetation communities. Sediment redox, level of bare ground and the presence of artificial structures do not impact on the field and shore vegetation communities of Loch Lomond to a significant extent.

To summarise, a combination of environmental and recreational factors influence the field and shore vegetation communities of Loch Lomond (table 5.7). The geographical division (between the north and south basin and between the field and shore zone) is attributed to differences in the following environmental factors: exposure, shade and grazing level, along with recreation pressure

[22] Communities D and F include the sites Ardlui, Inverbeg and the Narrows. All of these sites were found to suffer from high environmental damage levels in the visitor damage survey. Therefore, the results from the ecological survey and visual assessment survey correspond.

[23] Again, the results of the ecological survey concur with the general visitor damage survey. The latter survey recognised that (some) visitor damage was present at the Loch Lomond golf course.

(i.e. possible recreation pressure) and visitor damage level (i.e. visible visitor damage that is already present).

Aquatics Groups

For the aquatic plant groups, table 5.6 illustrates the statistical results for all variables.

Environmental Variables	**ANOVA *P* Value**	**Kruskal – Wallis Test (adjusted for ties)**
Light attenuation coefficient *k* (m^{-1})	0.549	-
Euphotic depth *Zeu* (m)	0.377	-
Sediment redox (mV)	0.964	-
Exposure	0.049 *	-
Shade	-	H = 18.31, Df = 4, *P* = 0.001 **
Bare Ground	-	H = 4.50, Df = 4, *P* = 0.342
Grazing intensity	-	H = 11.77, Df = 4, *P* = 0.019 *
Artificial structures	-	H = 5.63, Df = 4, *P* = 0.229
Recreation pressure	0.037 *	H = 11.06, Df = 4, *P* = 0.026 *
Visitor damage	0.092	H = 7.00, Df = 4, *P* = 0.136
Log10 *k*	0.455	-
Log10 *Zeu*	0.455	-
Log10 redox	0.801	-
Log10 Exposure	0.000 ***	-
Square root Exposure	0.004 **	-
Log10 Recreation Pressure	0.005 **	-
Log10 Visitor damage	0.071	-

* Significant at $P<0.05$ level.
** Significant at $P<0.01$ level.
*** Significant at $P<0.001$ level.

Table 5.6: Statistical tests for all aquatic variables.

As with the field and shore groups, following tests for normality and robustness, the following variables are preferred: Log10 *k*, Log10 *Zeu*, Log10 redox, Square root Exposure, Log10 Recreation Pressure, Log10 Visitor damage, shade, bare ground, grazing intensity and artificial structures. For the groups of aquatic plants, the following environmental variables are significant at the $P = 0.05$ level or better: Square root Exposure, shade, grazing intensity and recreation pressure (the latter was again significant for both the ANOVA and Kruskal-Wallis tests). These findings correspond with the results obtained for the field and shore communities. The only difference is that visitor damage is not significant for the aquatics communities. This is not surprising as visitor damage was defined primarily as evidence of trampling, fire circles and other visible anthropogenic impact. Such impact is primarily a land rather than aquatic phenomenon.

Again square root exposure was significant for the groups of aquatics plants. In particular ANOVA produced significance at the p <0.01 level. Thus, the null hypothesis that population means are the same is rejected: exposure rates in each aquatics group are highly significantly different from one another. Communities associated with high exposure include aquatic groups C, D and E. Communities associated with low exposure include groups A and B (see figure 5.19).

For the ANOVA procedure, log recreation pressure was significant at $p < 0.01$. For the Kruskal–Wallis Test (adjusted for ties) $H = 11.06$, $Df = 4$, $P = 0.026$ and therefore the null hypothesis is rejected for both statistical tests. As with the field and shore communities, this result is crucial. Recreation pressure varies between the groups of aquatics and so recreation pressure does influence the development of aquatic plant communities. In particular recreation pressure greatly influences the community of aquatic group C.

Both shade and grazing intensity were significant using the Kruskal-Wallis test (adjusted for ties) with $H = 18.31$, $Df = 4$, $P = 0.001$ and $H = 11.77$, $Df = 4$, $P = 0.019$ respectively. Consequently, the null hypothesis that the population medians are equal is rejected. Shade and grazing intensity are significantly different for all TWINSPAN groups. Shade is a particularly important factor for groups B and D, while grazing influences the vegetation community of group A.

Referring back to the initial aim of the statistical analysis it is stated that, for the aquatic plant (macrophyte) communities, the invasive/non-invasive division is again the result of a combination of environmental and recreational factors (table 5.7). In particular the environmental factors of exposure, shade and grazing intensity have a significant influence in determining differences between groups. Perhaps more importantly recreation pressure varies significantly between groups, suggesting that the invasive/non-invasive division is due in part to disparities in the level of recreation at each site. Fundamentally, however, visitor damage level does not significantly differ for the aquatic plant communities.

5.3.4 Ecological survey conclusion

Table 5.7 assimilates these findings, characterising the TWINSPAN and 'Tablefit' community groups and their relation to the environmental and recreational factors. It illustrates the vegetational differences between sites and indicates the likely environmental and/or recreation pressures affecting the different plant communities. To conclude, then, the findings from the ecological investigation are as follows:

<u>TWINSPAN and 'Tablefit' results:</u> Six groups of field and shore communities were identified by TWINSPAN, at the third level of the divisive classification. A clear geographical division arose between the groups of the field and shoreline community, primarily between the north and south basin of Loch Lomond. More specifically, a field/shore division was apparent. Using 'Tablefit', each of these field and shore groups were assigned a NVC community, and again a field/shore separation was evident.

TWINSPAN Group	Indicator Species	NVC community	Sites	Environmental Factors	Recreation Pressure/Visitor Damage
Field/Shore Group A	*Carum verticillatum*	S23/OV28 *Other water-margin* vegetation/*Agrostis stolonifera-Ranunculus repens* community	WHW, shore zone only	No significant environmental factors	Recreation pressure but to a lesser extent than Field/Shore Groups D or F
Field/Shore Group B	*Phalaris arundinacea*	M27 *Filipendula ulmaria-Angelica sylvestris* mire	C & GC, shoreline only	Shade	No significant recreation factors
Field/Shore Group C	*Agrostis stolonifera*	U17 *Luzula sylvatica-Geum rivale* tall-herb community	GC, field zone only	Shade	Visitor Damage
Field/Shore Group D	No indicator species	M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture	A, KB, I. Shore only	Exposure Grazing pressure	Recreation pressure
Field/Shore Group E	*Polytrichum commune; Dryopteris filix-mas; Vaccinium myrtillus*	OV28 *Agrostis stolonifera-Ranunculus repens* community	C, N, MB, KB & WHW. Field and Shore	Shade	Recreation pressure but to a lesser extent than Field/Shore Groups D or F
Field/Shore Group F	*Juncus effusus; Ranunculus repens; Oxalis acetosella; Plantago lanceolata*	OV28 *Agrostis stolonifera-Ranunculus repens* community	N, A, I. Field and Shore zone	Exposure	Recreation pressure
Aquatics Group A	*Juncus bulbosus*	A22 *Littorella uniflora-Lobelia dortmanna* community	WHW & KB	Grazing pressure	Recreation pressure (but less than for Aquatics Group C)
Aquatics Group B	*Elodea nuttalli*	A23 *Isoetes lacustris/setacea* community	C & I	Shade	No significant recreation factors
Aquatics Group C	No indicator species	A23 *Isoetes lacustris/setacea* community	I	Exposure	Recreation pressure
Aquatics Group D	*Elodea nuttalli*	A13 *Potamogeton perfoliatus-Myriophyllum alterniflorum* community	GC, MB & A	Exposure Shade	Recreation pressure (but less than for Aquatics Group C)
Aquatics Group E	*Lobelia dortmanna; Littorella uniflora*	A22 *Littorella uniflora-Lobelia dortmanna* community	N & A	Exposure	Recreation pressure (but less than for Aquatics Group C)

Key: C = Camas an Losguinn; N = The Narrows; GC = Bay at Golf Course site; MB = Milarrochy Bay; A = Ardlui; KB = Kenmore Bay; WHW = West Highland Way site; and I = Inverbeg.

Table 5.7: Summary of community types and environmental factors experienced.

For the aquatic communities TWINSPAN identified, again at level three of the divisive classification, five main community types. An invasive/non-invasive binary became apparent. The results suggested that there is a habitat in Loch Lomond not yet invaded by *Elodea spp.* Assigning NVC communities to these groups using 'Tablefit' again confirmed these findings.

Statistical results: The aim of the statistical analysis was to determine whether the geographical division for the field and shore communities and the invasive/non-invasive division for the aquatics groups can be attributed to environmental or recreation factors. If there is no significant difference between TWINSPAN groups (i.e. Ho cannot be rejected), the environmental variable under study is not an important influence on species community group.

For the field and shore communities, the TWINSPAN geographical division (i.e. between north/south basin and field/shore) can be attributed to the following environmental factors: exposure, shade and grazing, along with recreation pressure and visitor damage level. The findings are very similar for the Lomond aquatics. Namely, the environmental factors of exposure, shade and grazing are significant, as is recreation pressure. Visitor damage is not significant for the aquatic communities.

Summary: Overall, exposure, recreation pressure, visitor damage (for the field/shore communities only), shade and grazing are all important in determining differences between species groups. Crucially, recreation pressure appears to be an important influence on vegetation communities and hence the "real" ecology of Loch Lomond. The consequences of this finding will be discussed in the following chapters, linking this discovery with the more "perceptual" findings of the research project.

5.4 Conclusion

Together the visual assessment of visitor induced environmental damage survey and the vegetation ecological survey provide evidence of "real" environmental conditions, using both a boat survey and a shore survey. The former survey showed that a relatively limited area of the loch shore (9.1%) is subject to severe environmental damage. However, the latter survey demonstrated that the loch's six groups of field and shore vegetation communities and five aquatic communities are significantly affected by recreation pressure. The results of the detailed ecological survey correspond with the general visual assessment survey results. The field and shore communities of the ecological survey most greatly affected by recreation pressure concur with those areas rated 'very high visitor impact' in the visitor damage survey. Examples of such areas include Milarrochy Bay and Inverbeg. The implications of both surveys' findings are investigated, and compared to the "perceived" results of the project, in the following integrative chapter.

Chapter 6. Discussion – four themes

"All resources are defined by human perception" (Lucas 1964, 373).

6.1 Introduction

As Lucas (1964) recognises, there is an intricate link between human perception and the environmental resource. The aim of this chapter is to discuss four themes connecting the social and natural environment, namely: crowding, noise, environmental conditions[24] and the PWC debate (which includes the theme of conflict). These four factors are the key focal point to this research project and as such each theme is investigated in turn. It is argued that crowding, noise, environmental conditions and conflict all influence visitor enjoyment to varying extents. The chapter shows that noise appears to be the most important factor affecting utility per visit (where utility per visit encompasses visitor enjoyment and recreation satisfaction).

6.2 Crowding

The first theme to be discussed is crowding. As introduced in chapter two, a crowding hypothesis has been created, namely: high visitor numbers lead to overcrowding and reduced utility per visit. A number of the findings presented in chapter four support this hypothesis. They support the satisfaction model as discussed by Manning (2001) and others (section 2.3). Relevant results are now discussed with reference to the crowding hypothesis.

Descriptive statistics generated from the on-site questionnaire surveys support the crowding hypothesis and hence satisfaction theory. As shown in chapter four (section 4.3.1), only 0.5% of respondents stated that their preferred company on site was "lots of other people". 82.4% of respondents stated that they liked to be either with only a few people (maximum of ten), family and friends only, or on their own. These results suggest that high visitor numbers reduce utility per visit for the majority of Loch Lomond visitors. As one visitor stated: "the fewer people the better in my opinion" (Male Visitor, Rowardennan). From this perspective, the crowding hypothesis and satisfaction model are supported. Moreover, respondents were asked directly whether or not the presence of crowding affected the enjoyment of their visit. 79.7% stated that crowding did negatively affect the enjoyment of their visit[25]. Again, then, the satisfaction model is supported.

[24] Vegetation is the main environmental indicator investigated. However, more general environmental impact is also addressed (for example shore erosion and water pollution).
[25] As seen in section 4.3.1, from question 18 in the Loch Lomond Boat User Survey (2001), 12.9% of boaters stated that their enjoyment of a day out on Loch Lomond was affected "very much" or "quite a lot" by the presence of other boats. More qualitative research is required to determine whether this "presence" creates feelings of crowding and/or visitor conflict.

Respondents were subsequently asked how their number of trips made to the Loch Lomond area would change if twice as many people than at present visited the site, i.e. if it became overcrowded. For 99.3% of respondents the number of trips made would be reduced, with 11.1% of individuals stating that they would make no trips in the coming years. Again this is informative as it implies that visitor satisfaction is severely reduced by crowding (severe enough to reduce number of trips). Asking the visitors whether or not twice as many people at the site than at present would make the recreation experience "a lot lot worse", "a lot worse", "worse", "the same", "better", "a lot better" or "a lot lot better", 86.8% of respondents replied that the experience would range from "a lot lot worse" to "worse", 12.5% stated that it would be "the same", and only 0.7% stated that the experience would be better. Again, then, satisfaction theory and the crowding hypothesis are supported. The chi-square test of association (at $p>0.95$) showed a significant relationship between perception of crowding and the number of people in a group. The number of visitors in one group equates to density, signifying that high visitor numbers themselves do reduce utility per visit and supporting the crowding hypothesis, namely: high visitor numbers lead to overcrowding and reduced satisfaction with the initial recreation experience.

It is important to think about the above issues of density and perception of crowding on a site by site scale. Using chi-square tests of association ($p>0.99$), a significant relationship was found between site visited and the perception of crowding. Of the four sites visited (Milarrochy Bay, Firkin, Rowardennan and Sallochy), crowding was seen to the largest extent at Sallochy and to the least extent at Firkin (at Sallochy 31.8% of respondent rated perceived crowding at level '3' to '5' with '5' equal to overcrowded, while at Firkin only 18.7% of respondents rated perceived crowding at the three to five level). Of further interest is that at Firkin physical carrying capacity (or physical density) was not met nor exceeded on any of the six survey days. Indeed, on many occasions the site of Firkin appeared "empty", with neither physical carrying capacity nor general sustainability compromised (see figure 6.1).

Figure 6.1: Firkin – The "empty" beach (*Photograph taken by author on Sunday 4th July 2004).*

However, at Sallochy physical carrying capacity was exceeded on one of the six survey days. Results such as this indicate that physical density is directly related to perception of crowding. When questioned explicitly about crowding and enjoyment the following results were found:

\Site	**Sallochy**	**Firkin**	**Rowardennan**	**Milarrochy Bay**
Enjoyment	**Number of respondents *(Percent of valid respondents)***			
No	34 *(29.3%)*	17 *(17.7%)*	13 *(13.5%)*	18 *(18.8%)*
Yes	82 *(70.7%)*	79 *(82.3%)*	83 *(86.5%)*	78 *(81.3%)*
Total	116 (100%)	96 (100%)	96 (100%)	96 (100%)

Table 6.1: Does the presence of crowding affect the enjoyment of your visit?

From table 6.1 it is seen that crowding affected recreation enjoyment most at Rowardennan. It was at Rowardennan that physical carrying capacity was exceeded most often, on two of the six randomly selected survey days (section 4.2); again suggesting that physical density has an important influence on perception of crowding.

Indeed, interviews with managers and policy-makers indicate that, in general, many managers equate crowding with high visitor numbers and density. As an example they often made statements such as: "Milarrochy Bay is the most densely used area of the loch according to the boat survey and boat counts" (Ranger, LLTNPA). More specifically, during the interview process all managers and policy-makers were asked whether or not they agreed with the crowding hypothesis. 70% of respondents believed that high visitor numbers do lead to overcrowding and reduced utility per visit; 10% of all respondents disagreed with the hypothesis, stating that many like crowds; and the remaining 20% of interviewees said "I don't know, maybe it's true". Thus, for the majority of managers crowding was synonymous with density and physical carrying capacity:

"There are a number of sites where physical capacity is reached. For example, last year at Drumkinnon Bay capacity was reached during fourteen days. The ability to handle the visitors was exceeded and reached a critical level. The capacity of the car park was full and people were being turned away. But, the capacity of the loch was not met. Just because the capacity of the car park was at its limit, it didn't mean that the loch's capacity was anywhere near full. The capacity of the loch and the shore are very different. Also, although Drumkinnon Bay was full on these fourteen days, a lot of areas around the loch would have been empty, or would have had very few people. Crowding varies spatially" (Manager, LLTNPA).

As the final sentence of the above extract demonstrates, managers recognise that crowding is distributed unevenly around the loch:

"Recreation is concentrated in specific areas around the loch, like Milarrochy Bay, Sallochy and Luss. There are lots of areas along the loch where you can find no people; certain areas remain deserted, where only people who know about them have access" (Manager, LLTNPA).

Crowding, as a social impact of recreation, is therefore limited spatially and temporally. Such concentration in time and space allows a number of coping mechanisms to be adopted by those visitors who dislike crowding. Specifically, in order to cope with the dissatisfaction derived from crowding, and hence following the "coping behaviours" box in Manning's (2001) conceptual model, visitors were asked about their behaviour, if faced with overcrowding at a site. 74.3% of respondents stated that if the site visited was perceived to be "overcrowded" they would relocate to another site within the loch; 3.5% stated that they would relocate to another loch; and 11.1% said they would return home. 11.1% reported that they would stay at their current site. These findings correspond with the boat user survey conducted for the Loch Lomond and Trossachs National Park Authority in 2001, which found that there is a small, but significant increase of people modifying their behaviour at crowded times, namely moving to another site within the loch (Loch Lomond Boat User Survey, 2001). More specifically, 39.9% of boat users changed <u>where</u> on Loch Lomond they boated depending on the high presence of other users. Only 7.1% of respondents frequently or occasionally moved to another water body, the remainder preferring to move within Loch Lomond (section 4.3.1).

More generally, 28.7% of boat users frequently or occasionally change their boating behaviour depending on the presence of crowding (Loch Lomond Boat User Survey, 2001). Similarly, in the on site questionnaire survey, when asked whether or not the presence of crowding affects the frequency of visits, 62.9% stated that their frequency of trips was affected, i.e. they would make fewer trips if crowding were present. These results support Manning's expanded crowding model, which states that displacement is a "coping behaviour" adopted by visitors wishing to avoid crowded sites. Crowding leads to dissatisfaction, and this can lead to recreation displacement. As one visitor suggested, "if it was too busy here we'd just go to Loch Katrine. We like to cycle round there" (Male Visitor, Firkin). Managers and policy-makers were similarly questioned about their understanding of recreation displacement. They were asked whether or not they agreed with the following hypothesis: crowding contributes to long-term users altering their activity and leads to recreation relocation/displacement. Four of the ten manager/policy-makers believed that crowding was leading to recreation displacement. Five of the respondents suggested that more research on displacement was required.

In addition to displacement, another "coping behaviour" that visitors adopted to avoid crowding was to visit Loch Lomond only when they knew the site would be relatively quiet. The following quotes demonstrate this point:

"I try to avoid the crowds by arriving in the early morning and leaving before the lunch-time rush. I also try to avoid the traffic" (Male Visitor, Firkin).

"I hate the crowds! I know you must think that I'm very opinionated but I can't stand them. In the height of summer we get here in the early morning and we're gone by lunch-time. Luss is always a non-starter. The spring and autumn are definitely the best months to visit. August is a nightmare" (Male Visitor, Firkin).

Managers also appear to be aware of this coping mechanism, namely:

"Overcrowding tends not to be a problem for the people who are there but a problem for those other visitors who are not there if you see what I mean. What I mean is the people who don't like crowds avoid the sites on days they know they'll be busy, so they'll avoid any overcrowding. The people who are there don't mind too much about the overcrowding or they would leave. The question then becomes: do people know it's overcrowded? They then make a choice about whether to go elsewhere. People who don't like crowds won't visit on busy days" (Manager, Forestry Commission).

Apparently, then, the satisfaction model of recreation crowding and hence the crowding hypothesis is supported. However, such a claim is not straightforward. Crowding was not significant in the travel cost model (TCM), suggesting that high levels of crowding do not affect number of trips made to the study area, and supporting previous studies that show that crowding is not related to recreation satisfaction (see for example Gramann and Burdge, 1981; and Hammitt, 1983). The TCM model may, however, miss out the impacts on utility per trip of increases in crowding at particularly busy occasions. This is addressed through the combined stated/revealed preference approach of the crowding contingent behaviour model (CBM) in which the crowding variable is significant. Here it was found that if an individual believed that crowding was increasing in the Loch Lomond area, they would reduce their number of visits made each year. Eventually, the total number of trips made by all visitors to the Loch Lomond area would decrease by 9.04%. Overall crowding levels would be consequently reduced. Again, then, the CBM supports the claim of individual perception of crowding as defined in the satisfaction model. Namely, crowding has a detrimental effect on the individual's recreation experience.

Constructing the CBM involved asking a question about whether the expectation of crowding impacts on recreation participation decisions. This question adds further complexities to the crowding hypothesis. Each respondent was asked "before you set out today, how crowded did you expect it to be once you got here (with 1 = no crowding and 5 = overcrowded)?" 11.4% of respondents gave the answer '1'; 2.7% gave the answer '5'. They were then asked, "now you are here, how would you rate the crowding level of this site today (with 1 = no crowding and 5 = overcrowded)?" The answers were valuable: 39.1% of respondents provided a '1' rating and 0.9% stated a '5' rating. Subsequently, in both cases the site was less crowded than expected, suggesting that people would still visit a site even if it were expected to be crowded, hence it is not only the actual number of people that influences recreation participation decisions, there are also a number of other factors involved.

It therefore appears that it is not only high visitor numbers that lead to a perception of overcrowding and reduced utility per visit. Various factors, other than physical density, are also important. This makes accepting the initial crowding hypothesis more problematic. Personal and social variables are involved in any perception of crowding. This is normative theory (section 2.3), i.e. crowding exists when it is seen to disrupt one's objectives, values and social norms. A number of managers were aware of this dimension of crowding as illustrated by the following quotes:

"Do high visitor numbers lead to overcrowding and reduced utility per visit? For some yes, however, some like crowds. Those who don't like the crowds will avoid the sites on days they know them to be busy. I think that quality rather than quantity is important, in other words, will the "neds" be there?" (Manager, Forestry Commission).

Reference to "quality" rather than "quantity" demonstrates the importance of crowding as a psychological and social construct, reliant not only on physical density but also personal preference (Lee and Graefe, 2003). As one policy-maker said:

"High visitor numbers can lead to reduced enjoyment although I suppose it depends on a number of personal factors. Do I like crowds for example... If an area is crowded people could leave and come back at another time. Decide to come back on Thursday evening instead of Sunday afternoon" (Policy-Maker, SNH).

Thus, as stated in the following interview extract:

"It's the perception of crowding that's important. The number of days when Sallochy, for example, is overcrowded is pretty small, but these are the days that stick in people's minds. Personally these busy days have a big impact on them. They remember feeling affected by the crowds and associate this negative feeling with all of Loch Lomond... Crowding is perceptual and is based on past experience and future expectations" (Manager, Forestry Commission).

Individuals evaluate crowding in relation to their previous recreation experience and personal normative standards (Manning *et al*, 1996). Chi-squared tests conducted on the variable "crowding" and other variables demonstrate the importance of personal and social values. A significant relationship was found between perception of crowding and the following variables: site, weather, and length of stay on site (at $p>0.99$); and the origin of visitors (i.e. whether they were locals or tourists) at $p>0.95$ (section 4.3.2). The most revealing result in terms of normative theory is the relationship between perception of crowding and the origin of visitors. Using descriptive statistics and the chi-square test of association, it is seen that local visitors are more likely to perceive negative levels of crowding than are tourists. As one visitor stated "crowding doesn't affect me because I'm not local. I don't come here often enough for it to be a problem" (Female Visitor, Milarrochy Bay). This finding supports Manning's (2001) normative claim that more experienced users are more sensitive to crowding. Taking this further, the relationship between preferred company and age was also significant (using a chi-square test of association at $p>0.99$), with those under 34 years old more likely to prefer bigger groups to those in the 35 and over age group. Many visitors over 35 years old stated that they had been "visiting Loch Lomond for years" (Male Respondent, 45–54 years, Sallochy), again lending support to the hypothesis that with more experience of an area, sensitivity to crowding is increased. Familiarity influences perception of crowding and an individual's perceptual carrying capacity.

Interviews with respondents on-site also indicate that personal characteristics, the characteristics of other users, and the environment also influence perceptions of crowding. All contacts do not contribute equally to perceived crowding, as "crowding is a complicated psychological construct" (Lee and Graefe 2003, 2). The following quotes, obtained from visitors while on site and issuing the questionnaire survey, provide good examples of this:

"As long as people are well-behaved, crowding doesn't bother me" (Female Visitor, Firkin).

"I try to avoid the really busy periods, it's not the people that bother me though, it's the jet-skis. I tend not to go to Milarrochy Bay because I know it'll be full of jet-skiers... Oh and the dogs, they really annoy me. They run along the shore, off their leash, barking and scaring my daughter. And then there's the dog mess that's lying about. Look at the state of that *points to "dog mess"*. *If that's not environmental damage I don't know what is. They* [dogs] *shouldn't be allowed"* (Female Visitor, Sallochy).

"I don't care about numbers of people, it's the people who destroy the peace and quiet, they're the ones who should be stopped coming here. They shouldn't be allowed to play loud music or listen to their blaring radios. Then we all have to listen to their bloody music. It destroys the quiet, scenic beauty that many people, including myself, come here to enjoy" (Male Visitor, Sallochy).

Again then it is the "quality" of the recreation experience rather than the number of people that is important to visitors. For some it is specifically the "type"[26] of person present that influences their enjoyment. In short, "perceived alikeness between groups can affect normative judgements about crowding" (Manning *et al*, 1996, 53). For example:

"I like to come here rather than say Sallochy. A better class of people come to this site. I don't mean to sound snobby, I just mean that the people who come here appreciate the countryside; they appreciate the beauty of nature. They don't destroy it" (Male Visitor, Firkin).

For others it is external, environmental and practical considerations that affect enjoyment, i.e. "situational variables" as defined by normative theory (Manning, 2001), namely:

"Crowding for me depends on the time of year and whether the weather is good" (Male Visitor, Milarrochy Bay) and

"If there were twice as many people at this site then the car park would be full and I wouldn't get parked. Then I'd be very, very annoyed!" (Female Visitor, Rowardennan).

The final quote in particular is revealing. It demonstrates that the visitor was interested in the number of cars in the car park, i.e. parking availability, rather than the number of people. There is therefore a question of "what is crowding?" Indeed for many the crowding experience was based on their previous recreation experience, i.e. visitors remember crowding levels from previous trips and this affects their perception of the current crowding conditions – "I would have said that this

[26] This belief that certain "types" of persons are "out-of-place" (Cresswell, 1996) in the rural environment is returned to in section 6.5.

was crowded, but this is nothing compared to last Sunday. You should have seen it, it was mobbed here" (Female Visitor, Sallochy). For many crowding does not only equate with people, it is affected by previous experience, familiarity, and expectations, supporting the concepts of normative theory and making the satisfaction concept more problematic to accept.

For other visitors the initial crowding hypothesis is completely false, in other words they like crowds. Namely:

"I don't mind the crowds. I'm happy if people are enjoying themselves. It's a free world. One aim of the National Park is to provide enjoyment for all people so everyone's welcome in my eyes" (Female Visitor, Firkin).

"I like the crowds. If it's crowded it means it's a nice day [i.e. good weather] *and that's great. The sunnier the better!"* (Female Visitor, Milarrochy Bay).

"I like lots of people when I'm here – the more the merrier" (Male Visitor, Sallochy).

A number of managers also recognised that many visitors liked crowds. As explained by the following interview extract:

"Other people being there can actually make the experience for many; they like the crowds. Some don't even notice the crowds. When I last visited Yosemite [National Park] *it was very busy, very crowded, like the streets of New York City, and I felt very overcrowded. However, when I got to the Yosemite Falls the crowds didn't matter. When I saw the Falls, and I remembered what it was like on my first visit to see the Falls, I felt so* [respondent emphasis] *inspired that the crowds melted away and it was just me and the Falls or me and the Arch... So is crowding really an issue or is it only an issue because we are trying to preserve the Arch for us and for future generations? The last thing we want to do is deny people from seeing the Arch"* (Ranger, Arches National Park).

According to this respondent, then, crowding can "disappear" if there is an "inspiration factor"[27], such as Delicate Arch located in the Arches National Park. Again, then, perception of a crowded situation is complex. The crowding literature indicates that crowding norms may be a function of several variables, including the type and size of group, characteristics of respondents, the characteristics of visitors encountered, visitor behaviour, the degree to which groups are perceived as alike, and situational or environmental variables (Manning *et al*, 1996). Crowding is not simply related to the number of people, it is an intricate psychological and social phenomenon. The findings of the research project likewise reveal that the initial crowding hypothesis, while in general is not rejected, is more complex than merely incorporating the satisfaction model. While high visitor numbers do appear to lead to overcrowding, reduced utility per visit is a consequence of a variety of factors in addition to physical numbers of people. Indeed current findings support

[27] The researcher defines an "inspiration factor" as any feature (environmental, landscape or otherwise) that creates awe, wonderment and appreciation in the eye of the beholder.

Manning's (2001) conceptual model of crowding: a variety of personal, psychological and social factors influence visitor perception of crowding.

A number of previous user-perception studies concur with the above analysis of crowding. Such studies emerged primarily in the U.S.A. (see for example Lucas's 1964 "classic" study of the Boundary Waters Canoe area, which informed much subsequent research; and Kearsley's 1990 study of "User Perceptions of Wilderness"). Westover and Collins (1987) provide a good example of the effects of perceived crowding in recreation settings. Although based on an urban case study, the researchers show that the actual number of visitors present is the most important individual predictor of perceived crowding, thus supporting the satisfaction hypothesis. Through statistical analysis Westover and Collins (1987) found a significant positive relationship between perceived crowding and familiarity, indicating that more frequent visitors were more likely to perceive park crowding and again supporting normative theory as discussed by Manning (2001). Similar findings with reference to experience and perceived crowding were found in the current project.

Another study confirming that perceptions of crowding are more dependent on experience levels, situational variables, and environmental factors than on physical use levels is provided by Lee and Graefe (2003) in their study of a festival setting in Pennsylvania. They discovered that the majority of respondents had encountered about as many people as they had expected or fewer than expected. A number of hypotheses were tested including "estimated density will be directly and positively related with perceived crowding of festival visitors" (Lee and Graefe 2003, 4). This hypothesis was confirmed. Here, then, the study confirms the results of the current project. In addition Lee and Graefe discovered that a number of additional variables affect visitor perception of crowding, such as the value systems of users and the character and behaviour of other users. Again these findings validate the claims of the current research project.

Similarly, results from Shelby and Heberlein's studies (1984, 1986) show that higher use levels do not always make people feel more crowded. As Manning (2001) notes crowding means "too many people", but many studies find that use levels do not entirely explain feelings of "crowdness". Perceived crowding is affected by the personal standards people bring with them (defined by culture and experience) and the way they define the setting in question. This is the case with the current research project and with many previous studies, i.e. perceived crowding is a complex phenomenon. It appears, therefore, that the findings of this thesis concur with the results of many previous crowding studies.

The research findings have many links to social (or perceptual) carrying capacity, which states that there is a certain level of crowding beyond which the quality of the recreation experience diminishes. In order to establish a social or perceptual carrying capacity of crowding, managers need to be aware of the factors influencing visitor perception of crowding. The findings of this project illustrate that it is not only physical density or number of people that influences perception of crowding; there are a number of other personal, social, and situational factors involved in any perception of crowding. Social carrying capacity, which is an aggregation of individual response with distinctive sub-groups, allows standards to be set to determine the point at which feelings of crowding reaches unacceptable levels. The application of this framework is discussed further in chapter seven.

A number of theoretical concepts can contribute to a social carrying capacity framework including the satisfaction model and the normative approach. Manning's expanded crowding model (figure 2.2) appears to be the most useful model for developing a theoretical and empirical approach to crowding. This model brings together a number of theories including the satisfaction and normative approach and relates directly to the current research project.

Thinking specifically about the crowding hypothesis, high visitor numbers do lead to overcrowding and reduced utility per visit. However, reduced utility per visit is complex. While crowding was significant in the crowding CBM, and many chi-squared tests, it is not the most important site quality variable for many. As seen from previous theory and findings, feelings of crowding and visitor perception of crowding are dependent not only on physical numbers (density) but also on social conditions, culture, experience, and environmental factors. Still, as shown through the traffic counts, Lomond sites were very rarely extremely crowded; perhaps if this had been the case crowding would have been a greater problem for many. Thus, while the crowding hypothesis is not rejected, it is recognised that this statement is complex. In addition to numbers of people, a variety of social, environmental and psychological variables also affect any perception of crowding.

6.3 Noise

Like crowding, a hypothesis has been created for the theme of noise (section 2.9). The noise hypothesis states that high noise levels result in reduced utility per visit. Descriptive statistics generated from the on-site questionnaire survey support the noise hypothesis. Crucially, looking at the three site quality variables of noise, crowding and environmental damage, it is noise that has the greatest influence on recreation enjoyment. As shown in chapter four, 81.4% of respondents stated that noise pollution did affect the enjoyment of their visit. 63.7% of respondents believed that noise pollution affected the frequency of their visits. When looking at the same question split by site results again support the noise hypothesis as seen in the following tables:

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Enjoyment	**Number of respondents (Percent of total respondents for site (%))**			
No	34 (22.4%)	16 (12.1%)	22 (16.7%)	30 (22.7%)
Yes	118 (77.6%)	116 (87.9%)	110 (83.3%)	102 (77.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table 6.2: Does the presence of noise pollution affect the enjoyment of your visit?

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Frequency of visits	**Number of respondents (Percent of total respondents for site (%))**			
No	55 (36.2%)	41 (31.1%)	57 (43.2%)	47 (35.6%)
Yes	97 (63.8%)	91 (68.9%)	75 (56.8%)	85 (64.4%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table 6.3: Does the presence of noise pollution affect the frequency of visits?

For both enjoyment of visit and frequency of visits, noise pollution affected those visiting Firkin most. Indeed 87.9% of respondents at Firkin stated that noise pollution affected the enjoyment of their visit. This suggests that visitors at Firkin recreate at this site with the hope of a peaceful experience (as PWC are not launched here). The expectation of peace and quiet is a major element of their recreation experience. It is also interesting that it is Milarrochy Bay, the only site under study that allows the launching of PWC, where, relatively, people are least affected by noise pollution. Perhaps again then this demonstrates that visitors will visit a site with the expectation that noise pollution will be present. These findings suggest that expectation and prior experience of a site (familiarity) affects perception of noise. It is still important to recognise, however, that 77.3% of visitors at Milarrochy Bay were adversely affected by noise pollution, again lending support to the initial noise hypothesis.

Again thinking on a site-by-site basis, worthy of note is actual perception of noise on site. Chi-square tests indicate that there is a significant relationship (at p>0.95) between perception of noise and site. At Firkin only 2.3% of respondents rated noise level high ('4' or '5' on the one to five scale), at Sallochy this figure was 7.9%, at Milarrochy Bay it was 6.1%, and at Rowardennan it was 0.8%. Again this is interesting as it suggests that it is PWC generated noise at Milarrochy Bay and noise from groups of youths at Sallochy that affects visitor enjoyment to the greatest extent. Specifically:

"Jet-ski generated noise seems to be the thing that annoys most people... I've had lots of complaints directed towards me because of jet-ski noise both here at Drumkinnon Bay and up at Milarrochy Bay... The industry that produces jet-skis is very conscious of noise and pollution, but that doesn't stop the visitors complaining" (Ranger, LLTNPA).

"Anti-social behaviour, the ned's music blaring for example, is one thing that affects people's enjoyment at Sallochy. It's a party site" (Manager, Forestry Commission).

Furthermore, while at Sallochy the researcher was told, "noise from the boats doesn't really bother me, but if the noise is caused by a group of lads drinking, swearing and shouting then yes it bothers me. I don't like that one bit" (Male Visitor, Sallochy). Relationships between, and the values of, recreationists affect the perception of noise. The sounds of a region are embedded within relations of power (Matless, 2005).

Therefore, although the noise hypothesis is supported at all four sites, it appears that it is at Milarrochy Bay and Sallochy that noise pollution is highest, both in terms of actual sound and response of visitors to noise.

Findings from the TCM also support the initial noise hypothesis. The TCM shows that perception of noise level has a significant negative impact on trips, indicating that as the noise level increases, the number of trips decrease. Accordingly it is expected that as a site becomes noisier, less people will want to visit. Visitor perception of their recreation experience and the site in general is negatively affected by noise. Likewise, the noise CBM supports the noise hypothesis. It indicates that perception of noise level is a highly significant influence on the number of trips to the study area (at $p>0.05$). Again the coefficient on the noise variable is negative, thus as the level of noise at a site decreases, the number of trips made increases. The quieter a site is perceived to be, the more trips are made; the noise hypothesis is not rejected. As with the crowding CBM, predicted trips under changed noise conditions were calculated. Again the noise hypothesis is supported. The noise CBM found that if noise level were reduced to '1' (no noise), predicted trips would increase to the Loch Lomond area by 0.19%.

It is therefore determined that high noise levels do result in reduced utility per visit. Noise is detrimental to other recreationists and is the central concept of "soundscape" management (Matless, 2005). The following quote from a visitor at Firkin supports this claim:

"Everything that destroys the peace and quiet should be banned. Jet-skiers and speed-boaters should be stopped from coming to Loch Lomond. They're just too noisy. People shouldn't be allowed to play loud music or listen to their blasting radios. Dogs shouldn't be allowed to run about uncontrollably barking their heads off. It all destroys the quiet wilderness that many people, including me, come here to enjoy" (Male Visitor, Firkin).

The above quote derives the question: "which sounds should be present in the public open air?" (Matless 2005, 747). The sounds of technology are clearly seen to be out-of-place; however, the sounds of nature, for example birdsong, are acceptable to visitors. Noise is seen to be concurrent with technology and anti-social behaviour. Insider/outsider distinctions and value judgements are salient. Interestingly, as Matless (2005, 760) suggests, "if sounds are deemed out of place this is not for intruding into silence but from disrupting an acoustic ecology whose 'silence' is already full of sounds…" The presence, absence and nature of sound is a key concern.

Moving on to think about the variables that significantly influence this visitor perception of noise, and hence provide answers to the factors influencing perceived noise and reduced utility per visit, chi-squared tests on perception of noise and a number of social and psychological variables indicate the following significant relationships at p>0.90 or better (see table 6.4):

Data Sets	**Pearson Chi-Square Value**	**df**	**Level of Significance**	**Reject or do not reject Ho?**	**Is chi-square significant?**
Perception of Noise and Site	22.173	12	.036	Reject	Yes at P>0.95
Perception of Noise and Age	28.844	20	.091	Reject	Yes at P>0.90
Perception of Noise and Sex	5.621	4	.229	Do not reject	No
Perception of Noise and Length of stay on site	52.986	20	.000	Reject	Yes at P>0.99
Perception of Noise and origin of visitors (tourist vs. local)	8.451	4	.076	Reject	Yes at P>0.90
Perception of Noise and Date	407.007	100	.000	Reject	Yes at P>0.99
Perception of Noise and number in group	99.813	48	.000	Reject	Yes at P>0.99
Perception of Noise and Income	29.243	32	.607	Do not reject	No

Table 6.4: Chi-square tests relating to noise, where Ho = there is no relationship between data and HA = there is a relationship between data.

As table 6.4 illustrates, the following variables significantly influence perception of noise: site, age, length of stay on site, origin of visitors, date, and number in group. Interestingly, the socio-economic variables of sex and income do not influence perception of noise. These findings make the claim of Fay (1991) that the liability to feel annoyance with noise exhibits individual differences, problematic. It would appear that differences in socio-economic status do not significantly affect perception of noise. Still, age of respondent does affect noise perception. Descriptive statistics indicate that it is the older respondents that are more greatly affected by noise. 1.9% of those aged 34 years and younger rated noise level at a high level, while 6% of those aged 55 years and over rated noise at a high level. When asked specifically about the effects of noise on recreation enjoyment, 93% of those aged 55 years and over said they noise pollution did affect their enjoyment, while only 53% of those aged 24 years and under stated that noise pollution affected their enjoyment. It therefore appears that age is an important influence on annoyance by noise pollution. This finding supports the claim of Fay (1991).

There are a number of additional claims made by Fay (1991), a number of which appear to be supported by the findings of the current research project. In particular Fay (1991) states that the relationship between fear and noise is a significant factor on noise perception. As table 6.4 shows there is a highly significant relationship between perception of noise and number in group. Looking at this more closely, descriptive statistics indicate that if an individual sees a large group, their perception of noise is likely to be greater. Although statistically this cannot be attributed to a "fear" of the larger group, interviews with visitors on site indicate that "fear" can contribute to perceptions of noise:

"We won't stay here for long, look, a big group of neds have just arrived. God knows what they'll be up to... Aye, we won't be hanging about" (Female Visitor, Sallochy).

Similarly, Fay (1991) asserts that past experiences will influence perception of noise. The chi-square test of perception of noise against age, length of stay on site and origin of visitor all appear to support this claim. Specifically, the older respondents, many of whom are likely to have the greater recreation experience, perceive noise at a higher level than those younger visitors. Similarly those staying on site longer and obtaining a greater familiarity with the site, perceive noise to a greater extent than those visiting for a shorter period. And finally origin of visitor significantly affects perception of noise. Local visitors were more likely than tourists to perceive noise level at an "annoying" level (89% of tourists rated perceived noise level "low", 79% of locals rated noise level "low"). Moreover, policy-makers recognise that noise perception varies with experience:

"My perception of noise has changed over time, with greater experience of the loch and with the introduction of different activities... Jet-skis make a pulsating noise that is very annoying. It used to be water-skis that were seen to be the problem, they make a constant noise, but this constant disturbance isn't as bad as the pulsating noise of the jet-skis. Now water-skiers seem almost pleasant compared to jet-skis... There are standards for noise pollution. Acts and legislation exists in urban areas, these are measurable. It's recognised that there are different levels of noise – in some areas it's acceptable, in other areas it's not. In my experience the noise jet-skis make on the loch is not acceptable" (Retired Policy-Maker).

These findings indicate that it is not just "loudness" that influences perception of noise, there are a variety of other factors influencing whether or not a person perceives a site as "noisy". This again relates to the earlier statement that it is often difficult to specify/measure noise. In particular chi-square tests show that site (a "situational" factor as discussed by Manning, 2001), age, length of stay on site, origin of visitors, date of visit, and number in group all correlate significantly with perception of noise.

During interviews with managers and policy-makers, noise is not seen to be an important issue. Crowding is also not seen to be a significant issue. Environmental conditions and resource impacts are often the biggest concern. This is in contrast with visitor perception (results from questionnaires) where noise is seen to be the most significant issue, followed by crowding and lastly environmental damage. In the travel cost model noise was the only statistically significant site quality variable. The implication of this is that noise pollution should become a bigger priority for the LLTNPA, as this project indicates that high noise levels result in reduced utility per visit. As such the initial noise hypothesis is not rejected.

Although little empirical research has been carried out to investigate perception of noise in the outdoor recreation setting, there are a few studies of noise perception that are worthy of consideration in light of the above discussion. Komanoff and Shaw (2000) provide a unique study, which addresses, in quantitative terms, "just how annoyed beachgoers in the United States are by the sound of jet-skis operated nearby" (Komanoff and Shaw 2000, 1). Using a CVM, they estimate that the average jet-ski imposes $47 (£27) of noise pollution costs on beachgoers in the course of a day's use, and provide the following strategies to reduce noise costs: develop quieter jet-skis, require jet-skis to operate further from shore, and restrict jet-ski usage to fewer bodies of water. Overall they claim that "people don't like noise and will pay to avoid it" (Komanoff and Shaw 2000, 1). This study has many links to the current research work, which also indicates that it is PWC noise that is a large deterrent to recreation enjoyment.

Matless (2000) uses the example of the Norfolk Broads in England to illustrate that any outdoor recreation area is defined through contested modes of sound. The Norfolk Broads is an area which promotes "quiet enjoyment" and noise is considered to be out of place by the Broads Authority. Modes of conduct in tune with nature appreciation and conservation are encouraged; noise is detrimental to the defined moral code. Likewise, this research project indicates that noise is seen by many as out-of-place in the "natural" environment.

In another interesting study Miller (2003) examines "transportation noise and the value of natural quiet". Looking at transportation in the U.S.A., Miller asks "what is the value to society of seeking to manage natural soundscapes for restoration and preservation?" and then estimates the geographic extent of transportation noise in the U.S.A. Using a number of complex mathematical models he shows that soundscape management in National Parks, for example, is difficult and time-consuming. Of interest to the current research project, he shows that this has not prevented the U.S. National Park Service from specifically identifying natural soundscape preservation as a management objective for all National Parks. Following on from this study, perhaps an objective concerned with noise pollution should also be a priority for National Park Management in the U.K.

A final case study of relevance to the current thesis is provided by Reijnen *et al*(1995) who studied the effects of car traffic on breeding bird populations in woodland. Looking at 43 bird species in coniferous and deciduous woodlands in the Netherlands, they tested the assumption that noise is the most critical cause of reduced bird populations. They found that 26 of the 43 species (60%) showed evidence of reduced density adjacent to roads, i.e. where traffic noise was highest. After creating a variety of different regression models Reijnen *et al*(1995) concluded that the model with noise only gave the best overall results. To conclude, then, "the effect of car traffic on breeding bird densities in woodland can be largely explained by noise load" (Reijnen *et al* 1995, 197). High noise levels appear to reduce bird population density in woodlands near main roads. This conclusion again supports the findings of the current research project, i.e. high noise levels are a negative factor that reduces recreation enjoyment. High noise levels do results in reduced utility per visit.

