DEFINING WILD LAND IN SCOTLAND THROUGH G.I.S. BASED WILDERNESS PERCEPTION MAPPING

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by

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Declaration

This thesis has been composed in its entirety by the candidate. Except where specifically acknowledged, the work described in this thesis has been conducted independently and has not been submitted for any other degree.

Signature of candidate:

Date: 12th April 1999.

Dedication

For my Mother and Father.

Abstract

In a country such as Scotland, there is little land, if any, that has escaped the influence of humankind in one way or another. The degree of human influence varies along a continuum from, for example, the city centre office block, to a very remote mountain hillside. Despite the effects of human influence, the landscapes at the latter end of the continuum are still perceived by many as wild and are relatively untouched. Wild land is valued for both utilitarian and intrinsic reasons and provides a range of benefits. However, owing to the subjective nature of current wild land definitions, these values and benefits are rarely taken into account in current land use management and new developments. The aim of this study was to define in spatial terms the concept of wild land in Scotland using people's visual perceptions of the landscape. This was achieved through the development of a method to define objectively wild land by quantifying the wildness of a location based on the surrounding landscape attributes. The main objectives of the study were an assessment of the physical and perceptual characteristics of wild land, the examination of the current wildness of a range of Scottish areas which in turn enabled the stability of wild land perceptions over time to be evaluated in comparison with existing data.

The perceptual nature of wild land necessitates a multidisciplinary approach and requires a broad range of opinion to be consulted in its definition. The use of a photographic questionnaire enabled the views of those living nearby and visiting potential wild land areas to be gathered. The photographs represented the range of characteristic landscape attributes within the two study areas of the Cairngorms and Wester Ross, and were rated for their wildness. The extent of visible landscape attributes was quantified using a geographical information system (G.I.S.) and was used along with wildness ratings to develop and test predictive wildness models using multiple linear regression techniques.

Wildness models were then applied within each of the two study areas, producing maps of wild land that could then be used in decisions on future planning and conservation issues.

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AML	ARCINFO Macro Language
AONB	Area of Outstanding Natural Beauty
CC	Countryside Commission
CCS	Countryside Commission for Scotland
CPRE	Council for the Protection of Rural England
DEM	Digital Elevation Model
ESA	Environmentally Sensitive Area
GIS	Geographical Information System
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature and Natural Resources
JMT	John Muir Trust
LAC	Limits of Acceptable Change
LCS88	Land Cover of Scotland 1988
MCE	Multiple Criteria Evaluation
MCofS	Mountaineering Council of Scotland
NNR	National Nature Reserve
NSA	National Scenic Area
NTS	National Trust for Scotland
NWPS	National Wilderness Preservation System
OS	Ordnance Survey
PAT	Point Attribute Table
RARE I/II	Roadless Area Review and Evaluation I and II
ROS	Recreation Opportunity Spectrum
RSPB	Royal Society for the Protection of Birds
SCU	Scottish Crofters Union
SLF	Scottish Landowners' Federation
SNH	Scottish Natural Heritage
SSSI	Site of Special Scientific Interest
SWCL	Scottish Wildlife and Countryside Link
WARS	Wilderness Attribute Rating System
WPS	Wilderness Purism Scale

Chapter 1

Introduction

The concept of wilderness is a product of the relationship between people and their environment and is a cultural construct of a perceptual nature. As a result of its perceptual character, the term conjures up an image that is both individualistic and subjective in nature. Present day expression of the wilderness concept varies between countries, from statutory protection of designated areas to debate about its relevance in the late 20th century. The concept is generally applied to areas that could be labelled as pristine, for example much of Antarctica. In contrast, the concept of wild land is distinguished from that of wilderness, and refers to wilderness in cultural landscape contexts.

Within the context of Scotland as a whole, both 'wild land' and 'wilderness' are words frequently used to describe many parts of the country. Indeed these are key selling points used in many of the tourist brochures encouraging people to visit the country. These strategies obviously tap into a common need to experience such landscapes, as shown in a recent survey of visitors from mainland Europe: the 'remote and wild countryside' was the third most important reason for visiting Scotland after 'mountain scenery' and 'coastline and islands' (Macpherson Research, 1996). Similar results from earlier studies of visitors to the River Spey area, indicated that the wildness of the area was one of the most attractive and enjoyable elements of their visit (Watson, 1988). Further evidence of the general publics' use of the wild land concept was presented in a survey of public attitudes to moorland in which people described it as, amongst other things, 'wild' and 'wilderness' (Mackay, 1995). The notion of wild Scotland is also presented in publications such as the book *Highland Wilderness* (Prior & Linklater, 1993) and in television programmes such as *Wilderness Walks*, (BBC1, 1998) presented by Cameron McNeish, both featuring images of the uplands and mountains of Scotland.

Despite the way in which much of Scotland is marketed, either as Europe's last great wilderness, or the wild and beautiful land of the north, it is without a doubt a cultural landscape. People continue to be a part of the landscape and have been a major force in its change since the end of the last ice age approximately 10,000 years ago. As in other areas of Europe, this unique area is continually undergoing change. In some areas of Scotland some developments such as the spread of conifer plantations in the Flow Country have had a deleterious effect on landscape quality and are not regarded as a sustainable land use (Hanley & Craig, 1991). In contrast, there are examples of more sustainable land uses such as the restoration of dry-stone dykes and the conservation management of semi-natural habitats in the Breadalbane Environmentally Sensitive Area (ESA) (Robinson, 1994).

The concept of wilderness has been used to good effect in other parts of the world for the management of areas primarily for conservation and recreation as in the USA, and in some cases to foster a sustainable development approach to the use of natural resources as in Zimbabwe. At the international level, calls have been repeatedly made to reinforce the definition of wilderness in terms of measurable objective criteria in order to enhance its conservation status (Eidsvik, 1988; Eidsvik, 1995); the same applies to wild land. The main issue for Scotland, which is clearly regarded as wild by many people, is how can the concept of wild land be applied to cultural landscapes? The thesis of this study is that wild land can be defined in a more objective manner than has previously been the case in this country, and that it can be given spatial expression to make it part of a sustainable conservation ethic for Scotland. The working definition of wild land is perceptual in nature and is heavily based on the influence of surrounding landscape features many of which are cultural in origin.

Many countries have defined wilderness in their own terms and for their own purposes, but all definitions have the common underlying aim to protect land by allowing processes of natural change to continue unhindered by the intervention of humankind where possible. Concern for the protection of wild land in Scotland was expressed in *The Mountain Areas of Scotland* report (Countryside Commission for Scotland, 1991) that recommended that the extent of such land should be evaluated. This report also suggested that a new National Planning Guideline should promote the incorporation of wild land values into planning and conservation policies. In light of these observations it is clear that there is a need to define the current concept of wild land in Scotland and to use this information to enhance current land management practices. In essence there is a need for a more objective definition of Scottish 'wild land' that could be used by all in discussing the future land use policy of such areas.

There are many ways of defining the concepts of wilderness and wild land, however one approach that has received little attention in Scotland is the perception of the landscape by those who live near and those who visit such areas. Recent research has established that the meanings of the concept of wilderness both within North American culture and across ethnic, cultural and national boundaries remain poorly understood (Watson & Williams, 1995). The same can be said for Scotland and this project is concerned with identifying the relationship between the perception of wild land and the different groups of people who interact with extensively managed Scottish landscapes. A perceptual approach allows the individual to decide what is and is not wild. With reference to disputes between Highland communities and conservationists, for example the Lingerbay super quarry proposal (Mackenzie, 1998), it is likely that their perceptions of wild land and also those of recreational visitors are different. Involving the local communities within areas subject to landscape designations in policy planning and studying their perceptions of the area and its management was suggested as a way forward in a study of tranquil areas in the English and Welsh National Parks (Caffyn & Prosser, 1998). In a perceptually based study, it is important to take into account the views of all the parties concerned in order to obtain a broad cross section of opinion.

Increasingly there is a move to integrate the physical or tangible elements of the land with a consideration for the more intangible components when planning the future land uses of the Scottish Highlands. Intangibles such as the value of wild land, solitude and landscape aesthetics are becoming important factors that need to be taken into account by land managers. There is an increasing interest in the actions of land managers by people who value the landscape in which they work. The application of tools such as a geographical information system (GIS) and image processing techniques to the study of these landscape elements is allowing research to be undertaken at an unprecedented level of detail and speed for example the remoteness mapping work of Fritz and Carver (1998). Justification for the use of intangibles such as aesthetic preference in land use decisions comes from the premise that the visual impacts of development are usually the most immediate and direct of any caused by a new project.

The methodological approach used to assess the character and spatial expression of perceived wild land is multidisciplinary out of necessity. The techniques used, from the fields of landscape perception and management research are brought together for the purposes of improving understanding of the wild land concept in Scotland. This study will add to the work of Aitken (1977) on wilderness areas in Scotland, who suggested that research be undertaken into the views of other subject groups, apart from recreational visitors, such as land managers in upland areas. In addition, calls were made for a perceptual mapping survey to bring the knowledge of peoples perceptions of such areas up to date both in 1977 (Aitken, 1977) and again in 1995 (Aitken *et al.*, 1995). Similar suggestions were made in the USA in order to increase understanding of the variations in perceptions and influences on the variability (Stankey & Lucas, 1984). Some of these suggestions have helped to shape the nature of the current study. The next chapter develops the objectives and hypotheses of the thesis by reviewing the concepts of wilderness and wild land focusing on their adaptability for use in Scotland.

Chapter 2

The Concept Of Wild Land And Wilderness

2.1 Introduction

This chapter presents an analysis and review of the literature covering the background to the concept of wild land. An examination of how the wild land concept originated from the wilderness idea is presented, as are the changes that have taken place over the last century in the reasoning behind the decision to set aside some areas of a country's terrestrial, and more recently, marine environment with a certain degree of protection. The reasons for protecting some wilderness areas in terms of the benefits with which they are associated, and the values people attach to them are presented. How these values have been addressed by governments worldwide in the form of designated wilderness areas is then reviewed. The chapter looks at contributions in defining the concept of wild land and evaluates these definitions in terms of their applicability to Scotland and details any theoretical or empirical weaknesses that exist in the literature. The problems associated with the spatial expression of differences in wild land perception between diverse groups of people are also discussed. The need to define 'wild land' is developed in terms relating specifically to the Scottish landscape which acknowledges the long history of human interaction with the land.

2.2 Wild Land Or Wilderness?

The terminology of wild land in the Scottish context is important. There is no wilderness in Scotland, if the word is understood to describe an area untouched by humankind in a pristine natural state. However this is a somewhat simplistic interpretation of the word 'wilderness' although it will suffice for the purposes of the line of argument of the thesis. To the people who live in the Highlands of Scotland the landscape represents an emptied land (Aitken *et al.*, 1995), but one that is perceived more often than not by the urban dweller as an empty wilderness. The degree of human influence on the Scottish landscape has left little untouched, and yet in many places there still exists a sense of wildness. It is these areas that are referred to as 'wild land', an idea which owes its origins to the concept of wilderness.

Fenton (1996) has classified North American wilderness as 'primary wilderness':

"an area with the full range of its indigenous flora and fauna, large in area and possessing no people or artefacts". (p. 17).

The next level of classification, which is applicable to some areas of Scotland, refers to 'secondary wilderness':

"an area of semi-natural vegetation where wild animals predominate over domestic stock, medium to large in area and possessing few people or artefacts" (Fenton, 1996, p. 17).

Although Fenton's definition is applicable to Scotland, any label containing the word 'wilderness' implies 'natural' or 'pristine', and as already mentioned is not applicable to Scotland. As an alternative, the term 'wild land' can be used in place of 'secondary wilderness' as suggested by Aitken *et al.* (1995) and this practice is followed here. The word 'wilderness' is used in the case where referenced work explicitly uses this term, as is predominantly the case in work from the USA, Canada, Australia and New Zealand, all containing areas of primary wilderness. When the narrative refers to the Scottish context, the term 'wild land' will be used.

2.3 Historical Development Of The Concept

Several reviews of the historical development of the wilderness concept have been written (Aitken, 1977; Stankey, 1989; Oelschlaeger, 1991; Short, 1991), but the majority of them refer back to the first major work on this topic by Nash (1967), *Wilderness and the American Mind.* A broad summary of the historical development of the concept of wilderness worldwide is presented here.

Within hunting and gathering societies there is no concept of wilderness (Short, 1991), and this has been reaffirmed time and time again by present day scholars in North America (Lyons, 1988) and Australia (Franks, 1995). The origins of the wilderness concept lie in the first agricultural revolution about 10,000 years ago (Short, 1991). This period was the start of the domination of nature by humankind and the psychological separation of civilised and settled land from the rest of the landscape. Wilderness was a place to fear before the 18th century when it began to be a place to revere (Nash, 1967). From early accounts until the eighteenth century, the land beyond the village was viewed in a negative sense and feared, as the place of superstitious creatures (Aitken, 1977). In the later part of this period, ideas were also influenced by the Bible: this contains many references to wilderness and the human domination of nature, that are mainly negative and that greatly influenced Judaeo-Christian thought on the relationship between man and nature (Aitken, 1977). These views remained dominant in western Europe well into the 18th century when the only places left undeveloped were mountain areas. Around that time, from the Romantic Revolution beginning in 1761 with Jean-Jaques Rousseau (Aitken, 1977), the mountains of Scotland went through an increase in their appeal. Previously feared, mainly because of the lawless character of their inhabitants' raids on the lowlands (Trevelyan, 1960), they became places of beauty. As a result of these influences, the aesthetic view of nature has changed through time from one of disgust to admiration (Short, 1991; Schama, 1995).

The Romantic movement can be seen as the starting point that began to change how undeveloped land in Scotland was valued. Authors such as Sir Walter Scott and James MacPherson (Aitken, 1977) provided an image of the Scottish landscape that left behind past fears associated with the Highlands and instead made it a place to visit for the sake of the spectacular scenery. Their writings enabled people to appreciate the Highlands of Scotland from their homes, but also encouraged what Aitken (1977) termed 'Romantic Action' leading to the development of tourism in the Highlands and the early mountaineering clubs in Scotland (Aitken, 1977). The change in how the land was viewed by the educated classes, occurred over a 50 year period beginning after the 1745 rebellion. The manner in which the land was perceived shifted from a totally utilitarian view of the Highlands, to a more aesthetic and even intrinsic viewpoint (Smout, 1993). Along with this change in perception of the Highlands came a wish to preserve areas for the enjoyment of visitors and for the protection of the wildlife they contained.

Callicott (1991) discusses the development of the wilderness idea in the history of American conservation philosophy, beginning with thinkers including Ralph Waldo Emerson and Henry David Thoreau before detailing the preservation effort lead by John Muir. The Scottish born John Muir did much to further the cause of wilderness preservation in the USA. Muir had a deeply held conviction that natural objects were 'the terrestrial manifestations of God' and was seen to invent modern environmental lobbying (Hunter, 1995). At the same time as John Muir was advocating wilderness preservation, Gifford Pinchot was calling for the wise use of America's natural resources under the banner 'the greatest good of the greatest number for the longest time' (Callicott, 1991). The debate between these two opinions on appropriate uses of wilderness still continues today (Grumbine, 1994; Wildes, 1995).

The modern concept of wilderness continued to develop in the United States with the writings of Aldo Leopold and Bob Marshall, both foresters, and interested citizens such as Howard Zahniser (Stankey, 1993). Definitions of wilderness initially based on recreational needs such as "*a continuous stretch of country preserved in its natural state, open to lawful hunting and fishing, big enough to absorb a two weeks' pack trip*" (Leopold, 1921, p. 719), gradually developed with the popularisation of the concept, into something less utilitarian and more intrinsic by the time the 1964 Wilderness Act was signed. Indeed, Leopold's own definition of wilderness changed to a base-datum of normality for a science of land health (Leopold, 1949). However, some authors continued to define wilderness in recreational terms. Hardin (1974) suggested that wilderness should only be accessible to those who can walk many miles, carrying all their provisions with them.

The 1964 US Wilderness Act provided the first statutory definition of wilderness and is applicable to all federal lands, e.g. those owned by the National Park Service, the Forest Service and the Bureau of Land Management. The Act recognises that wilderness can provide a range of public values and benefits including conservation, education and recreation. The Act does not demand that the area be in a pristine state, but instead stresses the overall appearance of the area (Stankey, 1993). Providing the first statutory definition of wilderness, the US Wilderness Act has been used as a model by many other countries, e.g. Australia.

2.4 The Interaction Of People And Nature

Today there is a plethora of ideas on what the concept of wilderness may cover. These alternative viewpoints stem from the variety of philosophical positions held by their originators which, in Western and more specifically American thought, range from an anthropocentric utilitarian approach, known as resourcism, to an ecocentric intrinsic valuation of the world by deep ecologists (Oelschlaeger, 1991). Emphasis must be placed on 'Western thought' as there are other viewpoints from different cultures. This is because wilderness is essentially an eurocentric concept that is not accepted by all cultures, and which is seen by some to violate fundamental territorial and cultural rights and aspirations of indigenous peoples (Magga, 1995). However, western thought is a major factor in the industrialisation of much of the undeveloped world, and hence with development comes the underlying paradigm of resourcism. Resourcism regards nature as a means to human ends, in which humankind is seen to be apart from the natural world

(Oelschlaeger, 1991). It is the combination of these factors that brings Oelschlaeger to state that "*resourcism rules the modern world*" (Oelschlaeger, 1991, p. 316).

There is a range of other ideas regarding humankind's relationship with the natural world which are all part of Modernism (defined by Oelschlaeger (1991) as a historical movement that begins with the Renaissance and extends to the present in which a worthless wilderness is transformed into industrialised, democratic civilisation). Oelschlaeger considers the advantages and disadvantages of preservationism, ecocentrism, deep ecology and ecofeminism, concluding that all, along with resourcism, are points on a theoretical spectrum that is fundamentally based in western culture (mechanistic materialism). In order to get away from the constraint of Modernism in defining the idea of wilderness, he suggests a post-modern view that should be understood in terms of cosmic synergism. In current environmental thinking Oelschlaeger (1991) states that there is a philosophical transformation underway from Modernism to Post-modernism. It is apparent that contemporary environmentalism regards wilderness areas as the epitome of the biocentric ethos (McCloskey, 1990), setting areas aside for their intrinsic value while excluding the harmful attentions of human beings.

However to consider the activities of human beings as 'unnatural' is to perpetuate the classical man-nature dichotomy (Callicott, 1990). Change is fundamental to nature and changes caused by human beings are as 'natural' as any other: the issue is one of deciding if one type of change is as good as any other (Callicott, 1990). To this end Callicott (1990) suggests the use of Aldo Leopold's concept of ecosystem health. As good health is a universally valued condition then it follows that people would prefer to live as an integral part of a healthy biota rather than a sick one (Callicott, 1990). The notion of humans and nature being inextricably linked and that each has helped to shape the other was developed by Budiansky (1995). His views on the way forward take a more anthropocentric line than the ideas of Leopold and Callicott. Budiansky (1995) writes:

> *"From the beginning to the end the goals we must seek in nature are human goals, goals that reflect an imperfect mix of morality and commerce, aesthetics and need, stewardship and politics. We might as well admit it and get on with the job. Having renounced the irresponsibility of living a pipe dream, we cannot duck the responsibility that comes with embracing reality. Part of facing up to the realities and complexity of nature is admitting that any approach we take will be incomplete, imperfect, provisional, experimental - a compromise based on many*

competing objectives and a good deal of uncertainty about the result. The important thing is to try." (p. 249).

A 'hands off' approach to environmental conservation does not work and is not how nature works (Budiansky, 1995). This is especially apparent in Scotland following many years of 'hands on' involvement with the landscape. Budiansky (1995) argues for reinventing the wild through ecological restoration.

The view that pre-European Australia and the Americas were untamed wilderness, untouched by human beings, was one of the building blocks on which the wilderness concept was built (Nash, 1967). However, much evidence has been presented that clearly shows Australia and the Americas to have contained vast areas of land influenced in some way by human beings prior to European contact (Gamble, 1986; Callicott, 1990; Budiansky, 1995; Franks, 1995). This points to a major flaw in the wilderness concept as expressed today in the form of statutory designated wilderness areas in some countries, for example the USA. In the strict sense of the word, such areas are not true wilderness, as people have influenced their development in some way. For example, following designation of Yellowstone National Park in 1872, the army was called in to remove Crow, Blackfeet and Shoshone Indians from within the boundaries of the newly created park (Hunter, 1995). In this case people were removed to create a wilderness in which evidence of their influence would continue to exist. However, when these areas are viewed today in terms of a continuum of the degree of human influence in the landscape, with the city centre at one end, they are placed at the opposite end and are described as wilderness.

Using the range of views that Oelschlaeger (1991) describes, a common factor among the contrasting philosophical arguments for the existence of wilderness emerges: wilderness is valued. The nature of the value attached to wilderness is based on the underlying philosophy and so varies as much as the philosophical arguments. This means that the reasons for preserving an area of wilderness range from an anthropocentric utilitarian viewpoint, to an ecocentric intrinsic valuation of the resource (McCloskey, 1990). Which of these values need to be considered in arriving at a definition of wild land is up to the decision makers of the day. From the scientific point of view, some values are more easily quantified than others, for example the utilitarian value of the functioning of an uncontaminated river catchment can be defined in terms of the watershed boundary, and an area designated as a wild land area to protect its integrity.

However attaching a quantifiable measure to the ecocentric value of the rights of nature would be much more difficult and subjective.

2.5 The Values And Benefits Associated With Wild Land

Driver *et al.* (1987) review the benefits of wilderness and develop a taxonomy of benefits. This is reproduced in Table 1.

Table 1 Taxonomy of wilderness benefits (After Driver *et al.*, 1987).