6.4 Environmental Conditions

Two hypotheses have been created to analyse environmental conditions. These are termed environmental hypotheses one and two, and are discussed below.

6.4.1 Environmental Hypothesis One: high visitor numbers place pressure on the natural environment.

The ecological (vegetation) survey, as presented in chapter five, supports environmental hypothesis one. For the field and shore species, TWINSPAN found, at the third level of the divisive classification, six groups of plant communities. Indicator species for the final groups include *Dryopteris filix-mas, Oxalis acetosella,* and *Vaccinium myrtillus.* According to Liddle (1997) these species have different levels of tolerance to trampling, while the former two species are tolerant to very low levels of trampling, the latter species is able to withstand low to moderate levels of trampling – suggesting that such communities are able to withstand some recreation pressure. Further, species defined by Liddle (1997) as trampling communities and which were found during the course of the field research are: great plantain (*Plantago major);* ribwort plantain (*Plantago lanceolata*); meadow grass (*Poa pratensis)*; annual meadow grass (*Poa annua*); fiorin (*Agrostis stolonifera)*; and daisy (*Bellis perennis).* According to Liddle (1997, 63), as these species are generally recognised as trampling-resistant plants they occur in lightly to fairly heavily trampled areas which are moist and quite fertile, i.e. they are indicative of areas subject to fairly high recreation pressure. The implication of this is that as these species were found during the research project, recreation pressure on the ecology of Loch Lomond is high. Likewise, Tivy (1980) states that trample-resistant plants include *Plantago major, Plantago lanceolata, Trifolium repens, Poa annua, Poa pratensis,* and *Ranunculus repens* and that these species (all of which are classic R species, i.e. grasses and weeds) tend to replace the less durable species when trampling is present. All of the species mentioned by Tivy were found during the thesis field work, again suggesting evidence of recreation pressure in the area. In particular Tivy (1980, 98) shows that on Scottish sites the dominance of annual meadow-grass (*Poa annua*) and a high proportion of bare ground are the most widespread and most distinctive indicators of damage. Again this species was found on a number of the ecological survey sites, including Kenmore Bay and Inverbeg. Very high recreation pressure was observed at the latter site in particular (see figure 6.2).

Moreover, the ecological surveys demonstrated a clear geographical division between vegetation community groups of the field and shoreline communities, primarily between the north and south basin of Loch Lomond. Statistical analysis indicated that this difference can be attributed to exposure, shade, and grazing; along with recreation pressure and visitor damage level. Crucially, recreation pressure is an important influence on the vegetation communities of Loch Lomond – supporting the initial environmental hypothesis. What is more, the plant communities are separated by recreation pressure. The implication of this is that recreation pressure is localised in specific areas around the Loch (this finding is confirmed by the visual assessment of visitor damage survey). Figure 6.2 illustrates the differences in recreation pressure (on a one to five scale, with one equal to no recreation pressure and five equal to high recreation pressure) at each survey site (see section 3.3; and section 5.3 for further explanation of assessing recreation pressure).

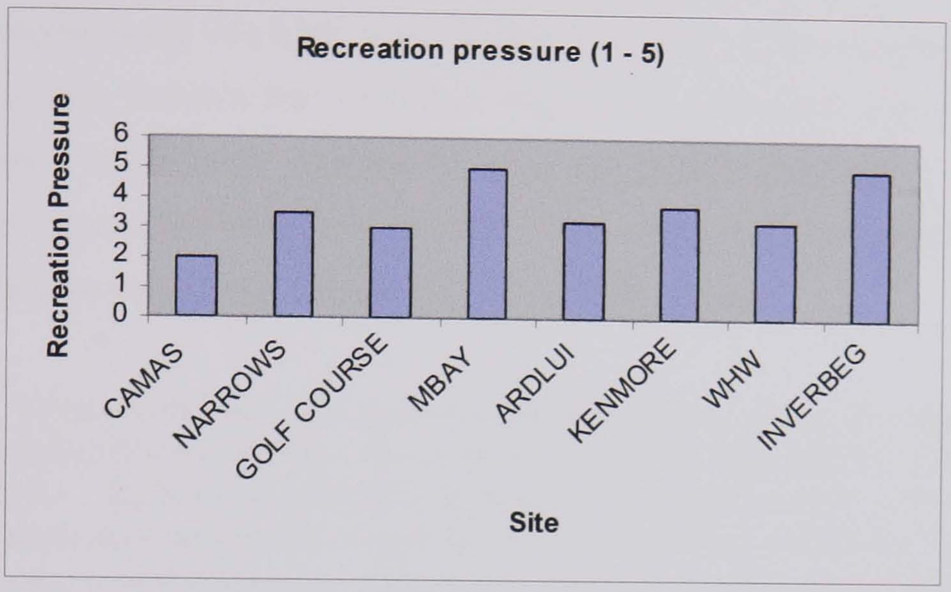


Figure 6.2: Recreation Pressure by site.

Recreation pressure is highest at both Milarrochy Bay ("MBAY" in figure 6.2) and Inverbeg (both rated 'five' on the one to five scale). At Milarrochy Bay the species *Polytricum commune, Dryopteris filix-mas* and *Vaccinium myrtillus* were found. All of these species are tolerant to certain levels of recreation pressure and can thus survive stressful recreational pressures, as discussed by Grime's 1979 CSR model (section 2.5). It is revealing that for the aquatic communities, no plant species were found during sampling in the months of May, June or September 2003. Only during July 2003 was *Elodea canadensis* found. ANOVA tests show that the lack of macrophytes obtained is partly the consequence of high recreation pressure. More generally, for the macrophytes, TWINSPAN identified, again at level three of the divisive classification, five main community types. An invasive/non-invasive division arose, implying that there is a habitat in Loch Lomond not yet invaded by *Elodea spp.* Again using ANOVA tests this division arose because of exposure, shade, and, crucially, recreation pressure (significant at $P>0.05$). Again then it appears that environmental hypothesis one is supported. High visitor numbers do place pressure on the vegetation communities of both the field and shore zone and on the aquatic macrophytes.

The visual assessment of visitor-induced environmental damage survey looks at environmental damage more generally. As the discussion of environmental literature in section 2.5 illustrates, it is important to recognise that, *"there are different forms of ecological impact. With boat recreation so popular there is now an issue about the number of boats on Loch Lomond. In particular there is a water quality, phosphorus issue emerging in the catchment. Water is a big issue for the Park, but then there are also the issues of vegetation impact, shore erosion, wildlife disturbance, and so on..."* (Manager, LLTNPA).

The environmental damage survey therefore addresses more than just impacts on vegetation. In addition to vegetation impacts, the survey investigates levels of litter, broken branches, water pollution, and shore erosion. As shown in section 5.2, it was discovered that 44% of the loch shore zone (including all major islands) experiences some level of visitor impact, with just over 9% experiencing very high visitor impact levels. It is interesting that it is the areas where visitor access is most possible that experience highest environmental damage, such as at Sallochy on the east shore of the loch. In areas where access is prevented, such as at locations in the northern basin, environmental damage is not seen. The access issue and its relevance to environmental impact is also recognised by managers of the LLTNP. Namely:

"Certain sites face the most ecological damage. Along the West Highland Way is a significantly damaged area because this is the area with the most people. Demand on the resource base is high here. Sallochy in particular is facing ecological damage since this is not as tightly controlled as those sites monitored closely by the National Park Authority. Access to Sallochy is excellent, very easy, so environmental degradation is higher here than elsewhere" (Manager, LLTNPA).

The implication of the access issue is that it is in areas where visitor access is easiest that greatest damage to the environment will result. Thus, despite the fact that only 9.13% of the loch shore experiences high levels of environmental damage, it is in these areas where recreation pressure is highest – again lending support to the hypothesis that high visitor numbers place pressure on the natural environment.

All managers and policy-makers agreed with environmental hypothesis one. Many argued, however, that it is imperative to recognise that it is difficult to disentangle the impacts of recreation from the impacts of other land-uses or indeed from the role of nature:

"We need to look at both the positive and negative changes associated with visitor use and indeed whether changes in the environment are caused by recreation or other land-uses or whether it's just natural change" (Manager, LLTNPA).

Others recognised that damage to the environment caused by recreation is not often as great as it is portrayed to be:

"In some places recreation does have serious ecological impact, yes. There is a disturbance issue associated with outdoor recreation in the Loch Lomond area. Recreation can disturb nesting birds around the loch, which is a problem... Fishing is another significant issue. The introduction of ruffe to the loch has had impacts on the ecology but we can't do anything about this, management isn't possible, we just have to monitor carefully and educate fishermen about correct procedures over the longer term... Shore erosion is another impact of outdoor recreation around the loch.

However, if boaters and users of personal watercraft stick to the speed limit then there is no problem. In fact when PWC travel faster they cause less damage than when they travel slower because of the creation of fetch and waves.... The same can be said for faster speed-boats. The huge boats moored at Cameron house do tend to contribute to ecological problems; still, they often just stay put at Cameron house and so aren't all that significant. The emergent shoreline vegetation can be damaged by these moored boats and by propellers and so on.... Ecological damage to the shoreline is caused mainly by campers, however, the level of ecological damage caused by recreation isn't as great as it is often perceived to be "(Manager. LLTNPA).

This supports the findings of academics such as Dickinson (1996, 2000a&b) and Cole (2003) and indeed the current study. The overall impact of recreation in the Loch Lomond area is therefore relatively low. Thus, the environmental hypothesis is again complex. It cannot be denied that environmental damage as a result of recreation pressure is present in specific areas of the loch, such as at Sallochy and the Narrows, but "damage to the environment is very spatially constrained... It's only a small area when looking at the whole picture... Environmental pressure is only in specific, popular areas... there's a spatial and temporal concentration of resource impact" (Manager, Forestry Commission). Still, it is at these areas of spatial concentration that environmental damage appears to be highest, supporting the hypothesis that high visitor numbers place pressure on the natural environment.

Much previous research concurs with this finding (for example Walker *et al,* 1989; Brinska, 1984; and Monz, 2002). Murphy and Eaton (1981 and 1983) provide relevant empirical studies on the ecological impact of outdoor recreation, with particular reference to the effects of pleasure-boat traffic on macrophyte growth in canals. Murphy and Eaton (1983) found that an inverse relationship exists between total, emergent, and submerged macrophyte community abundance and boat traffic. They found evidence of a "critical" traffic range for aquatic plants. In an earlier study Murphy and Eaton (1981) studied the relationship between plant abundance, faunal diversity and boat traffic density. Again they discovered that boat traffic reduces the abundance of macrophytes. However, it was further suggested that large reductions in plants are likely to have a negative influence on fish populations. Murphy and Eaton (1981) thus undertook a questionnaire survey of angling societies and discovered that the majority of those areas perceived by anglers to have too little vegetation for angling were those areas with heavy boat traffic. They found that anglers complained that passing boats disturb both them and fish populations. Although primarily an ecological study, the work of Murphy and Eaton (1981) illustrates an early example of integration of the ecological and perceptual dimensions of recreational pressures, in this case boating and angling (see also Murphy and Pearce, 1987). Angler-perceived waterplant problems and perception of boat traffic are clearly related to the actual or "real" ecological effects of recreation throughout the study. The importance of the perception of environmental impact in relation to "real" environmental impact is investigated in section 6.4.2.

Murphy *et al* (1995) also provide an interesting discussion on the effects of boat traffic on inland waterways. They provide evidence that boats affect aquatic vegetation in four main ways: "direct physical damage is caused by propellers and contact with moving hulls"; "boat-generated waves and currents cause physical damage and uprooting"; "eroded and resuspended sediment shades submerged plants and at very high levels may cause abrasion damage to plant tissues"; and "macrophyte establishment and spread are likely to be inhibited by soft, accreting, unstable and periodically resuspended layers of sediment". There is consequently a significant negative relationship between boat traffic and quantity of vegetation, with damage to the plant communities increasing rapidly once a certain critical traffic density of boats is exceeded. Despite the fact that there are enormous differences in volumes of canal and loch systems (where, in the former, powerboats can provide significant kinetic energy inputs to a channel of a confined cross-section) and energy may be insignificant in a body of water the size of Loch Lomond, the research project discovered that this finding is also true in specific areas of Loch Lomond. According to the Loch Lomond boat survey (Adams, 2001), Milarrochy Bay (a shallow, crowded area) is the most popular area of the loch for boating. Boat density is highest in this area. At Milarrochy Bay grapnel sampling obtained only one plant species on one survey day (on the remaining survey days no macrophytes were obtained) and statistical analysis shows that recreation pressure contributes in part to this lack of macrophyte vegetation – supporting the findings of Murphy *et al*'s study.

Thinking now about previous studies carried out on vegetation in the Loch Lomond area specifically, it is interesting to compare the results obtained by the TWINSPAN and 'Tablefit' analysis (see section 5.3) with previous findings from similar Loch Lomond studies. McLeod and Murphy (2003) assessed macrophyte communities present in Loch Lomond over a monthly period from May to October 2001. Consequently their results can be compared only with the aquatic findings for the current study. The main finding of McLeod and Murphy (2003) is that the introduction of non-native species and changing nutrient levels are an important threat to the macrophyte communities of Loch Lomond. Indeed they discovered that *Elodea nuttalli*, a more recent introduction than *Elodea canadensis*, is present in Loch Lomond more now than it was in the past. Correspondingly, the current study found *Elodea nuttalli* to be an indicator species for two out of the five TWINSPAN groups: group B and group D (see section 5.3).

Like the current study McLeod and Murphy (2003) established TWINSPAN communities, but, unlike this study, they used combined 1990 and 2001 data to identify trends of change in the macrophyte communities of Loch Lomond. Using TWINSPAN McLeod and Murphy found three main community groups: A, B and C. The indicator species for group A is *Utricularia sp.*; group B has two indicator species, namely *Elodea nuttalli* and *Lobelia dortmanna*, while *Elodea canadensis* and *Potamogeton perfoliatus* are the indicator species for group C. These findings are similar to those of the current study, where in particular *Elodea nuttalli* and *Lobelia dortmanna* are found to be indicator species for two separate groups.

More generally McLeod and Murphy (2003) found that *Littorella uniflora* is the dominant species in Loch Lomond, followed by *Isoetes lacustris* and subsequently *Myriophyllum alterniflorum*. All three species are found to be dominant in the current study. Furthermore, interestingly, McLeod and Murphy (2003) recorded *Juncus bulbosus* in the north basin of Loch Lomond only. In the current study, *Juncus bulbosus* is an indicator species for group A, present in the north basin only. It can therefore be stated that the current findings support much of the assessment undertaken by McLeod and Murphy (2003) into the macrophyte communities of Loch Lomond.

Similarly, Murphy *et al* (1994a) investigated the freshwater and wetland plant communities of Loch Lomond, again using TWINSPAN to classify species into community groups. Following the results of McLeod and Murphy (2003), Murphy *et al* (1994a) found *Littorella uniflora* to be the dominant macrophyte species in Loch Lomond, again supporting the findings of the current study. Like McLeod and Murphy (2003), Murphy *et al* (1994a) identified three separate TWINSPAN communities: (1) a community indicated by *Elodea canadensis*; (2) a community recognised by the presence of *Nitella flexibus*; and (3) a diverse community in which *Callitriche hamulata* is prominent. They compared their findings with the previous work of Idle (1967) (cited in Murphy *et al*, 1994a) and found that the principal difference between the two surveys was the invasion of *Elodea canadensis*. Overall, therefore, these results support the trend of the current study, i.e. invasive species are now present in Loch Lomond and these are differentiated from the non-invasive species, both by location and in terms of biomass.

In addition to the aquatic macrophyte vegetation of Loch Lomond, Murphy *et al* (1994a) also studied the emergent and wetland vegetation of the loch. This can be compared with the field and shoreline groups established by TWINSPAN for the current study. Murphy *et al* (1994a) found that emergent and wetland plants occupy six major habitat types. These are: (1) alluvial silt and mud flats, which include amphibious forms for *Littorella uniflora*, found primarily in the south-east corner of the loch; (2) periodically-inundated boulder and gravel shores, including *Carex nigra*, *Caltha palustris*, *Ranunculus flammula* and *Carum verticillatum*; (3) low-lying valley bog, containing characteristic bog plants; (4) sheltered hinterland waters, supporting among other species *Lobelia dortmanna*; (5) fen and fen meadow, mainly occurring in the lower flood plain of the River Endrick and dominated by *Carex* communities and communities indicated by the presence of *Filipendula ulmaria, Juncus effusus and Phalaris arundinacea*; and finally (6) flood plain alluvial woodland, where alder, willow, birch and oak are all to be found. As can be seen, Murphy *et al* (1994a) discovered that there existed a wide range of plant communities located along a gradient from oligotrophic to eutrophic conditions, and along a hydrosere running from deep water through to fen and alluvial woodland. These geographical differences between communities reinforce the findings of the field/shore community groups for the current study's TWINSPAN classifications.

Furthermore, Murphy *et al* (1994a) believe that in the loch's emergent zone, and in the wetlands within the catchment, growing visitor pressure has the capacity to cause significant habitat damage – a finding confirmed by this study's ecological and environmental damage surveys. Further they suggest that increasing boat traffic, as recognised by Adams *et al* (1992), has the potential to cause localised damage to macrophyte beds, adding another threat to aquatic plant communities, which are already threatened by increasing levels of eutrophication in the loch. Indeed Murphy *et al* (1994a) note that if eutrophication continues to increase there is a possibility that increased growth of invading nuisance species adapted to richer nutrient conditions, such as *Elodea* spp., may outcompete and exclude those existing submerged species. The findings of this project suggest that perhaps this has already occurred in certain areas of the loch, certainly some TWINSPAN community groups were identified by *Elodea* spp. only: non-invasive species were not found during grapnel sampling.

In summary, both the findings of McLeod and Murphy (2003) and Murphy *et al* (1994a) lend support to the results of the current ecological study. Like the current project, the importance of geographical and site differences between community groups is recognised, particularly for the emergent and wetland vegetation discussed by Murphy *et al* (1994a). For the aquatics communities many of the indicator species recognised by McLeod and Murphy (2003) and Murphy *et al* (1994a) correspond with the indicators of this research project's TWINSPAN groups. The authors also recognise the dominance of the species *Littorella uniflora* in Loch Lomond and the increasing presence of invasive *Elodea* species in the waters of the loch. Perhaps the most interesting finding of the literature is that *Elodea canadensis* and *Elodea nuttalli* appear to have spread throughout Loch Lomond in a relatively short space of time, supporting the conclusion that *Elodea* is now an indicator species for two of the five TWINSPAN groups and reinforcing the invasive/non-invasive divide between aquatic communities. Such a division could have important consequences for the future of Loch Lomond macrophytes. Invasive species could continue to increase in Lomond and eventually out-compete non-invasives. This invasive/non-invasive classification, and indeed the geographical division of the field and shore plants, can be attributed to both environmental factors and crucially recreation pressure. It appears, therefore, that the current research project supports much previous work undertaken on the ecological impacts of recreation, both specifically within Loch Lomond and more widely. Furthermore, environmental hypothesis one is not rejected. The evidence discussed here suggests that high visitor numbers do place pressure on the natural environment.

6.4.2 Environmental Hypothesis Two: visitor perception of the indicators of environmental damage differs from the actual level of environmental damage.

Of all the hypotheses proposed during the course of this chapter, environmental hypothesis two is the most complex. It was recognised in the previous section that high visitor numbers do place pressure on the natural environment, but that in the Loch Lomond area at present this environmental impact is limited. To what extent then do visitors recognise this to be the case? Often perception of environmental impact is disproportionate to actual or "real" levels of environmental impact. Either visitors perceive environmental damage at one site and then believe it is present throughout Loch Lomond (i.e. they overestimate environmental damage) or they do not believe that damage to the environment is a significant problem. Environmental damage is not a concern for them. This relationship was recognised during many interviews with managers, rangers and policy-makers:

"The ecological impacts are very site specific. You could see ecological damage, walk 100 metres and then it's no longer there. What I'm trying to say is that the actual area of damage is small compared to the size of the whole Park. But this damage can be a disproportionate size to visitors. If visitors see a site with concentrated damage this influences their perception of the whole area, they believe that Loch Lomond is suffering from serious ecological damage. It's seen to be serious damage even if it's very localised. Another perception issue... Visitor perception of environmental damage does differ from the actual level of environmental damage; in both directions. Visitors could see environmental damage as being worse than it actually is or better than it actually is. Perception and what's on the ground don't always agree" (Ranger, LLTNPA).

Thus, as stated by Gold (1980, 4), "the environmental cognitions upon which people act may well differ markedly from the true nature of the real world". This section consequently discusses the hypothesis that visitor perception of the indicators of environmental damage differs from the actual level of environmental damage. Such a hypothesis integrates both perceptual and ecological carrying capacity and is useful for establishing an overall recreational carrying capacity. This is a crucial issue for managers, and is widely recognised by them as such, as discussed in chapter seven.

Perception of environmental damage is important because it helps to establish whether visitors believe that damage to the environment detracts from the visual qualities of the site (Tivy, 1972). For some, environmental damage may be a problem, for others it may not:

"Damaging trees by lighting fires is a real problem, environmental damage on the ground. But for the visitor who created the fire it's not perceived as a problem, it's a practical solution" (Policy-Maker, SNH).

A number of questions in the visitor survey related to environmental conditions. In terms of environmental damage and its effect on enjoyment and frequency of visits, 79% of respondents stated that environmental damage does affect the enjoyment of their recreation visit; 53% stated that it affected the frequency of their visits. This result suggests that the presence of environmental damage, whilst detrimental to the overall visitor experience, does not lead to high levels of recreation displacement. Perhaps of more interest is analysis of the results on a site by site basis. During interviews it was reported that "Milarrochy Bay and Sallochy are the major pressure points of the loch" (Policy-Maker). Each visitor was therefore asked to rate the perceived level of environmental damage on site, with one equal to no damage and five equal to severe damage. The following results were found (see table 6.5):

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Rating of environmental damage	**Number of respondents *(Percent of valid respondents)***			
1 (No damage)	11 *(9.5%)*	57 *(59.4%)*	34 *(35.4%)*	38 *(39.6%)*
2	38 *(32.8%)*	38 *(39.6%)*	45 *(46.9%)*	41 *(42.7%)*
3	39 *(33.6%)*	1 *(1.0%)*	17 *(17.7%)*	16 *(16.7%)*
4	21 *(18.1%)*	0 *(0%)*	0 *(0%)*	1 *(1.0%)*
5 (Severe damage)	7 *(6%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
Total	152 *(100%)*	132 *(100%)*	132 *(100%)*	132 *(100%)*

Table 6.5: Rating of Environmental Damage on site.

As shown in table 6.5, perception of environmental damage varied by site. Environmental damage rating was lowest at Firkin and highest at Sallochy. Interestingly these results correspond with the visual assessment of visitor-induced environmental damage survey. Here again environmental damage was lowest at Firkin, highest at Sallochy. At Firkin, for example, many respondents stated, "the water here is very clean. It was one of the first things I noticed when we got to the site" (Female Visitor, Firkin) and "I don't like to see trees chopped down. It takes away from the visual quality of the area. Luckily I don't see any damage like that here "(Male Visitor, Firkin). As the visual assessment of environmental impact also shows that visitor damage is high at Sallochy, but that it is also present (although to a lesser extent) at Firkin, perception of environmental damage partly corresponds with "real" levels of visitor impact. It appears that the initial hypothesis can be rejected. Defining "environmental damage" further the following results were found (see table 6.6):

Environmental damage	**VISITORS - % YES (actual rating of environmental damage on site: with 1 = not seen, 5 = severe damage).**			
	Milarrochy Bay	**Sallochy**	**Firkin**	**Rowardennan**
Litter	15.6% (2)	83.6% (5)	6.3% (1)	25% (3)
Dead trees	9.4% (4)	60.3% (5)	1% (2)	17.7% (1)
Water pollution	3.1% (2)	31.9% (1)	0% (1)	3.1% (1)
Exposed tree roots	26% (4)	56.9% (5)	1% (3)	19.8% (3)
Broken branches	22.9% (4)	71.6% (5)	1% (2)	29.2% (3)
Damage to ground vegetation	15.6% (4)	62.9% (5)	1% (2)	28.1% (3)
Wearing away of the beach	21.9% (4)	54.3%% (4)	2.1% (1)	9.4% (3)
Does it worry you to see any of these things?	68.8%	79.3%	91.6%	70.8%

Table 6.6: Perception of Environmental Damage by site *(Q 15: Did you notice any of the following kinds of environmental impact on the site...?).*

Like the visual assessment of visitor-induced environmental damage, systematic observation on the day questionnaires were issued showed that Sallochy is subject to the highest levels of environmental damage, and Firkin the least. Visitor perception agrees with these findings, but to varying extents. For example, at Firkin exposed tree roots, broken branches, and damage to the ground vegetation were underestimated by the visitor, while at Milarrochy Bay water pollution was overestimated (the researcher saw no evidence of water pollution at Milarrochy Bay, however, 3.1% of respondents believed water pollution to be present). The water pollution factor is particularly revealing. Perhaps because many boats and PWC were present at Milarrochy Bay visitors assumed that water pollution would be present, although they did not actually see any evidence for this on-site. Clearly here perception is influencing visitor opinion.

As with the crowding and noise themes, chi-squared statistical tests of association were carried out on environmental variables (section 4.3.2). Perception of environmental damage included aggregated data from perception of litter, dead trees, water pollution, exposed tree roots, broken branches, damage to vegetation, and beach erosion. Using chi-square tests of association ($p>0.99$) a significant relationship was found between site visited and perception of environmental conditions. A good example of this is litter. At Sallochy 83.6% of respondents noticed litter on site, while at Firkin only 6.3% reported seeing litter. Similarly, while at Sallochy 62.9% of people recognised damage to the ground vegetation, at Milarrochy Bay only 15.6% of respondents recognised such environmental conditions. It is thus suggested that the environment is perceived to be significantly worse at Sallochy than it is at either Firkin or Milarrochy Bay (or indeed Rowardennan – see table 6.6).

Interestingly, the variables age and experience of site were not significant using chi-square tests, suggesting that familiarity with a site does not have a significant affect on perception of environmental damage. Perception of environmental damage and activity undertaken by the respondent is also not significant using the chi-squared test. Still, during on-site interviews the interviewer was told, "environmental damage certainly affects my enjoyment. I'm a photographer so any environmental damage affects my photos" (Male Visitor, Rowardennan). Perhaps then if type of activity had been differentiated further, a significant relationship would have been found. There is nonetheless a significant relationship between perception of environmental damage and mode of transport and date of site visit. The former finding suggests that those walking to a site are more environmentally conscious than those driving, while the latter result implies that time of year has a significant influence on the perception of environmental damage on site. Those visiting at the beginning of the season recognised less environmental damage than those visiting at the end. Perhaps this does reflect reality, i.e. the site became more degraded or "damaged" as the summer season progressed and hence here perception and reality do correspond.

The contingent valuation model investigates the factors influencing visitor perception of environmental damage in more detail, specifically with reference to whether or not visitors would be willing to pay for environmental improvements. 81.2% of visitors would be willing to pay a car parking fee to fund environmental improvements and the average willingness to pay to fund environmental improvements is £1.76. Furthermore, the CVM shows that income, sex and perception of environmental damage all significantly influence visitor willingness to pay for improved environmental conditions. In particular perception of environmental damage was positive and significant at $p>0.05$, thus as the level of perceived environmental damage increases, people are more willing to pay a parking fee to fund environmental improvements. It is therefore argued that a parking fee to fund environmental improvements would be most widely accepted at those sites where visitors recognise that there already exists some level of environmental damage, such as Sallochy. In order for this implementation to be successful it is fundamental that perception of the environment and actual environmental conditions correspond. Indeed, it is worthwhile remembering that the variable "perception of environmental damage" is not significant in the travel cost model, implying that environmental damage need not be a priority for National Park management in the Loch Lomond area. However, both the visitor damage survey and systematic observation of environmental conditions show that at specific sites (in particular Sallochy and "pockets" along the west shore) environmental damage is of significant scientific concern, meaning that action is justified. What is more, the CVM survey shows that people are willing to pay for measures that reduce environmental damage, once this has been explained to them. There is, therefore, a need for perception of the environment and actual environmental conditions to correspond in order for environmental management to be deemed successful.

In terms of valuation, the travel cost model estimated consumer surplus per trip at £20.53 under current conditions. This consumer surplus is relatively high and thus in theory a parking fee could be put in place at various sites around Loch Lomond, to "capture" some of this surplus for park authority use and fund environmental improvements. The high consumer surplus value suggests that visitors to Loch Lomond do not currently pay as much as they would be willing-to-pay as they enjoy the park. At the 95% level of confidence, as much as £24.72 per person per trip could be gained by the LLTNPA. The valuation results of this study's negative binomial model can be compared with previous travel cost studies. Consumer surplus can vary considerably depending on the model specification. Here only studies employing negative binomial and semi-log specification are addressed – since the semi-log form is very close to that of the negative binomial.

Hanley (1989) undertook travel cost analysis for 319 respondents visiting the Queen Elizabeth forest park. The forest park survey site is located approximately 20 minutes from Loch Lomond. Four candidate functional forms for the trip generating equation were considered. For comparative purposes only the semi-log is reported here. Indeed, Hanley (1989) found that the semi-log produced the best estimate for consumers' surplus, with a value of £1.70 per trip or £160,000 per annum. This is equivalent to £3.45 or £324,857 in 2002 prices (GDP inflation index, 2005). In a similar study Willis and Garrod (1991a) measured the recreational value of Queen Elizabeth Forest Park, again using a semi-log specification. They valued a CS of £2.72 per visitor (equivalent to £5.10 in 2002 – GDP inflation index, 2005). Although both these estimates are a lot lower than the current CS for Loch Lomond it must be remembered that as this survey was undertaken in 1987 costs of trips are now considerably higher. Moreover, Loch Lomond could be seen to be a more "attractive" area than the Queen Elizabeth forest park, producing different CS values.

In 1989 Willis and Benson valued a further six U.K. forests for the Forestry Commission. Using a semi-log specification and a CS based on individual visits per annum, they obtained the following results:

Forest District	**Travel-Cost Coefficient**	**CS per visitor (1988 £)**	**CS per visitor (2002 £) (GDP index)**
Brecon	-0.3837	2.60	5.77
Buchan	-0.4442	2.26	5.01
Cheshire	-0.5252	1.91	4.24
Lorne	-0.6937	1.44	3.19
New Forest	-0.7021	1.43	3.17
Ruthin	-0.3963	2.52	5.59

Table 6.7: U.K. Forest Sites. Adapted from Willis and Benson (1989).

As table 6.7 shows, the coefficients are considerably different in size than the DISCOST coefficient (section 4.4.1), again giving rise to a much smaller CS estimate. This implies that the current negative binomial model has a relatively large CS estimate, which is advantageous in the creation of a car parking fee at Loch Lomond sites. The higher CS is the consequence of Loch Lomond having fewer substitution sites and being more special than these forest sites. It is also an area of unsurpassed Scottish beauty. The values derived above are relatively close to the current study's negative binomial CS estimate of £20.53, suggesting that a stable and robust TCM has been created.

Furthermore, while the TCM values a typical day at Loch Lomond at £20.53, from the contingent valuation study it is seen that visitors would be willing to pay an additional £1.76 per trip to fund specific environmental improvements. Clearly these figures suggest that there is an opportunity for the National Park Authority to generate revenue and help conserve the natural environment, primarily through various environmental pricing policies. Moreover the environmental contingent behaviour model found that perception of environmental damage significantly influences the number of trips made to the study area. In particular as the level of perceived environmental damage is reduced, the number of trips made should increase (by 0.21%). Environmental improvements would significantly increase trips and attract visitors to the Loch Lomond area[28]. Again then it is fundamental that perception of environmental damage and actual level of environmental damage correspond.

The majority of managers and policy-makers interviewed believed that visitor perception and actual levels of environmental damage differ and hence do not correspond. When asked the extent to which they agreed with the hypothesis that visitor perception of the indicators of environmental damage differs from the actual level of environmental damage, 70% said that they agreed with the hypothesis (perception and actual conditions do differ), 20% of interview respondents stated that they disagreed with the hypothesis, and 10% stated "I don't know, maybe". Some argued, "people don't appreciate how the environment works. They don't realise that human activity can be intrusive. The public don't recognise the indicators of environmental damage and should be educated to realise these" (Policy-Maker, SNH). Attitudes to the environment are influenced by the level of environmental education and must be viewed in terms of local knowledge (Harrison and Burgess, 2000). Others believed that:

"Acceptance that environmental impact exists must become part of everyday life. Ecological damage is real but this reality depends upon how people judge the damage... People must accept that an action that they perceive to be good can in fact be harmful: it can have real consequences" (Retired Policy-Maker).

In short, people must realise that they have an intricate relationship with their environment (Brady, 2006). During one interview, the following revealing anecdote was provided:

"There is ecological damage on our sites but not on a large scale; it's not major. Why I say this is because I spent eight years living in the centre of Manchester where wildlife survives in what can only be described as dumps! The perception is that these dumps look bad but in reality wildlife is surviving and so environmental damage in its real sense is not present. With real environmental damage I remain to be convinced that it is actually there... If a beaver fells a tree it's no problem at all, it's natural, but if "neds" fell it then it's a problem. This leads us to the question of what is environmental damage? When a lot of people speak about environmental damage they're referring to vegetation trampling. Trampling isn't a big problem in the forest itself because most people stick to the paths and from the car parks most people head to the beach. There is probably damage to the aquatic shoreline but what is the environment if not to be enjoyed by humans? I'm not convinced that any serious ecological damage exists in our area. Most woodland wildlife can co-exist with people. I've seen squirrels in Sallochy even when it's been very busy" (Manager, Forestry Commission).

As seen in the above extract, the definition of what environmental damage actually is, is crucial. Often what is perceived as damage for one person, is a "natural" environmental condition for another. Indeed, this thought-provoking question is directly relevant to wider philosophical issues surrounding nature, the natural environment, and culture (see Warren, 2002; Zimmerer, 2000; Van

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[28] As an interesting aside, 46.2% of Lomond boaters in the 2001 survey agreed or strongly agreed with the statement, "the general environment on the loch and its shores has improved" (Loch Lomond Boat User Survey, 2001), implying that some environmental improvements have already taken place.

den Born *et al*, 2001; Brady, 2006; and Havlick, 2006), namely: what is natural? Is enhanced naturalness always an appropriate objective? What is the appropriate place for human beings within non-human nature? Is "natural" always best? As Van den Born *et al* (2001) note, visions of nature are the subject of much philosophical debate. 70-90% of the population recognise the right of nature to exist even if not useful to humans in any way (Van den Born *et al*, 2001). Nature deserves respect (Cooper, 2000). However, in much of the developed world few areas of true natural wilderness remain; wilderness is no longer a "natural" state. Humans have shaped the natural landscape over many millennia. The Scottish landscape, in particular, has been modified by human processes, through, for example, forest removal and agricultural change (Warren, 2002). The place of human beings in the environment does, however, remain a controversial topic (see Warren, 2002). Often environments that have been altered by humans are regarded as less valuable than pristine wilderness areas. But it is unhelpful to assume that non-human nature is "good" and human involvement is "bad". As Warren (2002) suggests, the choice should not be between interference and non-interference, but rather about the extent of environmental management required. "In its current state, nature needs nurture" (Warren 2002, 15).

Practical answers to the above ethical questions are often site-specific. For example, of all the indicators of environmental damage suggested for Loch Lomond, it was litter – an anthropogenic impact – that was of greatest concern to the majority of visitors:

"The litter should be removed. It's disgusting to see. I respect the countryside and other people should do the same" (Female Visitor, Sallochy).

"There is far too much litter on this site. It makes the site look really untidy. There's a tree over there with lots of plastic bags under it where people must be collecting their rubbish. They really need bins on this site. Yesterday I picked up some broken bottles and crisp packets and things that were lying about. They need bins" (Female Visitor, Sallochy).

Removing litter from Sallochy, for example, was seen as more important for many visitors than reducing the level of trampling to the ground vegetation. Possibly this is because litter is one of the most visible signs of damage to the environment. Litter is seen as unnatural in the "natural" environment. It was not just at Sallochy that litter was seen to be a problem. Visitors at all four sites mentioned litter as one form of environmental damage, for example:

"There are enough bins here already for there to be no litter. Litter really annoys me and there's no excuse! Any litter that I see I'll pick it up" (Female Visitor, Milarrochy Bay).

"It worries me to see litter lying about. If I do I always tidy it up. That's one of the reasons why I like this site: it's very clean" (Female Visitor, Firkin).

While many visitors believed that "the site and loch in general is a lot more pleasant without any environmental damage" (Male Visitor, Firkin), others stated, "yeah, there is environmental damage here but it's been here for years... Does it affect the enjoyment of my visit? It depends, probably not" (Male Visitor, Sallochy) – indicating that perception of environmental damage can be specific to individual preference. Indeed, as presented in chapter four, overall 34.7% of respondents rated environmental damage as a '1' on site, i.e. they did not see any environmental damage on site. As the visual assessment of visitor-induced environmental damage showed that the sites where visitors were questioned were those areas of highest visitor damage, this perception seems problematic. Apparently, reality and perception do not correspond. However when it is realised that the visitor damage survey only found 9.13% of the loch to suffer from high environmental damage levels, then perception and reality do appear to correspond.

As the above discussion explains, the initial hypothesis that visitor perception of environmental damage differs from the actual level of environmental damage is complex. To summarise, in terms of "real" environmental damage, it was found that this was highest at Sallochy, followed by Milarrochy Bay, then Rowardennan and least at Firkin. At Sallochy the visitor damage assessment rated environmental damage "severe". The visitor survey indicated that visitor perception confirmed this finding. However, for many it was litter rather than damage to the vegetation, for example, that disrupted their recreation enjoyment. Moreover, although environmental damage was recognised by many, others (9.5%) did not see any damage on site and stated that such impact would not detract from their overall enjoyment or alter the frequency of their visits. In terms of enjoyment, the presence of crowding or noise pollution (from "local youths") was seen to be more important than actual environmental conditions. At Sallochy then the hypothesis is neither rejected nor accepted.

At Milarrochy Bay, crowding and noise were seen to be even more important than environmental damage. 39.6% of respondents stated that they saw no environmental damage on site (see table 6.5), despite the fact that both the visual assessment of visitor damage and the ecological surveys recognised that environmental damage and recreation pressure was present at Milarrochy Bay. At Milarrochy Bay, then, it appears that the hypothesis is not rejected. Visitor perception of environmental damage does differ from the actual level of environmental damage.

At Rowardennan 35.4% of respondents said that they saw no environmental damage, and nobody rated environmental damage severe at either rating four or five (see table 6.5). This is interesting as the visual assessment of visitor damage survey rated Rowardennan as an area of high visitor damage. Clearly the majority of visitors did not perceive this. Again then the hypothesis is not rejected; it is confirmed.

Firkin is an interesting site. Here systematic observation by the researcher and the visitor damage survey recognised that while some environmental damage was present, this was to a much lesser extent than at any of the three remaining sites. The visitor damage assessment did. however, rate Firkin as a four on the one to six scale. As shown in table 6.5, a resounding 99% of visitors rated environmental damage at '1' or '2' on the perception scale. Clearly for the Firkin visitor environmental damage is not an issue, implying that perhaps the visitor underestimates the presence of environmental damage at Firkin. Again then perception and reality do not appear to correspond, and thus the hypothesis cannot be rejected.

The above site summary shows that rejection of the second environmental hypothesis is not straightforward when investigated on a site-by-site basis. Looking at the level of environmental damage around Loch Lomond overall, the hypothesis is neither rejected nor confirmed. The ecological surveys showed that recreation pressure and visitor damage level both have a significant influence on the vegetation communities of the loch. However, the visitor damage survey illustrated that this impact was very site specific and localised. As for the "typical" Loch Lomond visitor crowding and noise, rather than environmental damage, is the main issue, it could be claimed that visitor perception and environmental reality overall do correspond. However, a statement such as this is problematic, as shown through the site discussion above. It is therefore maintained that perception and reality are highly interwoven. When looking at perception of environmental damage and correspondence with actual levels of environmental damage. this should be done on an individual site basis. As the contingent valuation study shows, visitor perception can be altered. Even visitors who did not recognise environmental damage on site were willing to pay for environmental improvements once the impacts had been explained to them. Any disparity between reality and visitor perception should therefore be addressed by management and overcome through the provision of information and education (see chapter seven).

Fundamental to environmental hypothesis two is the interaction between people and their environment. There have been a number of perception studies where human/environmental relationships are emphasised (see Walmsley and Lewis, 1993; Hammitt, 1983; Kates, 1970; Brookfield, 1969; and Lowenthal, 1967), and many of these concur with the above discussion. From the late 1960s a plethora of research developed in Geography concerned with perception of environmental hazards (see for example Arsdol *et al*, 1964). Most notable is the work of Saarinen, who in 1966 studied the perception of the drought hazard on the Great Plains. Saarinen (1966) was interested in wheat farmers' perception of the drought hazard. He hypothesised that perception of the drought hazard will vary according to the aridity of the area, the amount and frequency of drought experienced by farmers, and personality differences. The hypotheses were tested in six areas within the winter wheat belt of the Central Great Plains, where a random number of farmers were selected and interviewed. For each area "real" climate data were compared with perceived climate data. All three hypotheses were confirmed and the strongest single relationship found was that perception of the drought hazard varies with aridity. Thus, the greater the amount of drought experience, the more accurate the perception of drought risk (Saarinen 1966. 138). Similarly, the current research project found, for example, that perception of the environment varies according to site visited, but this is not affected by age of the respondent, appearing to confirm the findings of Saarinen (1966), who concluded that the environmental situation rather than personality differences are more important when looking at perception of the environment.

Although research into perception of environmental hazards forms the majority of early work on perception and the environment, later work demonstrated a shift toward studies of perception specifically in relation to the outdoor recreation environment (see Knopp, 1972; Aldskogius, 1977; and Theodori *et al*, 1998). Hillery *et al* (2001) offer a useful analysis of tourist perception of environmental impact at ten sites in Central Australia. The hypothesis tested was that "the extent of environmental impact was likely to be greater at sites with higher annual arrivals and, if this was the case, that visitors would perceive sites with higher tourist numbers and impact to be more changed than those frequented less" (Hillery *et al* 2001, 855). Environmental variables and tourist perceptions were measured. It was found that tourists' perception of impact varied in degree, and an equivalent finding was obtained in the current research project. A positive relationship between annual visitation to a site and measurable impact was found, despite the small amount of tourism impact in the area (Hillery *et al*, 2001). Hillery *et al* (2001) conclude that it is important to study and manage recreation areas in relation to a critical level of environmental impact for user satisfaction. A similar conclusion can be drawn from the current study: management must address both the environmental and social impacts of outdoor recreation.

A further, overall, conclusion is that environmental hypothesis two is neither rejected nor confirmed. 'Real' environmental damage around the loch, from the visitor damage survey, was seen to be relatively low. The majority of visitors correspondingly believed that environmental damage in the Loch Lomond area was low (in comparison to noise levels and levels of crowding). Therefore both perception and reality concur and the hypothesis should be rejected. However, when addressing the hypothesis on an individual site basis, it cannot be denied that environmental damage is present locally, particularly at Sallochy where many visitors did not recognise environmental damage, or if they did it was not a priority for them. Thus, from this site perspective the hypothesis should not be rejected: visitor perception of the environment and environmental reality do differ.

6.5 The PWC Debate and Conflict

A significant element of outdoor recreation in recent years has been the growth of fast, powerful water-craft. In particular PWC are fast becoming numerous in many waters, as they are relatively cheap and easy to transport (Dickinson 2000a, 44). The growth in PWC use has been accompanied by a growing controversy surrounding use of such craft. Controversial issues surrounding their use include noise, safety and environmental impact. The current controversy surrounding the use of PWC on many inland waters therefore combines both perceptual and ecological issues, and integrates the previously discussed themes of crowding, noise and environmental conditions. To this end the "jet-ski" debate is now investigated as a case study, firstly from an ecological and then from a social perspective.

The environmental impacts of PWC are as interesting as they are complex. The growth in PWC use throughout the U.K. in recent years has the potential to contribute to multiple environmental impacts. In 1998 there were approximately 17,000 jet-skis in the U.K.. By 2002 this figure had risen to 20,500 and continues to rise (Boocock, 2002). Such high numbers do have an impact on ecosystems that are fragile and have little ecological resilience. It is widely accepted that PWC impact on the environment in the following ways: through emissions which contribute to water pollution, through the harassment of wildlife/bird populations as a consequence of PWC noise, and through the disruption of aquatic vegetation. These impacts are now briefly examined in turn.