I. Personal benefits (accruing primarily to individuals and might or might not benefit society at large) See: Kaplan & Talbot (1983), Knopf (1987), Hendee & Pitstick (1995). A. Developmental (desired changes in self-concepts and skills) 1. Self-concept 2. Self-actualization 3. Skill development B. Therapeutic/healing 1. Clinical 2. Nonclinical (stress mediation/coping) C. Physical health D. Self sufficiency E. Social identity (development / maintenance of desired social relations with family and others) F. Educational G. Spiritual H. Esthetic / creativity I. Symbolic (benefits from options to realize that actions are being taken in support of preservation-related beliefs) 1. Resource stewardship 2. Anit-anthropocentricism / moralistic 3. Option demands 4. Other J. Other personal wilderness recreation-related benefits K. Commodity-related (benefits to individuals from goods produced from wilderness such as those related to water and to grazing by domestic animals) L. Nuturance
II. Social benefits (accruing across individuals to society collectively or to large segments of society) A. Aggregate personal benefits B. Spin-off benefits C. Historical cultural benefits D. Preservation-related benefits 1. Representative ecosystems 2. Species diversity 3. Air visibility 4. Unique landforms, including areas of outstanding scenic beauty 5. Historic sites 6. Educational values 7. Scientific laboratory 8. Stewardship (options for future generations) E. Quality of life F. Commodity uses (water, minerals, grazing etc.) G. Economic benefits 1. National economic development 2. Local / regional economic development
III. Inherent / intrinsic (benefits to non-human organisms)

This list of reasons for valuing wilderness areas has developed a great deal from the original notion in the USA that these should be purely recreation areas (McCloskey & Spalding, 1989).

Of the benefits listed above, six were considered to represent the core of wilderness philosophy (Driver *et al.*, 1987):

1. Preservation of representative national ecosystems,
2. Spiritual values,
3. Aesthetic values,
4. Inherent / intrinsic values,
5. Historical and current cultural values,
6. Specific types of recreation that depend on wilderness settings.

The authors suggested that any attempt to conserve wilderness areas should be based around these central values, a view echoed by Rolston III (1985), Henning (1987), Nash (1988), McCloskey (1990), Noss (1991) and Prokosch (1995). Hardin (1988) also defends wilderness in terms of point 5, using the concept of cultural carrying capacity, which includes values on the standard of living and on the 'quality of life'. The values on which a defence of wild areas cannot be based are those of scenery, recreation and economics (Nash, 1988). Scenic beauty is very much in the eye of the beholder, recreation by itself is not wilderness dependent and the value of wilderness recreation requires further research. As for economics, wilderness should be measured using a different measure of value other than money, perhaps like the way in which the Parthenon or St. Paul's Cathedral is valued (Nash, 1988).

Attempts at valuing wilderness by economists have been made using the contingent valuation method e.g. Pope III & Jones (1990). These studies have been criticised by Rolston III (1985) for over simplifying the complexities of the real world. This technique has also been applied to Scotland, more specifically, to the Mar Lodge Estate in the Cairngorms, (Cobbing & Slee, 1993) and the Flow Country (Hanley & Craig, 1991). A recent development applied to Environmentally Sensitive Areas in Scotland has been the use of choice experiments, the outcomes of which were compared to the contingent valuation method and were found to be better at valuing individual landscape and wildlife characteristics (Hanley *et al.*, 1998).

Some or all of the benefits of wild land in Table 1 are highly valued in the USA, and this is reflected in the degree of support that wilderness areas receive. In a US national survey the presence of wilderness in a county was an important reason why 53 % of the people moved to or lived in the area and 81 % thought that wilderness areas were important to their counties (Rudzitis & Johansen, 1991). Despite this general level of support for the concept, research shows that in the USA use of wilderness is dominated by the semiautonomous class (highly educated professional-technical and craft employees who have limited control over what work they do, but a great deal of control over how they do it) (Walker & Kiecolt, 1995). These findings give further support to the idea that some of the people who endorse the concept of wilderness are just happy to know that it exists without ever needing to experience it first hand (Rothenberg, 1995).

2.6 Wilderness And Culture - A Contrast Of Ideas

An international definition of wilderness does not and, more importantly, cannot exist. The closest to a universal definition is provided by the International Union for Conservation of Nature and Natural Resources (IUCN) which has published a classification of natural areas, one of which is wilderness. Their definition attempts to include the wide range of cultural and historical differences encountered around the world and defines wilderness as an enduring natural area, legislatively protected, and of sufficient size to protect the pristine natural elements that may serve physical and spiritual well-being. It should be an area where little or no persistent evidence of human intrusion is permitted, allowing evolution of natural processes (Eidsvik, 1990). This definition is very broad in scope and can be interpreted in many ways and tailored to a particular need.

At a conference to celebrate a quarter century of the US Wilderness Act in 1989, McCool and Lucas (1990) suggested that the definition of the "wilderness resource" was difficult, but that a workable definition was necessary to address adequately the countless problems faced by the managers of wilderness areas. If this is still the case in the USA with 30 years of applied wilderness research under its belt, then the problem of finding a workable definition is obviously a complicated one.

2.6.1 Developed Nations And Definitions

An early definition of wilderness was given by Darling (1960), where wilderness was:

> *"a country carrying its natural vegetation and the associated fauna, unaffected by the activities of man beyond his hunting-food gathering stage of development."* (p. 96).

The first statutory definition of wilderness was provided by the 1964 US Wilderness Act. Merrian &Ammons (1968), quoting directly from the Wilderness Act, write that wilderness is legally defined as:

> *"an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions, and which generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable..."* (p. 390).

Another section of the 1964 Act is quoted by Grumbine (1994) and provides further clarification of the term 'wilderness':

> *"a wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain."* (p. 228).

Additions to the National Wilderness Preservation System have been made periodically since 1964, and there is increasing debate on how the above definition can be interpreted in terms of the criteria used to select new wilderness areas. The US Forest Service carried out RARE I and II (Roadless Area Review and Evaluation) which used the WARS (Wilderness Attribute Rating System) to select suitable areas for designation (Osborne, 1980). The WARS used four categories which were natural integrity, apparent naturalness, opportunity for solitude and opportunity for primitive recreation. However the method used to assess areas was relatively subjective, relying solely on the opinions of local foresters (Osborne, 1980). Wilderness defined from a scientific point of view in the USA has included such parameters as size and shape of the area, the naturalness, diversity and representativeness of the communities, the uses permitted in the area and the long term security of the area (Stankey, 1987). Ecological criteria are not specifically measured at present but are increasingly put forward as important factors in wilderness designation decisions (Petersen & Harmon, 1993; Merrill *et al.*, 1995) in order to protect biological diversity (Davidson *et al.*, 1996).

In Australia, the Wilderness Society uses the following definition of a wilderness area:

> *"A wilderness area is a large tract of land remote at its core from access and settlement, substantially unmodified by modern technological society or capable of being restored to that state, and of sufficient size to make practical the long-term protection of its natural systems."* (Fuller *et al.*, 1990, p. 84).

This definition stems in part from the wilderness continuum concept in which areas with differing relative amounts of pristine landscape and human influence form a continuum of wildness (Lesslie *et al.*, 1988). The theory says that there will be a continuum of wild land quality or wildness from settled land to undeveloped land as shown in Figure 1. This method has been applied in the UK to map the wilderness continuum at the national and local scale (Carver, 1996; Fritz & Carver, 1998).

<table>
<tr><td>SETTLED LAND</td><td colspan="3">UNDEVELOPED LAND
INCREASED
REMOTENESS
AND
PRIMITIVENESS
→</td></tr>
<tr><td rowspan="2">NO WILDERNESS QUALITY</td><td colspan="3">WILDERNESS QUALITY</td></tr>
<tr><td>LOW</td><td>MEDIUM</td><td>HIGH</td></tr>
</table>

Figure 1 The wilderness continuum concept (After Lesslie & Taylor, (1985)).

2.6.2 Developing Nations And Ideas

The concept of wilderness in its current form (the western modernist view as described above) is not totally prevalent throughout the world, although many countries are beginning to adapt the concept to suit their own needs. Neither is it without its critics, with some authors arguing for an approach to conservation of wild areas more closely allied to the concept of sustainable development (Guha, 1989; Gómez-Pompa & Kaus, 1992; Cubit, 1994; Grumbine, 1994; Pretty & Pimbert, 1995). Criticisms by Guha (1989) of the wilderness concept as put forward by deep ecologists, are based on the issues that deep ecologists appear to neglect. Guha (1989) emphasises the lack of attention which deep ecologists give to over consumption by industrialised countries, this being the major source of the inequitable distribution of resources and the root of environmental problems worldwide. In many developing countries environmental debate centres on who benefits from natural resources, with local groups attempting to regain some of their former control over their rural surroundings to which they are increasingly denied access (Guha, 1989). In many ways the views of Guha (1989) on the Indian sub-continent, and Prokosch (1995) in the arctic, are similar to those of Hunter (1995) with respect to the Scottish Highlands. Hunter (1995) is very much concerned with access to natural resources by the local people, who have a vested interest in the ecological health of the land that often provides their livelihood.

The sustainable development idea is gaining more support, even in the USA, the home of the wilderness concept. The bringing together of preservationist and utilitarian views into the concept of sustainable development is seen by some as the way forward (Wildes, 1995). Callicott (1991) argues for the removal of sheep and cattle from publicly owned rangelands, some of which are adjacent to designated wilderness areas. Instead Callicott (1991) argues for developing an economy based on the hunting of native game animals, which can exist in substantial numbers based on Pre-Columbian descriptions of massive herds of bison and antelope seen on the prairies. This idea could be transferred to Scotland with the removal of sheep in favour of red and roe deer hunting.

Having wild land areas that can also provide a livelihood follows the principles of the biosphere reserve concept which constitute the basis for a conservation system that is both ecologically and socially sustainable (Cubit, 1994). Studies show the management of such areas require the continual involvement of the local population if they are to work (Dasmann, 1988; Cubit, 1994; Pretty & Pimbert, 1995). In an arctic context, the Inuit live in what many westerners think of as wilderness, but which to them is home, a living wilderness full of people. Their economy is similar to Callicott's (1991) model for the USA. The Inuit are interested in sustainable security rather than development (Kaltenborn, 1993).

When the wilderness concept is transferred from the USA to other countries, the involvement of indigenous peoples in the planning and management of new wilderness areas has been shown to be the most important factor for the success of such projects. Designation of some protected areas in the past has been the direct cause of the displacement of local communities and increases in social conflicts, threatening the conservation goals of those areas the designation was put in place to protect (Pretty & Pimbert, 1995). The acceptance of the importance of the views of local people has taken rather a long time. It has only been relatively recently that planners have realised that the views of aboriginal people on wilderness and the effective use of land and wildlife in parks is different to their own (Peepre, 1992; Pretty & Pimbert, 1995). Examples of successful designations involving local people in the management of parks include work with the Inuit on Baffin island in the creation of a Biosphere Reserve in which protection of the population of bowhead whales will allow sustainable harvesting to recommence at sometime in the future (Nickels *et al.*, 1992). Another example is the inclusion of

Inuvialuit, Selkirk First Nation, and Ta'an Kwach'an peoples in the management of protected areas in the Yukon (Peepre, 1992).

The call to respect the practices of indigenous peoples who through ceremonies and songs, follow the ancient laws of nature has come from native North Americans (Lyons, 1988). In the language of the Onondaga Nation there is no word for 'wild', the nearest being 'free' (Lyons, 1988). Lyons (1988) emphasises that they do not perceive their landscape as wild, but as a place of peace and security. For indigenous peoples of the Arctic the concept of wilderness also does not exist, although they do have a concept of wildness in terms of the functioning of nature without obvious human intervention or disturbance (Roots, 1995). It is in this context that the term 'wild culture' has gained support, to describe a place where humanity and nature are not opposed to each other (Rothenberg, 1995).

It is clear that other cultures have their own conservation traditions and beliefs which are quite distinct from those of western culture (Gómez-Pompa & Kaus, 1992). A further example comes from the Masai people of East Africa who do not define wilderness as they do not have a word to describe their home as something distinctive (Stankey, 1993). The same is true for Denmark, although Stankey gives another reason for this, mainly that there has been an absence of undeveloped or wild land for so long that there has ceased to be a word to describe such areas. Similarly, Spain and Jamaica have no word for 'wilderness' or hold no concept of it (Eidsvik, 1987). This fact has repercussions throughout much of Central and Southern America, where Spanish is the predominant language in areas which people in the developed world would almost certainly class as wilderness. Stankey (1993) also makes the point that where two cultures meet, as in the case of European colonisation of land occupied by Native American people, one nations wilderness is another nations home. The same can be said for the indigenous groups who make their home in tropical forests, to them an urban setting may well be viewed as a wilderness (Gómez-Pompa & Kaus, 1992).

In Australia there is a dichotomy in thought that has existed since European colonisation began in 1788. Here the land that European settlers called an untouched wilderness holds a much greater significance for the aboriginal peoples. The Ngarinman people of the Northern Territory call the same land 'quiet country', meaning tame, domesticated, not dangerous, and under control (Franks, 1995). The aboriginal peoples may not actually have a concept of wilderness, but they do have a strong and special relationship with their landscape.

The Finnish concept of wilderness appears to be one which could be applied to Scotland. In the Sami culture, wilderness has two meanings 1. 'a source of livelihood' and 2. 'home'. The 1991 Act on Wilderness Reserves provides for the multiple use of wilderness areas, helping to protect the Sami way of life (Pietikäinen, 1995).

Further evidence to support the hypothesis that culture has a large part to play in how wilderness is perceived was shown in a comparison between the use and users of wilderness areas in Australia and the United States (Stankey, 1986) both of whom are of predominantly European descent. This study revealed that there were some similarities in the users and the specific activities undertaken in each area, but also that there were striking differences in the perception of the wilderness conditions. Each group was influenced by cultural ideas of how wilderness should be used and managed, and what it represented to them. It is generally agreed that people mean many different things when they speak of wilderness (Rothenberg, 1995).

2.7 Wilderness Designation Worldwide

In many countries of the world, wilderness areas have been designated since the passing of the US Wilderness Act in 1964 (see Figure 2).

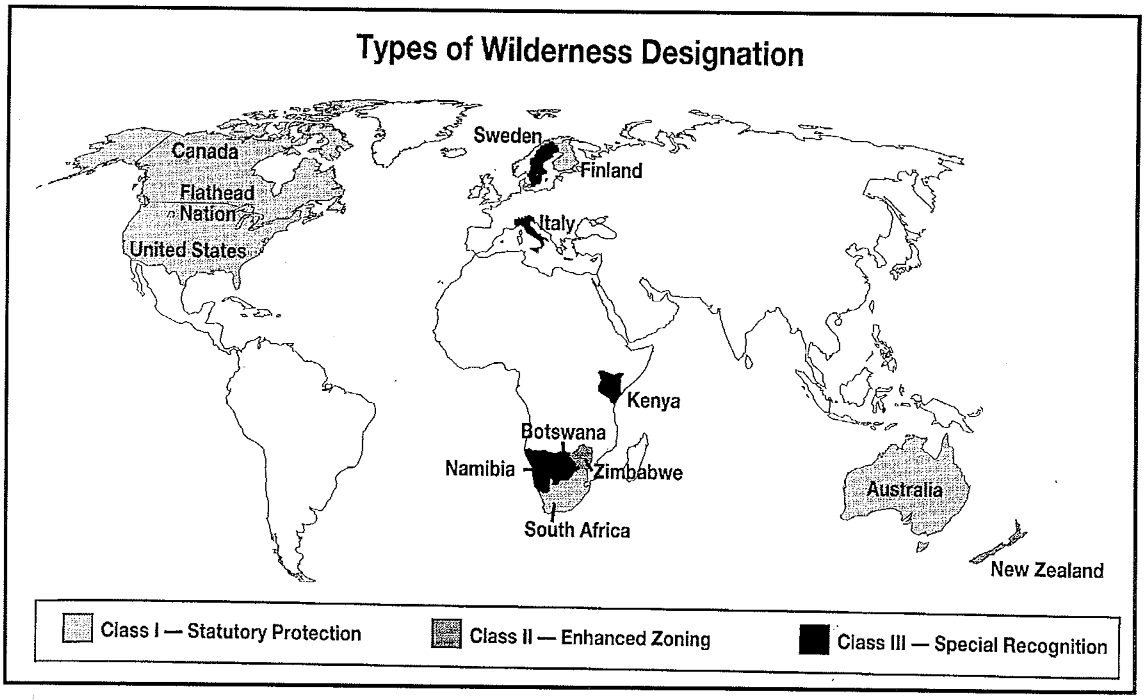


Figure 2 Types of wilderness designation throughout the world (After Martin (1995)).

Attempts have been made to quantify the area of wilderness worldwide (McCloskey & Spalding, 1989; Hannah *et al.*, 1994). The estimates vary from one third (Figure 3) (McCloskey & Spalding, 1989) to one half (Hannah *et al.*,1994). Most of the areas identified as wilderness are unprotected and lie in the Arctic or Antarctic (41 %) while another 20 % lies in temperate regions (McCloskey & Spalding, 1989).

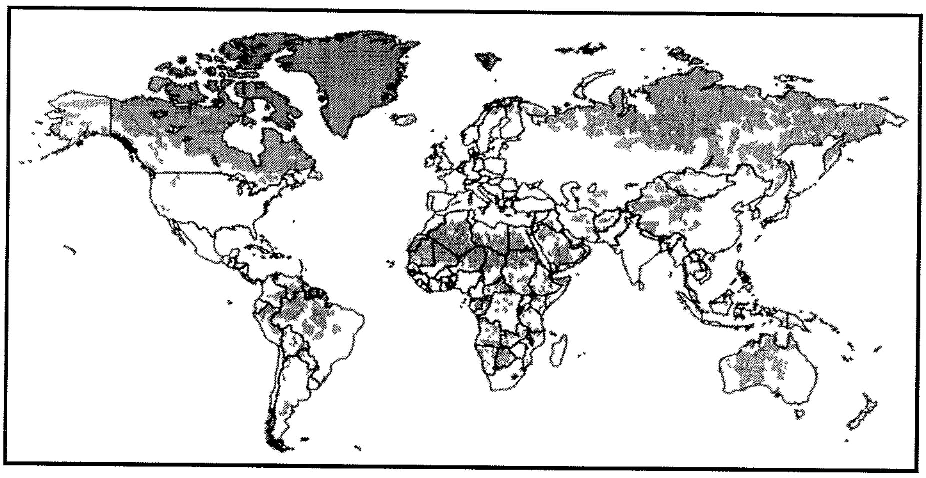


Figure 3 The distribution of wilderness areas as of August 1988, as defined by the Sierra Club, Washington D.C. (After McCloskey & Spalding, (1989)).

The USA has over 104 million acres in the National Wilderness Preservation System (National Park Service, 1994). This is all publicly owned land and therefore open to public access. It covers 4.5 % of the USA, an area equivalent to just under twice the size of the UK. Within the US there are over 300 recognised American Indian reservations all of which are sovereign nations (Martin, 1995). The Flathead Indian Reservation is home to the confederated Salish and Kootenai tribes who designated the Mission Mountains Tribal Wilderness Area in 1980, covering an area of 36,000 hectares (Martin, 1995).

Canada has 2.6% of its land mass protected in wilderness areas (McNamee, 1990) in 4 of the 10 provinces, each of which has its own wilderness legislation. Of these four no real definition of wilderness is attempted except in Ontario, but even here the Wilderness Areas act, passed in 1959, is almost useless because it can only prohibit industrial activities within areas of up to 640 acres. The percentage of a Province designated as wilderness varies, in British Columbia it is 6%. This is a Province that covers 235 million acres, 94% of which is public owned and which therefore has potential for increasing the amount of designated wilderness in the future (Vold & Scott, 1990).

The situation in Australia is similar to Canada in that some states have enacted legislation to protect wilderness areas, but others have not (Stankey, 1993). One that has protected wilderness is Victoria with the passing of the 1992 National Parks (Wilderness) Act that created 20 wilderness areas (Mercer, 1993), another is New South Wales which passed the 1988 Wilderness Act (Preece, 1990). New Zealand has 400,000 hectares of designated wilderness areas, a process that started in 1955 with the creation of the 12,000 hectare Otehake Wilderness in Arthur's Pass National Park (Molloy, 1997).

Whereas the majority of developed countries consider wilderness areas to be places where humans are only visitors, such areas in developing countries are home to people who are regarded as an integral part of a balanced equation of land use that has been worked out since Palaeolithic times. The presence of people is seen in the sense of sustainable development and the continuation of age old land use practices that have influenced the present landscape. Mavuradonna Wilderness Area in Zimbabwe was created in 1989 by Mzaribani District Council, a tribal authority, and is an example of such an area where the emphasis is on the sustainable development of the local economy (Martin, 1990). The area, covering 500 square kilometres of escarpment in the Zambezi Valley, has set a precedent for developing countries, and has attracted attention from two other tribal authorities, Plum Tree and Tjolotjo.

In South Africa where there is a stark contrast between the developed and developing worlds, the concept of wilderness has been incorporated into the interface between the two differing sets of environmental priorities (Martin, 1990). The first administratively declared wilderness areas were Umfolozi and Lake St. Lucia in 1958, and since then other areas have been designated by provincial, administrative and national legislation bringing the total protected area to over 1 million hectares (Martin, 1995). The KwaZulu Bureau of Natural Resources (KBNR) which is equally staffed by white and Zulu has taken over the management of these and other game reserves. As a consequence of the strong ties the Zulus have with their land, they continue to have access to controlled use of some of the resources within these areas, such as occasional hunting and fishing, and the collection of medicinal plants (Martin, 1990). This example shows the importance of the role played by cultural values in the implementation of a wilderness policy.

Finnish legislation passed in 1991 allows the designation of wilderness areas of which 12 have been created covering 1.5 million hectares (Tynys, 1995) in which hunting and fishing are allowed (Pietikäinen, 1995). In the absence of legal protection some countries have still designated wilderness areas on an administrative basis, these include Zimbabwe, as already mentioned, along with Sweden, Kenya (Stankey, 1993), Botswana, Namibia and Italy (Martin, 1995). The only international wilderness area is shared by the USA and Canada, and comprises the Quetico Wilderness in Ontario, and the adjacent Boundary Waters Canoe Area Wilderness in Minnesota (Stankey, 1993).