Many PWC are powered by two-stroke engines, which run on a mixture of oil and petrol (gasoline), and can discharge as much as one-third of unburned fuel into the water. The Bluewater Network claim that an average two-hour "thrill" ride on a PWC can emit between three and four gallons of petrol and oil into the water. This is twice as much pollution as an equivalently powered motorboat. The reasons for this are threefold: PWC operate at higher average horsepower than do conventional motorboats; PWC operate at higher average throttle settings; and, PWC have higher annual usage rates than do conventional motorboats (Bluewater Network, 2003). In addition to water pollution through the spilling of uncombusted oil and petrol, two-stroke PWCs can also pollute the air by producing hydrocarbons and nitrogen oxides. A number of studies have been carried out on water, and air, pollution generated by PWC use, particularly in the U.S.A. where jet-skis are highly controversial. An investigation into the use of two-stroke PWC at Mission Bay, San Diego is one such example. The study concluded that the extent of pollution in Mission Bay is considerable (Bluewater Network, 2003). Many studies have, however, shown that the levels of exhaust emissions found in many lakes are not so high as to impose harmful effects (United States Environmental Protection Agency, 1994).

Disturbance to wildlife is seen through the vulnerability of wading birds, waterfowl and sea birds to PWC noise (see for example the British Marine Industries Association, 1999; Rodgers, 2003; and Burger, 1998). Absence of external propulsion enables PWC to operate in shallow water with less risk of damage to the craft than other types of motorboat. This allows jet-skis to "play" in areas where wildlife is often present, causing disturbance (including disturbance to breeding patterns). Moreover, there is a danger of physical collisions between PWC and wildlife. A similar problem is also seen for vegetation. A good example of this is PWC damage to seagrasses, particularly in shallow areas where other craft are unable to reach (see for example The Port Hacking Society, 2001). A study conducted by the Personal Watercraft Industry Association (1997) on the effects of PWC operation on shallow-water seagrass communities in the Florida Keys has nonetheless given rise to some interesting results. The conclusion reached was that PWC had not caused scarring of grassbeds, as water turbulence did not extend down to the level of the seagrass blades. Further studies carried out by the Personal Watercraft Industry Association in the U.S.A. indicate that PWC manufacturers are now making their vessels quieter and cleaner. Technology is changing, many newer PWC contain cleaner, less environmentally polluting, four-stroke engines. Studies such as these demonstrate the complex nature of the environmental impacts of PWC use. Generally, however, it cannot be denied that environmental impact does result from high levels of PWC use, particularly in fragile, vulnerable ecosystems.

Moving on to the environmental impacts of PWC in the Loch Lomond area specifically, again such impacts are a consequence of the rising number of this fast-moving craft. Bissett *et al* (2000) show that there has been a change in recreational boating activities at Loch Lomond. In particular it is estimated that there has been a statistically significant increase in the number of PWC on Loch Lomond between 1989 and 1999 ($p<0.01$). As seen in table 6.8, in 1989 1.3% of recorded craft were jet-skis, but by 1999 this figure had risen considerably to 11.1%. Interestingly, as the number of jet-skis increased, the number of fishing boats and canoes significantly decreased (at $p<0.01$) (Bannan *et al*, 2000). Traditionally conflict has arisen between these different recreational groups, suggesting that perhaps PWC use is displacing traditional boating activities.

Overall, at Loch Lomond there has been an increase in all craft activity between the period 1989 to 1999. Bannan *et al* (2000) predict that such craft activity will double in approximately eleven to thirteen years, with the general trend being a switch from slow moving powered craft towards higher speed craft, such as PWC. This is a general trend across most of the areas of the loch and can also be seen at relatively small spatial scales (Bannan *et al*, 2000).

Year	Jet-ski (%)	Fishing Boats (%)	Canoes (%)	Total (Number)
1989	1.3	14.8	7.6	2246
1990	3.0	7.8	7.0	2233
1991	4.8	8.2	3.1	2930
1992	6.3	6.2	5.5	1481
1993	4.6	7.6	6.9	2245
1994	5.8	6.6	3.9	5390
1995	4.6	4.3	4.8	6583
1996	7.6	3.8	3.0	7290
1997	6.7	4.7	2.8	7454
1998	9.8	4.2	3.2	7871
1999	11.1	5.2	2.9	8097

Table 6.8: The percentage of jet-skis, fishing boats and canoes recorded from 1989-1999. (Source: Bissett *et al* 2000, 263.)

The increasing numbers of jet-skis on Loch Lomond once again have the potential to contribute to environmental degradation. Bannan (1999) has shown that rising number of jet-skis, along with recreational boating in general, has increased the amount of hydrocarbons in Loch Lomond and has detrimentally affected water quality. He found that jet-skis have the highest emission rates of all craft, producing an estimated mean of 2150 g of hydrocarbons per hour. This is 6.5% of the total amount of emitted hydrocarbons into Loch Lomond, which was estimated at 25.50 tonnes in 1999 (Bannan, 1999). In addition to hydrocarbon pollution, other environmental impacts as a result of PWC use on Loch Lomond include: increased turbidity caused by PWC, bank erosion caused by boat wash, damage to vegetation and associated plant communities, and disturbance to wildlife caused by jet-ski use. In the latter case, fish may swim at deeper levels and some bird species may be displaced locally (Dickinson 2000a, 45). Studies carried out at Loch Lomond into these issues have, however, shown that environmental impact is limited in spatial extent and there is little evidence that these impacts are a serious problem at Loch Lomond at present (Dickinson, 2000a). Indeed, as illustrated in figure 6.3, at Milarrochy Bay (one of the most popular areas for PWC in Loch Lomond) swans, cygnets, and PWC appear to exist side by side.

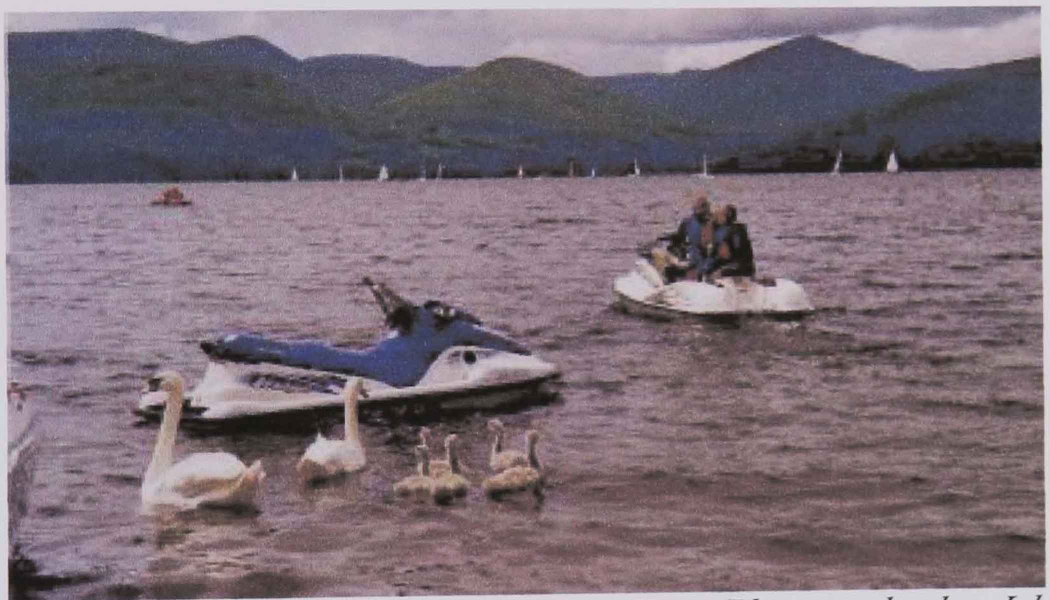

Figure 6.3: PWC and swans, Milarrochy Bay *(Photograph taken July 2004 by author).*

Still, it should not be overlooked that the ecological effects of PWC could increase as the number of craft continues to grow. Ecological thresholds may be exceeded. Moreover, the perception that PWC causes serious ecological degradation is often used to substantiate the anti jet-ski claims of fishermen, sailors and the like. It is this perception of PWC use that partly fuels the conflict between recreation users and should hence be of great pertinence to the resource manager. There is a disparity between perception and reality. As the British Marine Industries Association (1999, 5) state, "even when used with care and skill, high speed PWCs create a perception of danger. However they do not feature significantly in the overall picture for U.K. marine rescue and lives lost at sea".

Furthermore, relating the PWC debate findings (section 4.6) back to the theoretical position outlined in section 2.6, out-group conflict (as opposed to in-group conflict) exists between different recreation groups, namely those jet-skiing and those not jet-skiing. In terms of interpersonal conflict (direct contact, where physical presence is required) and social values conflict (indirect contact/shared norms), the research indicates both types of conflict. Interpersonal conflict is demonstrated in the results of the on-site questionnaire: when asked about any impacts on their recreation enjoyment, 48.4% of respondents stated that "jet-skiers annoy me". As this statement was given on-site, where jet-skis were present, this is clearly an example of interpersonal conflict. Conversely, interviews with sailors and anglers, both undertaken away from the major recreation sites, demonstrate social values conflict. The following quote from one sailing club member illustrates this point:

"Jet-skis? Oh, they're so noisy and they're often driven by aggressive people... Jet-skiers are completely different to sailors. We're a lot more placid!" (Sailor).

Clearly, the respondent was differentiating between the supposed norms of a jet-skier and the norms of a sailor, despite the fact that there were no jet-skis present on the day when the interview was conducted. Here, then, there is a social angle to conflict. This view also hints at a bigger question of <u>who</u> is Loch Lomond for? Who has the <u>right</u> to make use of this resource? Who has apparently demonstrated the right levels of respect, appreciation, sensitivity and commitment to the local environment? Evidence from the current research indicates that the answer to these questions varies for each of the different recreation groups and cultural background. The jet-skiers believe that everyone has a right to enjoy Loch Lomond, while the more traditional users argue that only those participating in quiet, environmentally sustainable pursuits should be allowed access to the loch. Values and opinions are specific to recreation group, and, more generally, "conflict and its means of resolution are culturally determined" (Sidaway 2005, xiv).

In terms of the theory that resenting relationships are asymmetrical (Devall and Harry 1981, 402), it was confirmed that more traditional, passive users – such as anglers and sailors – dislike the more obtrusive jet-skiers much more than the latter dislike the former. In other words, while the non jet-skiers demonstrate a dislike towards users of PWC, the PWC users themselves are not especially affected by other recreation activities. Interview findings such as "there are no specific groups or sports that disrupt me" (Jet-skier, telephone interview), and statistical findings confirm this trend. Indeed, there was a statistically significant relationship between perception of jet-skis and activity, with the more traditional the activity, the greater the dislike towards jet-skiers. This one-way, or asymmetrical, relationship confirms the results of many previous conflict studies (see for example Devall and Harry, 1981; and Carothers *et al*, 2001). It also supports the findings of Vaske's conceptual model and five formal hypotheses introduced in chapter two.

In terms of hypothesis one (see section 2.6), the findings confirm this statement. Noise, facilities and differences between recreation activities all affect the importance attached to activity.

Moreover, both anglers and sailors stated that they had been undertaking their activity for many years. The average number of years sailing on the loch was 27.5 years, with a number of sailors stating that they had sailed for over thirty. Similarly, anglers had been fishing on Loch Lomond for an average of 30.6 years. Conversely, jet-skiers had been jet-skiing for an average of 6.3 years (nine of the thirteen respondents had been jet-skiing for less than two years). It is assumed that recreationalists undertaking their activity for a longer period, such as anglers and sailors, will have a higher affinity with this activity and therefore attach a greater importance to their sport. The longer a recreationalist has been using a place, the more they feel that they have <u>earned</u> the right to use it (and to have their views respected). As such there will be more conflict from groups with a greater historical attachment to their recreation activity: they will dislike the activities of new, mechanised sports and new technologies more than will the newer recreationalists, such as jet-skiers. The anglers and sailors therefore attach more importance to activity than do the jet-skiers.

Hypothesis two is also confirmed by the findings of the interviews, particularly with anglers. The primary resource for the angler is the fish, and they thus attach great importance to this resource. Jet-skiers are seen to disturb the fish and consequently conflict results. The quote below demonstrates this argument:

"They [jet-skis] *leave disruption, they've disrupted the fish and destroyed your fishing experience and they have no idea"* (Angler).

Environmental impact concerns also affect resource specificity, and hence the importance attached to the recreation resource. Again it is anglers and sailors who attach a greater importance to environmental impact, and are more concerned with resource degradation than are jet-skiers.

Hypothesis three is also addressed by the results of interviews. Mode of experience is defined as being either focussed or unfocussed (Vaske *et al* 2000, 300). All groups interviewed appear to be focussed, but for different reasons. While the anglers were focussed on the availability of fish, the sailors were more focused on weather conditions and a peaceful natural environment. Conversely, the jet-skiers were focussed on fun and enjoyment – waves created by speed boats for example were often cited as an important element of the recreation experience. The mode of experience for all groups was focussed (rather than unfocused), but for different reasons. As recognised by Vaske *et al* (2000), this hypothesis could be the subject of further study, and there is a need for education and information in order to alert recreation users to different modes of experience. In addition to theoretical value, then, this is an important policy finding: there is a need to establish broad-based user groups to inform Park policy, allowing different constituencies to talk to one another in an informed fashion. Such an approach should help reduce conflict.

In terms of tolerance for lifestyle diversity (hypothesis four), it is clearly seen that, as tolerance for lifestyle diversity increases, conflict decreases, thus supporting the hypothesis. Sensitivity to conflict is relevant here. The jet-skiers often have a "live and let live" attitude, and they are tolerant of diversity and not affected by the activities of other loch users. On the other hand, the sailors and anglers have a low tolerance for lifestyle diversity, preferring to be in the company of their "own kind", and as a result conflict between themselves and jet-skiers is high. Anti-social and irresponsible behaviour undoubtedly increase conflict for non jet-skiing groups. These findings confirm that "those who demonstrate low tolerance for persons with differing lifestyles will be more likely to experience conflict" (Vaske *et al* 2000, 300).

Finally, hypothesis five is also confirmed by the findings of the case study. Safety concerns do represent a potential indicator of conflict, with anglers, sailors and local businesses often stating that jet-skis represent a safety hazard. Speed, in particular, is seen to lead to potentially dangerous situations, and there is a perceived need to police jet-skis or implement some kind of zoning or even the implementation of a ban against jet-skis. Overall, anglers and sailors perceive the jet-skiers to be reckless and threatening to a safe environment. In particular:

"If there are a lot of jet-bikes in one area then the danger increases... People want to be safe when they're out on the water. If jet-bikes are buzzing about all over the place then you can be certain that they won't feel safe. I know I don't" (Sailor).

As the anglers and sailors perceive more safety-related problems than did the jet-skiers, hypothesis five is confirmed.

The above hypotheses all form the basis of Vaske's conceptual model (section 2.6). The findings of the research case study correspond with this conceptual model and, taking the current findings into consideration, Vaske's model has been modified and adapted to represent "conflict" as it is experienced by recreation users at Loch Lomond. The adapted model is shown in figure 6.4. This model indicates the main themes from all (jet-ski debate) interviews and defines where they correspond with Vaske's conceptual model. It is necessary here to reiterate that the conflict is one-sided, jet-skiers do not experience it, and therefore the model is for sailors and anglers only. A conceptual model such as this is a useful means by which to think about recreation conflict from a theoretical perspective.

A theoretical perspective on conflict is fundamental with respect to management of the recreation experience. Indeed, for Manning (2001), management of conflict must be based on an understanding of the underlying causes of conflict. Management actions will only be effective if they address these factors. The implications of the conflict findings for resource and recreation management are subsequently now examined. It is proposed that, in order to reduce conflict, management should address all factors outlined in the conceptual model (figure 6.4). A number of strategies could be used to address these causes of conflict including pricing, zoning, education and a PWC ban. Each of these actions is now discussed.

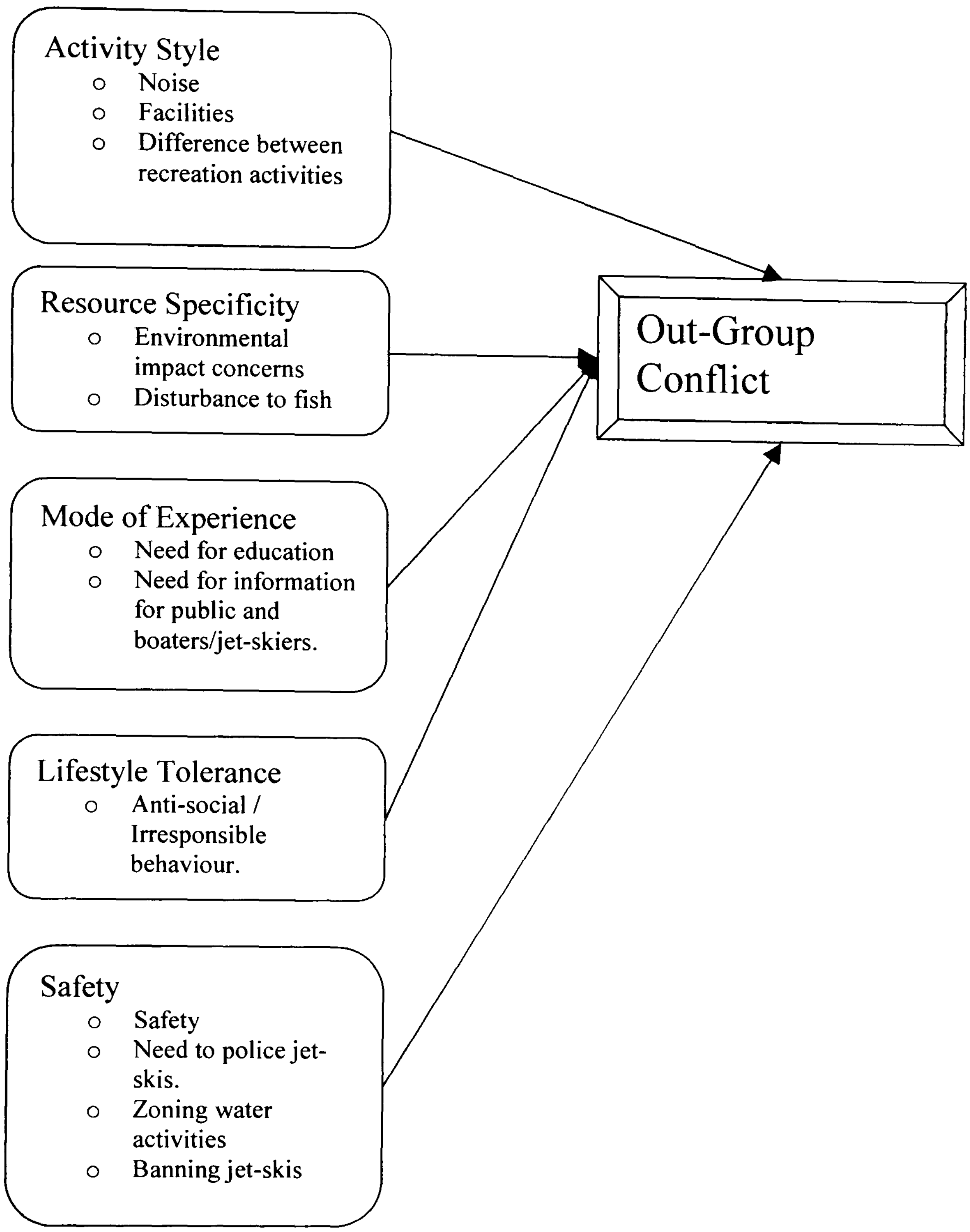

Figure 6.4: Adapted conflict model (after Vaske *et al* 2000, 301).

It is suggested that charging recreationalists to use Loch Lomond is a valid and possible management action. Such pricing is a possibility as it is currently free to launch any boat on the loch. Currently all boat users, including PWC, must register with the LLTNPA. It is suggested that, on registration, a standard payment could be made. Perhaps this payment could be higher for PWC, although this could be seen as discriminatory against such craft. Pricing was an issue often contemplated by the interviewees. One angler stated:

"Pricing is definitely the way to go for the jet-skis, yes. I've thought about this a lot actually and I've often thought that this would be a good solution to the jet-ski problem. As fishermen we are the only group of loch users that currently have to pay to use the loch. There are many restrictions on us. We can't fish on Sundays for example. There are no such restrictions on jet-skis: they can use the loch whenever they want, for as often as they want, and they're the group causing all the problems... Make them pay!" (Angler).

Many agreed with this stance, adopting the "polluter pays" principle. In particular:

"The only people who pay to use Loch Lomond at the present time are the anglers. They should charge jet-bikes, speed boats and power cruisers – all of the recreation activities that have a disturbing influence" (Angler).

It is interesting – yet unsurprising – to consider that many jet-skiers were against such a pricing mechanism. Many agreed that:

"One of the attractions of Loch Lomond is that it's free to jet-ski here" (On-site jet-skier).

Before the implementation of any pricing strategy, therefore, a further investigation into public opinion is required. More research is needed. Still, pricing is one of the best management strategies available to the Park Authority at the present time. Such a possibility is examined in more detail in chapter seven.

Another management possibility is the zoning of the Loch into different areas for different activities. According to Manning (2001, 204), zoning or separation of conflicting recreation activities is probably the most common management approach to conflict. He suggests that where interpersonal (direct) conflict is present, zoning may be an effective management strategy. It is maintained that zoning Loch Lomond into certain areas for certain activities is a management possibility, but the location of such zones would require careful consideration by the National Park Authority. Furthermore, interviews with respondents indicate a mixed response to management zones. Some respondents agreed with zoning as a management action, as is shown in the following extracts:

"Zoning could be beneficial. I know that a lot of beginners can feel threatened by the bigger boats. When I was a beginner in the area it was scary to see the big boats coming towards you. So they could zone the loch into different activities or maybe it would be better to have zones for beginner areas and areas for the more experienced jet-skier. It would be far less scary when starting out that way" (On-site jet-skier).

"Zoning might work. It might stop people getting onto us for nothing!" (On-site jet-skier).

It is useful, then, that jet-skiers themselves see zoning as a possibility. Furthermore, the zoning approach has the possibility of becoming more sophisticated, as is illustrated by the following quote:

"Zoning is a good plan, but it has to be determined not by the number of users but by the type of usage. You can have 100 canoeists out at one time causing no problem, you can have half a dozen jet-skis out at one time and they are extremely intrusive. I can't make this point enough!" (Sailor).

Thus, while many anglers and sailors agreed that zoning of jet-skis was a good idea, they themselves did not want to be "zoned" into certain areas of the loch. Their view was that there should be one law for the jet-skiers and another for themselves. For example:

"Jet-skis are grossly polluting and intrusive. There needs to be some sort of zoning put in place, but it would depend on whether or not the activity is intrusive as to whether it's zoned or not. We're not noisy; we don't need to be zoned. We have races up and down the loch and so we wouldn't want zones that could restrict this freedom of movement" (Sailor).

In addition to spatial zoning, one respondent suggested the possibility of temporal zoning, i.e. allowing different users to use the resource at different times. There are hence several different zoning model possibilities, including temporal zoning, which would allow PWC on the Loch during certain times only, as shown below:

"Every weekend, regardless of season, people will be out on the water. This is not only bad for the environment, as it has little time to recover from high visitor numbers during the summer months, but it also means that there's no real time when we can enjoy total solitude and quiet. It's because there are now things like new technical equipment and wet-suits, which keep you dry and warm even in the cold winter temperatures. I just think it's a shame that there's no longer a closed season. There should be some sort of temporal zoning put in place, where jet-skis, and all fast moving motorised craft, are only allowed out on the water during certain times. This would benefit the environment and the other people who are wanting to enjoy the loch in peace and quiet" (Sailor).

Temporal zoning is a possibility for Loch Lomond, allowing fast moving motorised craft to use the Loch during certain time periods only. However, it could be claimed that this is an effective ban on PWC at certain times. As such many believe that zoning, either spatially or temporally, is a bad idea, which would not be successful. Non jet-skiers argued:

"Zoning is artificial. It's only natural if people can go where they want to go. It tells us where to go and what do to. No thank you!" (Sailor).

"I like to be able to move around the loch freely. One of the attractions of Loch Lomond is that it's a fantastic body of water that can be enjoyed in its entirety. Zoning would prevent this. I don't know what the answer is to the jet-ski problem but I know that zoning isn't it. I don't want to be put in a certain box, in a certain zone" (Sailor)[29].

"Zoning would lead to a concentration of PWC numbers, which leads to problems in itself. If PWC are concentrated in certain areas, and these are often areas where there are picnickers, then the perceived conflict will increase. For example, at the moment if there are 100 jet-skiers using the Loch at the two sites [Milarrochy Bay and Drumkinnon Bay], *this averages out at 50 jet-skis per site; if there were four sites then this averages out to 25 jet-skiers per site. This would cause the perceived problem to decrease, as there would be less jet-skis present at one site. If there are a lot of jet-skis in one area then noise increases and there's a greater perceived danger. If all PWC are in one area, the danger and perceived problem of danger, and safety issues, increases. There*

[29] It is suggested that this respondent shows a resistance to spatial "policing" of the Loch.

would be a problem of increasing noise pollution in those areas where the PWC have been concentrated" (Local Businessman).

Many jet-skiers themselves believed zoning to be a "bad idea", and an inappropriate approach to conflict resolution (as discussed by Sidaway, 2005):

"Zoning is very restricting. It's a bad idea. I've still got friends who own speedboats and we like to go out on the water at the same time and go to the same place. If the loch was zoned into different areas for different activities we wouldn't be able to do that. The social aspect would be taken out of my enjoyment and that wouldn't be good. It's one of the main reasons that I jet-ski, I like to mix. I'm very sociable!" (On-site jet-skier).

"Zoning could be good but it could be bad. We would have a hard time playing about if there were loads of jet-bikes everywhere. It would be too congested. There would be no room for us all to have fun. Jet-bikes like to keep to the bays of the Loch, the centre is far too choppy and it can get freezing out there. We also tow bananas [30] *so we like a lot of space. The bays are the best for towing as well; it's too cold out in the centre for the people on the bananas. It's fun to run round the bays and play back and forth"* (On-site jet-skier).

In an interesting conversation with a member of the sailing club, who is notably also a member of the "Friends of Loch Lomond", the researcher was told:

"Zoning has been looked into by the 'Friends of Loch Lomond' but we came to the decision that it wouldn't work and that jet-skis should be banned. Since the writing of that paper, however, a possible zone has came to our attention. This possible zone for PWCs would be just north of Luss and just south of Inverbeg, where there is only one house. But I still maintain that zoning would not be successful; there would still be a lot of noise generated from the PWCs in that area. The only solution is to ban jet-skis. We actually submitted a 'Friends of Loch Lomond' questionnaire to people living in the Loch Lomond area. All together we sent out 600 questionnaires and we received 150 back. Of those we got back 83% were in favour of a ban. Jet-skis should be banned, as was the conclusion of the 'Friends of Loch Lomond' paper" (Sailor).

Banning PWC is certainly a management alternative to zoning and one with which organisations such as the "Friends of Loch Lomond" concur. General conflict, environmental impact, high noise levels and safety concerns all warrant a complete ban of PWC, according to the "Friends of Loch Lomond". Statistical analysis indicates that there is a significant relationship between perception of jet-skis and a ban of jet-skis (at $p \geq 0.95$). Findings illustrate that for those who perceive jet-skis negatively, a PWC ban would improve their experience (this relationship is statistically significant at $p \geq 0.99$). Similarly, the noise CBM confirms that a PWC ban would significantly increase the number of trips made by visitors to the study area. It is unsurprising, therefore, that many interview respondents felt strongly that a complete jet-ski ban was the only solution to eradicate conflict:

"I now feel that my sailing experience is really disrupted by the jet-skis. In the past I wasn't disrupted, but now I am. The increase in jet-bikes has been the problem; other boats never caused a problem. They are a danger because of their inherent power and speed and in the long run they

[30] A banana, as used here, is an inflatable banana-shaped dinghy, which is towed behind a PWC.

must be contributing to environmental problems. We should ban all PWC. A ban is the only solution... I know for a fact that many international people no longer stay at the local campsite [Milarrochy Bay Camping and Caravan Site] *because of the noise from PWC. I knew friends from America who were regular visitors to Milarrochy Bay, now they no longer visit because of the jet-bikes. These are only two international visitors but I'm sure there are a lot more who don't like them. They spoil people's enjoyment of this beautiful area and should be banned"* (Sailor).

The statement that "they must be contributing to environmental problems" is particularly revealing. It demonstrates a perception that, because of their newness and technological sophistication, PWC must be environmentally harmful (seen as almost "unnatural" in the rural environment). Similarly, the following view shows further social "demonisation" (Cresswell, 1996) of the jet-ski group. There is an underlying "them/us" dichotomy. There is an opinion that they (jet-skiers) are not the right sort of people to be let loose on this lovely resource[31] and as such PWC should be banned:

"The only solution is to do away with the jet-bikes. Ban them all together. They are a law into themselves. They cut inside and across and they're mostly driven by young people who don't consider others" (Angler).

As to be expected the jet-skiers do not support such a ban and view such an action as unjust and discriminatory. According to the Port Hacking Protection Society (2001) though, fairness is in favour of PWC bans. They state that:

"Accepting that the rights of any user is equal to those of any other, it must be that the enjoyment of one low impact user is no less significant than the enjoyment of one higher impact user (and vice versa). If the pleasure for one user causes a loss of pleasure of another, the person achieving enjoyment is doing so at the cost of the other. If the pleasure of one user is achieved at the distress of a greater number there is an unfairness, which ought to be corrected. The loss to the many is far greater than the benefit to the one" (Port Hacking Protection Society 2001, 27).

Taking this opinion on board, PWC has now been banned throughout many areas in the United States of America. Some local communities who have banned PWC use include San Juan County, Washington; Mendocino County, California; and Pacifica, California (Bluewater Network 2002, 5). Although bans have also been put in place in many areas outwith the U.S.A., findings from this project suggest that a ban is not (yet) necessary in the Loch Lomond area.

A fairer and less direct management strategy is education and providing more information about PWC to all recreationalists. Manning (2001, 204) suggests that education is an effective management approach to conflict, particularly where conflict is related to indirect causes such as alternative social values. For Manning, educational programs can be effective in two ways: (1) they can help establish a basic etiquette, or code of conduct or other behavioural norms that might lessen both direct and indirect conflict; and (2) they can help address indirect or social values-related conflict by increasing tolerance of recreation visitors for other types of groups and activities

[31] As a comparison, similar widespread negative attitudes have been found toward skateboarders in urban spaces (see Cresswell, 1996).

(Manning 2001, 204). It is therefore suggested that educational leaflets could be distributed to recreation users on site. These leaflets could outline (the lack of) the actual environmental impacts of PWC and discuss the scientific advances being made by PWC manufacturers. In addition, information provided to recreationalists could also emphasise similarities between recreation groups and activities. A shared user group could be set up, which could enlist different constituencies to broader ends (i.e. the overall good and conservability of Loch Lomond). Information would be shared during such a group and education would be central. Education must be a two- (or multi-) way process: jet-skiers ideally should learn more about the needs of sailors and anglers (and in the latter case, about fish and their movements and so on), and vice-versa. In their study of tolerance and conflict between motorboaters and canoeists in the Everglades National Park, Florida, Ivy *et al* (1992) demonstrate the importance of information and education in affecting expectations and conflict during the recreation experience. They argue that management could influence expectations for the likelihood of encountering other activity groups. For example, information provided could emphasise the chances of meeting motorboats, and so delineating the potential range of out-group encounter. This, Ivy *et al* (1992, 359) claim, would cause some recreationalists to "adjust their goals to coincide with the opportunities available".

A good example of how information and education affect expectations is the age factor. The expectation is often that young people drive PWCs. The Bluewater Network, for example, claims that around 70% of jet-skiers are less than twenty-one years old (Bluewater Network, 2004). On the contrary the Personal Watercraft Industry Association state that the average jet-skier is forty years old (PWIA, 2004). In the current interview sample all respondents were over twenty-five years of age, with 16.7% of the sample aged forty-five to fifty-four. In addition, chi-squared tests of association, along with frequency statistics, show that there is a highly significant relationship ($p \geq 0.99$) between perception of jet-skis and age. Namely, the older the respondent, the more negative their perception of jet-skis. These findings suggest that it is important to educate visitors on the "typical" PWC user, i.e. the "typical" user is not necessarily "young" and irresponsible. Education is needed for both older and younger age groups, which should inform visitor expectations and subsequently improve the recreation experience. Education and providing information leaflets on recreation conditions are hence a possible policy for Loch Lomond management.

Perhaps when thinking about solutions to the jet-ski conflict, the LLTNPA could look at the actions of the Lake District National Park Authority, as they provide a good practical example of the controversies surrounding PWC management. The Lake District National Park Authority (LDNPA) has imposed a ten mile per hour speed limit for all power driven vessels on Lake Windermere, effective from March 2005. Although speed limitation is not an infringement on the rights of navigation, it does in effect ban PWC from the Lake. The experience at Windermere has shown that these speed limits were resisted vigorously by not only by many boat users, but also by local people whose livelihoods depended on boat use (Dickinson 2000b, 233). Hence, there was a bigger anti-constituency than just the jet-skiers. Although there is no need with present Loch Lomond craft densities to follow the LDNPA example and impose a blanket 10mph speed limit, the Windermere experience is of value to the LLTNPA and illustrates the common controversy surrounding a PWC ban.

In general, then, whilst zoning (particularly temporal zoning) and banning PWC use on Loch Lomond are management options available to the LLTNPA, pricing and education are preferred options. The latter two policies could be used to prevent conflict as seen from the non jet-skier. Indeed, it is interesting to be aware of Manning's (2001, 204) suggestion that "the asymmetric or one-way nature of much recreation conflict suggests that management is needed to maintain the quality of recreation for visitors who are sensitive to conflicting uses. Without active management, visitors who are sensitive to conflict are likely to be dissatisfied or ultimately displaced". In other words management options should address the causes of conflict experienced by the non jet-skier (anglers, sailors and so on), i.e. conflict that is caused by activity style, resource specificity, mode of experience, lifestyle tolerance and safety. It is recommended that pricing and education/information are two ways by which such conflict could be addressed, but zoning or an outright ban of all PWC could also be employed – if warranted as necessary by the LLTNPA.

6.6 Conclusion – The Four Themes

The overall aim of this chapter was to discuss, by theme, the implications of the research findings as presented in chapters four and five, and to relate these to the theoretical background on crowding, noise, environmental conditions, and conflict. The main conclusions are:

- Manning's (2001) expanded crowding model is a useful conceptual approach with which to develop a theoretical and empirical methodology of crowding.
- High visitor numbers do lead to overcrowding and reduced utility per visit.
- Perception of crowding is dependent not only on density (the physical number of people), but also on social, psychological and environmental conditions.
- High noise levels do result in reduced utility per visit.
- Noise, particularly jet-ski related noise, should be a priority for the Loch Lomond and Trossachs National Park Authority.
- High visitor numbers do place pressure on the natural environment.
- "Real" environmental damage is limited both spatially and temporally. Overall, just over 9% of the loch shore area suffers from severe visitor damage – found only in areas where visitor

access is possible. Access is therefore crucial when thinking about actual levels of environmental damage.

- Many findings indicate that perception and reality do differ.
- PWC have the potential to cause environmental degradation, but this impact is not a serious problem at Loch Lomond at present. The impacts are not as great as many sailors and fishers perceive them to be.
- Perceived impacts are a greater problem to the "typical" Loch Lomond visitor than the actual environmental impact of jet-skis. This has important management implications.
- There is an extreme division between jet-skiers and non jet-skiers. While the jet-skiers themselves are more concerned with fun and enjoyment (termed here the importance of play), non jet-skiers (sailors and anglers) are affected by noise, safety and environmental impact.
- Conflict appears to be asymmetrical, one-sided, from non jet-skiers. It is out-group, interpersonal and social values conflict[32].
- The adapted conceptual model shows that conflict from non jet-skiers is caused by: activity style, resource specificity, mode of experience, lifestyle tolerance, and safety concerns.
- Management must address this conflict. It can do so in four main ways: pricing (charging users to use the loch), zoning watercraft, banning PWC, and education/information. Pricing and education/information are the best mechanisms by which to deal with this conflict.

Of the three primary themes – crowding, noise and environmental damage – noise appears to be the most important factor affecting visitor enjoyment and hence utility per visit (81% of respondents stated that noise affected the enjoyment of their visit; 80% stated that crowding affected the enjoyment of their visit; 79% stated that environmental damage affected the enjoyment of their visit). Noise was the only site quality variable statistically significant in the travel cost model. Crowding and environmental damage were not significant in the travel cost model. However, when addressed separately, noise, crowding and environmental damage were statistically significant in the contingent behaviour models. For managers, environmental conditions are more important than either crowding or high noise levels. This visitor/manager discrepancy is addressed further in chapter seven, as are the implications of the crowding, noise and environmental damage findings for establishing perceptual, ecological and, more generally, a recreational carrying capacity.

[32] The negative perception from the non jet-skier maybe tells us more about their dislike of the kind of people they suppose jet-skiers to be. There is a conflict-ridden social geography of using Loch Lomond – almost a study of how an "outsider" group (the jet-skiers) gets demonised as "out-of-place" (Cresswell, 1996) on the loch. This relates back to social values conflict, but has further dynamics built in (i.e. class, age, respectability and so on).

Overall, then, although crowding and environmental damage should not be overlooked, the findings suggest that addressing noise pollution (i.e. "real" and perceived noise levels) should be the recreation management priority for the LLTNPA:

"The noise generated by the jet-skis is a much more crucial issue for me than either crowding or environmental damage. Even if the environment was perfect and I couldn't see anyone for miles, if jet-skis were zooming about on the water my recreation experience would be ruined" (Male Visitor, Sallochy).

Indeed, the PWC conflict is a fascinating element of outdoor recreation in both the Loch Lomond area and more widely throughout the developed world. Consequently, the current study contributes to an ever-growing body of academic literature concerned with conflicts between recreation groups. Previous investigations into conflict include: canoeists and motorboaters (Lucas, 1964; and Ivy *et al*, 1992); physically obtrusive recreation technologies and less obtrusive technologies (Devall and Harry, 1981); skiers and snowboarders (Vaske *et al*, 2000); hikers and mountain bikers (Carothers *et al*, 2001); and, fishers and water-skiers (Gramman and Burdge, 1981). A distinctive finding among many of these studies is the asymmetric nature of conflict. This finding was confirmed in the current research study. Previous studies into recreation conflict commonly anticipate the conclusions of the current research. Future conflict research is needed to elicit a further in-depth study of other recreation groups, i.e. investigating groups that are neither sailors nor anglers. It would be interesting, for example, to elicit the perceptions that walkers, picnickers or canoeists have towards jet-skiers. Furthermore, more research is needed to investigate Vaske's (2000) conceptual model. Perhaps a quantitative study on each of the factors leading to conflict could be undertaken. As the questions asked throughout the interviews with recreation groups were not leading respondents, answers given were often vague. In particular, the responses from jet-skiers were often limited, suggesting that a more structured questionnaire was required. A quantitative study could elicit more specific answers relating to feelings of conflict. Still, the qualitative findings of this study deepen understanding of the many nuances in inter-group conflict, many of which defy simple quantification, and also suggest possible management/policy responses (such as the subtle differences and problems between zoning strategies and attempting to create new alliances/coalitions through information and education).

Conclusively, the PWC case study has shown that "the problems with jet-skis lie mainly in their impact on other visitors" (Dickinson 2000a, 49). Conflict between recreation users has a greater influence on recreation enjoyment than does actual environmental impact. Discussions of the ecological impacts of PWC use on Loch Lomond, the perceived impact of PWC on the loch and then a presentation of the theoretical and management implications of such a study support this statement. Management implications, more generally, are explored in the following chapter.

Chapter 7. Combining Perceptual and Ecological Carrying Capacity for Recreation: Management Implications

"The Park Authority must balance appreciation of the environment with protection of the environment. Without this balance we have nothing"
(Interviewee, Loch Lomond and the Trossachs National Park Authority).

7.1 Introduction

The above quote encompasses the essence of much recreation management: the need to combine environmental enjoyment with environmental protection. Consequently, this final thesis chapter investigates the management implications of both the ecological and perceptual findings. It aims to create a perceptual-ecological relationship of outdoor recreation through the structure of management; to present possible carrying capacity frameworks under which to guide this recreation management; and to recommend possible management strategies for the LLTNPA. It is argued that all recreation management brings together ecological and social resources and shows cross-cutting interactions between these two themes. Further, LLNTPA policy encompasses the concept of sustainability, which has ecological, social, managerial and economic components. As shown in chapter two, sustainability can only be achieved if the ecological and social dimensions, along with economic and political factors, of recreation are integrated into resource management. Sustainability must be built into any recreation management framework and all National Park Authorities should manage both people and the environment. Only then will the recreation environment provide enjoyment for current and future generations.

This penultimate chapter therefore questions recreational carrying capacity frameworks and their relevance to the Loch Lomond area, including a comparison with the Arches National Park; it discusses management practices in the LLTNP area and recommends possible additional/alternative strategies; and concludes with some guidelines / recommendations for the LLTNPA.

7.2 Application of a carrying capacity framework for the Loch Lomond and Trossachs National Park.

The LLTNP Plan recognises that "promoting a comprehensive visitor monitoring framework with partner organisations should be a recreation management priority" (LLTNPA 2005a, 13). Section 7.2 therefore discusses the compatibility of possible management frameworks with the LLTNP, with reference to the findings of this research project.

There is currently no overall carrying capacity management framework employed in the Loch Lomond and Trossachs area. Partly this is because "while at the theoretical level we understand the complexities involved in the human relationship with protected environments, we continue to be challenged to make integrative management tools operational in the field" (Newman *et al* 2001, 31). It is interesting, then, that when questioned about the adoption of an overall management framework, managers from the LLTNPA did recognise the benefits of such a measure:

"A robust methodology and theoretical links are important and necessary. We need something that we can use quickly and easily and say 'yes, this works'... Relating recreation management to carrying capacity is an important and useful thing to do, but it is very difficult to implement in practice" (Manager, LLTNPA).

"If you relate the management of recreational land to its carrying capacity then this allows you to reduce pressure on sensitive sites and allows you to promote managed sites for visitors... It's a two-edged debate. It's important to encourage people to go to a site if it's a 'honey-pot' site (an area with a high carrying capacity); this keeps pressure away from areas with a lesser carrying capacity. So knowing carrying capacity is essential to effective land management... Robustness must be a key element. Any carrying capacity framework must have tight braces and we must make sure that it would do the job" (Ranger, LLTNPA).

Many within the LLTNPA would accept possible frameworks. They recognise that although it is difficult (and unhelpful) to prescribe an overall "magic number", carrying capacity can be integrated into clearly specified management goals (Burch, 1984). As demonstrated in section 2.7, possible frameworks within which to address carrying capacity include SVMS and VERP.

As shown in section 2.7, SVMS is set within the conventional cyclical plan-implement-monitor-review model and it has been piloted at a number of sites around Scotland. According to an interviewee (recreation research consultant), the overall benefit of SVMS is that it will help secure, enhance and maintain both the quality of the environment and the cultural heritage values of the resource and visitor experience. There are benefits to managers, site users and the wider community. Once established the SVMS cycle has three regularly repeating elements: (1) action on the ground; (2) monitoring of site qualities, visitor impacts, the visitor experience, and the results of past management; and (3) evaluation of the monitoring data against the objectives and standards to identify what revisions are required to the management prescriptions and action plan (Masters *et al* 2002, 20). When undertaking a baseline assessment of a site, SVMS suggests asking a number of questions, including: what importance does the site have for natural and cultural heritage conservation? What importance does the site have for the local community? What importance does it have for other visitors? Why do visitors come and what is/are their principal activities? What are the key visitor impacts and conflicts? What degree of management is needed? In terms of degree of management required, three levels are suggested: level 1, low intensity management; level 2, moderate intensity management; and level 3, high intensity management (Masters *et al* 2002, 23). It is clear then that SVMS is site based, rather than park-wide based. It is also people-focussed rather than resource-focussed. Although the interviewee (recreation research consultant) suggested that the SVMS system was not expected to provide substantial input into the Park Plan process, it is a relevant framework for the LLTNPA to explore in the future. It conveniently incorporates carrying capacity and sustainability in a practical context (Filho, 2000). In particular, the initial baseline questions regarding the importance of a site for visitors have been answered in part by the current research. These answers could be used to identify appropriate indicators and standards.

The concepts underlying the VERP framework (section 2.7) could also be employed by the LLTNPA. Indeed, VERP is a good example of the wider implications of setting indicators and standards in any outdoor recreation area, i.e. the implications are applicable outwith the LLTNP. The Arches National Park (ANP) – designated as such as 1971 – was the first area to implement the VERP framework, and can be used to inform proposed management frameworks in the LLTNP. The aims of the ANP are to: "(1) protect the extraordinary examples of eroded sandstone formations (see figure 7.1) and the setting in which they occur; (2) protect other features of geological, historical, prehistorical and scientific interest; and (3) provide opportunities for visitor appreciation and education that leave park resources unimpaired" (Arches NPS 1995, 10). The general objectives of resource protection and providing opportunities for visitor enjoyment are therefore present in both the ANP mandate and that for the LLTNPA.

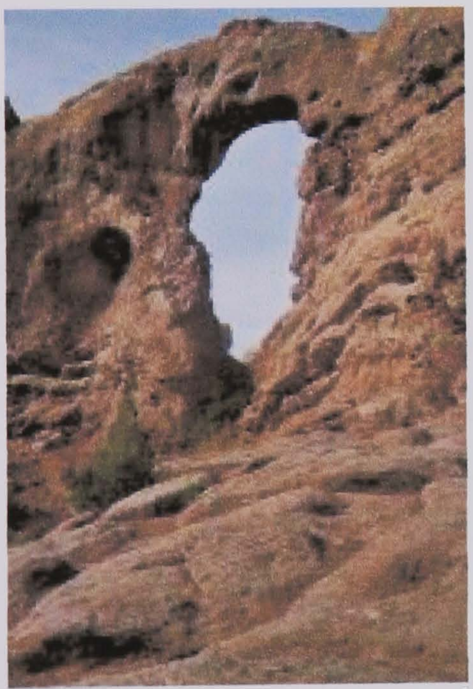

Figure 7.1: Arch, Arches National Park *(Photograph taken October 2003 by author)*.