The extent of designated wilderness areas worldwide shows that the concept of wilderness protection continues to receive support from many cultures and the network of protected areas continues to expand. New definitions of wilderness are continually developing in line with local expectations, taking into account important cultural practices and uses of the land. There are some similarities between the various national and regional definitions: 1) the need for public support to preserve wilderness, and 2) the inclusion of people resulting from historical and traditional differences in land use, human settlement and resource practices (Stankey, 1993). The above discussion reveals the essentially meaningless and highly subjective nature of a global wilderness definition, and points more towards a national or even regional definition of wilderness as possessing more objective purpose.

2.7.1 Mapping Wild Land

In conjunction with the above procedures to designate wild land areas, there have been academic projects to map wild land according to a range of criteria which have been given spatial expression. The following section discusses the mapping of wild land areas from initial work using hard copy maps to the present use of geographical information systems (GIS), which is an ideal tool for this purpose. GIS is a tool that has been applied to the issue of wilderness mapping in Australia, New Zealand, the Barents region and the United States, by resource managers and research staff alike.

In the most important study to date in Scotland, Aitken (1977) identified areas he assessed as being most like wilderness. Aitken (1977) argued that the only objective method of defining wilderness in Scotland was to calculate the remoteness of an area. This he did based on the time it would take to reach a given point in an area on foot from the nearest public road. The results were recorded on hard copy maps.

Lesslie *et al.* (1988) and Lesslie (1990) developed a method that used four indicators to map the quality of wilderness in south-eastern Australia. The four indicators used in the calculation of the wilderness quality index were:

a) remoteness from settlement,
b) remoteness from access,
c) aesthetic naturalness,
d) biophysical naturalness.

Once the wilderness indicator database had been established, in which each grid point had a wilderness value, Lesslie (1990) suggested weighting each indicator on the basis of their perceived importance. However, the method for doing this was not described, and appears to have been just a suggestion. This type of approach would be useful if much of the necessary information for the indicator database had already been established, before a project to delineate wilderness areas was begun. Lesslie's (1990) method was subsequently applied in the Euro-Arctic Barents region in a project to map wilderness quality (Henry & Husby, 1995). The project was developed as a result of the International Convention on Biological Diversity signed in 1992, which, among other things, requests each signatory to identify areas of wilderness. The map output from this project could be used within the environmental decision making process in the region (Henry & Husby, 1995). However, Lesslie's use of a wilderness quality index has been criticised by Bradbury (1996) for the way in which it is calculated through the addition of ordinal parameters.

The wilderness continuum concept has been applied in Britain using factors similar to those applied in Australia with the added dimension of a multiple criteria evaluation (MCE) approach (Carver, 1996). The MCE approach allows individuals to attach their own importance weightings to the several factors that are used to evaluate the wild land quality of a particular area and hence the output maps can be tailored to the perceptions of the individual (Carver, 1996).

2.7.2 Permitted Uses Of Wilderness Areas

Appropriate uses of a wilderness area vary greatly between countries In general, self-sufficient activities such as walking and climbing are allowed. Some countries also allow fishing and hunting (e.g. Zimbabwe). Alberta, a province of Canada, prohibits these activities along with berry picking and the use of horses. Generally, more legislation is devoted to restricting certain activities and limiting the presence of artefacts within wilderness areas, such as roads, buildings, bridges, dams, resource extraction, development of any kind, vehicles or mechanised transport, and machinery (Stankey, 1993). Callicott (1991) suggests that hunting should be permitted as a means of helping to restore some of the original human influence on wild land that has been removed by the 'hands off' approach of contemporary wilderness management. This is something that could be applied to Scotland and, with the removal of some of the 9.5 million sheep in Scotland, 90 % of which are found in Less Favoured Areas (LFA) (Reid, A., Scottish Office, pers. comm., 1998), would also benefit the conservation of a range of other species. Suggestions have been made as to what should be permitted in Scottish wild land areas (Cousins, 1982), and these are very similar to guidelines in the US Wilderness Act.

2.8 Wild Land In Scotland

2.8.1 Views On The Scottish Landscape

To understand the views of Highlanders with respect to the landscape surrounding their homes, also requires an understanding of the processes that have helped to shape that land. Areas of Scotland have been occupied since 8500 BP as people moved into the area at the end of the last ice age (Wickham-Jones, 1990). The degree of human influence in the Scottish landscape in general is high. Informed opinion suggests that there is evidence for human impact in many straths, over a range of timescales. The once extensive woodland that established following the last glacial maximum (Birks, 1989), began to decline between 6500 and 5100 years B.P. as a result of clearance for agriculture, and other possible causes such as climate change and disease (Edwards, 1988; Rackham, 1988). Cultivation continued to expand in the lowlands, the sheltered glens of the uplands and along the coast (Aitken, 1977). In the Highlands a system of transhumance developed for cattle and sheep that formed the backbone of the old Highland economy (Aitken, 1977). Changes in the structure of the Highland social system which was based on kinship obligations and communal ties, to one based on commercial relations began during the 18th century after the battle of Culloden (Short, 1991). These changes led Short (1991) to argue that wilderness ceased to exist in the UK after the battle of Culloden. With the subsequent clearances of people from the Highlands beginning in the early 19th century to make way for more sheep, there were fewer people living in the Highlands in 1980 than in 1780 (Short, 1991). As a result of these changes, there would have been less direct human influence on the landscape over this period.

The new extensive sheep farming methods introduced after the 1745 rebellion have since had an effect on more or less all of upland Scotland, including the mountain tops, especially in the west where stocking densities have continued to increase since the 1940s (Sydes & Miller, 1988). In the Victorian period there was a growth in the number of sporting estates and a consequent increase in the red deer population which still continues (Sydes & Miller, 1988). The most pristine areas in Scotland today are most likely to occur on the Cairngorm plateau, where there is increasing pressure from various forms of recreation (Watson, 1990), and in the large tracts of ancient pine and birch forest, sections of the coast and some wetlands (Watson, 1984a). Elsewhere, only land above 700 - 800 m in the montane zone, and then not all of that, is considered to be in a truly 'natural' state (Balfour, 1984; Thompson & Brown, 1992).

An awareness of the land use history of Scotland and especially the Highlands, fosters and understanding of the Scottish landscape more in the terms of reference used by the local population. However, this has not always been the case and as Smout (1993) points out, there appear to be two main strands in current thought on the Scottish landscape. Firstly there is the traditional standpoint reflected in the views of those who live in the Highlands and who invariably do not see their surroundings as wild. This group of people tend to have a utilitarian outlook on the Highland resource, comprising three main groups: a) land as a resource for farming, forestry and fishing from which to make a living, b) land as a resource for hunting, shooting and sport fishing, and c) land as a resource for industry. Not all Highlanders would agree however: Hunter (1995) argues that the Highlands have *"played a singularly distinctive role in the development of environmental thinking"* (p. 14) and that green consciousness was prevalent in Scotland 1000 years before the rest of Europe (Hunter, 1995). The second standpoint is that of the post-Romantic (Smout, 1993), where the land is sometimes perceived as wild (*cf.* Aitken, 1977), and is valued a) for the purposes of recreation, b) as a place for spiritual refreshment, and c) as the result of a wish to preserve some areas for science and for the sake of the area itself. This second, post-Romantic philosophy includes a range of values associated with the land from the utilitarian to the intrinsic. These two conflicting standpoints, the traditional versus the post-Romantic, or the insider versus the outsider, have been entwined in any debate about the future of the Scottish Highlands over the last 25 years (Robertson, 1985; Mather, 1993; Smout, 1993). Articles in scientific magazines with titles such as the "Rape of Scotland's wilderness" (Caufield, 1985) provide many examples of large landowners ignoring the planning system for the creation of new hill roads, and planting conifers on SSSIs (Robertson, 1985). This conflict is the result of differing perceptions of urban and rural inhabitants as to why and how conservation should be practised (Mather, 1993).

However, the issue is not quite as clear cut, given that there are people willing to discuss and compromise. Calls to integrate better conservation and development in rural areas of the UK are often being made (Robertson, 1985; Mowle, 1987; Hunter, 1995) and Mather (1993) detected the start of a paradigm shift away from the 'scientific reserve' model towards a 'sustainable conservation' approach, a view echoed by Wightman (1994). A key early figure in this movement was Patrick Geddes who did much to stress the interaction between the environment, economic activity and community (Purves, 1997).

One author who has worked to bridge the gap between those who live in the Highlands and the conservation movement is James Hunter. He advocates 'a wilderness with people', in which community and culture are every bit as valued as landscape, scenery and wildlife (Hunter, 1984). He espouses the idea that the Highland landscape is not independent of the people who live there (Hunter, 1984). This is based on the notion of sustainable development and a rehabilitation of the land after many years of misuse. By looking more at the cultural and ecological history of the Highlands, it becomes clear that the Highlands today are more of a 'wasteland' or a 'wet desert', in the often quoted phrase by Frank Fraser Darling (1955), than a 'wilderness' as they were 2000 years ago (Hunter, 1984). Conservation based on post-Romantic ideas is beginning to occur taking the views of the local community into account. This is illustrated in the work of the John Muir Trust (JMT). As stated in their aims, the JMT:

> *"works closely with local communities. It believes that sustainable conservation can only be achieved by recognising special qualities of wild places and understanding the human factors and other aspects which contribute to the landscape we think of - and value - as wild."* (John Muir Trust, 1998).

In another collaborative effort between rural development and conservation interests, it was emphasised that there is no wilderness in Scotland and that almost every landscape in northern Scotland bears the mark of human influence (Scottish Crofters

Union and The Royal Society for the Protection of Birds , 1992). This partnership would have seemed very unlikely 20 years ago given the level of disagreement between such organisations on land use issues and conservation practices.

2.8.2 Growth Of The Wild Land Concept In Scotland

The idea of statutory designated wilderness areas such as those in the USA has influenced debate on wild land in Scotland (Aitken, 1977; Aitken *et al.*, 1995) and encouraged thinking about the characteristics of such areas, should a similar designation be introduced to Scotland. The result of these thoughts has been a uniquely Scottish version of the concept of wild land which has had to take into account the long and complex cultural and ecological history of the Highland landscape.

Early discussion on the presence of wilderness areas in Scotland regarded such areas to be remote, with little sign of human influence and closed to vehicular traffic (Study Group No. 9, 1965 in Huxley, 1974). Ecological wilderness was considered not to exist, and that:

> *"wilderness is where one feels oneself to be in a wild place, according to the sensibility of one's particular experience and knowledge on a global and local scale."* (Huxley, 1974, p. 371).

This is pointing towards the idea of perceptual wild land in Scotland rather than primary wilderness as defined by Fenton (1996). In an assessment of the scenic resources of Scotland, Linton (1968) identified 'wild landscapes' (Figure 4) as areas *"dominated by ground too steep or too rough for expenditure on improvement"* (p. 232). The areas were delineated with the aid of the Ordnance Survey Seventh Series one-inch maps, extensive knowledge of the ground and some field checks (Linton, 1968), and was a rather arbitrary method. These wild landscapes were regarded as highly valued and coincided with the areas of highest scenic resources.

In the past decade there appears to have been a growth of interest in the concept of wild land from the voluntary, statutory and academic communities. Aitken *et al.* (1995) point out that the wild land value of an area is often only appreciated by the public in the event of a major threat to that area, when people are spurred into defending it. The authors mention the proposal for ski development in Lurcher's Gully in the Cairngorms during 1981 and the sale of the Knoydart estate between 1983 and 1985, whose future remains uncertain with another sale pending (Hawkins, 1998). These two significant events brought an increased awareness of the wild land qualities of these two areas (Aitken *et al.*, 1995).

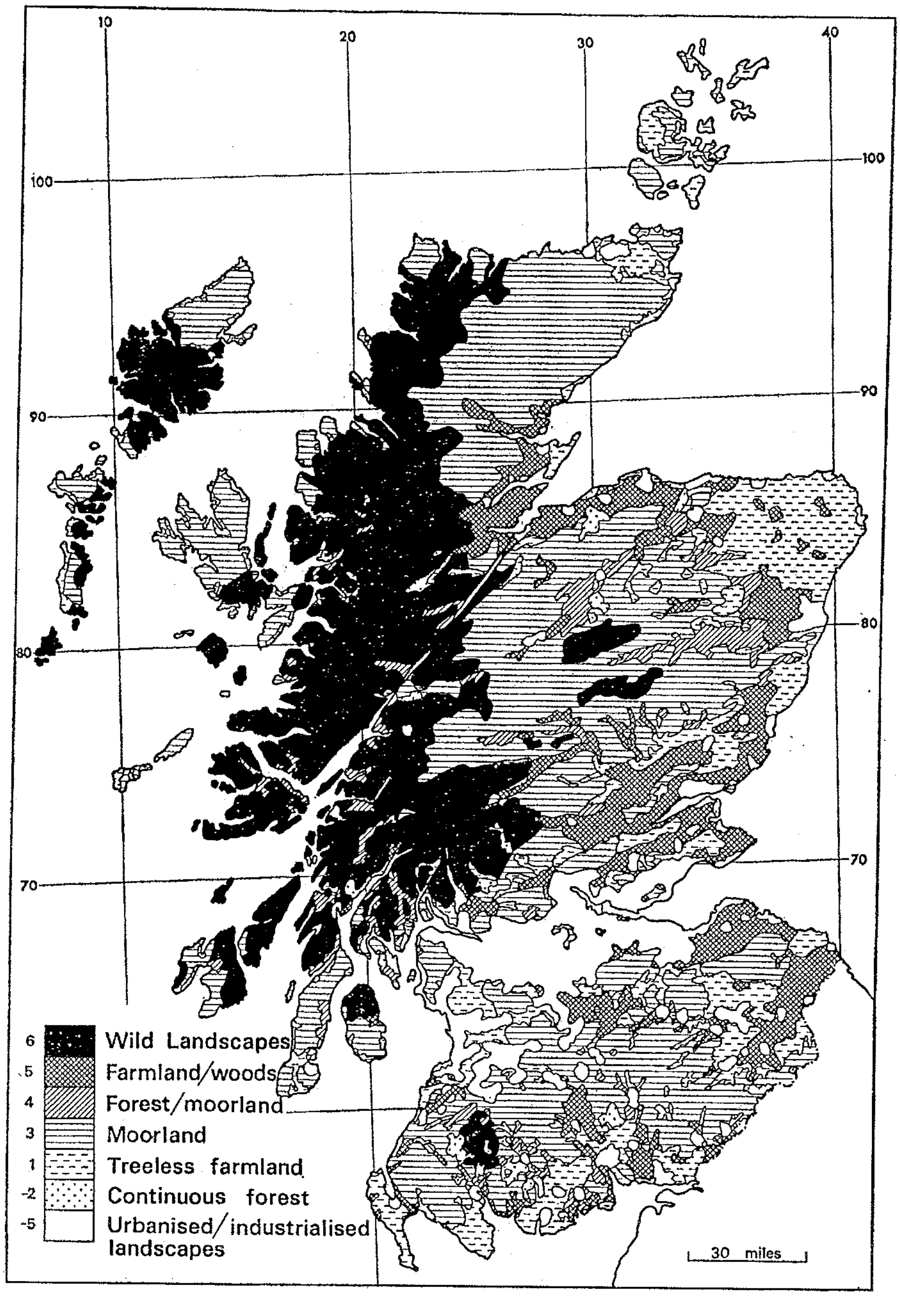


Figure 4 Scotland's land use landscapes (After Linton, (1968)).

As a result of these events and a general increase in environmental awareness throughout Britain, the number of voluntary organisations involved in the protection of wild land rose. The Mountaineering Council of Scotland was formed in 1970, the North East Mountain Trust started in 1975 after opposition to quarries on the Aberdeenshire coast (Aitken *et al.*, 1995). The Scottish Wild Land Group was created in 1982 as a result of the pressures by ski development in the Cairngorms, and the John Muir Trust was established in 1983 and has since purchased 44,500 acres of land in Knoydart, Sutherland and on the Isle of Skye. These organisations have tended to be proactive as a result of missing out on conservation issues in the past (Cousins, 1982). Within conservation there has been a move to decide what types of countryside should be protected and to work towards the creation and management of this landscape (Green, 1995). This approach has been precipitated by a lack of confidence in government bodies at protecting the nature conservation value of much of Scotland and has led increasingly to the purchase of land by conservation interests (Wightman, 1996). In total, such organisations now own over 330,000 acres of land (Wightman, 1996), approximately 1.7 % of Scotland.

Statutory bodies have also been concerned with the concept of wild land. The Countryside Commission for Scotland, one of the predecessor organisations of the present day Scottish Natural Heritage, produced a report entitled *Mountain Areas of Scotland* (Countryside Commission for Scotland, 1991), and concluded that the extent of wild land should be evaluated and recommended that a National Planning Guideline should promote the incorporation of wild land values into planning and conservation policies. The Cairngorms Working Party (1992) considered wild land to be a dwindling resource and regarded conserving the wildness value of the area as one of the key elements of the Management Strategy for the area.

The concept of wild land has even gained interest in England with the publication of *The Scope for Wilderness,* a report for the Countryside Commission (Landscape Design Associates, 1994). This report concluded that a wilderness strategy for England would contribute to restoring depleted ecological resources and enhance people's experiences of nature. The 1994 CC report built on work published in 1990 titled *The Management of the Wilder Areas of the National Parks* (Countryside Commission, 1990) in which recommendations were made to protect the 'long walk-in', and put a ban on new developments, roads, signs and marked paths in wild land areas. Based on this work and the Council for the Protection of Rural England's (CPRE) Tranquil Areas Study (Council for the Protection of Rural England, 1995, in Caffyn & Prosser, 1998), the 11 National Parks of England and Wales have begun to classify 'quiet' and in some cases 'wild' areas (Caffyn & Prosser, 1998).

The conservation movement which has been working to buy and protect areas of undeveloped land has usually done so on the basis of the scenic or scientific values of a particular area, the wild land value not being specifically taken into account. For example, the National Trust for Scotland (NTS) initially bought and managed Glencoe for its scenic qualities, and the Royal Society for the Protection of Birds (RSPB) purchased Abernethy forest in the Cairngorms for the wildlife it did, and could potentially, contain. The NTS property in Glencoe was purchased with money from Percy Unna who also left instructions on how such areas were to be managed (The Unna Principles), which essentially controlled the development of new facilities on the land. Unna's views were more akin to the provisions for management of the US Wilderness Areas (Aitken *et al.*, 1995) where the land is left to the forces of nature with as little human intervention as possible. In general, management practices have begun to change with more weight put on the wild land value of an area as a specific reason for buying the land.

The reasons for which some areas of the landscape have been protected with designations such as National Nature Reserve (NNR) or Site of Special Scientific Interest (SSSI) have been for scientific values. A whole suite of other statutory designations including National Scenic Areas (NSAs), Environmentally Sensitive Areas (ESAs) and Areas of Outstanding Natural Beauty (AONBs) have been created to answer calls to protect landscapes because of their scenic appeal, or for moral/ethical concerns and general environmental protection. However, no designation exists in the UK with the specific purpose of protecting areas with high wild land values.

The discussion on wild land in Scotland was brought into the international spotlight by the meeting of the 3rd World Wilderness Congress at Findhorn in 1983 (Martin & Inglis, 1984). This large gathering of scientists, philosophers, artists and tribal people brought together many alternative ideas on what constituted wilderness in an area of the world valued for its wild land qualities.

Hays (1984) suggested that from an American viewpoint, the British environment and conservation ethic appeared devoid of something akin to the US idea of wilderness. Hays (1984) suggested that it would not be impossible to create such an area, which would be similar to wilderness areas in the eastern USA that have been created from land which has undergone heavy timber production in the past. Such wilderness areas are being created elsewhere in Europe, for example in the Bayerischer Wald National Park in Germany (Hays, 1984). Hays' (1984) article was written in the context of the English and Welsh National Parks, with no specific reference to Scotland. In Britain, more so in England and Wales than in Scotland, the underlying paradigm of the conservation movement is one of interventionist management (Henderson, 1992). It is for this reason that Hays (1984) saw the rejection of the wilderness idea in Britain. He stated that there appeared to be little *"human attraction to natural systems"* (p. 21) which had played such an important role in the US environmental movement. Had Scotland been the focus of Hays' attention, then he may have been a little more optimistic about the potential of the wild land concept in this country.

The concept of wild land in Scotland has evolved over the last 250 years as a result of the influence of popular authors, a growth in tourism, the actions of voluntary conservation and recreation organisations, and the US Wilderness Act. The situation today is the result of the perceptions of some post-Romantic outsiders that certain areas of Scotland are truly wild. This contrasts with the views of the local population, although attitudes are also changing towards appreciating the economic needs of the local inhabitants.

2.8.3 Threats To Wild Land

The concept of threats to wild land quality is not new: in the USA a framework for assessing threats to wilderness areas has been developed and implemented within the NWPS (Cole, 1994). In Scotland the main current land uses in the uplands are not seen as being sustainable, such as conifer plantations (Hanley & Craig, 1991), present levels of overgrazing, construction of hill roads, quarrying and ski developments (SWCL, 1997). There have been major land use changes over the last 200 years that have generally caused a gradual deterioration in the productivity and quality of the environment. For example, soil and peat erosion has been shown to have affected 12 % of sample areas of the uplands (Grieve *et al.*, 1995). In another case, while considering the value of peatlands in the Flow Country following large scale afforestation, Hanley and Craig (1991) referred to the preservation values of wilderness, concluding that intensive, short-rotation forestry was not a sustainable land use for a wilderness area.

There are many factors that are seen as threats to the integrity of wild land (Watson, 1984a). These threats relate to a series of changes in the Scottish landscape. For example there has been an increase in the number of vehicle tracks to allow access for deer stalking and game shooting (Watson, 1984b; Bayfield, 1986), and footpaths have increased in number and length as a result of growing numbers of walkers (Watson, 1984c). Afforestation schemes have more than doubled the area under forest since the second World War (Mather, 1992), with an increase in forest area of 40 % between 1975 and 1990 (Houston, 1989; Mather & Thomson, 1995). Other changes in the Scottish landscape have been caused by the development of five ski areas since 1961 (Watson, 1991). At the same time as these alterations to the physical landscape, there have also been significant biological changes, primarily overgrazing, resulting from increases in the number of grazing animals, principally deer and sheep. For example, estimates of the Scottish red deer population have increased from 150,000 in 1900 to 300,000 in 1989 (Staines *et al.*, 1995).