As introduced in chapter two, VERP is based on the identification of appropriate resource and social conditions – indicators and standards of quality – to be achieved and maintained in National Parks (Manning *et al* 1995, 46). It therefore looks at both visitor impacts and visitor perceptions, and is relevant to any managed outdoor recreation area. Explicit within the VERP framework is the concept of recreational carrying capacity. Unlike the LLTNPA, the U.S. National Park Service is required by law to address carrying capacity in planning for parks: "the 1978 National Parks and Recreation Act requires each park's general management plan to include the identification of, and implementation commitments for, visitor carrying capacities for all areas of the unit" (Arches NPS 1995, 2). Following on from this designation, the U.S. National Park Service developed VERP to assist national park planners and managers in addressing recreational carrying capacity. The ANP was selected in 1992 as the first park to test the VERP process, which defines carrying capacity as "the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions that complement the purposes of the park units and their management objectives" (Arches NPS 1995, 3). Thus, the VERP programme advantageously interprets carrying capacity "not so much as a prescription of numbers of people, but as a prescription of desired ecological and social conditions" (Arches NPS 1995, 3).

Central to the ANP VERP programme are four key elements: a parkwide management zoning scheme; indicators and standards for each zone; management actions that address visitor use and infrastructure in each zone; and a monitoring programme. The Management Zoning Scheme is based on the park's purposes and significance and the range of desired visitor experiences and resource conditions that park managers intend to provide. Nine management zones have been identified for the Arches and each zone has been designated specific indicators and standards, for both natural resource conditions and social conditions. When standards are reached (i.e. an area is "out of standard"), managers must take action to get an indicator back within its defined standard. Resource indicators include the condition of the cryptobiotic soil crust condition; density of social trails; relative soil compaction levels; cover and frequency of vascular plants (by species); and ground cover. Social indicators include the number of people at one time at major attraction sites or on trail segments; the number of different parties seen while travelling on or off trails or on backcountry sites; and traffic congestion on major paved park roads. Such indicators could be adapted for the LLTNP. Table 7.1 provides a detailed comparative example of selected indicators and standards for two zones: the pedestrian zone (an area of high visitor impact) and the sensitive resource protection zone (an area of low visitor impact). The former zone is equivalent to a high impact area such as Sallochy, the latter similar to much of the north-east shore of Loch Lomond.

SUMMARY OF THE INDICATORS AND STANDARDS FOR THE PEDESTRIAN ZONE
Resource Indicators and Standards: Indicator: Condition of soil crust – Soil crust index measured 8 feet (2.5m) from the trail centreline. Standard: 30% or more of the soil samples are rated as less than 4 on the soil crust index.
Social Indicators and Standards: General Indicator: Social crowding – number of people at one time (PAOT) at an attraction site or on a 0.1 mile (0.2 km) section of trail during peak hours of peak months. Standard: 20 or more PAOT observed for 10% or more of the peak hours of peak months. Windows Indicator: Social crowding – number of people at one time (PAOT) at the site during peak hours of peak months. Standard: 20 or more PAOT observed for 20% or more of the peak hours of peak months. Delicate Arch Indicator: Social crowding – number of people at one time (PAOT) at the site during peak hours of peak months. Standard: 30 or more PAOT observed for 10% or more of the peak hours of peak months.

SUMMARY OF THE INDICATORS AND STANDARDS FOR THE SENSITIVE RESOURCE PROTECTION ZONE
Resource Indicators and Standards: <u>Indicator:</u> Soil condition – soil crust index measured anywhere in the zone. <u>Standard:</u> Any sample that rates less than 6 on the soil crust index. <u>Indicator:</u> Number of social trails. <u>Standard:</u> Any social trails or evidence of visitors.

Table 7.1: Indicators and Standards for two zones in the Arches National Park.
(Source: Arches NPS 1995, 39 and 46.)

It is useful to determine the success or otherwise that the ANP Service has had in maintaining these standards and hence investigate the success of the VERP programme to date. As reported in chapter four, neither ecological nor social standards have been met in the ANP. Social <u>and</u> ecological standards have therefore been violated. It is the current challenge for the ANP Service to meet these standards. When thinking about these indicators and standards and questioning whether or not the VERP scheme can be deemed successful, an interviewee stated:

"I hesitate to call it successful; it's helped but we haven't yet been able to take the next step. We've now assessed whether or not we're meeting our standards, we're out of standard so now what do we do? We've been given a good handle on what we have but we now require management to take some action... The VERP process doesn't offer solutions to problems. If the Park is outwith standard it doesn't tell managers how to get back in standard, but it does show what's happening out there and what needs to be improved to ensure Park sustainability. From this perspective it's a useful tool" (Ranger, Arches National Park).

Management actions that the ANP Service are currently taking to try and "get back into standard" – and that could be adapted in a LLTNP context – include a number of measures such as additional fences, signs, and information boards to be installed in parking areas (see figure 7.2); printing brochures and warnings to be issued to visitors if standards continue to be exceeded; and a permit system to be issued to visitors at Fiery Furnace. In addition VERP issues regular questionnaires and observation surveys to gain trends in information about people's views on overcrowding, interactions with other users, and their perception of the state of the habitat and landscape. This is part of their long-term monitoring, and a similar process would be invaluable in the LLTNP. Information is therefore being obtained on what management action to take to bring natural resource and social conditions back within standard.

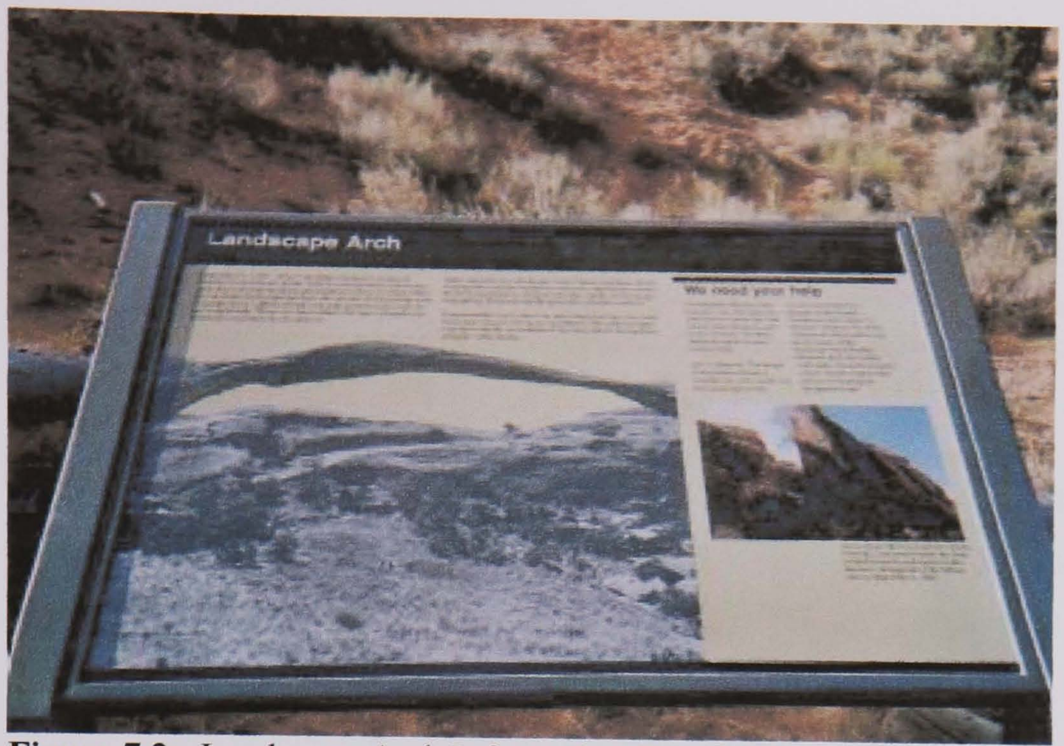

Figure 7.2: Landscape Arch Information Board *(Photograph taken October 2003 by author).*

What is important, then, is that the ANP recognises that improvements must be made in order for the area to be ecologically and socially sustainable. The application of the term sustainability remains controversial and is often criticised as being a "smoke screen" for environmental inaction (Filho, 2000). However, as shown through the application of VERP in the ANP, the concept has real practical value and utility. The advantages and challenges of the VERP process in any National Park area are summarised in the following interview quote:

Researcher's Question: "Do you think that a robust methodology, such as VERP, is useful to resource/recreation management in National Parks?"

"Yes, definitely. From a purely economic/practical viewpoint to that question, VERP has allowed more money to be plugged into the Arches. It's seen to be a framework (whether it's robust or not is a matter of debate since it is based on perceptions and not 'real' data but anyway), it's seen to be doing something about limits and carrying capacity and so money is given. In 1978 a Congress mandate stated that all National Parks in the States have to consider carrying capacity in their National Parks, but a framework to address carrying capacity in all National Parks was never developed. Our VERP framework shows Congress that we're achieving their carrying capacity aim. Having said that VERP doesn't deal explicitly with a carrying capacity methodology but it is there implicitly; it identifies indicators and creates standards to be met. It then needs management to meet these standards. This is the hard part, but it can be achieved. It's a crucial part of our overall Park management. It brings together social issues, such as overcrowding, and environmental issues, such as natural resource damage, within one framework. It gives us something to aim towards... VERP identifies indicators of social and environmental conditions and sets standards, which must be followed to ensure sustainability. As such Park Management closely monitors these standards and asks the question: is this area in or out of standard? Although we're currently out of standard, both socially and ecologically, at least we recognise that something must be done. We can now channel our management into the appropriate areas, allowing the recreation experience to improve and the environment on which everything depends to become more sustainable. We couldn't do this without VERP" (Ranger, Arches National Park).

To date, no overall Park capacity has been set for the Arches. As reported by a ranger:

"We did make several stabs at it but it was very complex... multiple entrances, varying lengths of stays, etc. We did want to get at the idea of overall park capacity because it would make management much easier. If you knew you could only allow say 700 cars in each hour or day or whatever, you as a manager could then set up a system to manage for that number. We did get a very rough computer model to generate varying use levels in the park but we weren't convinced that it was good enough to base management decisions on... They actually refined the model and are using it at Acadia for some of their issues there. So I think we would use overall carrying capacity if we had confidence in how that number was obtained... we just haven't gotten there yet" (Ranger, Arches National Park).

At Acadia National Park (Maine, U.S.A.), the VERP process was applied to the entire National Park area. Using a computer-based simulation model, an overall carrying capacity was established at 3000 visitors per day. Monitoring during 1997 and 1998 showed that carrying capacity standards had not been violated (Acadia National Park Service, 1997). VERP has also been applied, however not Park-wide, at Yosemite National Park, Glacier National Park and Mount Rainer National Park (all located within the U.S.A.). ANP has therefore "provided a model for applying the VERP process throughout the entire National Park system" (Manning *et al* 1995, 54). The model could be further extended to Scottish National Parks. It is not suggested that an overall carrying capacity number be allocated to the LLTNP, rather VERP's approach to dealing with crowding and resource impact should be considered, for example undertaking regular visitor surveys to elicit visitor perception of the environment and recreation conditions.

Implicit within the VERP framework, and transportable to the LLTNPA, is the idea of zoning. Already seen in part through the original Loch Lomond Local (Subject) Plan (February 1996), which has already delineated separate zones for a number of land-uses including tourism, recreation and conservation (Loch Lomond Regional Park Authority, 1996), the National Park Plan will continue to implicitly "zone" these different land-uses, and hence follow a similar framework to the VERP process. The official Plan is – at the time of writing – not yet in a complete, final form. Once approved the National Park Plan will guide the activities of the LLTNPA and its partners for the coming five years (LLTNPA, 2005a). During a discussion about the Park Plan, the following was reported:

"The Park Plan should look at carrying capacity. It's important to identify parts of the Park that are sensitive. We shouldn't encourage high visitor numbers if the existing infrastructure can't cope... The main vehicle for integrated management is the Park Plan. This brings together all aspects of catchment management, not just recreation. It's an integrated approach for all the catchment. The Park Plan will look at key monitoring indicators, for example visitor activities, visitor flows, visitor numbers, how people use the car parks and so on. It will set out how the Park Authority and its partners will manage the Park to achieve its four statutory aims, and present the long-term vision for Loch Lomond and the Trossachs and address the policies and actions that will be needed to move towards this vision... With the National Park Plan we'll be able to manage the area – over the long-term – in a better, combined and more holistic way" (Ranger, LLTNPA).

From this interview extract it appears that the Park Plan will look at key indicators and monitor the progress of such indicators, in a similar guise to that which already occurs at the ANP under the

VERP programme. The final form of the Park Plan should address carrying capacity in some form through either SVMS, VERP or a similar carrying capacity framework. A generic carrying capacity framework is provided by Manning (2001, 283) and shown in figure 7.3. It is suggested that a framework such as this could be adopted and applied in the Loch Lomond and Trossachs area. As figure 7.3 illustrates, such a framework would establish the baseline conditions, determine management objectives, set indicators and standards, and monitor and evaluate the success of the scheme to determine whether or not standards of quality are being met. Indicators and standards should be set for both social and environmental (ecological) conditions. Manning (2001, 290) recognises that there is a point at which baseline data will become outdated and no longer adequate, and then evaluation must return to stage one. This should be infrequent, perhaps every twenty years. The framework is cyclic in nature and that "recreation management is an iterative process involving feedback loops... carrying capacity is an organisational framework" (Manning 2001, 291).

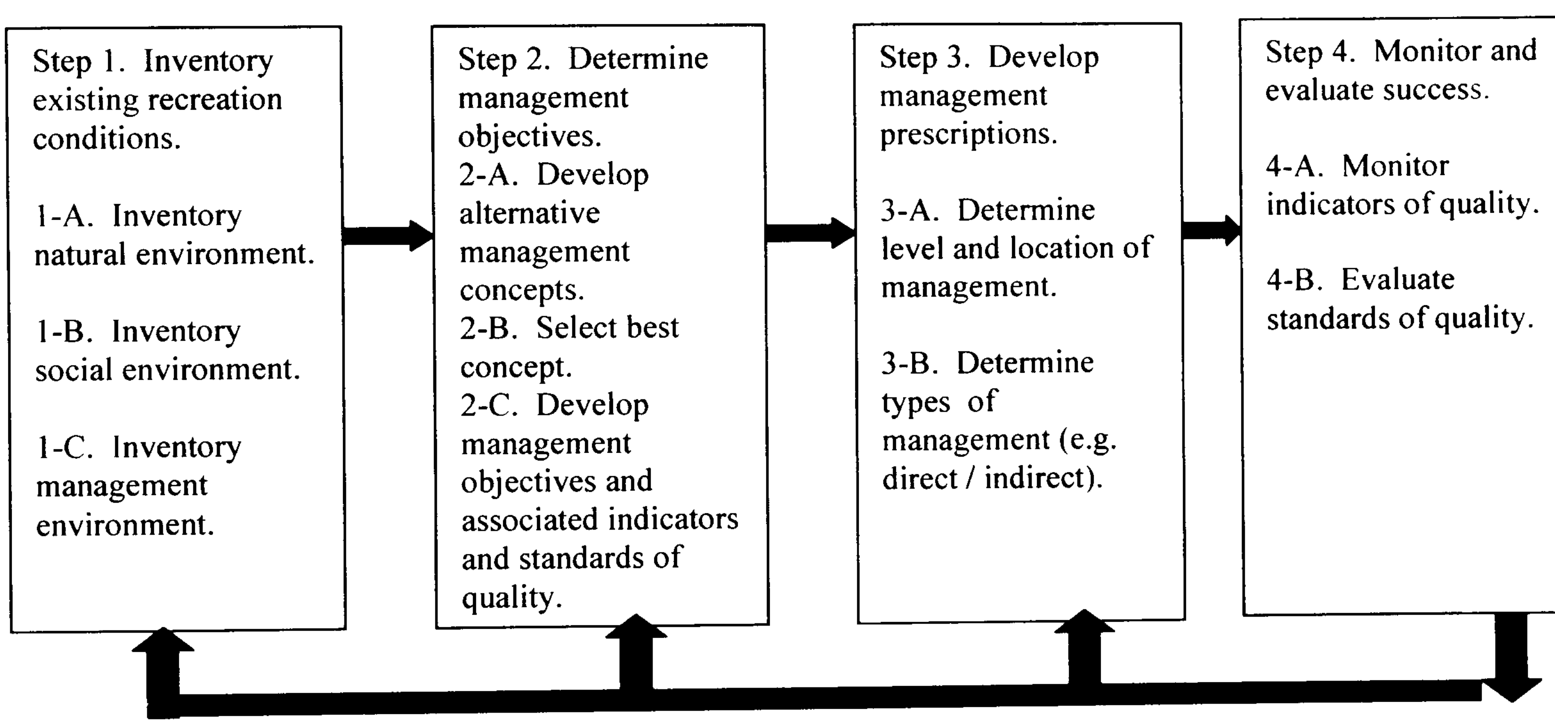

Figure 7.3: An outdoor recreation management framework. (Source: Manning 2001, 283.)

Regardless of whether a VERP, SVMS or more generic scheme is adopted, any carrying capacity framework requires indicators and standards to be set. Based on the current research, suggestions for indicators of quality are derived from the questionnaire survey issued to all visitors and include: (1) environmental indicators, namely extent of litter, dead trees, water pollution, exposed tree roots, broken branches, damage to ground vegetation and beach erosion; and (2) social indicators, namely presence of PWC (conflict), noise level and crowding level. When thinking about each issue experienced at the Loch Lomond sites studied (i.e. crowding, noise, environmental damage and conflict), the following table has been created, which includes possible indicators for each issue:

Vital Sign	Method	Indicator
Crowding	Direct field observation / Visitor Survey Questionnaire / Vehicle Counts.	- Visitor perception of crowding (scale 1-5). - Group size. - Number of cars in car park per hour.
Noise	Visitor Survey Questionnaires/ Interviews with jet-skiers, anglers, sailors, local businessmen / Boat Survey.	- Visitor perception of noise (scale 1-5). - Visitor perception of jet-skis. - Number of jet-skis using loch.
Environmental Damage	Visitor damage survey / mapping / Vegetation surveys / Environmental variables measured / Visitor Survey Questionnaire / Interviews with management.	- Location, extent and mapping of visitor damage sites. - Location and frequency of vegetation (aquatic and field/shore) subject to recreation pressure and visitor damage. - Visitor Perception of environmental damage. - Manager Perception of environmental damage.
Conflict	Visitor Survey Questionnaires / Interviews with jet-skiers, anglers, sailors, local businessmen.	- Visitor perception of jet-skis. - Visitor perception of recreation activities. - Activities undertaken.

Table 7.2: Possible indicators for the LLTNP. (Source: Adapted from Monz *et al* 2003, 138.)

Determining specific standards requires additional research. The current research is the preliminary stages of, for example, a VERP framework and thus, while it is possible to suggest indicators, it is difficult to set exact standards. Tentatively, however, thinking about findings from the current research project, possible standards could be suggested for the issue of crowding. For example, findings imply that visitor perception of crowding should be no higher than a level '2' (on a one (low) to five (high) scale) where possible. In addition, average group size should be maintained at the current average: 3.02; and the number of cars in a car park per hour should not exceed the current limit at each site, i.e. physical carrying capacity at Milarrochy Bay (134 vehicles), Sallochy (60 vehicles), Rowardennan (100 vehicles) and Firkin (50 vehicles). In other words, site intensity indexes – as defined in section 4.2 – should be sustainable. The issues of noise, environmental damage and conflict require more research before standards, such as those exemplified in table 7.3, can be set.

Indicator of Quality	Normative Mean
Encounters with PWC (noise, conflict)	3 encounters per trip
Evidence of litter (environmental damage)	Highly dispersed, low levels of litter, e.g. 5% of total site. Or litter not acceptable at all, i.e. standard = no litter.
Size and appearance of fire rings (environmental damage)	No fire rings seen. Or 5% of total site.

Table 7.3: Examples of possible standards for Loch Lomond area.
(Source: Idea derived from Manning 2001, 153.)

More importantly, there is a need to establish a task force to determine, for example, how much noise pollution is too much. Management should study the VERP scheme in the Arches National

Park Implementation Plan (Arches NPS, 1995) for advice on how to set satisfactory standards. It is recommended that a recreational carrying capacity task-force be established within the LLTNPA. This should be comprised of managers, scientists, researchers, local residents, and community representatives. It is also imperative to conduct more research on current conditions (which should be used for reference) and "ideal" conditions before standards can be established.[33]

This research should be both park-wide and site based. Indicators and standards should be adopted by site as each site has its own challenges. As one interviewee noted:

"Carrying capacity is all tied in with sustainability. Both can be looked upon from a site-by-site basis. Let me explain: Sallochy has had far less sustainability than Milarrochy Bay, but there is a need for both Sallochy and Milarrochy Bay. They cater for different people wanting different things from their recreation experience; different people with different carrying capacities" (Manager, Forestry Commission).

Setting indicators and standards should help contribute towards sustainability, both on a site-by-site level and park-wide. Sustainability is, therefore, a concept that is of immediate relevance to the findings of this research project. As previously noted, it is a contentious concept that has received much criticism (Filho, 2000). Warren (2002) suggests that three critiques of sustainability are most prominent: (1) it does not constitute a moral imperative; (2) it is unworkable because future needs are unknowable; and (3) it is riddled with contradictions and tensions. The latter critique corresponds with Mitchell's (2002) discussion of the paradoxes of sustainability (section 2.7). Although sustainability is contested, it is thoroughly embedded within current practice of the LLTNP and ANP and is a worthwhile ambition for environmental management. Tensions can be partly relieved through the application of sustainability on a site-by-site basis. Setting indicators by site is vital here. Again based on current research, possible indicators for each site are recommended in table 7.4. In an ideal Loch Lomond context, these should be incorporated into a management framework. As is seen, a number of variables should be measured at each site in order to monitor and evaluate sustainable recreation use. In this respect the SVMS framework is followed.

[33] The State of the Park Report already provides a basic overview of current environmental, social and economic conditions as well as visitor and recreation patterns (LLTNPA, 2005b). This should be expanded upon for specific crowding, noise, conflict and environmental damage indicators.

	Milarrochy Bay	Sallochy	Rowardennan	Firkin
Priority for Site	Reduce visitor conflict (primarily caused by PWC use).	Reduce environmental damage – especially litter.	Lack of car parking space during periods of peak use, contributing to environmental damage.	No priority areas.
Recommended indicators based on site priority	Visitor perception of noise (scale 1-5). Visitor perception of jet-skis. Number of PWC using loch.	Location, extent and mapping of visitor damage. Location and frequency of vegetation subject to recreation pressure and visitor damage. Visitor perception of environmental damage. Manager perception of environmental damage.	Vehicle count (limit number of car park spaces as seen at Delicate Arch, for example). Location, extent and mapping of visitor damage. Location and frequency of vegetation subject to recreation pressure and visitor damage. Visitor perception of environmental damage. Manager perception of environmental damage.	Survey visitor perception annually in order to maintain acceptable social conditions. Monitor resource conditions annually to ensure that the environment remains within an acceptable standard.

Table 7.4: Recommended indicators for each site.

Again more research on current conditions is required before standards can be established for each site. It is essential that all indicators of quality are specific, objective, reliable and repeatable, related to visitor use, sensitive, manageable, and efficient and effective to measure (Manning 2001, 153). As Manning (2001) also realises standards of quality should meet a number of characteristics; they should be quantitative, time- or space-bounded, impact orientated, and realistic. It is important to remember that, "it's still early days, the National Park Authority is just in its preliminary stages so it's difficult to tell what management strategies will be required to alleviate visitor pressure and environmental impact in the future" (Manager, LLTNPA). The preliminary stages of the LLTNPA should not be a deterrent to establishing indicators and standards. Indeed such "early days" are an asset as a carrying capacity organisational framework could be explored and developed with the development of the National Park itself. Fundamentally, the need for management frameworks arose as a key issue during interviews with various employees of the LLTNPA. A robust methodology such as VERP or SVMS could be applied in the LLTNP.

7.3 Management Practices

More specifically, the research indicates the applicability, or otherwise, of various management practices for the study area. Current and possible management practices are thus now considered.

7.3.1 Current Management Practice in the Loch Lomond area.

Despite the fact that the LLTNPA is still in its infancy, their objectives are already currently achieved in a number of ways, many of which relate directly to outdoor recreation and its management. In particular one objective of the LLTNPA is to provide information and educational services and to promote understanding and enjoyment of the Park: "it is crucial to get people to understand what a National Park Authority actually is. Few people actually know what a National Park means" (Policy-Maker). One way in which the LLTNPA achieves this objective is through countryside ranger teams which are present throughout the Park area. Countryside rangers "interact with the public and try to educate them" (Ranger, LLTNPA) through organising a number of educational events. Examples of such events include a Scottish Biodiversity week celebration; feed the birds with the Royal Society for the Protection of Birds; red deer spotting on Ben Lomond; and children's nature days. In addition there are National Park Visitor Centres located at Luss, Balmaha, and Balloch; site and field wardens; free leaflets available to the public; and litter collection and disposal at LLTNPA managed sites. Information and education (as promoted by Manning, 2001) is therefore a key recreation management "tool" practiced by the LLTNPA.

Information is not just available to those visiting the National Park. Communication with the local community is also seen to be extremely important. An interviewee summarises this need nicely: "a priority for the National Park Authority should be to educate the public on what environmental resources actually are... They need to educate the public on both the positive and negative issues of environmental use, and not just those visiting the Park, those living in the local area as well" (Policy-Maker, SNH). In addition to the official National Park website, the LLTNPA publicise and distribute National Park leaflets, a mainsheet newsletter for Loch Lomond boat users, a West Highland Way accommodation guide, and an events programme for each summer season (i.e. from April to September). Moreover, issued twice a year to the public living within the LLTNP is the National Park newsletter (for an example of this see LLTNPA, 2004). This newsletter provides the reader (primarily local residents) with information on the definition and aims of the National Park, the National Park Plan, and the State of the Park Report; along with loch codes of conduct, visitor survey information, and information on the ecology of the Park (for example a "squirrel survey") (LLTNPA, 2004). Clearly a newsletter such as this satisfies the "information and education" management tactic as defined by Manning (2001) and others, and fulfils the objective that "the locals must learn to love their environment and conserve it" (Policy-Maker, SNH).

In terms of the three remaining "tools" (zoning, pricing and limiting access) there are fewer examples. Officially "zoning" does not occur in the Loch Lomond area. According to an employee of the LLTNPA:

"Zoning is the buzzword that's used often and it does have a number of advantages and disadvantages, but more often than not it's difficult to implement successfully and to the satisfaction of all users... A better approach is using signs and education to influence visitor flows and to encourage visitors to go to certain locations. We need to manage visitor flows subtly in the best way for both the visitor and the environment" (Manager, LLTNPA).

Whilst there is no official zoning of Loch Lomond, this does still occur "unofficially" through the designated boat launching sites at Milarrochy Bay and Drumkinnon Bay, for example, and through prohibiting boat launching at sites such as Sallochy. This tends to produce a spatial concentration of boats in particular areas, though other factors do the same, and is hence known as spatial zoning (see Pigram and Jenkins, 2002). In terms of temporal zoning actions are again informal – in that they are not termed "temporal zoning". However car park sites with gates, such as Milarrochy Bay and Firkin, close at certain times prohibiting use thereafter. Milarrochy Bay, for example, closes at 10pm during the summer months.

Another management tool not currently employed by the LLTNPA is pricing. It is currently free to enter the National Park and there is no charge to park at the recreation sites or visitor centres. Although the literature indicates that there is an issue of equity involved in charging (Warren, 2002; and Sidaway, 2005), interviews with managers show that pricing would be well received by both the LLTNPA and the Forestry Commission. For example a LLTNP ranger states:

"Pricing? Yes. Charging at any site around the loch would create revenue to put back into the management of the loch. With pricing we could, for instance, employ more staff, put the [patrol] *boat out more often and so increase safety on the loch, and improve our ranger service. Pricing or fees would definitely help in the long-run"* (Ranger, LLTNPA).

Similarly an employee from the Forestry Commission suggests:

"We are really interested in the prospect of charging for parking at Sallochy. We've been interested in this for a long time; we just haven't done any research on it yet. Ideally we'd like to implement a parking fee, but we really need to know whether or not people would be willing to pay to park at Sallochy. Your visitor survey results should help us with this issue" (Manager, Forestry Commission).

Here manager and visitor perception correspond. Managers and visitors both believe pricing, through parking fees for example, would be a successful management tool for the LLTNPA.

The final management tool of interest – limiting access – is again unofficially used by the LLTNPA. At certain recreation sites, for example Firkin and Milarrochy Bay, the gates are closed when the site (car park) becomes full, when physical carrying capacity is met (Pigram and Jenkins, 2002). Cars are no longer allowed onto the beach to launch boats. Visitors are no longer allowed to park their cars and then picnic on site. This limits access to the site. Nonetheless, there are few rules and regulations or law enforcements that limit access more generally, i.e. for the entire National Park area. The regulations that do exist are primarily concerned with boating and watercraft. Boating byelaws must be followed and law enforcement through prohibiting speeding on the loch is present. Speeding and safety are monitored by the LLTNPA patrol boat rangers (see figure 7.4).

Figure 7.4: LLTNPA Patrol Boat *(Photograph taken Sunday 4th July 2004 by author).*

Under the registration and navigation byelaws any power driven craft can be reported to the Procurator Fiscal for a breach of LLTNPA bylaws. This includes speeding either over the maximum speed limit of 90 kph (55mph) or over 11 kph (7mph) in restricted areas. Thus, although laws and regulations are present for boating craft, in terms of preventing access there are no explicit laws or rules. Perhaps this is because a clear aim of Scottish National Parks is to provide access for all: "we need to find positive alternatives for people rather than implementing negative restrictions such as limiting access, road restrictions, or zoning" (Ranger, LLTNPA). Indeed, there is now new legislation to improve the public's access to the countryside under the Land Reform (Scotland) Act 2003. This Act gives rights of responsible access to most land and water and typically includes activities such as walking, horse riding, cycling and canoeing (non-motorised access) (LLTNPA 2004, 15). As expected, the Act derived much controversy, primarily from private landowners and farmers concerned about the potentially damaging implications for rural land use. As Sidaway (2005) notes, ideological differences between landowners and recreation groups seeking freedom of public access have been at the heart of the controversy. There has been a long tradition of "freedom to roam" in Scotland and the issue at stake is one of equity (Warren, 2002).

However, from February 9th 2005 the Scottish Access Code came into effect. This gives more people the right to enjoy the outdoors, but states that "with these rights comes more responsibility" (SNH 2005, 1). The Code explains what responsible access means and provides managers with information about how to welcome visitors onto their land (SNH, 2005). As a consequence of the Scottish Access Code, respecting people and the environment throughout the recreation experience is now included within LLTNP legislation. Specifically the Code states: "respect the interests of other people; care for the environment; and take responsibility for your own actions" (SNH 2005, 1). The Code provides an example of excellent information dissemination. It is available to the public through the Internet (primarily the Scottish Natural Heritage web-site), leaflets, television advertisements, rangers, publications compiled by Scottish Natural Heritage, and the LLTNP visitor centres (including those at Balmaha, Balloch and Luss).

As a consequence of these wider Acts and Codes, projects are now being carried out throughout the National Park to improve access (and hence avoid limiting Park-wide access), such as "Community Parks Networks" (LLTNPA 2003, 17). Another scheme that aims to provide improved access is the "Breakfree Scheme". Originally for disabled visitors, the Scheme lists recreation activities and walks based on geographical location and difficultly. It helps to achieve the recreation management objective of recreation for all. A "Breakfree" pack is available as information cards, an audio tape, a CD ROM or in an Internet edition. In terms of site management, "Breakfree" information cards allow a manager to see, at a glance, all the barriers to access in relation to all the features of interest. In doing so it offers a valuable tool in prioritising access improvements (Manager, LLTNPA). The "Breakfree Scheme", then, is a management programme that contributes to social inclusion through providing access and again information to the public.

In terms of the four practices of recreation management therefore (information/education, zoning, pricing and limiting access), information/education is the primary tool of the LLTNPA. Still, as presented in chapter four, managers are concerned with a number of further generic recreation issues. Visitor behaviour and conflict are major concerns for many managers (section 4.5). Yet, most managers do not believe that this visitor conflict is caused by noise levels (as perceived by visitors), but rather by anti-social behaviour – specifically by the presence of so-called "neds". The following interview extract demonstrates this point:

"Visitor conflict is present at some sites. This is partly what I like to call 'normal conflict': picnickers vs. cyclists; cyclists vs. hikers; fishermen vs. boaters etc..., but I don't believe this to be as big an issue as people like to make out. For me the bigger issue is age conflict: 'neds' at Sallochy especially. There's conflict both at the time the 'neds' are on-site and also after they leave the site: they leave litter and bottles lying about. I've even had complaints about syringes but I've never seen any at Sallochy myself. It's primarily drinking that's the main problem and the 'neds' leaving their empty bottles lying about. It is anti-social behaviour. In a city environment it wouldn't be seen as bad but because it's in rural areas it seems worse as it's out of place. Sallochy is now getting the problems of anti-social behaviour that Milarrochy Bay used to get: the problem has been displaced as Milarrochy Bay now closes its gates and is managed on-site. The 'neds' have moved up the loch side... Having said that, most people are relatively relaxed. Only a few complain and write in. We only get a handful of serious complaints every year (around six), which isn't big at all when you think of the number of visitors altogether. It'll be interesting to see the results of your questionnaires, especially your question about whether any improvements are needed. It'll be useful to see whether there are many people who although not grieved enough to write in and complain, are still not happy with their recreation experience because of whatever reason – to see whether they see any visitor conflict and how they define this" (Manager, Forestry Commission).

In addition a number of managers put forward the opinion that:

"Often visitor conflict is perceived by the public as there being a bigger problem than actually exists... Although there is a degree of conflict there is no real reason to manage this. Conflict is always going to happen no matter what we do. It's best to let people sort themselves out and they will... It [conflict] *is not really a significant management issue"* (Manager, LLTNPA).

This finding supports previous research such as Manning (2001) and Hendee *et al* (1990), that observed that visitor and manager perception differ. It is revealing that one LLTNP ranger believes that conflict between boaters and jet-skiers is a problem issue. He states:

"In specific areas conflict is a problem, Milarrochy Bay for example. In fact Milarrochy Bay was identified as the most densely used area of the loch in the Boat survey. It's not only popular with boaters, anglers also fish around Milarrochy Bay. Supposedly there are still a lot of fish in the area! On the whole it's normally ok as long as people don't get too close to each other" (Ranger, LLTNPA).

Perhaps this view is the result of the ranger seeing first hand the conflict that results between jet-skiers and sailors for example. Unlike managers, he works "on the ground" with the public.

Another theme of importance to the various management teams was the value of sustainability and how this would be incorporated within the National Park Plan. For Mitchell (2002), sustainability must be transformed from a concept to action. Integration, and relieving tensions between land-uses, is key. Many managers stated that environmental issues must be integrated with social and economic issues if sustainability is to be achieved. This also corresponds with the thoughts of Dovers (2002) who claims that the key essence of sustainability is integration, namely, integration of ecological, social and economic policy over the long-term. Indeed as the following interviewee concluded:

"If economic, social and environmental issues aren't integrated, if public perception of the environment and of management is poor, then we won't be sustainable... As an organisation we are led by perception. Our strategies and so forth are perception led" (Manager, Forestry Commission).

The final sentence of this interview extract shows the opinion of one manager on the relative importance of perception and reality in recreation management (for a good, comparative discussion of the "gulf" between scientific ecology and perception in conservation management see Pullin *et al*, 2004; Pullin, 2002; and Pullin and Knight, 2001). Indeed all managers were asked the following question: "what do you think is more important with reference to management of the resource base, real or perceived pressures? Why?" Answers varied, but in general many believed that both perception of the environment and the actual state of the environment were both important and of significance to the resource manager. One interviewee suggested, "there isn't a strong difference between real and perceived pressures. Often reality is what is perceived to be reality... What is real damage for one person isn't real for someone else" (Policy-maker); while another argued, "I really think reality and perception are highly interwoven. It's difficult to distinguish between the two" (Ranger, Forestry Commission). Many therefore believe that while real pressures give the initial clues to the recreation manager, there is also a need to understand visitor perception. Crucially "managers could interpret the real signs wrongly" (Policy-maker, SNH) and hence both real recreation pressures, environmental damage for example, <u>and</u> perception of recreation and perception of the environment should be important to the LLTNPA.

A particularly interesting reply to this reality/perception question is as follows:

"Management of the resource base must be based on sound science and real issues on the ground. I think that is the answer that any resource or recreation manager would give you. I mean perception and what is on the ground don't always agree.... But issues are often debated on perceptions, for example the barrage issue on Loch Lomond. Is shore erosion caused by the barrage or by natural processes? Perception is still taken into account when thinking about how to plan for and manage sites.... So in actual fact there is no doubt that perception does play a role. Yes, in actual fact, perceived pressures are probably more important" (Manager, LLTNPA).

As seen in this interview extract, the respondent began by stating that "real" issues were the most important, but then, with his own arguments, concluded that it was perception that was <u>the</u> issue that actually affected planning decisions and management. Perception rather than "real" environmental impact became the more crucial issue (see Pullin *et al*, 2004). In the following extract perception is again seen to be the more significant factor. Namely:

"For my job, perception is more important than real pressures. Real pressures are important in the long-term but in the short-term it's people's perceptions that must be addressed... If we don't deal with perception then the National Park will not be fulfilling its role and will loose its credibility with the public and as a National Park overall... Perceived conflict, perceived problems within the National Park must be addressed in order for management to be seen to be effective... To ensure that we fulfil our role and objectives we must deal with public perception of the National Park before we can even begin to address any real problems that may exist on the ground. Public perception and gaining public support are crucial for successful visitor management. Satisfaction must be achieved" (Manager, LLTNPA).

There were, however, a number of managers who believed that the state of the actual environment and hence "real" pressures were more important than visitor perception. In general they claimed that "people's perceptions can be flawed" (Ranger, Arches National Park Authority). In particular the following respondent argued:

"We deal with 'real' pressures and dismiss 'perceived' pressures through education. We need to replace the 'myth' with 'fact'" (Manager, Lake District National Park Authority).

Here, then, "real" environmental pressures are imperative. This is consistent with the "Sandford Principle", which states that environmental conservation should be given priority, should it come into conflict with other National Park aims. Similarly, an interviewee suggested that:

"Any management model is always based upon 'current' environmental conditions – not 'ideal' or improved conditions. So in management and planning 'real' pressures are always seen to be more important than perceived pressures" (Recreation Research Consultant).

In terms of real pressures many managers and policy-makers suggested that these must be assessed by subtle measures – education and information provision for example. Again, then, even where managers believed that "real" pressures were most important, perception and reality were actually seen to be interlinked. The following story paraphrases this argument well:

"A few years ago now there was a fault with a sign on a path. This resulted in one Boy Scout going through an area that he shouldn't have and 260 scouts followed him! The consequence was environmental damage since the footmarks had created a new route. There should have been better signs on the ground. Here people's perception of a sign led to direct environmental damage – it sounds crazy but it happened!" (Policy-maker, SNH).

"Real" pressures are indicative of the themes of resource impacts and "real" environmental damage – another fundamental issue for the managers interviewed (section 4.5). Management of the environment was crucial for all managers: "If we could keep resource damage in check we wouldn't have to worry about crowding because it wouldn't matter how many people were on the resource, it wouldn't get damaged" (Ranger, Arches National Park). The LLTNPA in particular have undertaken direct approaches to environmental management, such as hardening sites vulnerable to recreation use (Milarrochy Bay is a good example of this, as are parts of the West Highland Way long-distance footpath – see figure 7.5).

Figure 7.5: West Highland Way, Conic Hill, Balmaha. The photograph on the left shows part of the West Highland Way before any "hardening" by management. Footpath erosion is evident. The photograph on the right again illustrates the West Highland Way, however, this time modified by management, i.e. the steps are evidence of "hardening" to prevent erosion *(left photograph taken September 1997 by author; right photograph taken September 2000 by author).*

There have also been indirect approaches such as erecting signs at sites, providing the public with information about their local environment, and establishing the ranger service, which interacts with the public and encourages environmental education. As an employee of the Forestry Commission states, "what is the environment if not to be enjoyed by humans?" (Manager, Forestry Commission). A number of initiatives have been undertaken by the LLTNPA in order to achieve the objective of environmental protection and enjoyment including improving footpaths in the area. One LLTNPA manager stated that foothill areas have greatest priority in terms of environmental impact. Research into footpath erosion is critical and a key priority for the LLTNP (Manager, LLTNPA). Additional environmental impact concerns for managers included water pollution (caused by boat recreation and sewage levels), threatened wildlife habitats, disturbance to birds, damage to trees and ground vegetation (particularly by youths chopping down the trees and destroying branches), litter, exposed tree roots, shore erosion, and introduction of new species (in particular there were concerns regarding the fish ecology). All environmental impacts are identified in the ecological recreation literature (see Liddle, 1997; Tivy, 1980; and Wall and Wright, 1977). Like Dickinson (2000a), managers also recognised that environmental damage and ecological impact was limited in its extent and "what is real damage for one person isn't real for someone else" (Policy-Maker). One manager commented, "the level of ecological damage caused by recreation isn't as great as it's often perceived to be" (Manager, LLTNPA); echoing the claims of Dickinson (2000a). The following quote summarises this argument:

"When you look at it in the context of the whole national park, would a few damaged trees be classified as serious ecological impact? The ecological impacts are very site specific. You could see ecological damage, walk 100 metres and then it's no longer there. What I'm trying to say is that the actual area of damage is small compared to the size of the whole park. But this damage can be of a disproportionate size to visitors. If visitors see a site with concentrated damage this influences their perception for the whole area. They believe that all of Loch Lomond is suffering from serious ecological damage. It can be seen to be serious damage even if it is much localised. Another perception issue... I'm pretty sure there must be a big water pollution problem at a number of localised areas around the loch, inside the breakwater at Cameron House for one. People moor their boats and empty their toilets. It looks like there is horrible stuff in the water there. Having said that, there's no scientific evidence to support this. SEPA [Scottish Environment Protection Agency] *claim that Loch Lomond is a very clean loch. The government have stated that it's one of the cleanest lochs in terms of water quality; I'm not convinced. I think that research into environmental impacts, such as water quality, should be a priority for environmental management"* (Ranger, LLTNPA).

Again this extract not only illustrates the intricacies of the perception/reality debate, as discussed by Pullin (2002), but also shows the importance attached to environmental impact by many in the LLTNPA. It is interesting that from interviews with managers and policy-makers noise is not seen to be an important issue. Crowding is also not seen to be a significant issue. Environmental conditions and resource impacts are often the biggest concern. This is in contrast with visitor perception where noise is seen to be the most significant issue, followed by crowding and lastly environmental damage (81% of visitor survey respondents stated that noise pollution affected the enjoyment of their visit, 80% said crowding affected the enjoyment of their visit, and 79% reported that environmental damage affected the enjoyment of their visit). As recognised by Manning (2001) and Hendee *et al* (1990), correspondence between visitor and manager perception is an essential dimension of recreation management. Looking at environmental impact in particular, table 7.5 illustrates the differences between visitor and manager opinion.

Environmental damage	**VISITORS – YES (Percent of valid respondents)**	**MANAGERS – YES (Percent of all respondents)**
Litter	35.1%	100%
Dead trees	24.0%	100%
Water pollution	10.6%	62.5%
Exposed tree roots	27.5%	100%
Broken branches	33.2%	100%
Damage to ground vegetation	28.7%	100%
Wearing away of the beach	23.5%	100%
Does it worry you to see any of these things?	74.8%	100%

Table 7.5: Perception of Environmental Damage.
(Q.15: Did you notice any of the following kinds of environmental impact on the site...?)

For visitors the question outlined in table 7.5 was asked on site and as such respondents could report more than one sign of environmental damage. During each management interview the question was modified to ask "in your opinion, are any of the following a problem at any of your sites? Litter? Dead Trees? Water Pollution?" and so on. 548 respondents were questioned as part of the visitor survey; eight managers were interviewed as part of the management survey (interviews with a manager from the Lake District National Park Authority and interviews with employees of the ANP were excluded in this analysis). The results were revealing. For example, whilst only 24% of visitors said that they noticed dead trees on the site, all managers (100% of the sample) stated that dead trees were present at some of their sites. Similarly, while only 23.5% of visitors noticed shore erosion, all managers stated that this was a problem in many areas around the loch.

In addition, opinion on conflict between different recreation users also varies between the manager and the visitor. Whilst the visitor notices conflict caused by recreation activities other than his or her own, in particular jet-skiers, the manager believes that anti-social behaviour, from groups of youths, is the main problem issue. During implementation of the questionnaire survey, visitors were asked whether other people typically reduced their enjoyment of a day out on Loch Lomond. 51.5% of respondents stated that other people reduced their enjoyment. Of those answering "yes" to this non-leading question, 94.6% replied that "jet-skis annoy me", while 3.2% stated "neds annoy me". Again, then, there is a discrepancy between visitor and manager perception (confirming the findings of Hendee *et al,* 1990). Where managers did recognise conflict between visitors they believed this was the result of anti-social behaviour rather than activities such as jet-skiing. Perhaps this is because of the nature of the complaints received by managers, i.e. complaints of anti-social behaviour as a consequence of groups of youths rather than complaints against PWC. As a final note on visitor conflict, one manager argued, "while there is conflict at specific sites, this conflict isn't as big a problem as people perceive it to be" (Manager. LLTNPA). Results from the visitor survey would suggest otherwise.

One area where there was common ground between the manager and the visitor was with the willingness to pay for parking question. Pricing was seen to be beneficial by the majority of managers and the majority of visitors. Pricing is therefore a real option for the LLTNPA. On the whole, however, it appears that, "there is a wide difference between the perceptions of the general public and the environmental scientist or the environmental manager. This difference in opinion is a vital gap that should be closed" (Policy-maker, SNH). Results confirm findings in the recreation literature which suggests that "changing visitor values are not well understood by managers" (Manning 2001, 62). Hendee *et al* (1990) report that visitors often see problems differently from managers and that mangers need to be aware of this when defining problems and seeking solutions. Looking at previous recreation studies, Hendee *et al* (1990) conclude that managers perceive ecological impacts as a problem more often than visitor crowding or conflicts. In contrast, most surveys of visitors indicate more concern with social conditions such as crowding and conflict among visitors, than with resource conditions such as vegetation impacts. Thus while most visitors tolerate fire-rings, for example, many managers find such impacts unacceptable (Hendee *et al* 1990, 405). The findings of the current research project appear to support these claims. Hendee *et al* (1990, 406) suggest that where managers' and visitors' perceptions diverge, managers need to reconsider their ideas about their nature and importance of the condition they see differently from visitors[34]. If they are convinced that it is an important problem, they need to educate visitors to share this view. Again, then, education and information appear to be the main "tools" for recreation management and this is the primary management approach currently used by the LLTNPA. The following sub-section explores the possibility of a wider variety of management "tools" for the LLTNP and offers some recommendations.

7.3.2 Possible management practices (recommendations).

Table 7.6 summarises the discussion in the previous section, i.e. it shows whether or not a particular management practice is currently followed in the LLTNP. In addition it states whether or not a management practice is possible / recommended in the area.

[34] They should address the difficult issue of "management for whom?" Recreation management should not exclude certain groups of people, i.e. those seen as out-of-place in the rural environment (Cresswell, 1996).

Type	Example	Does it occur?	Would it work?
Direct	Pricing / Impose fees	No	Yes
Direct	Zoning	No	Possibly – more research needed
Direct	Limit access	No	No – too severe a measure
Indirect	Information / Education	Yes	Yes

Table 7.6: Management Practices in LLTNPA: current situation and recommendations.

Pricing for the Loch Lomond area is recommended not only because of management approval of the concept, but also because of evidence from the contingent valuation survey, which indicates that 81.2% of visitors would be willing to pay a car parking fee. More visitors were willing to pay at those sites where they recognised that some level of environmental damage already exists. The implication of this is that a parking fee should be implemented at those sites were visitors recognise that environmental damage does exist, for example Sallochy. It is recommended that the car parking fee should be close to the mean value of £1.76, the most the average visitor would be willing to pay to park for a maximum of one day at a Loch Lomond site. Similarly, the TCM also suggests that in theory a parking fee could be put in place at various sites around Loch Lomond to harness some of the current consumer surplus (£20.53 under current conditions) for LLTNPA use: the high consumer surplus suggests that visitors to Loch Lomond do not currently pay as much as they would be willing to pay as they enjoy the park. Likewise, the contingent behaviour models show that under improved crowding, environmental and noise conditions, £23.02, £20 and £22.83 respectively could be obtained through consumer surplus for use by the NPA. Clearly these figures, along with visitor and manager approval, suggest that there is an opportunity for the NPA to generate revenue and help conserve the natural environment through pricing, specifically through charging users at certain sites for parking their vehicles.

Zoning is another possible management tactic that could be adopted by the LLTNPA. Both spatial and temporal zoning are possible but neither is the preferred management approach. Evidence for this opinion comes from a number of sources including the visitor questionnaire survey; travel cost model; ecological surveys; visitor damage survey; and the jet-ski case study. Results from the visitor survey indicate that 92% of respondents travel to the site by car, suggesting that it would be relatively easy to influence visitor flows and encourage certain recreation activities in certain areas. The LLTNPA could control access to certain zones through vehicle flows. In addition 67.5% of respondents undertook passive recreation activities such as picnicking and sitting on or walking along the shore. Zoning areas exclusively for these "quieter" pursuits is therefore another option for the LLTNPA. This would also support the results from the jet-ski debate case study where there was found to exist a conflict between jet-skiers and other recreation users, specifically anglers, sailors and picnickers. Zoning areas specifically for jet-ski use was discussed in section 6.5. Findings from the TCM also suggest that visitors from different origins experience different travel costs when visiting a site. The implication of this is that National Park policy would have different consequences for visitors from different areas if zoning were implemented. From an environmental perspective, the ecological survey indicates that there appear to be differences in the level of recreation pressure and visitor damage experienced between plant communities, suggesting that zones with certain vegetation communities should be protected from recreation use. Likewise the visitor damage survey indicates that 39.7% of the total loch shoreline has no visible visitor damage. The implication of this is that environmental damage does not appear to be such a great problem as many managers perceive it to be, but more importantly such areas should not be allowed to suffer from recreation pressure in the future and should be (spatially) zoned to prevent any recreation use. This follows the theory of Cole (2003) (section 2.5): recreation concentration, rather than recreation dispersal, should be the favoured environmental management approach. Recreation concentration prevents environmental degradation in those areas not yet subject to recreation pressure and, as a consequence of trampling theory, there is no further detrimental impact to vegetation communities already affected by recreation. Zoning areas for recreation (and consequently no recreation), then, is environmentally beneficial, at least in terms of vegetation impact. It must be remembered, however, that not all managers supported the use of zoning within the National Park area. Therefore, it could be a controversial policy to implement and is thus only a possibility.

Limiting access, defined here as preventing (excess) visitors from entering the national park as a whole rather than on a site-by-site basis, is not recommended as a management policy. Recreation managers, policy-makers and recreation researchers generally do not favour this as an official management approach. In addition traffic counts indicate that physical carrying capacity was very rarely exceeded at the four sites under study: Milarrochy Bay, Firkin, Sallochy and Rowardennan. Only during peaks of recreation use (a warm August Sunday afternoon for example) was physical carrying capacity exceeded and was there cause for management concern. During such periods implementation of a parking fee could again be an appropriate management strategy, perhaps reducing site use at specific times. Descriptive statistics signify that 76.3% of visitors stay on site for less than four hours, thus turn-over at a site is relatively quick, suggesting that limits to access are not needed. Similarly, group size is relatively small (the mean group size is 3.02) again implying that access need not be limited. Both the ecological surveys and visitor damage surveys indicate that there are areas not yet subject to recreation or visitor pressure, such areas should remain free from severe environmental impact without the need to officially limit access. Limiting access may only become a possibility when looking at specific recreation activities, jet-skiing for example. The consequences of banning PWC remain controversial, thus limiting access is not recommended as an official management strategy for the LLTNPA.

Information and education already exists in the Loch Lomond area and, as shown through interviews with the LLTNPA, it is widely supported as a management tactic. The contingent valuation study shows that providing information to visitors does help influence their opinion of the environment. For example, although only 10.6% of respondents recognised water pollution in the loch, after explanation of the various environmental impacts and possible on-site environmental improvements, 81.2% of visitors were willing to pay to fund such improvements, suggesting that providing information on the environment to visitors is vital. It is recommended that more environmental information should be provided to visitors at specific sites. As an example, information leaflets on environmental impacts and ways to reduce these impacts could be distributed on site at Milarrochy Bay, Drumkinnon Bay and Firkin. Current information and education provision could be expanded upon.

The above section has outlined the research results and the implications for various management approaches. More generally, the results suggest that there are currently four problem issues for the Loch Lomond area: crowding, noise, environmental damage and visitor conflict. Using the findings and the possible management practices discussed above, table 7.7 recommends management actions to address each specific problem.

Current Problem / Challenge	**Recommended / Possible management action**
Crowding	(1) Zoning – temporal or spatial. (2) Charging fees at highly used sites. (3) Information / Education – inform visitors when sites are most likely to be crowded, when car parks are nearing full capacity.
Noise	Zoning – effectively bans jet-skis from certain areas.
Environmental Damage	(1) Charging fees – revenue used for environmental improvement at highly damaged sites. (2) Information / Education – leaflets to educate public on protecting their environment, damage caused by breaking branches, burning trees etc...
Visitor Conflict	Zoning – temporal or spatial.

Table 7.7: Management problems / challenges and possible actions.

Table 7.7 identifies the social and ecological implications for the Loch Lomond area in general. However, as it has been argued throughout this chapter that carrying capacity is most useful on a site-by-site basis, it is imperative to be more site-orientated when recommending specific management actions. Each major site under study is consequently now examined.

<u>Milarrochy Bay</u>

Milarrochy Bay beach area is managed for cars by division into car and non-car access by boulders. In terms of on-site management practice, there is a building on-site which houses National Park rangers and wardens (see figure 7.6).

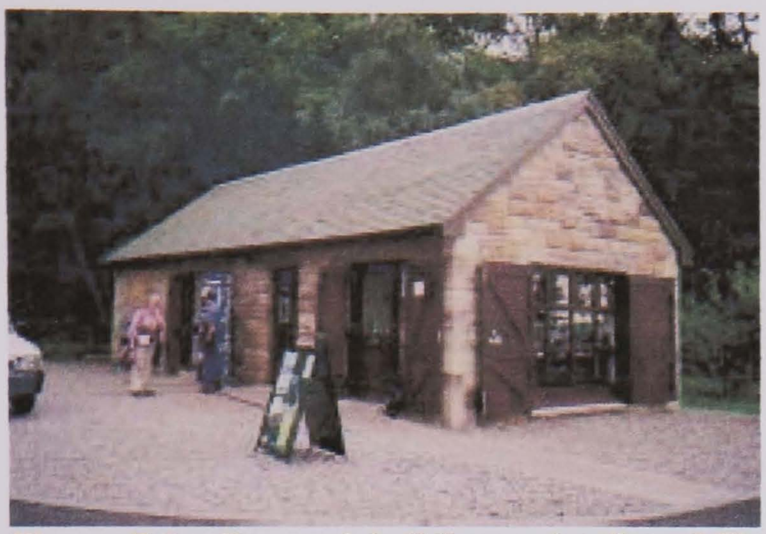

Figure 7.6: Rangers' building and toilets, Milarrochy Bay *(Photograph taken Sunday 4th July 2004 by author).*

The physical presence of the LLTNPA, through the presence of rangers, is an important management practice and influences the character of the site. On-site rangers also control traffic levels in the car-park and beach area by closing the site gates when the car park is deemed to be full. As one interviewee stated, "at Milarrochy Bay managers now control where cars go. This is important. Access is a crucial management issue at this site. They've adopted a hard engineering approach here" (Policy-Maker).

In terms of physical carrying capacity, then, on only one of the six days of the field study was this form of carrying capacity exceeded. At 1pm on Saturday 9th August 2003, visitors were already parking on the grassy verges, i.e. non-designated car parking spaces. However, by 1:30pm the gates on site were closed preventing any further over-use of the site. An on-site ranger presence prevents physical carrying capacity being severely exceeded.

Thinking about the four studied challenges of crowding, noise, environmental damage and visitor conflict, crowding at Milarrochy Bay only appears to be a problem during periods of peak use. Busy days are however rare, occurring only during periods of warm/hot weather and during the weekend, primarily on Sundays. When questioned about the level of crowding on site, the majority of respondents (40.6%) did not rate the site as crowded at all, although 81.3% said that crowding, if present, would affect the enjoyment of their visit. On a day of peak recreational use one visitor stated, "it is fairly crowded today. Put it this way, I wouldn't like it any busier" (Female, 25-34 years, Glasgow).

Of more concern to the visitor than crowding was the issue of the noise pollution, caused primarily by PWC use. Of the four sites addressed here Milarrochy Bay is the only site that allows the launching of jet-skis. As a result the majority of jet-skiers tend to congregate in this area. When looking at all four sites, Milarrochy Bay was rated worst in terms of noise pollution and 56.1% of respondents thought the jet-skis were causing noise pollution, for example:

"Milarrochy Bay has far too much noise from the jet-skis – especially today. I mean what the hell is that guy doing? *points to jet-skier "zooming" round and round in circles * *The site would be remarkably* [respondent's emphasis] *improved if they got rid of all the jet-ski noise"* (Female, 35-44 years, Glasgow).

Reducing noise pollution at Milarrochy Bay appears to be a challenge for the Park Management team, and is recognised as such by the draft National Park Plan (LLTNPA, 2005a). Noise pollution is invariably linked to the visitor conflict that exists at Milarrochy Bay. Interviews and the visitor survey both indicate that Milarrochy Bay is a prime site of visitor conflict.

Environmental damage is another issue that should be investigated when looking at Milarrochy Bay. Both the visitor damage survey and the ecological surveys identified Milarrochy Bay as an area that suffers from high visitor impact. Still, from the visitor survey it was seen that the majority of visitors did not recognise this environmental impact, since 39.6% of respondents rated the site as a '1', i.e. no visible environmental damage. The presence of on-site rangers helps not only to reduce visible environmental damage, but also to provide the visitor with a sense that the site's environment is "being well looked after" (Male, 45-54 years, Ayrshire). Despite this fact, the majority of respondents (71.7%) would be willing to pay a car parking fee to fund environmental improvements at Milarrochy Bay. This percentage of willingness to pay is still lower than that at Firkin, Rowardennan, or Sallochy. Perhaps this is because many visitors do not recognise that environmental damage exists at Milarrochy Bay, or perhaps the size (area of the site) could be a significant determinant on perception of environmental damage here.

In the author's opinion, then, management priority for Milarrochy Bay should be to reduce visitor conflict in the area, in particular between jet-skiers and other recreationalists. Information and education should be used to establish a dialogue of understanding between jet-skiers and other users. Visitors also asked for more local information to be issued on site: indicator viewpoints, signs, maps, leaflets, and so on (see Appendix G). Of all visitors interviewed, 32.5% reported that they believed the site could be improved, with 67.4% happy with current conditions at the site.

Sallochy

In contrast to Milarrochy Bay, Sallochy has no on-site management presence. There are no gates to separate the site from the main road and hence access is possible at any time, day or night (see figure 7.7).

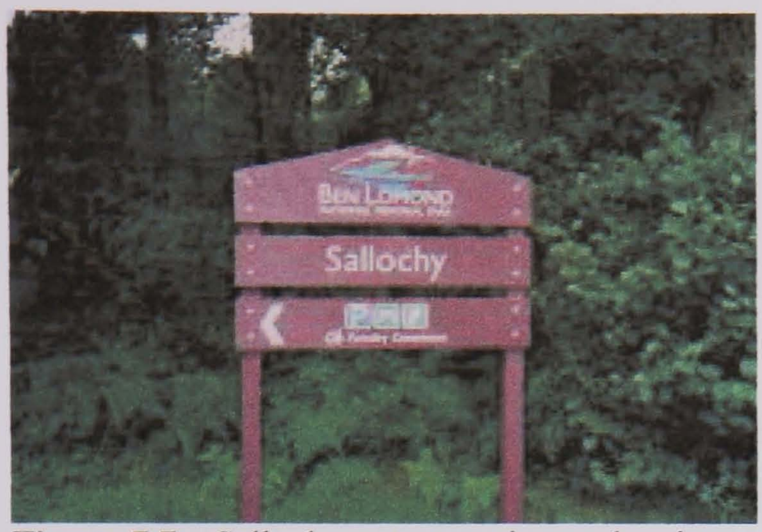

Figure 7.7: Sallochy entrance sign – showing parking, picnicking and forest walks *(Photograph taken Saturday 12th August 2000 by author).*

Popular with groups of local youths, especially at night, for many Sallochy has the reputation as a "party site" (Warden, LLTNPA). It is also popular with visitors wanting a "natural" experience: "Sallochy is a nice and natural site. There are no jet-skis or speed boats here and that is definitely good. The scenery is outstanding" (Male, 35-44 years, Ayrshire). Peace and quiet was the reason that 16.4% of visitors stopped at Sallochy on the day the surveys were issued, 11.2% did so because of the scenery.

As with Milarrochy Bay, physical carrying capacity was exceeded on one of the survey days. This was cause for environmental and social concern as not only were cars parked on the grass and litter clearly seen, but high noise levels from groups of people playing loud music was also heard. Crowding at Sallochy is consequently again a problem during these peak periods, particularly at night when local youths visit the site to play loud music, drink alcohol and eat, often from on-site barbeques (see figure 7.8). Such visitors are the origin of much of the noise on site, as PWC are not launched in this area. Environmental damage on this site is high. Litter is particular is very visible, as are broken branches, fire circles, and erosion in both the car park and beach area. 73% of respondents at Sallochy stated that they would be willing to pay a car parking fee to fund environmental improvements, perhaps because damage to the environment is so visibly obvious. Finally, looking at visitor conflict, whilst this does exist to an extent at Sallochy this is not so much between jet-skiers and other recreationalists, but rather between younger and older visitors: while the younger visitor may visit to play their loud music, the older visitor wishes to enjoy peace and quiet. Namely:

"For me the biggest issue at Sallochy is age conflict: so-called 'neds' at Sallochy especially. There's conflict both at the time they're on-site and also after they leave the site: they leave litter, cans and bottles lying about... It's a problem of anti-social behaviour" (Manager, Forestry Commission).

Figure 7.8: Remnants of a barbeque and cans, Sallochy *(Photograph taken Sunday 24th August 2003 by author).*

Suggestions for on-site improvements from visitors reflect these issues. 56.5% of respondents stated that improvements were required at Sallochy, the highest percent for all four sites. From those respondents, 52.3% believed that toilets on-site would improve their experience; similarly 52.3% reported that bins were required on site (obviously not aware of the Forestry Commission policy that prohibits litter bins in forest areas). Again Appendix G lists the remaining ways in which visitors believed the site could be improved.

Priority for Sallochy should be to reduce environmental damage. A general "clean up" of the site is needed. Litter was visible on every day the site was visited, and was commented on by the majority of visitors. Vegetation damage by vehicles also appears to be a problem on site, as do broken branches, fire circles, and deliberate damage to trees. The recommendation is that a parking fee should be implemented at this site in order to provide revenue to fund environmental improvements. It is recognised that practical difficulties could arise in the implication of such a parking fee. There is no gate on-site currently, for example[35], and hence educating users on the appropriate use of the environment – not breaking branches or burning trees for example – is again needed, through information leaflets or information signs/boards to be placed on site.

Rowardennan

Rowardennan is an interesting site in that its major role is as a car park for visitors climbing Ben Lomond (63% of visitors questioned during the visitor survey stated that they were using the site for this purpose – see appendix F). The end of the east road of Lomond, it is also a stopping site for many, where they leave their vehicles, view the loch (by walking to a small beach area) and then return home or to holiday accommodation on the east shore. There are information boards and a recently built rangers' building on site and thus on-site management is present.

[35] Although a gate for Sallochy is currently being considered according to a LLTNPA employee (interview).

Physical carrying capacity was exceeded at Rowardennan on two of the survey days (both Sundays). On both days the car park was full and visitors were parking on the grass verge or in the nearby hotel car park. This implies that current on site parking provision is not acceptable during periods of peak recreation use. Still, during these periods of peak recreational use the site is often not crowded with people, only with cars, as visitors leave the car park to walk to the summit of Ben Lomond. Crowding then is not a problem in terms of number of people seen; indeed only 11.5% of visitors stated that crowding levels reached a '4' or '5' (high or very high) on the days questioned, with the majority rating crowding levels as low. Similarly, noise pollution was not a priority problem for many visitors questioned. Again neither jet-skis nor boats are launched from the pier at Rowardennan, leading to little visitor conflict on-site. "Real" environmental damage at Rowardennan, while visible, is limited. It is during the periods of highest demand, when visitors park on the surrounding vegetation, that pressure on the environment is greatest (see figure 7.9).

Figure 7.9: Rowardennan car park (*Photograph taken Sunday 24th August 2003 by author).*

A resounding 93.3% of visitors would be willing to pay a car parking fee to fund environmental improvements at Rowardennan. Many questioned also believed that such a fee would help increase the number of car parking spaces available during peak recreation periods. Only 16.7% of respondents believed that improvements were needed at Rowardennan (see Appendix G for suggested improvements).

The priority area for management of Rowardennan should be to address the lack of car park spaces during periods of peak use. Parking on the grass verge and hence out of designated parking spaces is contributing to environmental erosion of the site and vehicle trampling of the vegetation. The management action suggested is therefore to introduce a car parking fee to be collected on site. This should be relatively easy to implement. There is already a barrier in place when entering the car park and wardens or rangers are located on site. Such a car parking fee would perhaps help solve the parking problem during periods of high demand, reducing trampling by vehicle wheels and as a result reduce on-site environmental damage.

Firkin

The final site under study is Firkin. Although there is no permanent ranger or warden presence on site, there are toilets and information boards, and wardens regularly visit the site to ensure both social and environmental standards are acceptable. There is also a gate on site, which is opened and closed at designated times. Again neither boats nor jet-skis can be launched from Firkin. It is not a boating slip-way, it is a picnic site with walks along the west loch shore and toilets for visitor use (see figure 7.10).

Figure 7.10: Firkin – car park and toilets *(Photograph taken Sunday 4th July 2004 by author).*

Firkin is the only site where physical carrying capacity was not exceeded on any of the survey days. As shown in chapter six, crowding, noise and conflict were not seen to be major problems at this site. Both the ecological and visitor damage surveys show evidence of environmental damage at this site, however, this is limited and to a much less extent than at Sallochy for example. Visitor perception of environmental damage is particularly revealing as very few recognised any environmental impact on site: 99% of visitors rated environmental damage at a '1' or '2' on the one to five environmental damage scale. Similarly visitor suggestions for on-site improvements were limited, with 93.2% stating that no improvements were needed. For the 6.8% that said improvements were needed these were primarily the need for more bins on site or more picnic benches (see Appendix G for further information). In terms of visitor perception, then, Firkin appears to be the most sustainable site. It is well managed for visitor use.

There are no obvious priority areas for management of Firkin. It is suggested that the management status quo be maintained. A parking fee here is not recommended as it would deter many people from stopping at the site and, as many who visit Firkin are just passing through the Loch Lomond area, this is not desirable. There are already information leaflets exclusively for Firkin available at the local visitor centres and tourist information centres, and on site boards provide information about the site (see figure 7.11). Information and education at Firkin is good. Firkin appears to be the most successfully managed, and hence most sustainable, site of those currently under study.

Figure 7.11: Firkin Information Sign *(Photograph taken Sunday 4^{th} July 2004 by author).*

Table 7.8 summarises the main challenge / suggested priority for each site and the suggested management action.

	Milarrochy Bay	Sallochy	Rowardennan	Firkin
Priority for Site	Reduce visitor conflict (primarily caused by PWC use).	Reduce environmental damage – especially litter.	Lack of car parking space during periods of peak use, contributing to environmental damage.	No priority areas.
Management Action suggested	Information and education to be issued on site.	Parking fee to provide revenue for environmental improvements or Information/Education.	Parking fee.	Maintain status quo.

Table 7.8: Suggested management priorities and actions by site.

7.4 Conclusions

This chapter has shown that recreation management brings together the ecological and social dimensions of outdoor recreation. There have been a number of sections to this chapter, each leading to specific conclusions. Section 7.2 examined the possible application of a carrying capacity framework in the LLTNP. Interviews with employees of the LLTNPA show acceptance of carrying capacity frameworks: they think they are "a good idea" (Manager, LLTNPA). Possible frameworks within which to address carrying capacity include SVMS and VERP. The ANP provides an example of the practical implications of the VERP framework. Although ecological and social standards have not been met in the ANP, the setting of indicators can still be deemed "successful". VERP is therefore a valuable framework within which to base management decisions. The example of VERP in the ANP provides a practical model for operation in the

LLTNP context. It illustrates that the results of this research project can be engaged in an international context. A generic framework, such as that provided by Manning (2001, 283), could also be used. Regardless of whether a VERP, SVMS or more generic scheme is adopted, any carrying capacity framework requires indicators and standards to be set. The section concluded by stating that it is important to set indicators and standards by site.

Section 7.3.1 presented current management practice at Loch Lomond. It was shown that in terms of the four practices of recreation management (information/education, zoning, pricing and limiting access), information and education appears to be the primary tool of the LLTNPA. Also of relevance is that managers from the LLTNPA believe that both perception of the environment <u>and</u> the actual state of the environment are important (with evidence provided from interviews with managers). From interviews with managers and policy-makers, noise is not seen to be an important issue. Crowding is also not seen to be a significant issue. Environmental conditions and resource impacts are often the biggest concern. This is in contrast with visitor perception where noise is seen to be the most significant issue, followed by crowding and lastly environmental damage. Pricing was seen to be a good management measure by the majority of managers and the majority of visitors. Pricing is therefore a real option for the LLTNPA.

Section 7.3.2 recommended possible future management practices, namely: (1) pricing, in the form of a car-parking fee; (2) spatial and temporal zoning; and (3) expanded information and education provision. Priorities by site are as follows: (a) Milarrochy Bay – to reduce visitor conflict; (b) Sallochy – to reduce environmental damage; (c) Rowardennan – to address the lack of car parking space during peak times, which leads to environmental damage; and (d) Firkin – there are no priority areas. The LLTNPA should maintain the status quo at this latter site.

Following on from these conclusions a number of guidelines / recommendations can be identified for the LLTNPA. Specifically, it is recommended that managers of the Loch Lomond area concentrate on the issues of crowding, noise, environmental damage and visitor conflict – especially noise, which appears to take precedence for many visitors. Information and education, along with pricing are suggested as the preferred management tools, while directly limiting access is not recommended. Zoning is another management possibility. However, this requires further research before such a measure could be implemented.

From the research findings, the following is an outline of recommended priority sites for environmental and social improvements (i.e. sites at which recreational carrying capacity is currently exceeded).

Management by site: recommended priority sites

Environmental improvements (i.e. ecological carrying capacity exceeded) required at:

- Sallochy.
- The Narrows.
- Localised areas ("pockets") along the west shore including a site near Luss and Kenmore Bay.
- Localised areas along the West Highland Way on the east shore, for example the area just south of Milarrochy Bay and near Milarrochy Bay campsite (here there exists small "pockets" of visitor damage where access to shore is possible).
- Rowardennan.

Evidence for these priority sites is primarily derived from the visual assessment of visitor-induced environmental damage survey, the ecological (vegetation) survey, and the perception of environmental damage question in the visitor questionnaire survey.

Social improvements (i.e. perceptual carrying capacity exceeded) required at:

- Sallochy (57% of respondents stated that improvements were needed).
- Milarrochy Bay (conflict exists between jet-skiers and other recreationalists).

Evidence for the social priority sites is obtained from the visitor survey questionnaires and the interviews.

Overall priority site (i.e. ecological and social priority, where ecological and perceptual carrying capacity, in other words recreational carrying capacity, is exceeded):

- Sallochy.

Evidence for the overall priority site is from all data gathered during the course of the research project, including the visitor questionnaire surveys, the interviews, the ecological (vegetation) survey, and the visitor-induced environmental damage survey.

As a more general recommendation, the adoption of an overall recreation management framework is suggested, for example VERP or SVMS. This requires indicators and standards to be set. Before these can be implemented further research is needed in the Loch Lomond area. In particular it is suggested that a task force be set up to examine the possibility of applying a carrying capacity framework in the LLTNP. Results from this project suggest that there is a need for a holistic capacity framework for all recreation management. To conclude, perhaps the best advice for the recreation manager is given by the Victorian climber Edward Whymper, namely: "do nothing in haste, look well to each step and from the beginning think what may be the end" (Whymper in Bryden and Donaldson 2004, 24).

Chapter 8. Conclusions

"Loch Lomond is a priceless asset"
(Interviewee, Policy-Maker).

8.1 Introduction

If outdoor recreation areas such as Loch Lomond (figure 8.1) are to remain "priceless assets", a sustainable approach to outdoor recreation management is required. Such an approach must encompass both the perceptual/social and ecological dimensions of recreation, as is demonstrated by this research project. Both dimensions of recreation can be effectively combined in a relevant management framework. The concept of recreational carrying capacity underlies such a framework and it is an important notion with which to address both the ecological and social impacts of outdoor recreation. As realised by Huggett (2005, 308), carrying capacity is a potentially valuable theoretical concept from which tools may be developed to devise and prioritise outdoor recreation and natural resource management in natural and modified systems around the world. This thesis has provided theoretical and empirical evidence to support Huggett's claim. The development of an integrated approach to outdoor recreation not only benefits recreation and resource management, but also offers academic insight and advancement.

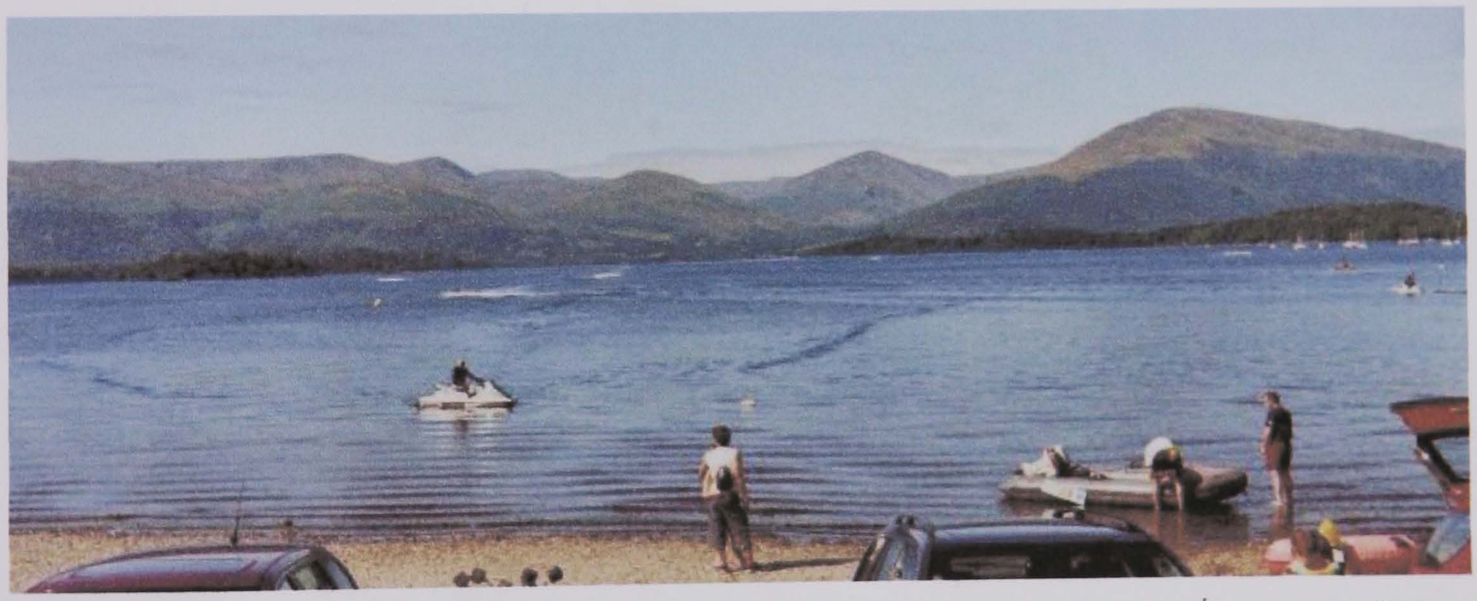

Figure 8.1: Loch Lomond, from Milarrochy Bay *(Photograph taken Sunday 24th August 2003 by author).*

The purpose of this final chapter is to reflect on the initial aims of the research project and to offer a commentary on the findings obtained. The first section of this chapter, therefore, summarises the research results and discussion of this thesis. Following on from this, the academic and policy-related implications of the research are presented, and overall conclusions are derived. The final section then offers a critique on the research process, and proposes a new research agenda and hence recommends possibilities for future research.

8.2 Summary of Results and Discussion

The purpose of this section is to offer an overview of the research methods, results and findings (see table 8.1).

Main Research Findings by Method Used		**Relationship to original research aims**
Research Method	**Main Findings**	
Questionnaire Survey: Descriptive Statistics	70% of the 548 respondents were aged 25 to 54 years; 92% of respondents arrived at the site by car; 72% of respondents carried out passive activities such as picnicking and sitting or walking near the shore; 51% said activities undertaken by other people typically reduce their enjoyment of a day out on Loch Lomond; 81% said noise pollution affected the enjoyment of their visit; 80% said crowding affected the enjoyment of their visit; and 79% said environmental damage affected the enjoyment of their visit.	Relates to Aims 1; 2 and 7.
Questionnaire Survey: Statistical tests of association (chi-square)	Highly significant relationship ($P \geq 0.99$) between: Perception of jet-skis and length of stay on site; perception of jet-skis and origin of visitor; perception of jet-skis and activity undertaken. Perception of noise and length of stay on site; perception of noise and number in group; perception of noise and activity undertaken. Perception of crowding and length of time on site; perception of crowding and weather. Perception of environmental damage and mode of transport; perception of environmental damage and date of visit.	Relates to Aims 1; 2 and 7.
Questionnaire Survey: Travel Cost Model (TCM)	Distance from site, length of time on site, perception of noise, age, sex, mode of transport and activity undertaken all significantly influence number of trips at $P \geq 0.90$ or better. Of the three site quality variables (noise, crowding and environmental damage), only noise is statistically significant. Hence, noise is the most important site quality variable. A reduction in noise level to no or very little jet-ski related noise would increase predicted visits to the Loch Lomond area by 4.2%. A typical day at Loch Lomond is valued at £20.53 (this is the consumer surplus) under current conditions.	Relates to Aims 1; 2; 3; 4; 5; 6 and 7.
Questionnaire Survey: Contingent Valuation Model (CVM)	Income, sex and perception of environmental damage all significantly influence visitor willingness to pay for improved environmental conditions (at $P \geq 0.95$ or better). 81.2% of interviewees are willing to pay a car-parking fee to fund environmental improvements. Mean willingness to pay is £1.76.	Relates to Aims 1; 2; 3; 5 and 7.
Questionnaire Survey: Contingent Behaviour Models (CBMs)	Crowding: Distance from site, length of time on site and perception of crowding all significantly affect number of trips. Consumer surplus is valued at £23.03 per person per trip. An increase in crowding levels to "overcrowded" yielded a 9.04% decrease in predicted trip frequency. Noise: Distance from site, length of time on site, perception of noise and the recreation experience with and without jet-skis all significantly affect number of trips. Consumer surplus is valued at £22.83. A decrease in noise level through a ban of jet-skis would increase predicted visits by 0.19%. Environmental Damage: Distance from site, length of time on site and perception of environmental damage all significantly affect number of trips. Consumer surplus is valued at £20. A reduction in environmental damage to "no environmental damage" would increase predicted trips by 0.21%.	Relates to Aims 1; 2; 4; 6 and 7. Relates to Aims 1; 2; 3; 5 and 7.

Ecological Surveys	Six groups of field and shore plant communities were identified by TWINSPAN at the third level of divisive classification. A clear geographical division arose between the north and south basin of Loch Lomond and the field and shore plants. Five main community types were identified for the aquatic macrophytes. An invasive/non-invasive binary became apparent. Exposure, recreation pressure, visitor damage (for the field/shore communities only), shade, and grazing are all statistically significant factors (at P≥0.95 or better) in determining differences between vegetation species groups. Crucially, recreation pressure is an important/significant influence on vegetation communities and hence the "real" ecology of Loch Lomond.	Relates to Aims 1; 2; 3 and 7.
Traffic Counts	<u>Milarrochy Bay</u>: Physical carrying capacity was exceeded during one of the six survey days. <u>Sallochy</u>: On one of the survey days physical carrying capacity was exceeded. <u>Rowardennan</u>: Physical carrying capacity was met and exceeded on two of the survey days (both Sundays). <u>Firkin</u>: Physical carrying capacity was not met nor exceeded on any of the six survey days.	Relates to Aims 1 and 7.
Interviews with management	<u>Main issues for managers</u>: the need for management frameworks; integrated planning and management; information/education; visitor behaviour and conflict; anti-social behaviour; park management actions; sustainability; resource impacts; environmental damage; and conflict between land-uses including conservation and recreation. Whilst environmental conditions and resource impacts are important concerns, managers view neither noise nor crowding as significant issues. This presents a visitor/manager discrepancy (for visitors noise was the most important site quality variable).	Relates to Aims 1; 2; 3 and 7.
Case Study: the Jet-Ski debate – interviews and documentary evidence	There is an extreme division between jet-skiers and non jet-skiers. While the jet-skiers themselves are more concerned with fun and enjoyment, non jet-skiers (sailors and anglers in particular) are affected by noise, safety and environmental impact. Conflict appears to be asymmetrical, from non jet-skiers.	Relates to Aims 1; 2; 3; 6; and 7.
Visual Assessment of Visitor-Induced Environmental Damage	44% of the loch shore zone experiences some level of visitor impact, with just over 9% experiencing very high visitor impact levels. Environmental damage is therefore present in the Loch Lomond shore zone area; however, this is to a limited spatial extent. Areas prone to high visitor damage include Sallochy, the Narrows and localised areas on the west shore.	Relates to Aims 1; 2; 3 and 7.

Table 8.1: Summary of main research findings and their relationship to the original aims of this work (as defined in section 1.2).

A commentary on each aim is now offered. Research aim one is, "to study outdoor recreation in the Loch Lomond area, focussing on the water and associated lake margin environment". Clearly this aim has been achieved through the adoption of all research methods (table 8.1) including a questionnaire survey issued to visitors at four sites around Loch Lomond, ecological surveys at eight sites around Loch Lomond, and the visual assessment of visitor-induced environmental damage survey, which covers the entire length of the loch. The second research aim is, "to determine the more important factor to the 'typical' Loch Lomond visitor, namely: perception and the social dimensions of recreation (crowding, noise, visitor conflict) or the actual environmental conditions of a site". Here is suggested that again all research methods (excluding the traffic counts) allow this aim to be addressed. For visitors it was found that the social dimensions of recreation (in particular noise) were most important, whereas for managers environmental conditions were seen to be more important (chapter seven). Evidence for the former claim is seen in particular from the TCM and CBMs, while interviews with management support the latter claim.

Thirdly, the next aim of this project was "to investigate whether visitor perception of environmental damage differs from actual levels of environmental damage, again focussing on the water and associated lake margin environment". Previous chapters illustrate that this aim is complex. However, in general the TCM, CVM, CBMs, ecological surveys, interviews with management, the PWC case study, and the visual assessment of visitor damage all allow this aim to be investigated. Perceptions of the environment and, more generally, visions of nature are fundamental in both academic and policy debate (see van den Born, 2001). Chapter six in particular demonstrated that there is no simple relationship between the perception and reality of environmental damage. Either environmental damage is not seen as important to the visitor, but it is a "real" issue at specific Loch Lomond sites or the visitor overestimates environmental damage, i.e. they see negative impact at one site and believe it is present throughout the Loch Lomond area. As the visitor damage survey shows, this is not the case: environmental damage is limited spatially. This gap between "real" and perceived environmental conditions has important consequences for resource management, as discussed in chapter seven.

Aim four intends "to construct a model for perceived crowding and to assess whether the expectation of crowding impacts on recreation participation decisions". Evidence for the effects of perceived crowding is provided through the TCM and crowding CBM. The crowding CBM in particular illustrates that the expectation of crowding does (negatively) impact on recreation participation decisions (section 4.4.3). Similarly, the fifth aim hopes to "construct a model for perceived environmental damage and to assess whether the expectation of environmental damage impacts on recreation participation decisions". Again this was achieved through the TCM and the environmental damage CBM. As stated in chapter four, a reduction in environmental damage to "no environmental damage" would increase predicted trips by 0.21% using evidence from the CBM. Again then the expectation of environmental damage does appear to have a negative impact on recreation participation decisions. The sixth aim is "to construct a model for perceived noise level and to assess whether the expectation of noise impacts on recreation participation decisions". Using evidence from the TCM, the noise CBM and the PWC case study it is suggested that once again perceived noise level does (negatively) impact on recreation participation decisions. The noise CBM concluded that a decrease in noise level through a ban of PWC would increase predicted trips by 0.19% (section 4.4.3). Moreover, noise was the only site quality variable statistically significant in the TCM and the most important factor arising during many interviews conducted as part of the jet-ski case study, all of which signify its importance when thinking about recreation participation decisions. Put simply, if noise levels increase people are less likely to participate in outdoor recreation.

The final aim of the thesis is "to integrate perceptual and ecological findings in order to recommend future resource and recreation management options". As with research aim one, this has been addressed by all methods employed (see table 8.1) and is seen, for example, in the policy recommendations derived from the TCM, CVM and CBMs. An example of such a policy recommendation is the implementation of a car parking fee at Sallochy. Although the perception of some is that charging curtails the feeling of freedom and right of access to countryside areas, the CVM study shows that visitors are willing to pay for parking as long as they know that their fee will be used to fund environmental improvements. To make payment credible, visitors need evidence that their outdoor recreation area is being successfully managed. Many recognise that "we will get the kind of countryside that we are prepared to pay for" (Edwards and Smout, 2000 cited in Warren 2002, 337). Recreational carrying capacity and management frameworks such as VERP also allow the integration of perceptual and ecological findings, and future resource and recreation management options have been recommended (chapter seven).

8.3 Implications of the Research Project and Overall Conclusions

A fundamental implication of this research project is the essential combination of qualitative and quantitative methods. It was decided that the initial research objective demanded the combination of such methods. That is to say the research aims are varied and consequently it is necessary to combine qualitative and quantitative approaches, to ensure assimilation of the perceptual and ecological dimensions of the project. Qualitative methods (such as interview) are used to complement traditionally quantitative approaches (for example the questionnaire survey) and vice-versa. This combination of methods has enhanced the validity and conclusions of the research project. This argument is supported by Bryman (1988), who states that by combining qualitative and quantitative methods the researcher's claim for validity of his or her conclusions is enhanced. Further, the adoption of a combined method approach allows the limitations of one method to be compensated for by the strengths of a complementary one (Marshall and Rossman 1999, 133). To this end a combination of qualitative and quantitative methods have been used to investigate the research aims.

The combination of qualitative and quantitative research methods is not unique to this project. Many researchers have realised the advantages to be gained from such a holistic approach (see for example Philip, 1998; Barbour, 1999; and Hammersley in Brannen, 1992). According to Barbour (1999, 40) the main reasons for bringing together the two approaches are: (1) for different stages in a project; (2) to compensate for each other's shortcomings; and (3) for purposes of triangulation[36]. The research project takes all three reasons into account. Philip (1998, 271) echoes Barbour's second point, in her claim that using more than one method reduces the risk of generating erroneous findings. Greene *et al* (1989) cited in Creswell (1994, 175), elaborate on the rationale for combining methods and state that such an approach can again allow triangulation, can be complementary, can develop the use of further methods, can initiate fresh perspectives and can be expansive, allowing scope and breadth to a study. This latter point is particularly relevant to the current research project: the methods employed have added scope and breadth to the study.

Nevertheless, many academics maintain that it is impossible to combine qualitative and quantitative approaches successfully within a single study (see for example Guba and Lincoln, 1989). These arguments are supported by the apparent bi-polarity of qualitative and quantitative approaches. Whilst qualitative research is seen to be an intensive, in-depth subjective study, quantitative research apparently possesses an objective stance, which allows an extensive study to be made, the results of which can be generalised from the sample to the population. These assumptions are unhelpful and, as noted by Hammersley in Brannen (1992), can obscure the complexity of the methodology of social research. The issue of the objective (quantitative) and the subjective (qualitative) researcher is particularly misleading. It is contended that no research undertaken in a social setting is completely objective. The human world is not a laboratory. Therefore, the gap between the quantitative researcher and the qualitative researcher is not as wide as often assumed. In both, the researcher is inextricably involved in the research process. Philip (1998) takes this argument further in her claim that there exists an "objective subjectivity" inherent in all social research, where the researcher acknowledges the existence of their own positionality and the problem of researcher subjectivity, whilst attempting to maintain freedom from overt bias and misrepresentation. Such "objective subjectivity" was endeavoured in the research project and it could be argued that by bringing together objectivity and subjectivity, the integration of quantitative and qualitative methods is increasingly feasible (Philip, 1998).

A similar facile criticism is that qualitative research employs the use of words rather than numbers (Hammersley in Brannen, 1992). Yet, as Hammersley (1992) shows, much qualitative research does employ the use of numbers. Quantitative claims are often made through formulations such as "regularly" and "frequently". Therefore, this claim for the separation of qualitative and quantitative methods is not valid. Indeed Seale (1999, 138) asserts, "to exploit fully the potential of numbers in qualitative research, I believe that we need to dispense with the view that researchers can be divided into two great camps".

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[36] Triangulation is a methodological process whereby the use of different methods to address the same research question will minimise the risk of bias in the data. As noted by Jick (1979), it always rests on the assumption that the weakness in a single method will be compensated by the strengths of another method.