2.8.4 Rehabilitating The Scottish Landscape

There is not much land left in Scotland that has not been altered to one degree or another by people as described in section 2.8.1. In this sense, there is very little ecologically wild land in Scotland, although this is reversible. The concept of rehabilitating areas to enlarge an area of ecological wilderness was mentioned by Stankey (1993) with respect to Scotland and Taiwan. There have been calls from within the UK to expand the area of native forest cover, removing unwanted forest tracks, built artefacts and fence lines (Dennis, 1995). However, the viability of recreating ecologically wild land has been called into question because of missing elements from ecosystems, such as large carnivores (Tubbs, 1996), instead Tubbs favours the enhancement of extensive cultural landscapes. For some areas of Australia, rehabilitation was also considered a viable and acceptable way to extend an area defined as already having wilderness qualities (Lesslie *et al.*, 1988). This study, in an area of Victoria, considered the removal of disused cultural features such as windmills, bores, tanks and the rehabilitation of four-wheel drive access routes. A geographical information system (GIS) model was used that showed that the area of wilderness increased as a result of these changes.

A move to more sustainable resource management practices in Scotland is seen as one way of benefiting those interested in conserving wild places, and also the local community (Hunter, 1984) who are given more control over the surrounding natural resources. This is a possible solution to the dilemma of choosing between conservation or development and could provide some hope for future conservation strategies.

2.8.5 Moving Towards A Scottish Definition Of Wild Land

However, despite these possibilities for the future there is still at present, little ecologically wild land, and this is in stark contrast to the perceptual views of the post-Romantics. There is a problem in defining the term 'wild land' for Scotland when, if thought of in terms of an ecologically pristine area (primary wilderness), there is none.

Aitken *et al.* (1995) provide a working definition for the concept of wild land in Scotland:

> *"Wild areas are extensive upland tracts remote from roads, where the main existing land use is extensive grazing or deer forest, which show minimal physical signs of human presence or direct influence, and which offer scope for high quality recreational experience"* (p. 25).

This definition concedes that much of Scotland cannot be referred to as ecologically wild land but is subject to a degree of human influence in terms of extensive agriculture. The above definition provides a starting point from which to explore developments in defining the concept of wild land in Scotland.

In the past, calls have been made to quantify the notions of site integrity and wilderness in the British context, and the ways in which these are perceived by people living in or visiting the uplands (Thompson *et al.*, 1987). Thompson *et al.* (1987) outline the land use issues which affect the biotic resource of the mountain plateaux in Britain: grazing impacts affected by far the largest areas, whereas recreational impacts were much more localised. Recreational impacts need to be managed and the authors suggest that associations between visitors' experiences, scenic and ecological impacts, and use restrictions need to be quantified in order to discover what guides human behaviour and perceptions (Thompson *et al.*, 1987).

The use of perceptual qualities of particular landscapes for conservation purposes is not new as they have been used by several of the English and Welsh national parks (Swanwick, 1987). Section 43 of the Wildlife and Countryside Act 1981 required maps of moorland or heathland considered to be particularly important to conserve. Some of the parks used perceptual qualities as one of the criteria which the park staff developed for judging value, others included landscape qualities, ecological and archaeological factors, and recreation and access. Within the perceptual qualities group, the specific criteria referred to 'qualities of openness, remoteness and wilderness'. The park authorities have subsequently used these maps in the development of conservation policies for these areas. With specific reference to wild land perception in Scotland, Aitken *et al.* (1995) have detailed the need for research in those areas that are perceived to be wild by users, policy makers and planners.

Taking a perceptual approach to defining wild land in Scotland allows a range of ideas to be studied concerning the physical make up of such a location. It is already apparent that the local inhabitants of rural areas view their surroundings differently compared with those people who visit the same areas for recreational purposes. This has been demonstrated to be the case in many parts of the world as well as in Scotland.

2.9 Landscape Perception

There is a large body of literature concerning landscape perception including reviews of the theory and application of the research (Zube *et al.*, 1982; Daniel & Vining, 1983; Zube, 1984; Zube, 1986; Zube *et al.*, 1987; Kaplan & Kaplan, 1989). These reviews detail many examples of studies that assess landscape quality by focusing on the visual properties of the environment. Daniel & Vining (1983) specifically mention that although wilderness values are not taken into account within landscape quality assessments, they would add to the knowledge of human values connected to a particular area of land if they were included. Within landscape perception research there are four main paradigms discussed in Porteous (1982) and Zube *et al.* (1982) for example:

1. *"The expert paradigm. This involves the evaluation of landscape quality by skilled and trained observers. Skills evolve from training in art and design, ecology or in resource management fields where wise resource management techniques may be assumed to have intrinsic aesthetic effects.*
2. *The psychophysical paradigm. This involves assessment through testing general public or selected population's evaluations of landscape aesthetic qualities or of specific landscape properties. The external landscape properties are assumed to bear a correlational or stimulus-response relationship to observer evaluations and behaviour.*
3. *The cognitive paradigm. This involves a search for human meaning associated with landscape and landscape properties. Information is received by the human observer and, in conjunction with past experience, future expectation, and sociocultural conditioning, lends meaning to the landscape.*
4. *The experiential paradigm. This considers landscape values to be based on the experience of the human - landscape interaction, whereby both are shaping and being shaped in the interactive process"* (Zube *et al.*, 1982, p. 8).

Perception of wild land is influenced by cultural background and previous experience and changes over space and time (Henderson, 1992). As a result, within any one country there is likely to be a diverse range of opinions as to what constitutes a wild land area. Relying on the expert paradigm to assess wild land quality depends on the perceptions of the individual expert. Previous work has shown the wilderness perceptions of managers and one recreational group, canoeists, to differ considerably (Peterson, 1974). Differences in the perceptions of managers, politicians and forest users were also illustrated in a study conducted in Denmark (Jensen, 1993). These findings question the reliability of 'expert' judgement in providing a basis for policies to manage the public estate in the interests of the general population. In the experiential paradigm there is a reliance on the literary and artistic expressions of landscape values by others, and this has caused this approach to be labelled as elitist by some (Zube *et al.*, 1982). In addition the experiential approach, considers past perceptions of the landscape, which in the case of wild land perception in Scotland has been covered in considerable depth already by Aitken (1977).

It appears that the psychophysical and cognitive paradigms have the most to offer in any attempt to understand people's perceptions of wild land in Scotland. The psychophysical paradigm allows the comparison of the views of diverse sections of the population, for example local inhabitants and hill walkers, to see how their views differ: this approach has been used profitably in other countries for different recreational groups (Lucas, 1964; Merriam Jr. & Ammons, 1968). This approach is also well established at providing applications for planning and management issues, a useful outcome of any research, especially in the applied field of environmental conservation. The cognitive paradigm provides an indication of those parts of the landscape that are important in assessments of scenic preference and potentially wild land quality. Zube *et al.* (1982) demonstrated that relative relief, land use diversity, water, predominance of natural versus man-made features, complexity and unity all influence scenic preference assessments.

From applied landscape perception research to date, it is clear that people have differing views concerning the use of landscapes. Distinct differences in the landscape perceptions of interest groups, including farmers, resource managers and local decision makers were found in a survey conducted in the vicinity of Safford, Arizona (Zube & Sheehan, 1994). Resource managers had more preservationist attitudes than the interest groups who were more inclined to favour commodity uses. Other studies (Yang & Kaplan, 1990) have shown that Western and Far Eastern cultural groups have a preference for natural forms as opposed to formal design showing similarities do exist between some groups. Both of these studies indicate that there are likely to be differences and similarities between groups of people from the general population in terms of their perceptions of wild land.

2.9.1 Wild Land Perception

There is not a great deal published in the USA regarding people's perceptions as to what constitutes a wild land area. This is primarily due to the fact that the 1964 Wilderness Act provided a definition of wilderness that has generally been accepted by all. However, calls have been made to measure the perceptions of users and the interested public with regard to wild land values in the USA to act as an input to the management process (Sober, 1989). There have also been one or two exceptions of which Merriam & Ammons' (1968) paper on the wilderness perceptions of users in Montana is one. Backcountry users perceived wilderness areas to be underdeveloped, natural, difficult to access, with no roads and few people. In addition, an important part of the 'wilderness experience' was overnight stays. In Glacier National Park, the wilderness was thought to begin at least 3 miles from surfaced roads and the routes of guided day walks. Roadside campers also considered wilderness areas to contain few people, but did not regard staying out overnight as important. For this group, the edge of the road was the start of the wilderness.

Osborne (1980) conducted a survey to provide data for the development of a model that objectively qualified users' perceptions of the relative positive or negative effects of various human impacts in wilderness like areas. A model was applied in two areas of the eastern USA, in Indiana and Arkansas and showed the negative influence on wildness of roads, power lines, structures and the proximity of an area to towns and cities. This type of perception research is seen as providing useful input to decisions made by wilderness managers whose perceptions of what recreationists think have been shown to be incorrect (Kroening, 1977).

Studies abroad have also found that of those who venture away from roads and into wild land areas, the different types of users generally have different perceptions as to what constitutes wilderness. Kearsley (1990) describes the results of a study in New Zealand in which trampers (backpackers), road-based tourists and holiday makers were surveyed for their opinions on wilderness. The groups were asked what was and was not acceptable within such areas, and as expected the trampers emerged as being more purist than the other groups. Trampers would not allow any development or artefacts within such areas, whereas the public would accept the presence of facilities such as toilets and nature walks. However, in the broadest sense all groups regarded wilderness as important and attached similar values to it (Kearsley, 1990).

Comparison of the views of different wilderness user groups has also been conducted in the USA (Shindler & Shelby, 1993; Warren, 1986). Hunters, horse riders and scouts gave less support to management policies than hikers, Sierra Club members and managers, who appeared more preservation oriented (Shindler & Shelby, 1993). In Alaska, developments were generally opposed by hunters and backpackers alike (Warren, 1986). Differences have also been described between rural and urban communities. Saremba & Gill (1991) found differences in the attitudes of resort residents and city dwellers towards the use of a nearby wilderness area. Resort residents had more of a utilitarian outlook, viewing the area in terms of potential for personal recreation, whereas people from the city regarded the area as having high wilderness experience and backcountry recreation value (Saremba & Gill, 1991).

Essentially perceptions of wild land are highly variable, and to take a consensus view of the meaning of wild land is one approach that could be used to identify a possible definition for a particular culture and/or country. However, despite the differing opinions from person to person as to what constitutes a wild land experience, there appear to be several common factors that underlie the concept, namely the enjoyment of nature, an escape from civilisation, and for relaxation and solitude (Kliskey *et al.*, 1994).