As illustrated above, there are many issues surrounding the use of combined methods designs. However, for Barbour (1999, 42) "the long overdue rapprochement between qualitative and quantitative camps is finally coming about" and "there is now an increasing acceptance that qualitative and quantitative methodologies can actually be compatible". In recent years there has been a drift towards the combination of the two approaches; qualitative and quantitative approaches are now often seen as complementary rather than in opposition (Bryman and Burgess, 1999). A combined method design was, therefore, adopted in the research project as the research aim is by its very nature is integrative, linking the perceptual (qualitative) and ecological (quantitative) aspects of recreation and thus, as noted by Barbour (1999, 40), "where methods have been integrated, the whole can be greater than the sum of its parts".

Following on from the implications of combining methods discussion, and the conclusions derived from each chapter and each method (as shown in table 8.1), **overall conclusions** to the research project are now presented.

There are academic and management implications as a consequence of this study. Indeed, a primary objective of this thesis was to address outdoor recreation on a broad theoretical and policy-relevant canvas. Specifically, it is an integrated investigation into the ecological, economic and behavioural-perceptual dimensions of recreation within relatively fragile environments, which are often vaunted as in need of conservation (i.e. the Loch Lomond and Trossachs National Park). The deep-seated conflicts between the differing demands placed on the Loch Lomond environment is a "capsule example" of similar conflicts played out in many recreationally-attractive environments the world over. Researching such conflicts and providing information on the social and ecological impacts of outdoor recreation is hence highly relevant to environmental policy/management; but carefully investigating differing methodologies for assessing these conflicts, weighing up the advantages and disadvantages of more quantitative (econometric / ecological) and more qualitative (open-ended questionnaires / interview) approaches, is also vital for establishing better interdisciplinary dialogue <u>and</u> more sophisticated tools for environmental planning and management. The first conclusion of this thesis is therefore that **multi-disciplinary research is the favoured framework when researching outdoor recreation.**

These world-wide issues are explored through the case study and "experimental" setting of the Loch Lomond and Trossachs National Park. The recent implementation of Loch Lomond and the Trossachs as Scotland's first National Park heralds an exciting time for outdoor recreation in Scotland. Based on the derived econometric models a "typical" day at Loch Lomond is valued at £20.53, with visitors willing to pay an <u>additional</u> £1.76 to fund environmental improvements. Looking at the particular recreation issues of noise, crowding and environmental damage, a second conclusion is derived, namely **noise pollution appears to have the greatest influence on visitor**

recreation enjoyment. Noise pollution, like crowding and environmental damage, is a world-wide issue and a concern in recreation areas throughout the developed world (see Miller, 2003; and Matless, 2005). It is therefore important to research the significance (or otherwise) of such an impact on visitor enjoyment. Noise pollution in this research project is caused primarily by the use of PWC.

A third conclusion is obtained through the PWC debate case study, where it was found that **conflict exists between jet-skiers and other recreationalists.** It is imperative to recognise that this conflict is one-sided, from the perspective of the non jet-skier. Crucially, it is the consequence of activity style, resource specificity, mode of experience, lifestyle tolerance and safety issues. This conclusion is consistent with the work of Vaske *et al* (2000) and Manning (2001), who argue that management of conflict must be based on an understanding of the underlying causes of conflict. Identifying that a conflict exists at Loch Lomond between jet-skiers and other recreationalists, and defining the causes of this conflict through a theoretical model (figure 6.4), allows management to proceed towards conflict resolution as discussed by Sidaway (2005).

In terms of "real" environmental impact around the loch area, the visitor damage survey estimates that just over 9% of the loch shore suffers from severe environmental impact. Ecological vegetation surveys also confirm that recreation pressure is a statistically significant influence on the presence/absence of plant communities, but that this ecological impact is spatially limited to only specific sites around the loch – for example Sallochy on the east shore. This conclusion confirms the findings of Dickinson (2000a) and, more generally, expands on previous ecological impact research conducted by Liddle (1997), Cole (1995a&b), and Wall and Wright (1977). The fourth conclusion, then, states that **environmental damage is present in the Loch Lomond area; however, this is spatially and temporally limited.** Furthermore, chapter six demonstrated that there is no simple relationship between the perception of and reality of environmental damage. However, **visitor perception of environmental damage often differs from actual levels of environmental damage** (conclusion five).

Following on from both the ecological and perceptual findings, policy and management implications, including the implementation of a possible parking fee at various sites around Loch Lomond, were addressed. Management actions, including (possible) zoning, pricing and providing information and education in the Loch Lomond area, were recommended in chapter seven. Again these management actions can be applied world-wide in outdoor recreation areas (Manning, 2001). More generally, it was suggested that carrying capacity frameworks such as VERP or SVMS should be applied in the Loch Lomond area as they bring together the ecological and social dimensions of outdoor recreation. Assessing social and ecological impacts and establishing trigger levels beyond which management action is required, are only two of the practical benefits of establishing a carrying capacity. Although often contentious concepts (see Lindberg *et al*, 1997; and Warren, 2002), the application of recreational carrying capacity and subsequently the strive to achieve sustainability should be real objectives for all national park authorities. Thus, as a sixth and final conclusion, it appears that **a sustainable approach (framework) to recreation management, one which is based on the outcomes of econometric, qualitative and ecological analysis and one that encompasses the perceptual and ecological dimensions of recreation, is the only way of maintaining the beauty and enjoyment of Loch Lomond – and, it is suggested, national parks world-wide – for present and future generations.**

8.4 Critique and Recommendations for Future Research

In addition to the overall conclusions and wider implications of the study, it is worthwhile presenting this reflective section, where the aim is to outline the lessons learned throughout the research process and offer a basic critique of this thesis. For a more specific critique on each research method and methodologies used and the problems/limitations arising during the research process see chapter three.

The overriding aim of the research project was to assess the ecological, perceptual and behavioural dimensions of outdoor recreation in the Loch Lomond area. Accordingly, data on the social and ecological impacts of recreation have been obtained. Social data were however limited to information regarding crowding, noise pollution and visitor conflict, while ecological data concentrated primarily on vegetation impact. Additional social and ecological impacts could be studied. In particular, the thesis could be criticised for including a lack of environmental data relative to social data. Initially, it was anticipated that data on further environmental impact such as wildlife disturbance by recreationalists, detailed scientific analysis on water pollution, and information on rates of shore erosion for Loch Lomond would be obtained. Due to time and cost restraints and a difficulty in obtaining previously derived information, such research was not possible.[37] Moreover, a difficulty arises when trying to measure shore erosion, namely: how does the researcher disentangle the role of recreation activity from the role of nature? "Natural" versus accelerated (anthropogenic) erosion is key here (see Hansom and McGlashan, 2000a).

Similarly, in retrospect, it is apparent that it would have been beneficial to co-locate the ecological and perceptual sampling sites. However, as vegetation was the primary indicator for environmental conditions, a representative loch vegetation distribution was preferred over a co-located sampling frame. Still, a detailed ecological and social survey in key sites, such as Sallochy, is a possibility

[37] In retrospect it was advantageous that this additional environmental information was not obtained. Due to the many results gathered it was already impractical to present ecological and perceptual findings within one findings chapter, as was initially desired (depicted by results chapters four and five).

for future research, and would further illustrate how far perception of environmental damage corresponds with reality.

A further critique of this research project is that it concentrates on one case study: Loch Lomond. It does not take into account the rest of the Loch Lomond and Trossachs National Park and the methodology has not been applied outwith the study area. A concept such as recreational carrying capacity is of more use if applied on a site-by-site basis rather than throughout a large recreation area (Newman *et al*, 2001). It is therefore claimed that concentrating on the Loch Lomond area is not a limitation; indeed it strengthens the specific results found and offers possibilities for future research.

The central use of environmental valuation within the thesis engenders a final critique. Although economic valuation is a robust method that has been in use for over 30 years to reveal preferences for environmental goods that are not directly observable from market transactions (MacMillan *et al*, 2005), valuing the environment has long been criticised as finding "a price for everything and the value of nothing" (Warren 2002, 341). It has been argued by some that costing the environment is inappropriate as not everything that is valued has a monetary value. Nature has an intrinsic value and it is inappropriate to put "hard figures on soft emotions" (Warren 2002, 336).

Warren (2002) presents a range of further criticisms levelled at the concept of environmental valuation. For example, it does not take into account the preferences of future generations and so perpetrates intergenerational injustices; it stresses the value to human beings only; and the values revealed by contingent valuation are contextual, dependent on socio-economic demographics for example. It is imperative to recognise all criticisms, however, in the case of the latter criticism for example, explicitly stating the influence of the demographic variables (as seen in the TCM and CVM) can in fact add further insight into public values. Demographic variables illustrate whether values are exclusive to a specific context.

An additional critique of environmental valuation, and in particular contingent valuation, is that respondents have insufficient time and information to make a rational decision about their willingness to pay (MacMillan *et al*, 2005). A questionnaire survey is unsatisfactory; respondents would benefit from further discussion. Here it is important to remember that the researcher issued the questionnaire on-site and was available to answer any questions that respondents may have had regarding the survey. Supplementary qualitative methods, such as interviews with jet-skiers, also compensate for this critique. Furthermore, MacMillan *et al* (2005) investigated the extent to which additional time and information affected willingness to pay bids and found that the role of information is ambiguous (MacMillan *et al*, 2005). They concluded that contingent valuation surveys are appropriate for environmental goods that are familiar to participants, such as recreation.

Thus in defence of the environmental econometric approach that underlies this thesis, it is recognised that whilst costing the environment is a challenge, environmental economics offers the best approach at present to link public perceptions to the outdoor recreation environment. Monetary values are universally informative. Environmental valuation assists decision-making, it does not provide a "right answer", but it is preferable to ignoring externalities altogether. As Warren (2002) recognises, it is not enough to acknowledge that aspects of the environment lie outwith the market (externalities), decisions have to be made. Environmental mangers can either ignore externalities or incorporate them in to decision making. Externalities cannot be ignored, people attach a high value to their recreation environment and these values should be measured. Indeed, ignoring externalities attracts a number of criticisms, including the accusation that an over reliance on science ignores the value judgements of the public (Warren, 2002).

Consequently, economic valuation offers a useful and convenient indication of the values that the public attach to the environment. These values can be built into the decision making process, for example to assess the level of public support for a change in environmental or recreation conditions. Further, there are currently no obvious alternatives to environmental valuation. It is the best approach to obtaining environmental values available at present.

Thus, although valuing the environment is a contentious approach, and whilst it would have been useful to obtain more information on the different types of environmental impact in particular, it is reiterated that in terms of the time period and resources available, the research project offers a sophisticated study of outdoor recreation and the assimilation of environmental-social impact.

With the conclusion of one research project, comes the possibility for new research questions and a new research agenda. This final section looks forward to such possibilities and outlines additional research that could be undertaken. In particular, with the exciting and ever-changing environment that is Loch Lomond, there are endless possibilities for future research within the National Park area.

From a theoretical perspective and drawing on the work of Warren (2002), one such possibility for a future research question is: "did Scotland wait too long to establish its first National Parks? Has the wait been detrimental to the Loch Lomond area?" Interviews with managers and policy-makers and the analysis of (primarily historical) documentary evidence could allow this research question to be answered.

From a more policy-orientated perspective, the Lake District National Park Authority has imposed a ten mile per hour speed limit for all power driven vessels on Lake Windermere, effective from March 2005. It is expected that Loch Lomond will thus become an alternative for the Lake

Windermere jet-skier or speed boater. Research into any displacement of such fast-moving craft from Windermere to Lomond would provide an interesting and relevant study.

Similarly, it would be interesting to investigate recreation conflict on a wider theoretical and empirical scale. Two themes of recreation activity conflict and conflict resolution (including management interests) could be examined, where such conflict resolution would provide links to the wider conceptual fields of sustainability and sustainable development (see for example Mitchell, 2002). This would also expand the work of Sidaway (2005), who has explored conflict resolution from the wider theoretical perspective of resolving environmental disputes. Such a research focus would allow an assessment of the complementary or conflictual roles of environmental protection and recreation management in strategies for rural use. As with the current research, a variety of qualitative and quantitative methods could again be employed. In-depth interviews with walkers, picnickers or canoeists, for example, would offer new and exciting perspectives on activity conflict. As stated in chapter six, future research is needed to elicit a further in-depth study of other recreation groups' perception of jet-skiers (i.e. not sailors or anglers). In addition, visitor conflict as a consequence of anti-social behaviour is another controversial and contemporary theme that arose during the interview stage of this current research. As Sidaway (2005, xiv) notes, "the definition of conflict and its means of resolution are culturally determined". Analysis of such conflict offers another possibility for future research. It is suggested that in-depth interviews with managers, rangers and law enforcement (i.e. the police); and a questionnaire survey to be issued to those believed to be perpetuating the "anti-social" behaviour and those individuals affected by such behaviour, could form the basis of such research. Potential avenues of conflict resolution, as defined by Sidaway (2005), should be explored.

Within a more combined theoretical and policy-relevant canvas, the VERP framework could be extended or a similar framework applied to the Loch Lomond and Trossachs National Park. Regardless of whether a VERP, SVMS or more generic scheme is adopted (such as that provided by Manning, 2001 – see figure 7.3), any recreational carrying capacity framework requires indicators and standards to be set. Suggestions for ecological and social indicators and, more tentatively, standards are provided in chapter seven. In particular it is suggested that a task force be set up in order to look at the possibility of a carrying capacity framework in the National Park area. Such a task force would require detailed information on the ecological and social impacts of outdoor recreation. It is therefore suggested that further research should include more detailed monitoring of environmental impacts, both on the loch shore and along forest paths. A systematic method could be used whereby trampled vegetation, for example, is monitored over time. More detailed ecological analysis would provide further information on the natural environment.

In terms of obtaining further information on the social environment, the questionnaire survey, as issued during the course of this research, could be repeated at different sites around Loch Lomond: for example at Drumkinnon Bay (south Loch Lomond), Luss (west Loch Lomond), Balmaha (east Loch Lomond), and Ardlui (north Loch Lomond). The entire methodology of this research project (i.e. ecological and social methods and analysis) could be repeated at concurrent sites in the remaining major lochs in the National Park – for example at Loch Earn, Loch Katrine, Loch Long, Loch Goil, Loch Eck and Loch Fyne. This would offer a comparison with Loch Lomond and would allow ecological and social baseline data to be obtained for use by the newly established Loch Lomond and Trossachs National Park Authority.

In addition to possible further research in the Loch Lomond and Trossachs National Park, the methodology and the ecological and social claims and ideas of this thesis could be adapted from the current case study and applied in different world contexts – for example in the National Parks of Australia or North America.

The thesis thus offers many possibilities for future research and it is reiterated that this further research would benefit greatly from the integration of qualitative and quantitative research. When researching an outdoor recreation setting, it is highly advantageous to combine methodologies from both the natural (biological) and social (geographical/economic) sciences – as has been achieved throughout this research project. Such an integrated approach provides an enhanced understanding of the dynamic and exciting field that is outdoor recreation research.

Appendix A: Questionnaire Survey

Questionnaire One: TCM and CVM.

SITE: **(WTP)**
DATE:
TIME:
WEATHER: **Poor** **Moderate** **Good**
Temperature: ______________________________
Conditions e.g. dry, overcast, drizzle: ______________
SITE CONDITIONS (e.g. crowded, noise level, litter): ____________
____
____

Interviewee: **Sex:**
Age (estimate):
16 -24 yrs
25-34 yrs
35-44 yrs
45-54 yrs
55-64 yrs
65 + yrs

Q.1 Did you travel to this site by car today? **YES** **NO**
If **No**, how did you get here? ____________________

Q.2 Have you visited this site before? **YES** **NO**
How many times in the last twelve months? ___________

Q.3 How long are you planning to spend here today?
Half hour or less
Half hour - 1 hour
1-2 hrs
2-4 hrs
4-6 hrs
Over 6 hrs

Q.4 Where did you travel from today? ______________________
Is that your home? **YES** **NO**
If **Yes**, what is your postcode? ____________________
If **No**, where is your home? ______________________

Q.5 Are you on holiday, a weekend trip, or is this a day visit? ___________
If on holiday or a weekend trip, where are you staying?
____
How long are you planning to stay in the Loch Lomond area?
One night
2 - 3 nights
4 - 7 nights
> 7 nights __________

Q.6 Have you undertaken, or are you planning to undertake, any of the following activities today?

Picnicking	**YES**	**NO**
Sitting or walking near shore	**YES**	**NO**
Cycling	**YES**	**NO**
Climbing or hill-walking	**YES**	**NO**
Fishing	**YES**	**NO**
Boating or Sailing	**YES**	**NO**
Canoeing	**YES**	**NO**
Jet ski-ing	**YES**	**NO**
Swimming	**YES**	**NO**

Anything else? ____

Q.7 Do any of these activities if undertaken by other people typically reduce your enjoyment of a day out on Loch Lomond?

YES **NO**

If **YES**, which of the activities? ________________________________

Q.8 Do you think that the jet-skis on Loch Lomond are:

nice to look at
fun/enjoyable
causing noise pollution
causing air pollution
causing water pollution
don't care
other ________________________

Q. 9 How would you rate the noise level on this site today (with 1 = little noise, 5 = too noisy)?

1 2 3 4 5

Q.10 Does the presence of noise pollution affect enjoyment of your visit? **YES** **NO**
Does it affect the frequency of visits? **YES** **NO**

Q.11 When you visit a site like this one, do you prefer to spend your time with

lots of other people (c. 100)
a moderate amount of people (c.30)
a few people (c.10)
family and friends only
on your own
don't care

Q.12 Before you set out today, how crowded did you expect it to be once you got here (with 1 = no crowding, 5 = overcrowded)?

1 2 3 4 5

Q.13 Now you are here, how would you rate the crowding level of this site today (with 1 = no crowding, 5 = overcrowded)?

1 2 3 4 5

Q.14 Does the presence of crowding affect the enjoyment of your visit? **YES** **NO**
Does it affect the frequency of visits? **YES** **NO**

Q.15 Did you notice any of the following kinds of environmental damage on the site?

Litter	**YES**	**NO**
Dead Trees	**YES**	**NO**
Water pollution	**YES**	**NO**
Exposed tree roots	**YES**	**NO**
Broken branches	**YES**	**NO**
Damage to ground vegetation	**YES**	**NO**
Wearing away of beach	**YES**	**NO**

Does it worry you to see any of these things? **YES** **NO**

Q.16 Again on a scale from one to five (one = no damage, five = severe damage), how would you rate environmental damage at this site?

1 **2** **3** **4** **5**

Q. 17 Does the presence of environmental damage affect the enjoyment of your visit?
YES **NO**
Does it affect the frequency of visits? **YES** **NO**

Q.18 Imagine that the National Park Authority decided to undertake some environmental improvements at this site. These environmental improvements would consist of the protection of ground vegetation and trees, the prevention of shore erosion, and a reduction in the level of water pollution. Imagine that the only way to pay for this programme was to introduce an on-site vehicle parking fee. The parking fee options are shown on this card. ***show card***. Thinking about how much extra pleasure you would get from such environmental improvements, would you be willing to pay such a fee to visit the site?

YES **NO**

If **Yes,** which amount on the card shows the MOST would you be willing to pay to visit this site with environmental improvements? ____________________

If **No,** why not? ____________________

Q.19 Why did you stop at this site today?

Convenient
Scenery of area
Peace and quiet
Been before / Know it well
Other ____________

Q.20 Are there any ways in which you think that this particular site could be improved?
YES **NO**
If **YES**, in what ways? ____________________

Q.21 How many people are in your "party"? ____________

Q.22 Finally, it would be helpful to have the following information to help me understand your choices: ***show card***

Which letter best represents your current level of household income (p.a.)? ___________

THANK YOU FOR YOUR TIME.

Questionnaire Two – TCM and CBa (perceived crowding).

SITE: **(CB – Version A)**
DATE:
TIME:
WEATHER: **Poor** **Moderate** **Good**
Temperature: ______________________________________
Conditions e.g. dry, overcast, drizzle: __________________
SITE CONDITIONS (e.g. crowded, noise level, litter): _________________
____
____

Interviewee: **Sex:**
Age (estimate):
16 -24 yrs
25-34 yrs
35-44 yrs
45-54 yrs
55-64 yrs
65 + yrs

Q.1 Did you travel to this site by car today? **YES** **NO**
If **No**, how did you get here? __________________________

Q.2 Have you visited this site before? **YES** **NO**
How many times in the last twelve months? ______________

Q.3 How long are you planning to spend here today?
Half hour or less
Half hour - 1 hour
1-2 hrs
2-4 hrs
4-6 hrs
Over 6 hrs

Q.4 Where did you travel from today? ______________________________
Is that your home? **YES** **NO**
If **Yes**, what is your postcode? _________________________
If **No**, where is your home? ___________________________

Q.5 Are you on holiday, a weekend trip, or is this a day visit? ___________
If on holiday or a weekend trip, where are you staying?
____

Q.5(continued) How long are you planning to stay in the Loch Lomond area?

One night
2 - 3 nights
4 - 7 nights
> 7 nights ___________

Q.6 Have you undertaken, or are you planning to undertake, any of the following activities today?

Picnicking	**YES**	**NO**
Sitting or walking near shore	**YES**	**NO**
Cycling	**YES**	**NO**
Climbing or hill-walking	**YES**	**NO**
Fishing	**YES**	**NO**
Boating or Sailing	**YES**	**NO**
Canoeing	**YES**	**NO**
Jet ski-ing	**YES**	**NO**
Swimming	**YES**	**NO**

Anything else? ____

Q.7 Do any of these activities if undertaken by other people typically reduce your enjoyment of a day out on Loch Lomond?

YES **NO**

If **YES**, which of the activities? ______________________________

Q.8 Do you think that the jet-skis on Loch Lomond are:

nice to look at
fun/enjoyable
causing noise pollution
causing air pollution
causing water pollution
don't care
other ________________________

Q. 9 How would you rate the noise level on this site today (with 1 = little noise, 5 = too noisy)?

1 2 3 4 5

Q.10 Does the presence of noise pollution affect enjoyment of your visit? **YES NO**
Does it affect the frequency of visits? **YES NO**

Q.11 Last year you made X trips, thinking about this and your feelings towards the presence of jet-skis, could you tell me how this number of trips would change if the National Park Authority banned jet-skis?

I would make _________________________ trips next year.

Q. 12 Taking the jet-skis into account, how would you rate the recreation experience at this site (With 1=poor and 10=excellent)?

1 2 3 4 5 6 7 8 9 10

Q.13 If jet-skis were banned at this site, how would you rate your recreation experience (again 1=poor and 10=excellent)?

1 2 3 4 5 6 7 8 9 10

Q.14 When you visit a site like this one, do you prefer to spend your time with

lots of other people (c. 100)
a moderate amount of people (c.30)
a few people (c.10)
family and friends only
on your own
don't care

Q.15 Before you set out today, how crowded did you expect it to be once you got here (with 1 = no crowding, 5 = overcrowded)?

1 2 3 4 5

Q.16 Now you are here, how would you rate the crowding level of this site today (with 1 = no crowding, 5 = overcrowded)?

1 2 3 4 5

Q.17 Does the presence of crowding affect the enjoyment of your visit? **YES NO**
Does it affect the frequency of visits? **YES NO**

Q.18 Again thinking of the X trips that you made last year, could you tell me how this number of trips would change if twice as many people than at present visited this site?
I would make _________________________ trips next year.

Q.19 Taking the number of people at this site into account, how would you rate the recreation experience at this site (with 1=poor and 10=excellent)?

1 2 3 4 5 6 7 8 9 10

Q.20 If there were twice as many people at this site, how would you rate the recreation experience?

A lot lot worse **a lot worse** **worse** **the same** **better**
a lot better **a lot, lot better**

Q.21 If faced with overcrowding at a site, would you:
(1) relocate within the loch
(2) relocate to another loch
(3) stay at this site
(4) return home

Q.22 Why did you stop at this site today?

Convenient
Scenery of area
Peace and quiet
Been before / Know it well
Other ______________

Q.23 Are there any ways in which you think that this particular site could be improved?

YES **NO**

If **YES**, in what ways? ____

Q.24 How many people are in your "party"? ____________________

Q.25 Finally, it would be helpful to have the following information to help me understand your choices: ***show card***

Which letter best represents your current level of household income (p.a.)? ______________

THANK YOU FOR YOUR TIME.

Questionnaire Three – TCM and CBb (perceived environmental damage).

SITE: **(CB – Version B)**
DATE:
TIME:
WEATHER: **Poor** **Moderate** **Good**
Temperature: ________________________________
Conditions e.g. dry, overcast, drizzle: ________________
SITE CONDITIONS (e.g. crowded, noise level, litter): ______________
____
____

Interviewee: **Sex:**
Age (estimate):
16 -24 yrs
25-34 yrs
35-44 yrs
45-54 yrs
55-64 yrs
65 + yrs

Q.1 Did you travel to this site by car today? **YES** **NO**

If **No**, how did you get here? ______________________

Q.2 Have you visited this site before? **YES** **NO**

How many times in the last twelve months? ____________

Q.3 How long are you planning to spend here today?

Half hour or less
Half hour - 1 hour
1-2 hrs
2-4 hrs
4-6 hrs
Over 6 hrs

Q.4 Where did you travel from today? ____________________

Is that your home? **YES** **NO**

If **Yes**, what is your postcode? ____________________

If **No**, where is your home? ____________________

Q.5 Are you on holiday, a weekend trip, or is this a day visit? __________

If on holiday or a weekend trip, where are you staying?

____

How long are you planning to stay in the Loch Lomond area?

One night
2 - 3 nights
4 - 7 nights
> 7 nights __________

Q.6 Have you undertaken, or are you planning to undertake, any of the following activities today?

Picnicking	**YES**	**NO**
Sitting or walking near shore	**YES**	**NO**
Cycling	**YES**	**NO**
Climbing or hill-walking	**YES**	**NO**
Fishing	**YES**	**NO**
Boating or Sailing	**YES**	**NO**
Canoeing	**YES**	**NO**
Jet ski-ing	**YES**	**NO**
Swimming	**YES**	**NO**

Anything else? ____________________

Q.7 Do any of these activities if undertaken by other people typically reduce your enjoyment of a day out on Loch Lomond?

YES **NO**

If **YES**, which of the activities? ____________________

Q.8 Do you think that the jet-skis on Loch Lomond are:

nice to look at
fun / enjoyable
causing noise pollution
causing air pollution
causing water pollution
don't care
other ____________________

Q. 9 How would you rate the noise level on this site today (with 1 = little noise, 5 = too noisy)?

1 **2** **3** **4** **5**

Q.10 Does the presence of noise pollution affect enjoyment of your visit? YES NO
Does it affect the frequency of visits? YES NO

Q.11 Last year you made X trips, thinking about this and your feelings towards the presence of jet-skis, could you tell me how this number of trips would change if the National Park Authority banned jet-skis?

I would make ________________________ trips next year.

Q. 12 Taking the jet-skis into account, how would you rate the recreation experience at this site (With 1=poor and 10=excellent)?

1 2 3 4 5 6 7 8 9 10

Q.13 If jet-skis were banned at this site, how would you rate your recreation experience (again 1=poor and 10=excellent)?

1 2 3 4 5 6 7 8 9 10

Q.14 Did you notice any of the following kinds of environmental damage on the site?

Litter	**YES**	**NO**
Dead Trees	**YES**	**NO**
Water pollution	**YES**	**NO**
Exposed tree roots	**YES**	**NO**
Broken branches	**YES**	**NO**
Damage to ground vegetation	**YES**	**NO**
Wearing away of beach	**YES**	**NO**

Does it worry you to see any of these things? **YES** **NO**

Q.15 Again on a scale from one to five (one = no damage, five = severe damage), how would you rate environmental damage at this site?

1 2 3 4 5

Q. 16 Does the presence of environmental damage affect the enjoyment of your visit? **YES** **NO**
Does it affect the frequency of visits? **YES** **NO**

Q.17 Again thinking of the X trips that you made last year, could you tell me how this number of trips would change if the National Park Authority reduced environmental damage at this site? Measures to reduce environmental damage would include ground vegetation and trees being protected, wearing away of the beach prevented and litter being eliminated.

I would make ________________________ trips next year.

Q.18 Taking the level of environmental damage into account, how would you rate the recreation experience at this site (with 1=poor and 10=excellent)?

1 2 3 4 5 6 7 8 9 10

Q.19 If the National Park Authority took measures to reduce environmental damage at this site. how would you rate the recreation experience (again 1=poor, 10=excellent)?

1 2 3 4 5 6 7 8 9 10

Q.20 Why did you stop at this site today?

Convenient
Scenery of area
Peace and quiet
Been before / Know it well
Other ______________

Q.21 Are there any ways in which you think that this particular site could be improved?

YES **NO**

If **YES**, in what ways? ____

Q.22 How many people are in your "party"? ____________________

Q.23 Finally, it would be helpful to have the following information to help me understand your choices:

show card

Which letter best represents your current level of household income (p.a.)? ______________

THANK YOU FOR YOUR TIME.

As explained in chapter three, section 3.2, all three questionnaires were issued by the author on-site. The author read out the questions to the respondent and then recorded the visitor's response on the questionnaire sheet – as exemplified here.

Appendix B: WTP and Income Cards (Questionnaire Survey)

WTP Payment Set Card

The willingness-to-pay (WTP) question in the questionnaire survey was as follows:

"Q.18: Imagine that the National Park Authority decided to undertake some environmental improvements at this site. These environmental improvements would consist of the protection of ground vegetation and trees, the prevention of shore erosion, and a reduction in the level of water pollution. Imagine that the only way to pay for this programme was to introduce an on-site vehicle parking fee. The parking fee options are shown on this card. ***show card***. Thinking about how much extra pleasure you would get from such environmental improvements, would you be willing to pay such a fee to visit the site?

YES **NO**

If **Yes,** which amount on the card shows the MOST would you be willing to pay to visit this site with environmental improvements? ______________________

If **No,** why not? ______________________"

The following payment set card was shown to respondents:

£3
50p
£1
£5
£1.50
£8
£2
£4

Household Income Card

The income question in the questionnaire survey was as follows:

"Q. Finally, it would be helpful to have the following information to help me understand your choices: ***show card***

Which letter best represents your current level of household income (p.a.)? ___________"

The following income card was shown to respondents:

Just say the letter that applies…

£4,000 or less per year	X
£4,001-£8,000	B
£8,001-£12,000	S
£12,001-£16,000	F
£16,001-£24,000	I
£24,001-£32,000	A
£32,001-£40,000	R
£40,001-£48,000	M
More than £48,000	O

Appendix C: Data Recording Sheet for Ecological Surveys

SITE DATA:

Date: ______________________ Location: ______________________

ENVIRONMENTAL DATA:

Underwater light availability: subsurface__________________

m__ depth__________________

Soil redox: ____________________mv_______

Substrate type: ______________________________________

Bare Ground:

	Level 1	Level 2	Level 3
	Little Bare Ground	**Approximately 50% Bare Ground**	**Mostly Bare Ground**
Tick Box			

Shade:

	Level 1	Level 2	Level 3
	Green	**Partial Shade**	**Heavy Shade**
Tick Box			

Current water table level (+/-cm): ________________________

Wind speed: ______________________________________

Wind direction: ___________________________________

Wave exposure index: _______________________________

Grazing Intensity:

	Level 1	Level 2	Level 3
	None / Very Low	**Moderate**	**High (sheep/cattle access to field)**
Tick Box			

Artificial Structures:

	Level 1	Level 2	Level 3
	None	**Minor Works**	**Major works (artificial embankments, slipways etc.)**
Tick Box			

Recreation Present?:

1	2	3	4	5
No				**Yes**

Visitor Damage (Trampling) Level:

	Level 1	**Level 2**	**Level 3**
	None discernible	**Slight**	**Substantial (heavy trampling, litter, broken shrubs, fire circles, broken branches/trees/bushes etc..)**
Tick Box			

Notes:

MACROPHYTE DATA:

ZONE: Transition to field (back-shore)

Sample Number: 1 2 3

SPECIES LIST (1 x 1 m Quadrat):

Species	Q/G (delete) **Frequency**

Dominant species: (Maximum 3).

1. ______________________

2. ______________________

3. ______________________

ZONE: Shoreline

Sample Number: 1 2 3

SPECIES LIST (1 x 1 m Quadrat):

Species	Q/G (delete) **Frequency**

Dominant species:
(Maximum 3).

1. ______________________

2. ______________________

3. ______________________

ZONE: Submerged Macrophytes

Water depth: ______________________________

Sample Number: 1 2 3

SPECIES LIST (Grapnels):

Throw	Q/G (delete) **Species**
1	
2	
3	
4	
5	

Dominant species (one only): ____________________________

Appendix D: Visual Assessment of Visitor-Induced Environmental Damage Survey – Data Recording Sheet

Code Number:

Grid Reference (GPS) and approximate location (to be used in conjunction with base map):

Visitor Impact Score (1-6):

Grazing Impact Score (1-5):

Dominant Landuse:

Substrate Type:

Additional Notes (e.g. fire circles, litter, evidence of trampling etc.):

The following should be used for the Visitor Impact and Grazing Impact scores:

Visitor Impact Six-point scale:

1. No evidence of visitor impact.
2. Evidence of low visitor impact.
3. Evidence of moderate visitor impact (e.g. some litter, some shore erosion, some trampling of vegetation, some evidence of water pollution).
4. Evidence of high visitor impact.
5. Evidence of very high visitor impact (e.g. complete erosion of top soil, massive littering etc.).
6. Substantially altered shoreline (i.e. artificial/armoured or rock shoreline).

Grazing Impact scale:

1. No grazing.
2. Low grazing pressure.
3. Moderate grazing pressure.
4. High grazing pressure.
5. Very high grazing pressure.

Appendix E: Forestry Commission Traffic Counts

Appendix E provides the reader with traffic counts conducted by the Forestry Commission during August 2003. This systematic observation provides further evidence of physical carrying capacity, as discussed in chapter four, section 4.2. Ecological and social (perceptual) implications are also seen as a consequence of this survey (these are discussed further in following paragraphs).

Before presentation of the Forestry Commission's "night patrol survey" results, the reader should be aware that the survey includes east Loch Lomond only. Specifically, the survey was implemented at the following sites: Balmaha Car Park, Pier Road, Craigie Fort, Sallochy, Lochan Maoil Dhuinne, and Rowardennan. Only results for the two sites studied during the field season (i.e. Sallochy and Rowardennan) are examined here. Rangers undertook the vehicle survey on the following nights during August 2003, between the hours of 9:30pm and 2am: Friday 1st to Monday 4th; Friday 8th to Sunday 10th; Friday 15th to Sunday 17th; and Friday 22nd to Sunday 24th. Vehicle information was included within the survey (i.e. number of vehicles present on site, car make, model, colour, and registration); as was the age range of visitors on site (where "child" is young persons up to 14 years; "youth" is persons over 14 but less than 25 years; and "adult" is persons over 25 years). All the activities that people were engaged in at the locations being surveyed were also included. Some examples are: camping, fires, barbeques, drinking, using drugs, damaging property, disco/rave, and using firearms. Finally, the issues that result from the activities that people were engaged in were noted. A Forestry Commission Ranger kindly provided the author with all the results of the night patrol surveys. The relevant data are presented below.

<u>Location: Sallochy</u>

Date	Time	Number of Vehicles	Number of People and Gender	Age Ranges	Activity	Issues
1/8/03	11:10pm	11	6 Male; 1 Female	Males Youths; Female Adult	BBQ	Fire on beach
2/8/03	1:07am	8	7 Male	All Youths	BBQ; Camping	Fire; Tent
2/8/03	1:45am	8	7 Male	All Youths	Camping; Disco/Rave	Fire; Loud Music; Wood Chopping
3/8/03	11:25pm	24	Male and Female	Youths	Camping; BBQ	Fires total 6 or 7. Some music – switched off. Some litter
4/8/03	1:20am	24	Male and Female	Youths	Camping	Fires still blazing; all quiet and peaceful
8/8/03	10:15pm	31	Male and Female	Youths and Family Groups	Camping; BBQs	Camping; Fires

Date	Time	Number of Vehicles	Number of People and Gender	Age Ranges	Activity	Issues
9/8/03	10:35pm	36	Male and Female	Youths and Adults	Disco/Rave; Camping	Loud Music; Tent
10/8/03	12:45am	22	Male and Female	Youths	Disco/Rave; Fires	Loud Music and Fires
15/8/03	10:45pm	13	Several small groups and couples	Youths/Young adults	Camping; Fires; Music Player (CDs); Singing; Drinking	Camping; Fires; Noise; Litter (at 12:40am all cars were still present)
16/8/03	10:50pm	19	34 approx. Male and Female	Very young youths (around 14 years) and youths and over 30 year old adults	Camping; Fires	Rangers were told to get out of Sallochy Car park by a 12 year old backed up by his family
17/8/03	12:40am	28	Around 50 people. Male and Female	Families and Youths	6 Tents; 5 Fires	Fires; Camping. There were a number of campers and fires that could not be directly linked to cars
22/8/03	10:18pm	10 (including one caravan and one minibus)	Male and Female	All Youths except 2 adults and 1 child with fire	2 Tents; 3 Fires (1 in forest; 2 on beach)	Music from 1 car; Fires
23/8/03	12:22am	13 (including one caravan and one minibus)	Male and Female	Mostly youths; one small family	3 Fires; 2 Tents	Fires
23/8/03	9:42pm	21 (including 1 camper; 1 caravan and 1 boat)	Male and Female	2 Adults; 1 Child; rest youths	Camping; Fires	Fires – 2 in forest; 1 on beach; 1 in car park
24/8/03	12:15am	22 (including 1 boat, 1 camper and 1 caravan)	4 large groups of male youths	Youths; 1 family of three	Drinking; BBQs; Music	2 Fires in forest; 2 Fires on beach; 1 Fire in car park; Loud Music from car

Table A.1: Vehicle Counts, Sallochy.
(Source: Forestry Commission, unpublished statistics.)

Physical carrying capacity at Sallochy is recorded to be sixty vehicles (see chapter four, section 4.2.2). Thus throughout the August survey, physical carrying capacity is not exceeded during the period from 9:30pm to 2am. The minimum number of vehicles recorded was 8 at 1:07am on 2/8/03; the maximum number of vehicles recorded was 36 at 10:35pm on 9/8/03. Consequently, 13% to 60% of the site was occupied during the night survey period. Clearly this is not threatening the physical carrying capacity of the site.

It is nevertheless recognised that perceptual and ecological carrying capacity are both important on-site issues. Loud music from groups of youths, along with fires burning both in the forest and on the beach, are clearly cause for concern. Therefore, although visitor numbers do not compromise the physical capacity of Sallochy, perceptual and ecological carrying capacity remain significant management issues.

Location: Rowardennan

Date	Time	Number of Vehicles	Number of People and Gender	Age Ranges	Activity	Issues
1/8/03	11:30pm	3	Not known	Not known	Camping	Tent on site
2/8/03	1:30am	2	Not known	Not known	Camping	Quiet; toilets dirty
2/8/03	12 midnight	2	Male and Female	Adult	Camping	Tent
3/8/03	1:35am	2	Male and Female	Adult	Camping	Person asleep on ground!
8/8/03	11:05pm	9	Male and Female	Youths and adults	Camping	Tent
9/8/03	1am	2	Not known	Not known	Camping	Tent
9/8/03	11:10pm	27	Male and Female	Youths and Families	Camping; motorcycle; Fire	Fire; Tent
10/9/03	12:55am	29	Male and Female	Youths and Families	Camping; fire	Fire, Tent
15/8/03	11:08pm	2	Small group	Family group	Camping	Tent
16/8/03	11:15pm	18	Male and Female (including 2 vans)	Youths and Families	Camping	Tent
17/8/03	1am	12	Male and Female	Youths and Families	Camping	Tent
22/8/03	10:39pm	6	Male and Female	Youths	Fires; 4 youths in car	1 fire next to beach
23/8/03	12:43am	5	Male and Female	Youths	4 youths	Fire
23/8/03	10:15pm	7	Male and Female	Youths	Sitting in cars	None
24/8/03	12:47am	7	Male and Female	Youths	Sitting in cars	None

Table A.2: Vehicle Counts, Rowardennan.
(Source: Forestry Commission, unpublished statistics.)

As shown in chapter four (section 4.2.3), physical carrying capacity at Rowardennan is set at 100 vehicles. During the Forestry Commission night surveys this threshold level was not reached. The number of vehicles ranged from 2 to 29; hence 2% to 29% of the site was used during the night survey period. Again this is not threatening the physical carrying capacity of the site.

In comparison to Sallochy, Rowardennan's ecological and perceptual carrying capacities are not significantly affected during the time period of 9:30pm to 2am. Large groups of youths tend to frequent Sallochy rather than Rowardennan and although fires and tents were found on-site, these were to a lesser extent than at Sallochy. Further family groups, rather than large groups of youths, were common. From the forestry commission surveys, then, it is concluded that Rowardennan is more socially and environmentally sustainable than is Sallochy.

Appendix F: Descriptive Statistics as split by Site

Appendix F presents the results found for all questions in the three questionnaires – WTP, CBa and CBb – as split by site. Further definition of these questionnaires was offered in chapters three and four.

Site	Number of respondents	Percent of respondents (%)
Sallochy	152	27.7
Firkin	132	24.1
Rowardennan	132	24.1
Milarrochy Bay	132	24.1
Total	548	100

Table A.3: Site.

Date	Site	Number of respondents	Percent of respondents (%)
Sat. 5/4/03	Sallochy	22	4.0
Sun. 13/4/03	Firkin	22	4.0
Wed. 23/4/03	Rowardennan	22	4.0
Sun. 27/4/03	Milarrochy Bay	22	4.0
Sat. 10/5/03	Firkin	22	4.0
Sun. 18/5/03	Milarrochy Bay	22	4.0
Fri. 23/5/03	Sallochy	22	4.0
Sun. 25/5/03	Rowardennan	22	4.0
Sun. 1/6/03	Sallochy	22	4.0
Sun. 8/6/03	Milarrochy Bay	22	4.0
Tues. 10/6/03	Firkin	22	4.0
Sat. 14/6/03	Rowardennan	22	4.0
Thurs. 17/7/03	Milarrochy Bay	22	4.0
Sat. 19/7/03	Rowardennan	22	4.0
Sun. 20/7/03	Firkin	22	4.0
Sun. 27/7/03	Sallochy	22	4.0
Sat. 9/8/03	Milarrochy Bay	22	4.0
Sun. 10/8/03	Rowardennan	22	4.0
Mon. 11/8/03	Firkin	22	4.0
Sun. 17/8/03	Sallochy	22	4.0
Sun. 7/9/03	Rowardennan	22	4.0
Fri. 12/9/03	Milarrochy Bay	22	4.0
Sat. 13/9/03	Sallochy	22	4.0
Sun. 14/9/03	Firkin	22	4.0
Sun. 3/8/03	Sallochy	10	1.8
Mon. 4/8/03	Sallochy	10	1.8
Total	26 days	548	100

Table A.4: Date.

Site	Sunday	Saturday	Weekday
	Number of Survey Days		
Milarrochy Bay	3	1	2
Sallochy	4	2	2
Rowardennan	3	2	1
Firkin	3	1	2
Total	13	6	7

Table A.5: Number of survey days at each site.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Time period	**Number of respondents (Percent of total respondents for site (%))**			
Before 10am	0 (0%)	1 (0.8%)	4 (3.0%)	0 (0%)
10:05am – 12 noon	28 (18.4%)	27 (20.5%)	73 (55.3%)	18 (13.6%)
12:05pm – 2pm	72 (47.4%)	74 (56.1%)	40 (30.3%)	67 (50.8%)
2:05pm – 4pm	27 (17.8%)	30 (22.7%)	15 (11.4%)	36 (27.3%)
4:05pm – 6pm	5 (3.3%)	0 (0%)	0 (0%)	11 (8.3%)
6:05pm – 8pm	14 (9.2%)	0 (0%)	0 (0%)	0 (0%)
After 8pm	6 (3.9%)	0 (0%)	0 (0%)	0 (0%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.6: Time.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Weather conditions	**Number of respondents (Percent of total respondents for site (%))**			
Poor	22 (14.5%)	0 (0%)	22 (16.7%)	22 (16.7%)
Moderate	32 (21.1%)	88 (66.7%)	88 (66.7%)	66 (50.0%)
Good	98 (64.5%)	44 (33.3%)	22 (16.7%)	44 (33.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.7: Weather.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Sex of respondent	**Number of respondents (Percent of total respondents for site (%))**			
Female	80 (52.6%)	71 (53.8%)	59 (44.7%)	72 (54.5%)
Male	72 (47.4%)	61 (46.2%)	73 (55.3%)	60 (45.5%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.8: Sex of respondent.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Age of respondent	**Number of respondents (Percent of total respondents for site (%))**			
16-24 yrs	28 (18.4%)	8 (6.1%)	13 (9.8%)	17 (12.9%)
25-34 yrs	32 (21.1%)	12 (9.1%)	30 (22.7%)	20 (15.2%)
35-44 yrs	40 (26.3%)	45 (34.1%)	39 (29.5%)	44 (33.3%)
45-54 yrs	30 (19.7%)	30 (22.7%)	32 (24.2%)	30 (22.7%)
55-64 yrs	13 (8.6%)	20 (15.2%)	12 (9.1%)	9 (6.8%)
65 + yrs	9 (5.9%)	17 (12.9%)	6 (4.5%)	12 (9.1%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.9: Age of respondent.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Car travel? ("CAR")	**Number of respondents (Percent of total respondents for site (%))**			
No	19 (12.5%)	1 (0.8%)	13 (9.8%)	11 (8.3%)
Yes	133 (87.5%)	131 (99.2%)	119 (90.2%)	121 (91.7%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.10: Mode of transport *(Q.1a: Did you travel to this site by car today?)*.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
No car ("NOCAR")	**Number of respondents (Percent of total respondents for site (%))**			
Bike	2 (1.3%)	0 (0%)	0 (0%)	0 (0%)
Motorcycle	0 (0%)	1 (0.8%)	1 (0.8%)	0 (0%)
Boat	1 (0.7%)	0 (0%)	0 (0%)	0 (0%)
Camper Van	2 (1.3%)	0 (0%)	1 (0.8%)	0 (0%)
Van	0 (0%)	0 (0%)	0 (0%)	1 (0.8%)
Minibus	0 (0%)	0 (0%)	2 (1.5%)	0 (0%)
Walk	14 (9.2%)	0 (0%)	9 (6.8%)	10 (7.6%)
Missing (i.e. came to site by car)	133 (87.5%)	131 (99.2%)	119 (90.2%)	121 (91.7%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.11: Mode of transport *(Q1b: If No, how did you get here?)*.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Been before?	**Number of respondents (Percent of total respondents for site (%))**			
No	35 (23.0%)	64 (48.5%)	69 (52.3%)	34 (25.8%)
Yes	117 (77.0%)	68 (51.5%)	63 (47.7%)	98 (74.2%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.12: Frequency of visits to site *(Q.2a: Have you visited this site before?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
"LAST YEAR"	**Number of respondents (Percent of total respondents for site (%))** ***(Percent of valid YES respondents (%))***			
None	7 (4.6%) *(6%)*	3(2.3%)*(4.4%)*	4 (3%)*(6.3%)*	2 (1.5%)*(2%)*
1-5	62 (40.8%) *(53%)*	40(30.3%)*(58.8%)*	56(42.4%)*(88.9%)*	42(31.8%)*(42.9%)*
6-10	18(11.8%)*(15.4%)*	20 (15.2%)*(29.4%)*	2 (1.5%) *(3.2%)*	37 (28%)*(37.8%)*
11-15	12 (7.9%) *(10.3%)*	0 (0%)	0 (0%)	7 (5.3%)*(7.1%)*
16-20	12 (7.9%) *(10.3%)*	2 (1.5%) *(2.9%)*	1 (0.8%) *(1.6%)*	8 (6.1%)*(8.2%)*
21-25	1 (0.7%) *(0.9%)*	2 (1.5%) *(2.9%)*	0 (0%)	0 (0%)
26 and over	5 (3.3%) *(4.3%)*	1 (0.8%) *(1.5%)*	0 (0%)	2 (1.5%)*(2%)*
Missing (i.e. "No" respondents)	35 (23%)	64 (48.5%)	69 (52.3%)	34 (25.8%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.13: Frequency of visits to site *(Q2b: If yes, how many times in the last twelve months?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Length of stay	**Number of respondents (Percent of total respondents for site (%))**			
½ and hour or less	24 (15.8%)	42 (31.8%)	16 (12.1%)	28 (21.4%)
½ to 1 hour	19 (12.5%)	21 (15.9%)	13 (9.8%)	15 (11.5%)
1 to 2 hours	36 (23.7%)	38 (28.8%)	11 (8.3%)	21 (16.0%)
2 to 4 hours	38 (25.0%)	28 (21.2%)	27 (20.5%)	40 (30.5%)
4 to 6 hours	18 (11.8%)	3 (2.3%)	55 (41.7%)	22 (16.8%)
Over 6 hours	17 (11.2%)	0 (0%)	10 (7.6%)	5 (3.8%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.14: Length of stay on site *(Q.3: How long are you planning to spend here today?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Travel from home?	**Number of respondents (Percent of total respondents for site (%))**			
No	34 (22.5%)	55 (41.7%)	71 (53.8%)	24 (18.2%)
Yes	118 (77.6%)	77 (58.3%)	61 (46.2%)	108 (81.8%)
Total	152 (100%)	132 (100%)	132 (1005)	132 (100%)

Table A.15: Travel origins *(Q.4a: Did you travel from home today?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Postcode district	**Number of respondents (Percent of total respondents for site (%))** ***(Percent of Valid YES respondents (%))***			
G (Glasgow)	87(57.2%)*(73.7%)*	47 (35.6%) *(61%)*	36(27.3%)*(59%)*	66 (50%)*(61.1%)*
EH (Edinburgh)	5 (3.3%) *(4.2%)*	3(2.3%)*(3.9%)*	3 (2.3%)*(4.9%)*	5 (3.8%)*(4.6%)*
FK (Falkirk)	15 (9.9%)*(12.7%)*	4 (3%)*(5.2%)*	7 (5.3%)*(11.5%)*	12(9.1%)*(11.1%)*
PA (Paisley)	4 (2.6%) *(3.4%)*	6 (4.5%)*(7.8%)*	4 (3%)*(6.6%)*	9 (6.9%)*(8.3%)*
ML (Motherwell)	3 (2%) *(2.5%)*	6 (4.5%)*(7.8%)*	2 (1.5%)*(3.3%)*	4 (3%)*(3.7%)*
Other post codes	4 (2.6%) *(3.4%)*	11(8.3%)*(14.3%)*	9 (6.8%)*(14.8%)*	7 (5.3%)*(6.5%)*
Missing (including "did not travel from home today")*	34 (22.5%)	55 (41.7%)	71 (53.8%)	29 (22%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

* Missing values also include "no reply" answers, i.e. people who were not willing to give their postcode.

Table A.16: Place of residence, identified by postcode district *(Q4b: If yes, what is your postcode?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Home	**Number of respondents (Percent of total respondents (%)) *(Percent of valid NO respondents (%))***			
Scotland	11(7.2%)*(32.4%)*	4 (3%)*(7.3%)*	7 (5.3%) *(9.9%)*	3 (2.3%) *(10.3%)*
England	11 (7.2%) *(32.4%)*	26(19.7%)*(47.3%)*	40(30.3%)*(56.3%)*	13(9.8%)*(44.8%)*
Wales	0 (0%)	1 (0.8%)*(1.8%)*	3 (2.3%)*(4.2%)*	0 (0%)
Ireland	0 (0%)	2 (1.5%)*(3.6%)*	2 (1.5%)*(2.8%)*	0 (0%)
Rest of Europe	8 (5.3%) *(23.5%)*	18 (13.6%)*(32.7%)*	18 (13.6%)*(25.4%)*	13 (9.8%)*(44.8%)*
U.S.A. & Canada	3 (2%) *(8.8%)*	3 (2.3%)*(5.5%)*	0 (0%)	0 (0%)
Other	1 (0.7%) *(2.9%)*	1 (0.8%)*(1.8%)*	1 (0.8%)*(1.4%)*	0 (0%)
Missing (including those who did travel from home today)	118 (77.6%)	77 (58.3%)	61 (46.2%)	103 (78%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.17: Home *(Q.4c: If no, where is your home?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Type of Visit	**Number of respondents (Percent of total respondents (%) for site)**			
Holiday	19 (12.5%)	53 (40.2%)	55 (41.7%)	24 (18.2%)
Weekend trip	28 (18.4%)	9 (6.8%)	18 (13.6%)	9 (6.8%)
Day Visit	105 (69.1%)	70 (53.0%)	59 (44.7%)	99 (75%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.18: Type of visit *(Q5a: Are you on a holiday, a weekend trip or is this a day visit?).*

	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Accommodation	**Number of respondents (Percent of respondents (%)) *(Percent of valid (tourist) respondents (%))***			
West Loch Lomond	1 (0.7%)*(2.2%)*	9(6.8%)*(14.5%)*	2(1.5%)*(2.7%)*	1(0.8%)*(3%)*
East Loch Lomond	30(19.7%)*(65.2%)*	0(0%)	34(25.8%)*(46.6%)*	18(13.6%)*(54.5%)*
Balloch	4 (2.6%)*(8.7%)*	2(1.5%)*(3.2%)*	10(7.6%)*(13.7%)*	3(2.3%)*(9.1%)*
Ardlui	0 (0%)	2(1.5%)*(3.2%)*	1(0.8%)*(1.4%)*	0(0%)
Trossachs	2 (1.3%)*(4.3%)*	1(0.8%)*(1.6%)*	5(3.8%)*(6.8%)*	2(1.5%)*(6.1%)*
Stirling area	3 (2%)*(6.5%)*	3(2.3%)*(4.8%)*	7(5.3%)*(9.6%)*	4(3%)*(12.1%)*
Glasgow area	4 (2.6%)*(8.7%)*	11(8.3%)*(17.7%)*	9(6.8%)*(12.3%)*	4(3%)*(12.1%)*
Edinburgh area	1 (0.7%)*(2.2%)*	2(1.5%)*(3.2%)*	3(2.3%)*(4.1%)*	0(0%)
Fort William	1 (0.7%)*(2.2%)*	10(7.6%)*(16.1%)*	0(0%)	0(0%)
Oban	0 (0%)	14(10.6%)*(22.6%)*	2(1.5%)*(2.7%)*	0(0%)
Other	0 (0%)	8(6.1%)*(12.9%)*	0(0%)	1(0.8%)*(3%)*
Missing (including non-tourists)	106 (69.7%)	70(53%)	59(44.7%)	99(75%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.19: Accommodation *(Q.5b: If on holiday or a weekend trip, where are you staying?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Length of stay in area	**Number of respondents (Percent of respondents (%))*(Percent of valid (tourist) respondents (%))***			
One night	6 (3.9%)*(12.8%)*	3(2.3%)*(5%)*	1(0.8%)*(1.4%)*	3(2.3%)*(9.1%)*
2 to 3 nights	26(17.1%)*(55.3%)*	4(3%)*(6.7%)*	26(19.7%)*(35.6%)*	16(12.1%)*(48.5%)*
4 to 7 nights	5(3.3%)*(10.6%)*	5(3.8%)*(8.3%)*	19(14.4%)*(26%)*	3(2.3%)*(9.1%)*
Over 7 nights	2(1.3%)*(4.3%)*	2(1.5%)*(3.3%)*	2(1.5%)*(2.7%)*	0
1 day only	8(5.3%)*(17%)*	46(34.8%)*(76.7%)*	25(18.9%)*(34.2%)*	11(8.3%)*(33.3%)*
Missing	105(69.1%)	72(54.5%)	59(44.7%)	99(75%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.20: Length of stay in area *(Q.5c: How long are you planning to stay in the Loch Lomond area?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Activity undertaken	**Number of respondents (Percent of total respondents for site (%))**			
Picnicking	44 (28.9%)	41 (31.1%)	11 (8.3%)	34 (25.8%)
Sitting or walking near the shore	75 (49.3%)	70 (53%)	31 (23.5%)	64 (48.5%)
Cycling	2 (1.3%)	8 (6.1%)	2 (1.5%)	0 (0%)
Climbing or hill-walking	13 (8.6%)	0 (0%)	83 (62.9%)	2 (1.5%)
Fishing	1 (0.7%)	1 (0.8%)	1 (0.8%)	1 (0.8%)
Boating or sailing	2 (1.3%)	0 (0%)	0 (0%)	13 (9.8%)
Canoeing	0 (0%)	0 (0%)	0 (0%)	4 (3.0%)
Jet-skiing	0 (0%)	0 (0%)	0 (0%)	4 (3.0%)
Swimming	8 (5.3%)	0 (0%)	0 (0%)	3 (2.3%)
Other	7 (4.6%)	12 (9.1%)	4 (3.0%)	7 (5.3%)
Total*	152 (100%)	132 (100%)	132 (100%)	132 (100%)

* Respondents stated only one activity undertaken.

Table A.21: Activity *(Q.6: Have you undertaken, or are you planning to undertake, any of the following activities today?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Category of activity	**Number of respondents (Percent of total respondents for site (%))**			
Water	10 (6.6%)	1 (0.8%)	1 (0.8%)	25 (18.9%)
Land (active)	16 (10.5%)	8 (6.1%)	87 (65.9%)	3 (2.3%)
Land (passive)	126 (82.9%)	123 (93.2%)	44 (33.3%)	104 (78.8%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.22: Category of activity.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Reduce enjoyment?	**Number of respondents (Percent of total respondents for site(%))**			
No	71 (46.7%)	62 (47%)	67 (50.8%)	62 (47%)
Yes	81 (53.3%)	70 (53%)	65 (49.2%)	64 (48.5%)
Don't know	0 (0%)	0 (0%)	0 (0%)	6 (4.5%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.23: Enjoyment and activity *(Q7a: Do any of these activities if undertaken by other people typically reduce your enjoyment of a day out on Loch Lomond?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Activity and enjoyment	**Number of respondents (Percent of respondents (%))*(Percent of valid YES respondents (%))***			
"Jet-skis annoy me"	68(44.7%)*(84%)*	70(53%)*(100%)*	59(44.7%)*(90.8%)*	68(51.5%)*(106.3%)**
"Neds annoy me"	9 (5.9%)*(11.1%)*	0 (0%)	0 (0%)	0 (0%)
Something else	4 (2.6%)*(4.9%)*	1 (0.8%)*(1.4%)*	6 (4.5%)*(9.2%)*	2 (1.5%)*(3.1%)*
Missing (i.e. those respondents who answered "no" to Q7a)	71 (46.7%)	61 (46.2%)	67 (50.8%)	62 (47%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

* Firkin and Milarrochy Bay are over 100% for valid YES responses because respondents could give more than one answer.

Table A.24: Enjoyment and activity *(Q.7b: If yes, which of these activities?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Perception of jet-skis	**Number of respondents (Percent of total respondents for site (%))**			
Nice to look at	6 (3.9%)	14 (10.6%)	15 (11.4%)	15 (11.4%)
Fun/Enjoyable	22 (14.5%)	10 (7.6%)	12 (9.1%)	18 (13.6%)
Causing noise pollution	91 (59.9%)	95 (72%)	86 (65.2%)	74 (56.1%)
Causing air pollution	3 (2.0%)	3 (2.3%)	3 (2.3%)	3 (2.3%)
Causing water pollution	17 (11.2%)	4 (3%)	6 (4.5%)	9 (6.8%)
Don't care	12 (7.9%)	6 (4.5%)	6 (4.5%)	8 (6.1%)
Other	1 (0.7%)	0 (0%)	4 (3.0%)	5 (3.8%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.25: Perception of jet-skis *(Q.8: Do you think that the jet-skis on Loch Lomond are:...?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Rating of noise level	**Number of respondents (Percent of total respondents for site (%))**			
1	71 (46.7%)	64 (48.5%)	66 (50%)	60 (45.5%)
2	47 (30.9%)	48 (36.4%)	49 (37.1%)	42 (31.8%)
3	22 (14.5%)	17 (12.9%)	16 (12.1%)	22 (16.7%)
4	7 (4.6%)	3 (2.3%)	1 (0.8%)	8 (6.1%)
5	5 (3.3%)	0 (0%)	0 (0%)	0 (0%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.26: Rating of noise on site *(Q.9: How would you rate the noise level on this site today, with 1 = little noise, 5 = too noisy?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Enjoyment of visit	**Number of respondents (Percent of total respondents for site (%))**			
No	34 (22.4%)	16 (12.1%)	22 (16.7%)	30 (22.7%)
Yes	118 (77.6%)	116 (87.9%)	110 (83.3%)	102 (77.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.27: Noise and enjoyment of visits *(Q10a: Does the presence of noise pollution affect the enjoyment of your visit?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Frequency of visits	**Number of respondents (Percent of total respondents for site (%))**			
No	55 (36.2%)	41 (31.1%)	57 (43.2%)	47 (35.6%)
Yes	97 (63.8%)	91 (68.9%)	75 (56.8%)	85 (64.4%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.28: Noise and frequency of visits *(Q.10b: Does it affect the frequency of visits?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Preferred Company	**Number of respondents (Percent of total respondents (%))*(Percent of valid respondents excl. CBb %)***			
Lots of other people (c. 100)	2 (1.3%)*(1.7%)*	0 (0%)	0 (0%)	0 (0%)
A moderate amount of people (c.30)	7 (4.6%)*(6.0%)*	4 (3%)*(4.2%)*	4 (3%)*(4.2%)*	3 (2.3%)*(3.1%)*
A few people (c.10)	24 (15.8%)*(20.7%)*	22 (16.7%)*(22.9%)*	28 (21.2%)*(29.2%)*	21 (15.9%)*(21.9%)*
Family and friends only	49 (32.2%)*(42.2%)*	45 (34.1%)*(46.9%)*	45 (34.1%)*(46.9%)*	42 (31.8%)*(43.8%)*
On your own	18 (11.8%)*(15.5%)*	11 (8.3%)*(11.5%)*	11 (8.3%)*(11.5%)*	17 (12.9%)*(17.7%)*
Don't care	16 (10.5%)*(13.8%)*	14 (10.6%)*(14.6%)*	8 (6.1%)*(8.3%)*	13 (9.8%)*(13.5%)*
Missing (i.e. CBb)	36 (23.7%)	36 (27.3%)	36 (27.3%)	36 (27.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.29: Preferred Company *(Q.11: When you visit a site like this one, do you prefer to spend your time with...?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Anticipated Crowding	**Number of respondents (Percent of total respondents (%))** ***(Percent of valid respondents excl. CBb %)***			
1	12(7.9%)*(10.3%)*	12(9.1%) *(2.5%)*	3(2.3%) *(3.1%)*	19(14.4%) *(19.8%)*
2	38 (25%)*(32.8%)*	28(21.2%)*(29.2%)*	33(25%) *(34.4%)*	33(25%) *(34.4%)*
3	33 (21.7%)*(28.4%)*	46(34.8%) *(47.9%)*	34(25.8%)*(35.4%)*	30(22.7%)*(31.3%)*
4	29 (19.1%)*(25%)*	10(7.6%) *(10.4%)*	26(19.7%) *(27.1%)*	7(5.3%) *(7.3%)*
5	4 (2.6%)*(3.4%)*	0 (0%)	0 (0%)	7(5.3%) *(7.3%)*
Missing (i.e. CBb)	36 (23.7%)	36 (27.3%)	36 (27.3%)	36 (27.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.30: Anticipated Crowding *(Q.12: Before you set out today, how crowded did you expect it to be once you got here, with 1 = no crowding and 5 = overcrowded?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Perceived Crowding	**Number of respondents (Percent of total respondents (%))*****(Percent of respondents excl. CBb %)***			
1	51(33.6%) *(44%)*	44(33.3%) *(45.8%)*	24(18.2%)*(25%)*	39(29.5%)*(40.6%)*
2	28(18.4%) *(24.1%)*	34(25.8%) *(35.4%)*	31(23.5%)*(32.3%)*	26(19.7%)*(27.1%)*
3	20(13.2%) *(17.2%)*	15(11.4%) *(15.6%)*	30(22.7%)*(31.3%)*	25(18.9%)*(26%)*
4	15(9.9%) *(12.9%)*	2(1.5%) *(2.1%)*	11(8.3%)*(11.5%)*	5(3.8%)*(5.2%)*
5	2(1.3%) *(1.7%)*	1(0.8%) *(1%)*	0 (0%)	1(0.8%) *(1%)*
Missing (i.e. CBb)	36 (23.7%)	36 (27.3%)	36 (27.3%)	36 (27.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.31: Perceived Crowding *(Q13: Now you are here, how would you rate the crowding level of this site today, with 1=no crowding and 5 = overcrowded?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Enjoyment	**Number of respondents (Percent of total respondents (%))*****(Percent of valid respondents excl. CBb %)***			
No	34(22.4%)*(29.3%)*	17(12.9%)*(17.7%)*	13(9.8%)*(13.5%)*	18(13.6%)*(18.8%)*
Yes	82(53.9%)*(70.7%)*	79(59.8%)*(82.3%)*	83(62.9%)*(86.5%)*	78(59.1%)*(81.3%)*
Missing (i.e. CBb)	36 (23.7%)	36 (27.3%)	36 (27.3%)	36 (27.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.32: Crowding and enjoyment of visits *(Q14a: Does the presence of crowding affect the enjoyment of your visit?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Frequency	**Number of respondents (Percent of total respondents (%))*****(Percent of valid respondents excl. CBb %)***			
No	44(28.9%)*(37.9%)*	37(28%)*(38.5%)*	42(31.8%)*(43.8%)*	27(20.5%)*(28.1%)*
Yes	72(47.4%)*(62.1%)*	59(44.7%)*(61.5%)*	54(40.9%)*(56.3%)*	69(52.3%)*(71.9%)*
Missing (i.e. CBb)	36 (23.7%)	36 (27.3%)	36 (27.3%)	36 (27.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.33: Crowding and frequency of visits *(Q.14b: Does it affect the frequency of visits?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Environmental damage	**Number of respondents (*Percent of valid respondents within site excl. CBa %*)**			
Litter	97 *(83.6%)*	6 *(6.3%)*	24 *(25.0%)*	15 *(15.6%)*
Dead trees	70 *(60.3%)*	1 *(1.0%)*	17 *(17.7%)*	9 *(9.4%)*
Water pollution	37*(31.9%)*	0 *(0%)*	3 *(3.1%)*	3 (3.1%)
Exposed tree roots	66 *(56.9%)*	1 *(1.0%)*	19 *(19.8%)*	25 *(26.0%)*
Broken branches	83 *(71.6%)*	1 *(1.0%)*	28 *(29.2%)*	22 *(22.9%)*
Damage to ground vegetation	73 *(62.9%)*	1 *(1.0%)*	27 *(28.1%)*	15 *(15.6%)*
Wearing away of the beach	63 *(54.3%)*	2 *(2.1%)*	9 *(9.4%)*	21 *(21.9%)*
Does it worry you to see any of these things?	92 *(79.3%)*	76 *(79.2%)*	68 *(70.8%)*	66 *(68.8%)*
Total	116 *(500.8%)**	96 *(91.6%)*	96 *(203.1%)**	96 *(183.3%)**

* The total percent for Sallochy, Rowardennan and Milarrochy Bay is greater than 100. This is because respondents to this question could report more than one sign of environmental damage, i.e. they could tick more than one category.

Table A.34: Perception of environmental damage *(Q.15: Did you notice any of the following kinds of environmental impact on the site...?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Rating of environmental damage	**Number of respondents (Percent of total respondents (%))*(Percent of valid respondents i.e. excl. CBa (%))***			
1	11 (7.2%)*(9.5%)*	57 (43.2%)*(59.4%)*	34 (25.8%)*(35.4%)*	38(28.8%)*(39.6%)*
2	38 (25%)*(32.8%)*	38(28.8%)*(39.6%)*	45(34.1%)*(46.9%)*	41(31.1%)*(42.7%)*
3	39(25.7%)*(33.6%)*	1 (0.8%)*(1.0%)*	17(12.9%) *(17.7%)*	16(12.1%) *(16.7%)*
4	21 (13.8%)*(18.1%)*	0 (0%)	0 (0%)	1(0.8%)*(1.0%)*
5	7 (4.6%)*(6%)*	0 (0%)	0 (0%)	0 (0%)
Missing (i.e. CBa)	36 (23.7%)	36 (27.3%)	36 (27.3%)	36 (27.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.35: Rating of environmental damage on site *(Q.16: Again on a scale from one to five (one=no damage, five = severe damage), how would you rate environmental damage at this site?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Enjoyment	**Number of respondents (Percent of total respondents (%))*(Percent of valid respondents, i.e. excl. CBa (%))***			
No	25(16.4%)*(21.6%)*	13(9.8%)*(13.5%)*	21(15.9%)*(21.9%)*	26(19.7%)*(27.1%)*
Yes	91(59.9%)*(78.4%)*	83(62.9%)*(86.5%)*	75(56.8%)*(78.1%)*	70 (53%) *(72.9%)*
Missing (i.e. CBa)	36 (23.7%)	36 (27.3%)	36 (27.3%)	36 (27.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.36: Environmental damage and enjoyment of visits *(Q.17a: Does the presence of environmental damage affect the enjoyment of your visit?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Frequency	**Number of respondents (Percent of total respondents (548) (%))*(Percent of valid respondents, i.e. excl. CBa (%))***			
No	41(27%)*(35.3%)*	53(40.2%)*(55.2%)*	41(31.1%)*(42.7%)*	55(41.7%)*(57.3%)*
Yes	75(49.3%)*(64.7%)*	43(32.6%)*(44.8%)*	55(41.7%)*(57.3%)*	41(31.1%)*(42.7%)*
Missing (i.e. CBa)	36 (23.7%)	36 (27.3%)	36 (27.3%)	36 (27.3%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.37: Environmental damage and frequency of visits *(Q.17b: Does it affect the frequency of visits?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
WTP	**Number of respondents *(Percent of valid respondents, i.e. excl. CBa&b (WTP only) for site (%))***			
No	22 (27.5%)	6 (10.0%)	4 (6.7%)	17 (28.3%)
Yes	58 (72.5%)	54 (90.0%)	56 (93.3%)	43 (71.7%)
Total	80 (100%)	60 (100%)	60 (100%)	60 (100%)

Table A.38: Willingness to pay for environmental improvements *(Q.18a:* [Explanation of environmental improvements funded through an on-site car parking fee] *Thinking about how much extra pleasure you would get from such environmental improvements, would you be willing to pay such a fee to visit the site?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Amount	**Number of respondents (*Percent of valid respondents. excl. CBa&b for site %)* (Percent of valid YES respondents (%))**			
50p	*5(6.3%)*(8.6%)	5 *(8.3%)*(9.3%)	*3(5%)* (5.4%)	3 *(5%)* (7.0%)
£1.00	15*(18.8%)*(25.9%)	23*(38.3%)*(42.6%)	17*(28.3%)*(30.4%)	17*(28.3%)*(39.5%)
£1.50	*6 (7.5%)* (10.3%)	8 *(13.3%)* (14.8%)	*4(6.7%)* (7.1%)	3*(5%)* (7.0%)
£2.00	19*(23.8%)*(32.8%)	11*(18.3%)*(20.4%)	*21(35%)* (37.5%)	12*(20%)* (27.9%)
£3.00	8 *(10%)*(13.8%)	7*(11.7%)* (13.0%)	8 *(13.3%)*(14.3%)	*5(8.3%)* (11.6%)
£4.00	3*(3.8%)* (5.2%)	0 (0%)	1 *(1.7%)*(1.8%)	1*(1.7%)*(2.3%)
£5.00	2*(2.5%)* (3.5%)	0 (0%)	2 *(3.3%)*(3.6%)	2*(3.3%)*(4.7%)
Missing (i.e. "No")	22 *(27.5%)*	6 *(10.0%)*	4 *(6.7%)*	17 *(28.3%)*
Total	80 (100%)	60 (100%)	60 (100%)	60 (100%)

Table A.39: Willingness-to-pay *(Q.18b: If yes, which amount on the card shows the MOST you would be willing to pay to visit this site with environmental improvements?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Type of bid	**Number of respondents *(Percent of valid respondents, i.e. excl. CBa&b for site %)* (Percent of valid NO respondents (%))**			
Protest bids (won't pay)	9 *(11.3%)* (40.9%)	2 *(3.3%)*(33.3%)	2 *(3.3%)*(50%)	5 *(8.3%)*(29.4%)
Genuine zeros	13*(16.3%)*(59.1%)	4 *(6.7%)*(66.7%)	2 *(3.3%)* (50%)	12 *(20%)*(70.6%)
Missing (i.e. "Yes")	58 *(72.5%)*	54 *(90.0%)*	56 *(93.3%)*	43 *(71.7%)*
Total	80 *(100%)*	60 *(100%)*	60 *(100%)*	60 *(100%)*

Table A.40: Willingness-to-pay *(Q.18c: If no, why not?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Reasons for stopping at site	**Number of respondents (Percent of total respondents for site (%))**			
Convenient	19 (12.5%)	31 (23.5%)	79 (59.8%)	13 (9.8%)
Scenery of area	17 (11.2%)	35 (26.5%)	25 (18.9%)	34 (25.8%)
Peace and quiet	25 (16.4%)	5 (3.8%)	6 (4.5%)	6 (4.5%)
Been before/know it well	68 (44.7%)	41 (31.1%)	12 (9.1%)	60 (45.5%)
Other	23 (15.1%)	20 (15.2%)	10 (7.6%)	19 (14.4%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.41: Reasons for stopping at site today *(Q.19: Why did you stop at this site today?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Improvements	**Number of respondents (Percent of total respondents for site (%))**			
No	66 (43.4%)	123 (93.2%)	110 (83.3%)	89 (67.4%)
Yes	86 (56.6%)	9 (6.8%)	22 (16.7%)	43 (32.6%)
Total	152 (100%)	132 (100%)	132 (100%)	132(100%)

Table A.42: Improvements *(Q.20a: Are there any ways in which you think that this particular site could be improved?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
How?	**Number of respondents (Percent of respondents total (%))*(Percent of valid YES respondents (%))***			
Toilets	45 (29.6%)*(52.3%)**	0 (0%)	4 (3%)*(18.2%)**	1 (0.8%)*(2.3%)**
(More) Bins	45 (29.6%)*(52.3%)**	1 (0.8%)*(11.1%)**	0 (0%)	5 (3.8%)*(11.6%)**
No more facilities, keep it natural.	7 (4.6%)*(8.1%)**	2 (1.5%)*(22.2%)**	5 (3.8%)*(22.7%)**	2 (1.5%)*(4.7%)**
Missing	55 (36.2%)	129 (97.7%)	123 (93.2%)	124 (93.9%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

* Where the percent values for valid YES respondents add up to over 100 this is because respondents could give more than one improvement. Where the percent values for valid YES respondents are less than 100 this is because respondents stated an improvement not included on this list (i.e. an improvement that did not involve toilets, (more) bins, or keeping the area natural).

Table A.43: Improvements *(Q.20b: If yes in what ways?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Group Size	**Number of respondents (Percent of total respondents for site (%))**			
1	13 (8.6%)	6 (4.5%)	23 (17.4%)	16 (12.1%)
2	61 (40.1%)	65 (49.2%)	63 (47.7%)	55 (41.7%)
3	19 (12.5%)	16 (12.1%)	15 (11.4%)	18 (13.6%)
4	30 (19.7%)	27 (20.5%)	20 (15.2%)	24 (18.2%)
5	8 (5.3%)	13 (9.8%)	8 (6.1%)	8 (6.1%)
6	8 (5.3%)	2 (1.5%)	1 (0.8%)	4 (3.0%)
7	3 (2.0%)	1 (0.8%)	0 (0%)	4 (3.0 %)
8	3 (2.0%)	1 (0.8%)	0 (0%)	1 (0.8%)
9	1 (0.7%)	0 (0%)	1 (0.8%)	1 (0.8%)
10	2 (1.3%)	0 (0%)	0 (0%)	0 (0%)
11	3 (2.0%)	0 (0%)	0 (0%)	0 (0%)
12	1 (0.7%)	0 (0%)	1 (0.8%)	1 (0.8 %)
13	0 (0%)	1 (0.8%)	0 (0%)	0 (0%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.44: Group size *(Q.21: How many people are in your "party"?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Income	**Number of respondents (Percent of total respondents for site (%))**			
Refused to answer	11 (7.2%)	4 (3%)	12 (9.1%)	12 (9.1%)
£4,001-£8,000	6 (3.9%)	0 (0%)	0 (0%)	0 (0%)
£8,001-£12,000	12 (7.9%)	11 (8.3%)	8 (6.1%)	3 (2.3%)
£12,001-£16,000	9 (5.9%)	9 (6.8%)	6 (4.5%)	9 (6.8%)
£16,001-£24,000	14 (9.2 %)	7 (5.3%)	7 (5.3%)	11 (8.3%)
£24,001-£32,000	14 (9.2%)	17 (12.9%)	10 (7.6%)	16 (12.1%)
£32,001-£40,000	21 (13.8%)	21 (15.9%)	29 (22%)	14 (10.6%)
£40,001-£48,000	17 (11.2%)	24 (18.2%)	19 (14.4%)	25 (18.9%)
More than £48,000	48 (31.6%)	39 (29.5%)	41 (24.1%)	42 (31.8%)
Total	152 (100%)	132 (100%)	132 (100%)	132 (100%)

Table A.45: Income *(Q.22: Which letter best represents your current level of household income (p.a.)**show card* – see appendix B).

The following questions are from the contingent behaviour questionnaires only (i.e. CBa and CBb).

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Number of trips	Number of respondents *(Percent of valid respondents, i.e. CBa & CBb, for site (%))*			
1-5	36 *(50%)**	45 *(62.5%)*	58 *(80.6%)*	33 *(45.8%)*
6-10	18 *(25%)*	14 *(19.4%)*	12 *(16.7%)*	18 *(25%)*
11-15	4 *(5.6%)*	11 *(15.3%)*	1 *(1.4%)*	12 *(16.7%)*
16-20	5 *(6.9%)*	1 *(1.4%)*	0 *(0%)*	2 *(2.8%)*
21-25	5 *(6.9%)*	1 *(1.4%)*	0 *(0%)*	6 *(8.3%)*
26-30	0 *(0%)*	0 *(0%)*	1 *(1.4%)*	1 *(1.4%)*
31+	4 *(5.6%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
Total	72 *(100%)*	72 *(100%)*	72 *(100%)*	72 *(100%)*

* As an example explanation, 50% of those questioned at Sallochy said that they would make between one and five trips next year if jet skis were banned.

Table A.46: Ban of jet-skis and number of trips *(Q.11(CBa&b): Last year you made X trips, thinking about this and your feelings towards the presence of jet-skis, could you tell me how this number of trips would change if the National Park Authority banned jet-skis? I would make ___ trips next year).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Recreation Experience	Number of respondents *(Percent of valid respondents, i.e. CBa&b, for site (%))*			
1	0 *(0%)*	1 *(1.4%)*	0 *(0%)*	0 *(0%)*
2	2 *(2.8%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
3	6 *(8.3%)*	3 *(4.2%)*	3 *(4.2%)*	5 *(6.9%)*
4	3 *(4.2%)*	6 *(8.3%)*	7 *(9.7%)*	10 *(13.9%)*
5	18 *(25.0%)*	23 *(31.9%)*	20 *(27.8%)*	13 *(18.1%)*
6	23 *(31.9%)*	20 *(27.8%)*	20 *(27.8%)*	25 *(34.7%)*
7	18 *(25.0%)*	13 *(18.1%)*	19 *(26.4%)*	13 *(18.1%)*
8	1 *(1.4%)*	2 *(2.8%)*	2 *(2.8%)*	5 *(6.9%)*
9	1 *(1.4%)*	3 *(4.2%)*	1 *(1.4%)*	1 *(1.4%)*
10	0 *(0%)*	1 *(1.4%)*	0 *(0%)*	0 *(0%)*
Total	72 *(100%)*	72 *(100%)*	72 *(100%)*	72 *(100%)*

Table A.47: Jet-skis and the recreation experience *(Q.12 (CBa&CBb only) Taking the jet-skis into account, how would you rate your recreation experience at this site (with 1=poor and 10=excellent)?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Recreation Experience	Number of respondents *(Percent of valid respondents, i.e. CBa&b, for site (%))*			
2	0 *(0%)*	0 *(0%)*	0 *(0%)*	1 *(1.4%)*
5	6 *(8.3%)*	9 *(12.5%)*	2 *(2.8%)*	6 *(8.3%)*
6	7 *(9.7%)*	3 *(4.2%)*	12 *(16.7%)*	6 *(8.3%)*
7	20 *(27.8%)*	23 *(31.9%)*	23 *(31.9%)*	21 *(29.2%)*
8	24 *(33.3%)*	20 *(27.8%)*	21 *(29.2%)*	22 *(30.6%)*
9	8 *(11.1%)*	6 *(8.3%)*	11 *(15.3%)*	10 *(13.9%)*
10	7 *(9.7%)*	11 *(15.3%)*	3 *(4.2%)*	6 *(8.3%)*
Total	72 *(100%)*	72 *(100%)*	72 *(100%)*	72 *(100%)*

Table A.48: Jet-skis and the recreation experience *(Q.13 (CBa&CBb only) If jet-skis were banned at this site, how would you rate your recreation experience (again 1=poor and 10=excellent)?)*[38].

[38] There were no responses for values 1, 3 and 4.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Number of trips	**Number of respondents *(Percent of valid respondents, i.e. CBa only (%))***			
0	3 *(8.3%)*	5 *(13.9%)*	3 *(8.3%)*	5 *(13.9%)*
1-5	24 *(66.7%)*	27 *(75%)*	31 *(86.1%)*	28 *(77.8%)*
6-10	7 *(19.4%)*	3 *(8.3%)*	2 *(5.6%)*	2 *(5.6%)*
11-15	0 *(0%)*	1 *(2.8%)*	0 *(0%)*	1 *(2.8%)*
16-20	1 *(2.8%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
21	1 *(2.8%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
Total	36 *(100%)*	36 *(100%)*	36 *(100%)*	36 *(100%)*

Table A.49: Overcrowding and number of trips *(Q.18 (CBa only) Again thinking of the X trips that you made last year, could you tell me how this number of trips would change if twice as many people than at present visited this site?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Recreation Experience	**Number of respondents *(Percent of valid respondents, i.e. CBa only (%))***			
3	0 *(0%)*	0 *(0%)*	0 *(0%)*	1 *(2.8%)*
4	1 *(2.8%)*	0 *(0%)*	0 *(0%)*	1 *(2.8%)*
5	2 *(5.6%)*	1 *(2.8%)*	0 *(0%)*	1 *(2.8%)*
6	8 *(22.2%)*	4 *(11.1%)*	5 *(13.9%)*	9 *(25.0%)*
7	7 *(19.4%)*	14 *(38.9%)*	18 *(50.0%)*	10 *(27.8%)*
8	6 *(16.7%)*	12 *(33.3%)*	12 *(33.3%)*	7 *(19.4%)*
9	6 *(16.7%)*	4 *(11.1%)*	1 *(2.8%)*	4 *(11.1%)*
10	6 *(16.7%)*	1 *(2.8%)*	0 *(0%)*	3 *(8.3%)*
Total	36 *(100%)*	36 *(100%)*	36 *(100%)*	36 *(100%)*

Table A.50: Crowding and its influence on recreation experience *(Q.19 (CBa only): Taking the number of people into account, how would you rate the recreation experience at this site (with 1=poor and 10=excellent)?)*[39].

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Recreation Experience	**Number of respondents *(Percent of valid respondents, i.e. excl. CBa only (%))***			
A lot lot worse	8 *(22.2%)*	8 *(22.2%)*	6 *(16.7%)*	12 *(33.3%)*
A lot worse	10 *(27.8%)*	13 *(36.1%)*	17 *(47.2%)*	8 *(22.2%)*
Worse	12 *(33.3%)*	11 *(30.6%)*	10 *(27.8%)*	10 *(27.8%)*
The same	5 *(13.9%)*	4 *(11.1%)*	3 *(8.3%)*	6 *(16.7%)*
A lot lot better	1 *(2.8%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
Total	36 *(100%)*	36 *(100%)*	36 *(100%)*	36 *(100%)*

Table A.51: Crowding and recreation experience *(Q.20 (CBa only): If there were twice as many people at this site, how would you rate the recreation experience?).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Crowding action	**Number of respondents (*Percent of valid respondents, i.e. CBa only (%)*)**			
Relocate within the loch	26 *(72.2%)*	29 *(80.6%)*	26 *(72.2%)*	26 *(72.2%)*
Relocate to another loch	1 *(2.8%)*	2 *(5.6%)*	1 *(2.8%)*	1 *(2.8%)*
Stay at this site	6 *(16.7%)*	2 *(5.6%)*	5 *(13.9%)*	3 *(8.3%)*
Return home	3 *(8.3%)*	3 *(8.3%)*	4 *(11.1%)*	6 *(16.7%)*
Total	36 *(100%)*	36 *(100%)*	36 *(100%)*	36 *(100%)*

Table A.52: Crowding and displacement *(Q.21 (CBa only): If faced with overcrowding at a site, would you:...?).*

[39] There were no responses for values 1, and 2.

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Number of trips	Number of respondents *(Percent of valid respondents, i.e. CBb only (%))*			
1-5	20 *(55.6 %)*	28 *(77.8%)*	32 *(88.9%)*	15 *(41.7%)*
6-10	10 *(27.8%)*	4 *(11.1%)*	3 *(8.3%)*	12 *(33.3%)*
11-15	2 *(5.6%)*	3 *(8.3%)*	1 *(2.8%)*	4 *(11.1%)*
16-20	1 *(2.8%)*	0 *(0%)*	0 *(0%)*	3 *(8.3%)*
21-25	0 *(0%)*	0 *(0%)*	0 *(0%)*	2 *(5.6%)*
26-30	1 *(2.8%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
31+	2 *(5.6%)*	1 *(2.8%)*	0 *(0%)*	0 *(0%)*
Total	36 *(100%)*	36 *(100%)*	36 *(100%)*	36 *(100%)*

Table A.53: Reduction in environmental damage and number of trips *(Q.17 (CBb only): Again thinking of the X trips that you made last year, could you tell me how this number of trips would change if the National Park Authority reduced environmental damage at this site?... I would make ____ trips next year).*

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Recreation Experience	Number of respondents *(Percent of valid respondents, i.e. CBb only (%))*			
2	1 *(2.8%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
3	4 *(11.1%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
4	1 *(2.8%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
5	8 *(22.2%)*	2 *(5.6%)*	5 *(13.9%)*	1 *(2.8%)*
6	13 *(36.1%)*	6 *(16.7%)*	11 *(30.6%)*	7 *(19.4%)*
7	9 *(25.0%)*	13 *(36.1%)*	14 *(38.9%)*	16 *(44.4%)*
8	0 *(0%)*	13 *(36.1%)*	4 *(11.1%)*	12 *(33.3%)*
9	0 *(0%)*	1 *(2.8%)*	2 *(5.6%)*	0 *(0%)*
10	0 *(0%)*	1 *(2.8%)*	0 *(0%)*	0 *(0%)*
Total	36 *(100%)*	36 *(100%)*	36 *(100%)*	36 *(100%)*

Table A.54: Environmental damage and its influence on recreation experience *(Q.18 (CBb only): Taking the level of environmental damage into account, how would you rate the recreation experience at this site (with 1=poor and 10=excellent)?)*[40].

\Site	Sallochy	Firkin	Rowardennan	Milarrochy Bay
Recreation Experience	Number of respondents *(Percent of valid respondents, i.e. CBb only (%))*			
5	0 *(0%)*	2 *(5.6%)*	1 *(2.8%)*	1 *(2.8%)*
6	0 *(0%)*	0 *(0%)*	2 *(5.6%)*	0 *(0%)*
7	11 *(30.6%)*	4 *(11.1%)*	5 *(13.9%)*	5 *(13.9%)*
8	17 *(47.2%)*	15 *(41.7%)*	17 *(47.2%)*	19 *(52.8%)*
9	5 *(13.9%)*	10 *(27.8%)*	7 *(19.4%)*	11 *(30.6%)*
10	3 *(8.3%)*	5 *(13.9%)*	4 *(11.1%)*	0 *(0%)*
Total	36 *(100%)*	36 *(100%)*	36 *(100%)*	36 *(100%)*

Table A.55: Environmental damage and recreation experience *(Q.19 (CBb only): If the National Park Authority took measures to reduce environmental damage at this site, how would you rate the recreation experience (again 1=poor and 10=excellent)?)*[41].

The following questions are for the Sallochy Night Surveys only. Twenty questionnaires were issued over two nights: Sunday 3/8/03 and Monday 4/8/03.

Return to Sallochy?	Number of respondents	Percent of total respondents (20 Sallochy Night questionnaires)
No	0	0
Yes	20	100
Total	20	100

Table A.56: Return to site *(Q.23a: Would you come back to this site?).*

[40] There was no response value 1.

[41] There were no responses for values 1, 2, 3 and 4.

Main attraction of Sallochy	Number of respondents	Percent of valid YES respondents (20) (%)
Forest Walks	4	20
Beautiful Scenery	2	10
Peace and Quiet	6	30
Good Beach	2	10
Good Car Park	3	15
Good access to water/loch	4	20
Lots of space (e.g. for kids to play)	4	20
Not overcrowded	2	10
Safe for children	1	5
Valley with water chute nearby	1	5
Somewhere to get away from it all	1	5
Total	30	150*

* Total percent is greater than 100 as respondents could give more than one answer.

Table A.57: Main attraction of site *(Q.23b: If yes what is the main attraction of this site?).*

Most enjoy – Sallochy	Number of respondents	Percent of total respondents (20) (%)
Spending time with family	1	5
Relaxation/Away from stress/Getting away from it all	6	30
Scenery	12	60
Open and clean	2	10
Peace and Quiet	2	10
Beach Area	3	15
Peace of mind, knowing that children are safe as they play	1	5
Forest walks	1	5
Total	28	140*

* Again total percent is greater than 100 as respondents could give more than one answer.

Table A.58: Enjoyment and Site *(Q.24: Finally, what did you most enjoy at this site?).*

Appendix G: Site Improvement Question in Questionnaire Survey

Question: are there any ways in which you think this particular site could be improved?

	S	F	R	M.B.
Toilets	47	0	0	1
Bins / Less Litter	49	0	1	3
Slides, swings, play area for children	1	2	0	0
Café facilities	1	1	1	1
Local information on site: indicator viewpoint, signs, maps etc…	0	2	3	1
Better signposting	0	0	1	0
Showers	0	0	1	8
Shop	1	0	0	2
More "natural"/wilderness appearance	0	1	0	0
(More) Benches	5	0	3	3
(More) Picnic tables	1	1	1	2
Keep jet-skis further out from shore	0	0	0	1
Ban jet-skis	0	0	1	3
Ban dogs	0	1	0	2
Sandy beach	4	0	0	7
Rain shelter	0	1	1	0
Vending machines	1	1	2	3
Separate boat launching and picnic areas more	0	0	0	1
Quieter, more secluded areas on site	0	1	0	1
Taps with drinking water	1	0	0	0
Wardens to monitor "loutish" behaviour	4	0	0	0
"There's dog's mess, they need bins"	1	0	0	1
Barbeque areas	2	0	0	1
Official camping area on-site	1	0	0	0
Better maintained/re-built footbridge	2	0	0	0
More parking spaces	0	0	4	1
Small bar	1	0	0	0
Sun-beds, umbrellas to hire	0	0	0	1
Better access for prams ("too pebbly")	0	0	0	1
Not an official campground so there should be no tents	2	0	0	0
East loch road re-surfaced	0	0	5	0
Better access to loch	0	0	1	0
Cleaner/nicer toilets	0	0	4	0
Jetty for boat	1	0	0	0
Kiosk for ice cream, sweets etc…	2	0	0	3
Reduce environmental damage (including broken branches, damage to vegetation etc.)	4	0	0	0
Ban loud music	2	0	0	0
Signs telling visitors to take litter home	1	0	0	0
First Aid Hut	1	0	0	0
Public transport to Rowardennan	0	0	1	0
Close site later	0	0	0	1
Hire boats from site	0	0	1	1
Lights at site (too dark in evening)	1	0	0	0
No rangers/wardens (more freedom)	0	0	0	1
No "neds"	1	0	0	0

(Where S = Sallochy; F = Firkin; R = Rowardennan; M.B. = Milarrochy Bay; and the number - for example 47 for "toilets" at Sallochy – represents the number of respondents suggesting this improvement. Question was open-ended; any answer could be given.)

References

Acadia National Park Service (1997) Acadia National Park Natural Resources Report Number 97-10. December 1997. Acadia National Park, U.S. Department of the Interior.

Adamowicz, W., Joffre, S., Boxall, P., Louviere, J. and Williams, M. (1997) "Perceptions versus Objective Measures of Environmental Quality in Combined Revealed and Stated Preference Models of Environmental Valuation." *Journal of Environmental Economics and Management*, **32**(1), 65-84.

Adamowicz, W., Louviere, J. and Williams, M. (1994) "Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities." *Journal of Environmental Economics and Management*, **26**, 271-292.

Adams, C. (2001) Loch Lomond Boat Survey. Unpublished Report (Loch Lomond and Trossachs National Park Authority). Rowardennan, University of Glasgow Field Station.

Adams, C. E., Tippett, R., Nunn, S. and Archibald, G. (1992) "The Utilization of a large inland waterway (Loch Lomond, Scotland) by recreational craft." *Scottish Geographical Magazine*, **108**(2), 113-118.

Agresti, A. (1996) *An Introduction to Categorical Data Analysis*. Chichester, John Wiley and Sons.

Aitken, B., Dargie, T. and Tantram, D. (1994) Trossachs Tourism Management Programme. Environmental Monitoring Final Report. August 1994. Dornoch, SNH.

Aldskogius, H. (1977) "A conceptual framework and a Swedish case study of recreational behaviour and environmental cognition." *Economic Geography*, **53**, 163-183.

Anon., (2003a) "Two feared dead in jet-ski horror", The Scotsman, 14th June.

Anon., (2003b) "The jet-ski: a spine tingling thrill", The Scotsman, 26th June.

Anon., (2003c) "Girl killed as uncle lost control of jet-ski", The Times, 28th August.

Anon., (2003d) "A truly exhilarating spin on beautiful Loch Lomond", The Herald, 8th September.

Anon., (2003e) "Record-setter aims to take yobbery out of jet-skiing", The Times, 18th September.

Anon., (2003f) "Jet-skiing father killed", The Times, 4th October.

Anon., (2004a) "Loch Lomond deters discerning tourists", The Herald, 12th August.

Anon., (2004b) "The Fast Set", The Herald, 6th December.

Arches NPS (1995) Visitor Experience and Resource Protection Implementation Plan, Arches National Park Report, June 1995. Arches; Arches National Park Service, U.S. Department of the Interior.

Arches NPS (2003) Arches National Park Visitor Guide. Volume One, Number Six. Arches; Arches National Park Service, U.S. Department of the Interior.

Arsdol, M. D., Sabagh, G. and Alexander, F. (1964) "Reality and the Perception of Environmental Hazards." *Journal of Health and Human Behaviour*, 5(4), 144-153.

Ball, R. (1984) *Management techniques and quantitative methods*. London, Heinemann.

Bannan, M. (1999) "The Effects of Powerboat Emissions on the Water Quality of Loch Lomond." Unpublished Ph.D. thesis (Department of Environmental and Evolutionary Biology, University of Glasgow). Glasgow, University of Glasgow.

Bannan, M., Adams, C.E. and D. Pirie (2000) "Hydrocarbon Emissions from Boat Engines: Evidence of Recreational Boating Impact on Loch Lomond." *Scottish Geographical Journal*. **116**(3), 245-256.

Barbour, R. S. (1999) "The Case for Combining Qualitative and Quantitative Approaches in Health Services Research." *Journal of Health Services Research Policy*, **4**(1), 39-43.

Barker, R. G. (1968) *Ecological Psychology: Concepts and Methods for studying the environment of human behaviour*. Stanford, California; Stanford University Press.

Barkham, J. P. (1973) "Recreational Carrying Capacity: A problem of Perception." *Area*, **5**(3), 218-222.

Bateman, I. J. and Willis, K.G. (eds.) (1999) *Valuing Environmental Preferences*. Oxford, Oxford University Press.

Bayfield, N.G. (1992) *Managing the impacts of recreation on vegetation and soils*. Aberdeen, Banchory Research Station.

Bayfield, N.G. and Conroy, J.W.H. (2000) "Environmental Audit of a Scottish Natural Heritage Area: The Cairngorms." *Eco-Management and Auditing*, 7, 122-130.

Bayfield, N.G., McGowan, G.M. and Paterson, I.S. (1991) Aonach Mor Ski Area: 1991 Environmental Audit. A Report. Banchory, Institute of Terrestrial Ecology.

Bennett, D.P. and Humphries, D.A. (1976) *Introduction to Field Biology*. London, Edward Arnold.

Bennett, J. and Blamey, R. (2001) *The Choice Modelling Approach to Environmental Valuation*. Cheltenham, Edward Elgar.

Bishop, R.C., Champ, P.A. and Mullarkey, D.J. (1995) "Contingent Valuation" in *The Handbook of Environmental Economics*. Bromley, D.W. (ed.). Oxford, Blackwell: 630-654.

Bissett, N., Grant, A.T. and Adams, C.E. (2000) "Long-term Changes in Recreational Craft Utilisation on Loch Lomond, Scotland." *Scottish Geographical Journal*, **116**(3), 257-266.

Bluewater Network (2002) Jet-Ski Position Paper. A Report by the Bluewater Network. San Francisco, Bluewater Network.

Bluewater Network (2003) Personal Watercraft. http://www.bluewaternetwork.org, last modified 30.3.2003, accessed 28.5.2003.

Bluewater Network (2004) The Bluewater Network, San Francisco. http://www.bluewaternetwork.org, last modified 30.3.2004, accessed 2.6.2004.

Bockstael, N.E. (1995) "Travel Cost Models" in *The Handbook of Environmental Economics*. Bromley, D.W. (ed.). Oxford, Blackwell: 655-671.

Boocock, P. (2002) Use of Personal Watercraft and 'Jet-Skis' on Loch Lomond. Positional Report to the Loch Lomond and Trossachs National Park Authority. Drymen, Friends of Loch Lomond.

Bowers, J. (1993) "A Conspectus on Valuing the Environment." *Journal of Environmental Planning and Management*, **36**(1), 91-100.

Brady, E. (2006) "The Aesthetics of Agricultural Landscapes and the Relationship between Humans and Nature." *Ethics, Place and Environment*, **9**(1), 1-19.

Brannen, J. (1992) *Mixing Methods: Qualitative and Quantitative Research*. Avebury, Aldershot.

Brinska, M. (1984) "Outdoor recreation - a new factor disturbing lake ecosystems, as exemplified by Lake Gim, Mazurian Lake District." *Verh. Internat. Verein. Limnol.*, **22**, 978-981.

British Marine Industries Association (1999) Managing Personal Watercraft – A Report. Gwynedd, Avalon.

Bromley, D.W. (ed.) (1995) *The Handbook of Environmental Economics*. Oxford, Blackwell.

Brookfield, H. C. (1969) "On the Environment as Perceived." *Progress in Geography*, **1**, 53-80.

Brown, R. (1974) Loch Lomond Recreation Report. Perth, Countryside Commission for Scotland.

Brown, W.G. and Nawas, F. (1973) "Impact of Aggregation on the Estimation of Outdoor Recreation Demand Functions". *American Journal of Agricultural Economics*, **55**, 246-49.

Bryden, D. and Donaldson, N. (2004) Management for People. A Commissioned Report for SNH, February 2004. Inverness, Scottish Natural Heritage.

Bryman, A. (1988) *Quantity and Quality in Social Research*. London, Unwin Hyman.

Bryman, A. and Burgess, R.G. (1999) *Qualitative Research*. London, Sage Publications.

Burch, W.R. (1984) "Much Ado about Nothing – Some Reflections on the Wider and Wilder Implications of Social Carrying Capacity." *Leisure Sciences*, **6**(4), 487-496.

Burger, J. (1998) Effects of Motorboats and Personal Watercraft on Flight Behaviour over a Colony of Common Terns. A Report for the Personal Watercraft Industry Association. Washington DC, Personal Watercraft Industry Association: 528-534.

Burton, R. (1974) *The Recreational Carrying Capacity of the Countryside*. Keele, University of Keele and the Social Science Research Council.

Burton, T. (1971) *Experiments in Recreation Research*. London, George Allen and Unwin Ltd.

Butler, R.W., Hall, M.C. and Jenkins, J.M. (1998) *Tourism and Recreation in Rural Areas*. Chichester, John Wiley and Sons.

Cameron, C.A. and Trivedi, P.K. (1998) *Regression analysis of count data*. Cambridge, Cambridge University Press.

Campbell, R.C. (1974) *Statistics for Biologists*. Cambridge, Cambridge University Press.

Carothers, P., Vaske, J.J. and Donnelly, M.P. (2001) "Social Values versus Interpersonal Conflict among Hikers and Mountain Bikers." *Leisure Sciences*, **23**, 47-61.

Carson, R.T. (1992) *A contingent valuation study of passive use values resulting from the Exxon Valdez oil spill*. Alaska, Attorney General of the State of Alaska.

C.C.S. (1990) *The Mountain areas of Scotland: conservation and management*. Perth, Countryside Commission for Scotland.

Cherrett, J.M. (ed.) (1989) *Ecological Concepts*. Oxford, Blackwell Scientific Publications.

Clark, R. N. and Stankey, G.H. (1979) The Recreation Opportunity Spectrum: A Framework for Planning, Management, and Research. A Report for the U.S. Forest Service. Pacific Northwest, U.S. Department of Agriculture Forest Service.

Clawson, M. (1963) *Land and Water for Recreation: Opportunities, Problems and Policies*. Chicago, Rand McNally.

Clawson, M. and Knetsch, J.L. (1966) *Economics of Outdoor Recreation*. Baltimore, John Hopkins Press.

Cloke, P., Philo, C. and Sadler, D. (1991) *Approaching Human Geography*. London, Paul Chapman Publishing Limited.

Cole, D. N. (1995a) "Experimental trampling of vegetation. I. Relationship between trampling intensity and vegetation response." *Journal of Applied Ecology*, **32**(1), 203-214.

Cole, D. N. (1995b) "Experimental trampling of vegetation. II. Predictors of resistance and resilience." *Journal of Applied Ecology*, **32**(1), 215-224.

Cole, D. N. (1997) Visitors, Conditions, and Management Options for High-Use Destination Areas in Wilderness. Making Protection Work. A Report for the George Wright Society. Albuquerque, New Mexico; The George Wright Society.

Cole, D. N. (2003) Carrying Capacity and Visitor Management: Facts, Values, and the Role of Science. GWS/National Park Service Joint Conference: Protecting our Diverse Heritage. San Diego, George Wright Society.

Cooper, N.S. (2000) "Speaking and listening to nature: ethics within ecology." *Biodiversity and Conservation*, **9**(8), 1009-1027.

Coppock, J. T., Duffield, B.S. and Best, J.P. (1976) "Recreation. A Scottish Tourism and Recreation Study." *Forest Recreation*, 64-67.

Cowan, J. P. (1994) *Handbook of Environmental Acoustics*. New York, Van Nostrand Reinhold.

Creel, M. D. and Loomis, J.B. (1990) "Theoretical and Empirical Advantages of Truncated Count Data Estimators for Analysis of Deer Hunting in California." *American Journal of Agricultural Economics*, **72**, 434-441.

Cresswell, T. (1996) *In place/out of place: geography, ideology, and transgression*. London, University of Minnesota Press.

Creswell, J. W. (1994) *Research Design. Qualitative and Quantitative Approaches*. London, SAGE Publications.

Dalrymple, G.F. and Hanley, N. (2005) "Using economic valuation to guide the management of outdoor recreation resources." *Tourism*, **53**(2), 105-114.

Davis, R.K. (1963) "The Value of Outdoor Recreation: An Economic Study of the Maine Woods" Ph.D. thesis (Department of Economics, University of Harvard). Boston, Massachusetts: University of Harvard.

Denscombe, M. (1998) *The Good Research Guide*. Buckingham, Open University Press.

Denzin, N. K. and Lincoln, Y.S. (eds.) (2000) *Handbook of Qualitative Research*. London, Sage Publications.

Desor, J. A. (1972) "Toward a Psychological Theory of Crowding." *Journal of Personality and Social Psychology,* **21**, 79-83.

Devall, B. and Harry, J. (1981) "Who Hates Whom in the Great Outdoors: The Impact of Recreational Specialization and Technologies of Play." *Leisure Sciences,* **4**(4), 399-418.

Dickinson, G. (1985) Public Policy and Outdoor Recreation in Scotland. Department of Geography, Occasional Paper. Glasgow, University of Glasgow.

Dickinson, G. (1989) The Scottish countryside in conflict: the private use of a public resource. Proceedings of a Public Policy Seminar organised by the Centre for Urban and Regional Research, University of Glasgow on 16th June, 1989. Glasgow, University of Glasgow.

Dickinson, G. (1994) "Vegetation and land use in the Loch Lomond catchment." *Hydrobiologia,* **290**, 53-61.

Dickinson, G. (1996) "Environmental Degradation in the Countryside: Loch Lomond, Scotland" in *Sustainable Tourism? European Experiences.* Priestley, G.K., Edwards, J.A. and Coccossis, H. (eds.) Oxon, CAB International.

Dickinson, G. (2000a) "Recreation at Scottish Lochs." *Journal of the Scottish Association of Geography Teachers,* **29**, 41-51.

Dickinson, G. (2000b) "The Use of the Loch Lomond Area for Recreation." *Scottish Geographical Journal,* **116**(3), 231-244.

Dickinson, G., Drummond, J., Murphy, K. and O'Hare, M. (1998) An Approach to Measuring Recreational Impacts on Inland Lochs. A Commissioned Report to Scottish Natural Heritage, Edinburgh. Glasgow, University of Glasgow.

Dickinson, G. and Murphy, K. (1998) *Ecosystems.* London, Routledge.

Dovers, S. (2002) "Sustainability: Reviewing Australia's Progress, 1992-2002." *International Journal of Environmental Studies,* **59**(5), 559-571.

Downs, R. M. (1970) "Geographic Space Perception." *Progress in Geography,* **2**, 65-108.

Eddison, A.M. (unknown) Eddison Quote – The Quote Garden. http://www.quotegarden.com/environment.html, last modified 18.6.2005, accessed 27.6.2005.

Edington, J. M. and Edington, M.A. (1986) *Ecology, Recreation and Tourism.* Cambridge, Cambridge University Press.

Eiswerth, M. E., Englin, J., Fadali, E. and Shaw, D.W. (2000) "The value of water levels in water-based recreation: A pooled revealed preference/contingent behaviour model." *Water Resources Research,* **36**(4), 1079-1086.

Englin, J. and Cameron, T.A. (1996) "Augmenting Travel Cost Models with Contingent Behavior Data." *Environmental and Resource Economics,* **7**(2), 133-147.

Eurolakes (2004) Eurolakes Report: Precious Blue Eyes. Wedel, Eurolakes.

Fay, T. H. (1991) *Noise and Health.* New York, The New York Academy of Medicine.

Field, A. (2000) *Discovering Statistics using SPSS for Windows.* London, Sage Publications.

Filho, W.L. (2000) "Dealing with the misconceptions of sustainability." *Journal of Sustainability in Higher Education*, **1**, 9-19,

Freedman, J. L. (1975) *Crowding and Behaviour*. New York, The Viking Press.

Garrod, G. and Willis, K.G. (1999) *Economic Valuation of the Environment*. Cheltenham, Edward Elgar.

Gauch, H.G. (1982) *Multivariate analysis in community ecology*. Cambridge, Cambridge University Press.

GDP Inflation Index (2005) Economic History Services, Lawrence H. Officer. What is its relative value in UK Pounds? http://www.eh.net/hmit/ukcompare, last modified 30.10.2004, accessed 18.1.2005.

Glyptis, S. (1991) *Countryside Recreation*. Essex, Longman Group Ltd.

Glyptis, S. (1993) *Leisure and the Environment*. London, Belhaven Press.

Gold, J. R. (1980) *An Introduction to Behavioural Geography*. Oxford, Oxford University Press.

Golledge, R.G. and Rushton, G. (eds.) (1976) *Spatial Choice and Spatial Behaviour: Geographic Essays on the Analysis of Preferences and Perceptions*. Columbus, Ohio State University.

Graefe, A.R., Vaske, J.J. and Kuss, F. (1984) "Social Carrying Capacity: An Integration and Synthesis of Twenty Years of Research." *Leisure Sciences*, **6**(4), 395-431.

Gramann, J. H. (1982) "Toward a Behavioural Theory of Crowding in Outdoor recreation: An evaluation and synthesis of research." *Leisure Sciences*, **5**(2), 109-126.

Gramann, J. H. and Burdge, R. (1981) "The effect of recreation goals on conflict perception: the case of water skiers and fishermen." *Journal of Leisure Research*, **13**, 15-27.

Grant, A.T. and Adams, C.E. (1999) Recreational Boating on Loch Lomond. A Commissioned Report for Scottish Natural Heritage. Rowardennan, University of Glasgow Field Station.

Greene, W. H. (1997) *Econometric Analysis*. New Jersey, Prentice-Hall.

Greig-Smith, P. (1983) *Quantitative Plant Ecology*. Edinburgh, Blackwell Scientific Publications.

Grime, J.P. (1979) *Plant Strategies and vegetation processes*. Chichester, Wiley.

Grogger, J. T. and Carson, R.T. (1991) "Models for Truncated counts." *Journal of Applied Econometrics*, **6**, 225-238.

Guba, E.G. and Lincoln, Y.S. (1989) *Fourth generation evaluation*. London, Sage.

Hall, C. M. and Page, S.J. (1999) *The geography of tourism and recreation: environment, place, and space*. London, Routledge.

Hammersley, M. (1992) "Deconstructing the qualitative-quantitative divide" in *Mixing Methods: Qualitative and Quantitative Research*. Brannen, J. (ed.). Avebury, Aldershot: 39-55.

Hammitt, W. E. (1983) "Toward an Ecological Approach to Perceived Crowding in Outdoor Recreation." *Leisure Sciences*, **5**(4), 309-320.

Hammitt, W. E. and Cole, D.N. (1998) *Wildland Recreation. Ecology and Management*. Chichester, John Wiley and Sons.

Hanley, N. (1989) "Valuing Rural Recreation Benefits: An Empirical comparison of two approaches." *Journal of Agricultural Economics*, **40**, 361-374.

Hanley, N., Alvarez-Farzio, B. and Shaw, W.D. (2001a) Rationing an Open-Access Resource: Mountaineering in Scotland. Unpublished Report (Department of Economics, University of Glasgow). Glasgow, University of Glasgow.

Hanley, N., Bell, D. and Alvarez-Farzio, B. (2002) Valuing the benefits of coastal water quality improvements using contingent and real behaviour. Discussion Papers in Economics (Department of Economics, University of Glasgow). Glasgow, University of Glasgow.

Hanley, N. and Kristrom, B. (2002) What's it worth? Exploring value uncertainty using interval questions in Contingent Valuation. Discussion Papers in Economics (Department of Economics, University of Glasgow). Glasgow, University of Glasgow.

Hanley, N., Shaw, D.W. and Wright, R.E. (eds.) (2003) *The New Economics of Outdoor Recreation*. Cheltenham, Edward Elgar.

Hanley, N., Shogren, J.F. and White, B. (2001b) *Introduction to Environmental Economics*. Oxford, Oxford University Press.

Hanley, N., Wright, R.E. and Koop, G. (2000) Modelling Recreation Demand Using Choice Experiments: Climbing in Scotland. Discussion Papers in Economics (Department of Economics, University of Glasgow). Glasgow, University of Glasgow.

Hansom, J. D. and McGlashan, D.J. (2000a) Impacts of Bank Protection on Loch Lomond. A Report to S.N.H. Glasgow, Scottish Natural Heritage.

Hansom, J. D. and McGlashan, D.J. (2000b) "Loch Lomond: A Special Place. Special Collection of Invited Papers." *Scottish Geographical Journal*, **116**(3), 177-266.

Harrison, C. and Burgess, J. (2000) "Nature in context: the contribution of common-good approaches." *Biodiversity and Conservation*, **9**, 1115-1130.

Havlick, D. (2006) "Reconsidering Wilderness: Prospective Ethics for Nature, Technology, and Society." *Ethic, Place and Environment*, **9**(1), 47-62.

Hellerstein, D. and Mendelsohn, R. (1993) "A theoretical foundation for count data models." *American Journal of Agricultural Economics*, **75**(3), 604-611.

Hendee, J. C., Stankey, G. H. and Lucas, R.C. (1990) *Wilderness Management*. Golden, Colorado; North American Press.

Hillery, M., Nancarrow, B., Griffin, G. and Syme, G. (2001) "Tourist Perception of Environmental Impact." *Annals of Tourism Research*, **28**(4), 853-867.

Hoggart, K., Lees, L. and Davies, A. (2002) *Researching Human Geography*. London, Arnold.

Huggett, A.J. (2005) "The concept and utility of 'ecological thresholds' in biodiversity conservation." *Biological Conservation*, **124**(3), 301-310.

Huxley, T. (1994) "Where the Shoe Hurts. The Ecological Impacts of Tourism" in *Cultural Tourism*. Fladmark, J.M. (ed.). Aberdeen, Robert Gordon University: 179-197.

Ireland, P. A. R., Kelly, I. and Fleming, L.A.O. (1998) Loch Lomond and Trossachs Inventory: S.N.H. Research, Survey and Monitoring Report. Edinburgh, Scottish Natural Heritage.

Ivy, M. I., Stewart, W.P. and Lue, C. (1992) "Exploring the Role of Tolerance in Recreational Conflict." *Journal of Leisure Research,* **24**(4), 348-360.

Jacob, G. and Schreyer, R. (1980) "Conflict in outdoor recreation: a theoretical perspective." *Journal of Leisure Research,* **12**, 368-380.

Jarvis, P.J. (2000) *Ecological Principles and Environmental Issues.* London, Prentice Hall.

Jeroen, C. (ed.) *Handbook of Environmental Economics.* Cheltenham, Edward Elgar.

Jick, T. D. (1979) "Mixing qualitative and quantitative methods: Triangulation in action." *Administrative Science Quarterly,* **24**, 602-611.

Kahn and Cannell (1987) in Marshall, C. and Rossman, G.B. (eds.) (1999) *Designing Qualitative Research.* London, Sage Publications.

Kates, R. W. (1970) "Human Perception of the Environment." *International Social Science Journal,* **22**(4), 648-660.

Kearsley, G. W. (1990) "Tourism development and the user's perceptions of wilderness in Southern New Zealand." *Australian Geographer,* **21**(2), 127-40.

Kennedy, P. (1998) *A Guide to Econometrics.* Oxford, Blackwell.

Kershaw, K. and Looney, J.H. (1985) *Quantitative and Dynamic Plant Ecology.* London, Edward Arnold.

King, D.M. and Mazzotta, M. (2002) Ecosystem Valuation: The Travel Cost Method. http://www.ecosystemvaluation.org, no date last modified, accessed 14.12.2002.

Kling, C. L. and Crooker, J.R. (1999) "Recreation demand models for environmental valuation" in *Handbook of Environmental Economics.* Jeroen, C. (ed.). Cheltenham, Edward Elgar: 755-764.

Knopp, T. B. (1972) "Environmental Determinants of Recreation Behaviour." *Journal of Leisure Research,* **4**, 129-138.

Komanoff, C. and Shaw, H. (2000) Drowning in Noise. A Report for the Noise Pollution Clearinghouse. New York City, Noise Pollution Clearinghouse.

Krebs, C. (1978) *Ecology. The Experimental Analysis of Distribution and Abundance. Second Edition.* London, Harper & Row Publishers.

Lavery, P. (1971) *Recreational Geography.* London, Newton Abbot.

Lee, C.K. and Han, S.Y. (2002) "Estimating the use and preservation values of national parks' tourism resources using a contingent valuation method." *Tourism Management,* **23**, 531-540.

Lee, H. and Graefe, A.R. (2003) "Crowding at an arts festival: extending crowding models to the frontcountry." *Tourism Management,* **24**(1), 1-11.

Lewis-Beck, M. S. (1993) *Regression Analysis.* London, Sage Publications.

Ley, D. and Samuels, M.S. (1978) *Humanistic Geography: Prospects and Problems.* London, Croom Helm.

Liddle, M.J. (1997) *Recreation Ecology.* London, Chapman and Hall.

Liddle, M.J. and Scorgie, H.R.A. (1980) "The Effects of Recreation on Freshwater Plants and Animals: A Review." *Biological Conservation,* **17**, 183-206.

Lime, D.W. and Stankey, G.H. (1974) "Carrying Capacity: Maintaining Outdoor Recreation Quality" in *Land and Leisure.* Van Doren, C.S., Priddle, G.B. and Lewis, J.E. (eds.). Chicago, Maaroufa Press.

Lindberg, K., McCool, S. and Stankey, G.H. (1997) "Rethinking Carrying Capacity." *Annals of Tourism Research,* **24**(2), 461-465.

LLTNPA (2003) Loch Lomond and the Trossachs National Park Annual Report 2002-2003. Balloch, Loch Lomond and Trossachs National Park Authority.

LLTNPA (2004) A Phairc. LLTNP Newsletter. Issue 1. April 2004. Balloch, Loch Lomond and Trossachs National Park Authority.

LLTNPA (2005a) National Park Plan. Consultative Draft. Balloch, Loch Lomond and Trossachs National Park Authority.

LLTNPA (2005b) State of the Park Report 2005. Balloch, Loch Lomond and Trossachs National Park Authority.

Loch Lomond Boat User Survey (2001) Loch Lomond Boat User Survey 2001. A Report for the Loch Lomond and Trossachs National Park Authority. Unpublished Report. Glasgow, University of Glasgow.

Loch Lomond Planning Group (1980) Loch Lomond Local (Subject) Plan for Recreation, Tourism, and Landscape Conservation. Glasgow, Loch Lomond Planning Group.

Loch Lomond Regional Park Authority (1995) Loch Lomond Registration and Byelaws. Balloch, Loch Lomond Regional Park Authority.

Loch Lomond Regional Park Authority (1996) Loch Lomond Local (Subject) Plan. February 1996. Balloch, Loch Lomond Regional Park Authority.

Long, S. J. (1997) *Regression Models for Categorical and Limited Dependent Variables.* London, Sage Publications.

Louviere, J. and Street, D. (2000) "Stated Preference Methods" in *Handbook of Transport Modelling.* Hensher, D.A. and Button, K.J. (eds.). Amsterdam, Pergamon: 131-143.

Louviere, J. J., Hensher, D.A. and Swait, J.D. (2000) *Stated Choice Methods. Analysis and Application.* Cambridge, Cambridge University Press.

Lowenthal, D. (1967) Environmental Perception and Behaviour. Department of Geography Research Paper No. 109. Chicago, University of Chicago.

Lowenthal, D. and Prince, H.C. (1964) "The English Landscape." *The Geographical Review,* **LIV**(3), 309-346.

Lucas, R. C. (1964) "Wilderness Perception and Use: The Example of the Boundary Waters Canoe Area." *Natural Resources Journal,* **3**(3), 363-374.

Lundgren, A. L. and Gregersen, H.H. (1997) The Role of Recreation Fees in the Management of National Parks. GWS Conference held in Albuquerque, New Mexico: Making Protection Work. Hancock, Michigan; The George Wright Society.

MacMillan, D., Hanley, N. and Lienhoop, N. (2005) "Contingent Valuation: Environmental Polling or Preference Engine?" Working paper. Revised version, August 2005.

Maitland, P.S., Adams, C.E. and Mitchell, J. (2000) "The Natural Heritage of Loch Lomond: Its Importance in a National and International Context" *Scottish Geographical Journal,* **116**(3), 181-196.

Manning, R. E. (2001) *Studies in Outdoor Recreation. Search and Research for Satisfaction.* Corvallis, Oregon; Oregon State University Press.

Manning, R. E., Lime, D.W. and Freimund, W.A. (1995) "The Visitor Experience and Resource Protection (VERP) Process: The Application of Carrying Capacity to the Arches National Park." *The George Wright Forum,* **12**(3), 41-55.

Manning, R. E., Lime, D.W., Freimund, W.A. and Pitt, D.G. (1996) "Crowding Norms at Frontcountry Sites: A Visual Approach to Setting Standards of Quality." *Leisure Sciences,* **18**, 39-59.

Marshall, C. and Rossman, G.B. (1999) *Designing Qualitative Research.* London, Sage Publications.

Masters, D., Scott, P. and Barrow, G. (2002) Sustainable Visitor Management System: a discussion paper. Perth, Scottish Natural Heritage.

Masters, D., Scott, P. and Barrow, G. (2004) Management for People Report. Perth, Scottish Natural Heritage.

Matless, D. and Philo, C. (1991) "Nature's geographies: social and cultural perspectives" in *New Words, New Worlds: Reconceptualising Social and Cultural Geography.* Philo, C. (ed.). Lampeter, Social and Cultural Geography Study Group of the Institute of British Geographers: 39-48.

Matless, D. (2000) "Action and Noise Over a Hundred Years: The Making of a Nature Region" in *Bodies of Nature.* Macnaghten, P. and Urry, J. (eds.). London, SAGE Publications: 141-165.

Matless, D. (2005). "Sonic geography in a nature region." *Social and Cultural Geography,* **6**(5), 745-766.

McCool, S., Cole, D.N., Lucas, R.C. and Stankey, G.H. (1988) Maintaining Wilderness Quality through the Limits of Acceptable Change Planning System. Management of Park and Wilderness Preserves Conference, University of Idaho, Sept. 14-18 1988. Idaho, Wilderness Research Centre.

McGowan, G. M. (2004) "Using a Limits of Acceptable Change (LAC) environmental monitoring and management scheme at ski resorts in Scotland." *In Practice: the Journal of the Institute of Ecology and Environmental Management,* **June 2004**(2), 1-9.

McLean, R. C. and Cook, W.R.I. (1968) *Practical Field Ecology.* London, George Allen and Unwin Limited.

McLeod, H. and Murphy, K. (2003) Temporal and Distributional Variation in Submerged Macrophyte Communities of Loch Lomond, Scotland. Proceedings of the EWRS International Symposium on Aquatic Weeds, Moliets et Maa (France), September 2-6 2002. France, EWRS.

Mendelsohn, R. and Brown, G.M. (1985) "Revealed Preference Approaches to Valuing Outdoor Recreation." *Natural Resources Journal,* **23(3)**, 607-618.

Miller, N. P. (2003) Transportation Noise and Value of Natural Quiet. GWS National Park Service Joint Conference: Protecting our Diverse Heritage. San Diego, George Wright Society.

Minitab Help File (2004) Help. http://www.minitab.com, no date last modified, accessed 5.4.2004.

Mitchell, B. (2002) *Resource and Environmental Management.* London, Prentice Hall.

Mitchell, J. (2001) *Loch Lomondside.* London, HarperCollins Publishers.

Mitchell, R.C. and Carson, R.T. (1993) *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Washington D.C., Resources for the Future.

Moffatt, I. and Hanley, N. (2001) *Measuring and modelling sustainable development.* London, Parthenon Publishing Group.

Monz, C. A. (2002) "The response of two arctic tundra plant communities to human trampling disturbance." *Journal of Environmental Management,* **64**(2), 207-217.

Monz, C. A., Leung, Y.F., Ingle, C. and Bauman, H. (2003) Visitor Impact Monitoring in the Coastal and Barrier Island Network. GWS/National Park Service Joint Conference: Protecting our Diverse Heritage. San Diego, George Wright Society.

Morey, E.R. and Rowe, R.D. (1993) "A Repeated Nested-Logit Model of Atlantic Salmon Fishing." *American Journal of Agricultural Economics,* **75**, 578-592.

Murphy, K.J., Beveridge, M.C.M. and Tippett, R. (1994b) *The Ecology of Loch Lomond.* London, Kluwer Academic Publishers.

Murphy, K.J. and Eaton, J.W. (1983) "Effects of Pleasure-Boat Traffic on Macrophyte Growth in Canals." *Journal of Applied Ecology,* **20**, 713-729.

Murphy, K.J., Hudson, K.D. and Mitchell, J. (1994a) "Freshwater and wetland plant communities of Loch Lomond." *Hydrobiologia,* **290**, 63-74.

Murphy, K.J. and Pearce, H.G. (1987) "Habitat modification associated with freshwater angling" in *Angling and Wildlife in Fresh Waters.* Maitland, P.S. and Turner, A.K. (eds.). Grange-Over-Sands, Cumbria; Institute of Terrestrial Ecology: 31-46.

Murphy, K.J., Willby, N.A. and Eaton, J.W. (1995) "Ecological Impacts and Management of Boat Traffic on Navigable Inland Waterways" in *The Ecological Basis for River Management.* Harper, D.M. and Ferguson, A.J.D. (eds.). New York, John Wiley and Sons.

Mussen, P., Rosenzweig, M.R. and Aranson, E. (1977) *Psychology: An Introduction.* Toronto, D.C. Heath and Company.

Newman, P., Marion, J.L. and Cahill, K. (2001) "Integrating Resource, Social, and Managerial Indicators of Quality into Carrying Capacity Decision-Making." *The George Wright Forum,* **18**(3), 28-40.

Nicholls, D.C. (1968) *Recreation and Tourism in the Loch Lomond Area.* Glasgow, Scottish Tourist Board.

O'Riordan, T. (1971) *Perspectives on Resource Management.* London, Pion Limited.

Outdoor Recreation Resources Review Commission (1962) *Outdoor Recreation for America.* Washington D.C., U.S. Government Printing Office.

Owen, F. and Jones, R. (1990) *Statistics.* London, Pitman.

Patmore, J. A. (1983) *Recreation and Resources.* Oxford, Basil Blackwell.

Pearce, D. (1989) *Tourist Development.* Essex, Longman Group Ltd.

Personal Watercraft Industry Association (1997) Effects of Personal Watercraft Operation on Shallow-water Seagrass Communities in the Florida Keys. A Report to the PWIA. Washington D.C., PWIA.

Philip, L. J. (1998) "Combining quantitative and qualitative approaches to social research in human geography - an impossible mixture?" *Environment and Planning A*, **30**(2), 261-276.

Phillips, E.M. and Pugh, D.S. (2001) *How to get a Ph.D.* Buckingham, Open University Press.

Philo, C. (1998) "Reconsidering quantitative geography: the things that count." *Environment and Planning A,* **30**, 191-201.

Pigram, J. J. (1983) *Outdoor recreation and resource management.* Kent, Crom Helm.

Pigram, J. J. and Jenkins, J.M. (2002) *Outdoor Recreation Management.* London, Routledge.

Port Hacking Protection Society (2001) Jet-Ski Issues. A Summary of Studies. Report by the Port Hacking Society. Sydney, Port Hacking Society.

Proshansky, H.M., Ittelson, W. and Rivlin, H.L.G. (1970) *Environmental Psychology: Man and his Physical Setting.* New York; Holt, Rinehart and Winston Inc.

Pullin, A.S. (2002) *Conservation Biology.* Cambridge, Cambridge University Press.

Pullin, A.S. and Knight, T.M. (2001) "Effectiveness in Conservation Practice: Pointers from Medicine and Public Health." *Conservation Biology,* **15**(1), 50-54.

Pullin, A.S., Knight, T.M., Stone, D.A. and Charman, K. (2004) "Do conservation managers use scientific evidence to support their decision-making?" *Biological Conservation,* **119**, 245-252.

P.W.I.A. (2003) Personal Watercraft. http://www.pwia.org, last modified 20.3.2003, accessed 8.5.2003.

P.W.I.A. (2004) Personal Watercraft Industry Association. http://www.pwia.org, last modified 10.3.2004, accessed 10.6.2004.

Reijnen, R., Foppen, R., Ter Braak, C. and Thissen, J. (1995) "The effects of car traffic on breeding bird populations in woodland. III. Reduction of density in relation to the proximity of main roads." *Journal of Applied Ecology,* **32**(1), 187-202.

Ricklefs, R.E. (1996) *Ecology. Third Edition.* New York, W.H. Freeman and Company.

Rodgers, J.A. (2003) Buffer zone distances to protect foraging and loafing waterbirds from disturbance by personal watercraft in Florida. A Report for the PWIA. Gainseville, Bureau of Wildlife Diversity Conservation.

Rodwell, J.S. (1991a) *British Plant Communities. Volume 1. Woodlands and scrub.* Cambridge, Cambridge University Press.

Rodwell, J.S. (1991b) *British Plant Communities. Volume 2. Mires and heaths.* Cambridge, Cambridge University Press.

Rodwell, J.S. (1991c) *British Plant Communities. Volume 3. Grasslands and montane communities.* Cambridge, Cambridge University Press.

Rodwell, J.S. (1991d) *British Plant Communities. Volume 4. Aquatic communities, swamps and tall-herb fens.* Cambridge, Cambridge University Press.

Rodwell, J.S. (1991e) *British Plant Communities. Volume 5. Maritime communities and vegetation of open habitats.* Cambridge, Cambridge University Press.

RYA (1999) *Managing Personal Watercraft.* Gwynedd, Avalon Design and Print.

Saarinen, T.F. (1966) *Perception of the Drought Hazard on the Great Plains.* Chicago, The University of Chicago.

Sagoff, M. (1988) "Some Problems with Environmental Economics." *Environmental Ethics,* **10**(1), 55-74.

Scheider, I. E. (2000) "Revisiting and Revising Recreation Conflict Research." *Journal of Leisure Research,* **32**(1), 129-132.

Scottish Household Survey (2004) Scottish Executive Research. http://www.scotland.gov.uk/Topics/Statistics, last modified 22.5.2004, accessed 7.6.2004.

Seale, C. (1999) *The Quality of Qualitative Research.* London, Sage Publications.

Shelby, B. and Heberlein, T.A. (1984) "A Conceptual Framework for Carrying Capacity Determination." *Leisure Sciences,* **6**(4), 433-451.

Shelby, B. and Heberlein, T.A. (1986) *Carrying Capacity in Recreation Settings.* Corvallis, Oregon; Oregon State University Press.

Shepard, J. (2005) Powerboating Glossary. http://powerboat.about.com/library/glossary.htm, last modified 11.5.2005, accessed 1.6.2005.

Shrestha, R.K., Seidl, A.F. and Moraes, A.S. (2002) "Value of recreational fishing in the Brazilian Pantanal: a travel cost analysis using count data models." *Ecological Economics,* **42**, 289-299.

Sidaway, R. (1994) The Limits of Acceptable Change: An assessment of the technique and its potential relevance to the management of public access on open land. A Countryside Commission Report. Edinburgh, Countryside Commission.

Sidaway, R. (2005) *Resolving Environmental Disputes: From conflict to consensus.* London, Earthscan.

Smith, V.K. (1989) "Taking Stock of Progress with Travel Cost Recreation Demand Models: Theory and Implementation." *Marine Resource Economics,* **6**, 279-310.

Smith, V.K. (1992) in Bateman, I.J. and Willis, K.G. (eds.) (1999) *Valuing Environmental Preferences.* Oxford, Oxford University Press.

SNH (2005) Scottish Outdoor Access Code. Public Access to Scotland's Outdoors. Your rights and responsibilities. Battleby, Perth; Scottish Natural Heritage.

Stankey, G.H. (1980) "Wilderness Carrying Capacity: Management and Research Progress in the United States." *Landscape Research,* **5**(3), 6-11.

Stokols, D. (1972) "A Social Psychological Model of Crowding Phenomena." *Journal of the American Institute of Planners,* **38**, 72-84.

Studenmund, A.H. (2001) *Using Econometrics: a practical guide.* Boston, Addison Wesley.

Sutherland, W.J. (1996) *Ecological Census Techniques. A Handbook.* Cambridge, Cambridge University Press.

Taaffe, E.J. and Gauthier, H.L. (1973) *Geography of transportation.* Englewood Cliffs, Prentice Hall.

Theodori, G. L., Luloff, A.E. and Willits, F.K. (1998) "The Association of Outdoor Recreation and Environmental Concerns: Reexamining the Dunlap-Heffernan Thesis." *Rural Sociology,* **63**(1), 94-108.

Tivy, J. (1972) *The Concept and Determination of Carrying Capacity of Recreational Land in the U.S.A.* Perth, Countryside Commission for Scotland.

Tivy, J. (1980) *The Effect of Recreation of Freshwater Lochs and Reservoirs in Scotland.* Perth, Countryside Commission for Scotland.

Tivy, J. and Dobson, M. (1979) *Shore Erosion Around Loch Lomond.* Perth, Countryside Commission for Scotland.

Train, K.E. (1998) "Recreation Demand Models with Taste Differences Over People." *Land Economics,* **74**(2), 230-239.

United States Environmental Protection Agency (1994) The Effects of Marine Engine Exhaust Emissions on Water Quality: Summary Report of Findings of Various Research Studies. Ann Arbor, Michigan; E.P.A.

Van den Born, R.J.G., Lenders, R.H.J., de Groot, W.T. and Huijsman, E. (2001) "The new biophilia: an exploration of visions of nature in Western countries." *Environmental Conservation,* **28**, 65-75.

Van Doren, C. S., Priddle, G.B. and Lewis, J.E. (1974) *Land and Leisure: Concepts and Methods in Outdoor Recreation.* Chicago, Maaroufa Press.

Various authors, (2004) Letters to the Editor, The Herald, 10th December.

Vaske, J.J., Carothers, P., Donnelly, M.P. and Baird, B. (2000) "Recreation Conflict among Skiers and Snowboarders." *Leisure Sciences,* **22**, 297-313.

Wagar, J.A. (1964) *The Carrying Capacity of Wildlands for Recreation.* Washington D.C., Society of American Foresters.

Walker, D. I., Lukatelich, R.J., Bastyan, G. and McComb, A.J. (1989) "Effect of Boat Moorings on Seagrass Beds near Perth, Western Australia." *Aquatic Botany,* **36**, 69-77.

Wall, G. (1983) "Cycles and Capacity: a contradiction in terms?" *Annals of Tourism Research,* **10**, 268-70.

Wall, G. and Wright, C. (1977) *The Environmental Impact of Outdoor Recreation.* Ontario, University of Waterloo Press.

Walmsley, D. J. and Lewis, G.J. (1993) *People and Environment: Behavioural Approaches in Human Geography.* Essex, Longman Group U.K. Limited.

Warnock, G. J. (1967) *The Philosophy of Perception.* London, Oxford University Press.

Warren, C. (2002) *Managing Scotland's Environment.* Edinburgh, Edinburgh University Press.

Watson, J. W. (1975) "Perception and Place." *Geographical Journal,* **141**, 271-274.

Westover, T. N. and Collins, J.R. (1987) "Perceived Crowding in Recreation Settings: An Urban Case Study." *Leisure Sciences,* **9**, 87-99.

Wiktionary (2006) Ned. http://en.wiktionary.org/wiki/ned, last modified 11.4.2006, accessed 16.4.2006.

Willis, K.G. and Benson, J.F. (1989) *Values of User-Benefits of Forest Recreation: Some Further Site Surveys.* Newcastle, University of Newcastle.

Willis, K.G. and Garrod, G.D. (1991a) "An Individual travel-cost method for evaluating forest recreation." *Journal of Agricultural Economics*, **42**(1), 33-42.

Willis, K.G. and Garrod, G.D. (1991b) "Valuing Open Access Recreation on Inland Waterways: On-site Recreation Surveys and Selection Effects." *Regional Studies*, **25**(6), 511-524.

Winchester, H.P.M. (1996) "Ethical Issues in Interviewing as a Research Method in Human Geography." *Australian Geographer,* **2**(1), 117-131.

Wordsworth, W. (1798) "Tintern Abbey" in Bloom, H. (1992) "William Wordsworth." *Poetry Criticism,* **4**, 409-414.

World Commission on Environment and Development (1987) Our Common Future. Oxford, Oxford University Press.

Zimmerer, K. S. (2000) "The Reworking of Conservation Geographies: Nonequilibrium Landscapes and Nature-Society Hybrids." *Annals of the Association of American Geographers* **90**(2), 356-369.