2.9.2 Spatial Expression Of Wild Land Perceptions

The majority of the studies undertaken to date on the perception of wild land has asked those people who visit such areas for their opinions as to what makes these areas "wild". From that starting point some authors have then used the attributes described by the sample and developed indicators to map areas of "wild land" (e.g. Schreyer & Nielson, 1978 in Stankey & Schreyer, 1987; Kliskey & Kearsley, 1993). Very few studies have asked people to delineate directly where their notion of wild land begins and ends.

The first attempt to describe people's perceptions of "wilderness" in spatial terms is generally attributed to Lucas (1964). In his survey of canoeists, motor boaters and some of the resource managers in the Boundary Waters Canoe Area of Minnesota, and the adjoining Province of Ontario, Lucas interviewed almost 300 groups in an attempt to answer the following three questions:

a) how important are the wilderness qualities of an area, relative to other potential uses?
b) What extent of the area is considered to be wilderness?
c) What are the essential characteristics of the wilderness and in particular the types of uses accepted?

The results showed that visitors held a wide variety of perceptions in all three categories mentioned above. The paddling canoeists were very sensitive to other users and evidence of the impact of human beings. This group could be termed the "wilderness purists", with high standards for their particular wilderness areas. As a result, the extent of wilderness for this group was smaller than for the motor boater group. This difference in wilderness extent was highlighted in the exercise where people were asked to indicate on a map where they thought they had entered the wilderness. The motorboaters were much less demanding of wilderness standards and felt that they had entered their wilderness soon after leaving the last town, while still driving to the launch point. In general the type of transportation used (canoe or motor boat) reflected a set of values and ideas as to what constituted wilderness.

An assessment of river floaters' perceptions of wilderness qualities was undertaken in Desolation and Westwater Canyons in Utah (Schreyer & Nielson, 1978 in Stankey & Schreyer, 1987). As in Lucas' study, respondents were asked to delineate where they felt the wilderness began, a third indicating it started while driving to the launch site and 15 % while at the launch site.

In the only comprehensive study to date of wilderness areas in Scotland, Aitken (1977) asked respondents:

a) which of a list of remote areas they considered to be wilderness;
b) to list those areas of Scotland they thought to be wilderness.

The second question was included to bring out any areas not specifically mentioned by the author. Results showed a close correlation between the two lists of areas, but also indicated that other areas such as Rannoch Moor were also regarded as very wild. Rannoch Moor is not mountainous and not particularly remote, two indicators that people appeared to use in selecting wild land areas.

Other studies have evaluated the desirability of certain physical attributes in wild land areas, many using Stankey's (1972) Wilderness Purism Scale. These attributes are then translated into spatial elements that are subsequently mapped. The following studies use two methods of analysis based on the same original data set, either one of which could be applied in the Scottish context.

These studies deal with multiple perceptions of wilderness in New Zealand (Kliskey & Kearsley, 1993; Kliskey, 1994a; Kliskey, 1994b; Kliskey *et al.*, 1994). Kliskey & Kearsley (1993) used a scale of wilderness purism to place backcountry users into one of four categories ranging from strong-purist to non-purist according to their response to certain properties of an area. The properties on which the interviewees were questioned included remoteness, artifactualism, naturalness and solitude. Respondents were asked to indicate an item's desirability on a five point scale, ranging from strongly desirable to strongly undesirable. These items were then translated into indicators for which spatial criteria, such as buffer zones, were established. The spatial extent of the various perceptions of wilderness were then mapped for an area of South Island. The study showed that a difference between the strong purist and non-purist perceptions equated to 42 % of the study area, showing the strong influence of human artefacts on the wilderness perceptions of some people. The second study (Kliskey, 1994b) used an alternative multivariate approach in which dimensions of wilderness purism were identified using principal components analysis. A sample of backcountry users were classified into one of the four principal components on the basis of their wilderness purism scale scores. Then the spatial criteria for each purism item of a principal component was chosen and weightings established for each criteria. The spatial criteria took the form of a buffer zone around the particular geographic item, e.g. 1 km around a hut. The data were then used to produce a weighted overlay using a GIS.

These two methods were compared by Kliskey (1994a), who concluded that there was considerable similarity in the results of the two approaches. However, the more complex and sophisticated second method (Kliskey, 1994b) revealed a more subtle distinction between wilderness perception areas and groups of users. However, Kliskey & Kearsley (1993) recommended the first method as it is simpler and more familiar, and recommended the second method where a more subtle degree of information is required.

All of the above studies share the common theme of defining perception of wild land in spatial terms using data collected from a sample of backcountry users. By using a questionnaire approach to assess people's visual perceptions of wild land on which to base a modelling exercise, areas of wild land in Scotland can be established. In this way wild land can be defined as a particular type of Scottish landscape of varying quality and spatial extent, depending on each person's own viewpoint. To map this landscape, a methodology which has the ability to take into account all these factors is required.

2.10 Summary

The current concept of wild land stems from Western thought which imposes a value on the resource ranging from an anthropocentric utilitarian viewpoint to an ecocentric intrinsic valuation of the land (Oelschlaeger, 1991). How this resource is perceived varies considerably from person to person but also generates several common feelings which can be used to establish a consensus value for, and perception of, wild land (Kearsley, 1990). The variation depends to some degree on a persons background, culture and experience (Stankey, 1986).

Wild land is perceived to exist in Scotland and is valued for reasons ranging from the utilitarian to the intrinsic. This is despite an absence of primary wilderness in much of the country. There is a need to tailor a definition of wild land for the Scottish landscape to meet the differing perceptions of its population. A definition of wild land based on people's visual perception of the Scottish landscape allows the spatial expression of wild land quality with the use of a GIS. An objective interpretation of the inherently subjective concept of wild land would be useful in assessing the impacts of threats to wild land quality as a result of, for example, development proposals. In addition, the model of wild land perception would be valuable as an input to the planning and conservation process.

2.11 Key Questions

This discussion of the literature has shown the concept of wilderness and wild land to be a state of mind created by certain types of surroundings. Given that the concept of wild land is a cultural construct, it follows that any culture can define wild land for its own purposes and in its own terms. As human occupation is an important part of the landscape history of Scotland, this could be made into one of the cornerstones of any Scottish definition of the term wild land. There would hence be no need to exclude people from the landscape. If wild land exists in Scotland, then the crux of the problem lies in providing a geographical context for an inherently ambiguous concept (Nash, 1967; Driver *et al.*, 1987). It depends on the perception of the individual as to whether wild land exists, and if it does, the answer to the question as to why it should be protected is likely to be equally variable.

This project tests the theory that wild land is a state of mind induced by certain surroundings and attempts to find out which features of a landscape make up those surroundings by using techniques available from applied landscape perception research. Once identified, their locations and hence those of wild land are mapped. This approach concentrates on understanding and expressing in spatial terms an individual's visual perception of wild land, which will lead to a more objective definition of wild land in Scotland.

2.12 Aim And Objectives Of The Study

2.12.1 Aim

To define in spatial terms the concept of wild land in Scotland using people's visual perceptions of the landscape.

2.12.2 Specific Objectives

1. Establish the essential characteristics of wild land including the requisite landscape attributes using case study areas.
2. Analyse how the list of essential elements of wild land differs between the different groups of people in contact with the wild land resource.
3. Develop indicators for those landscape attributes that influence wild land perceptions and that can be calculated from GIS base map data.
4. Use the indicators to develop a model to predict people's perceptions of wild land and test it.
5. Use the predictive capabilities of the GIS, to apply a validated wild land model to the chosen study areas.

2.12.3 Hypotheses

1. The concept of wild land is applicable in Scotland.
2. Different groups of people, grouped according to their activities, experiences, attitudes and behaviour, will have different perceptions of wild land.
3. There is a range of wild land quality within Scotland's upland areas.
4. The concept of wild land is clearly differentiated from the concepts of naturalness and beauty.

5. Visual perceptions of wild land are influenced by the presence or absence of certain landscape attributes.
6. Wild land quality can be predicted from the combined influence of the surrounding landscape attributes.

These hypotheses are summarised in Figure 5.

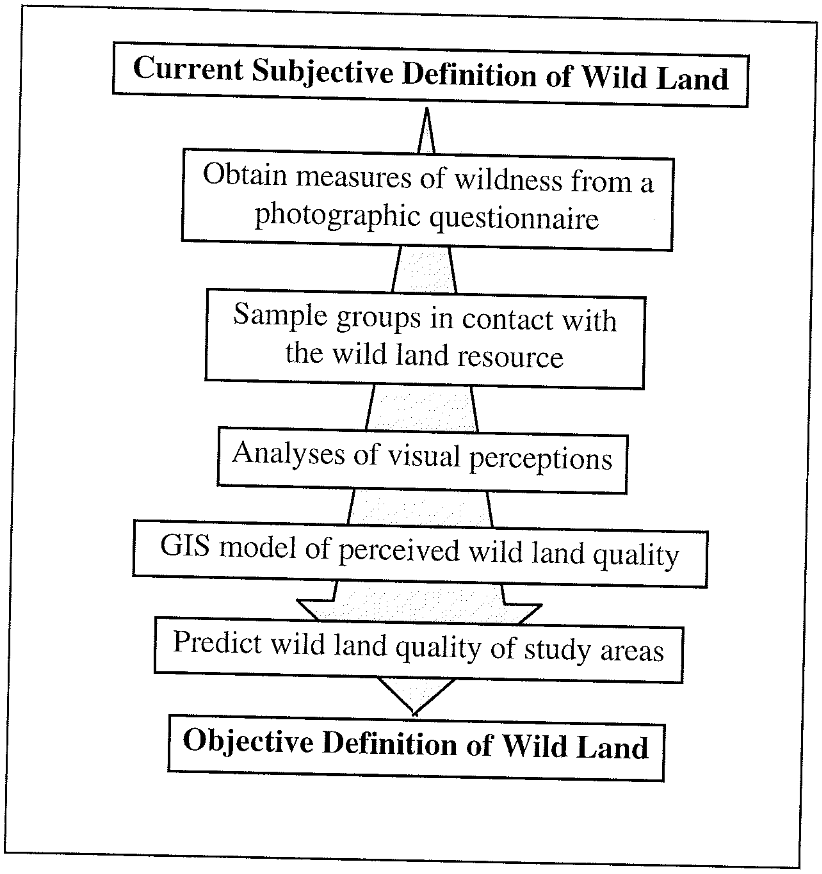


Figure 5 Developing an objective definition of wild land in Scotland.

Chapter 3

Methodological Framework for Gathering Data on People's Perception of Wild Land

3.1 Introduction

The need for a definition of wild land in Scotland that takes into account the needs of both the local inhabitants and visitors has been established. The definition based on people's visual perception of the wildness of the surrounding landscape attributes allows the variety of perceptions to be sampled. By rating a series of landscape photographs in terms of their wildness, data can be gathered on the range of current wild land perceptions.

The focus of this chapter is to justify the use of a photographic questionnaire to obtain a measure of people's perceptions of wild land and to assess the validity and reliability of this approach. The chosen study areas will be described and the use of photographs as surrogates for actual landscapes will be discussed. The selection process for the photographs used in the questionnaire, and the selection of the target groups of people are also discussed. The development and validation of the questionnaire concludes the chapter. A summary of the data collection process is shown in Figure 6.

3.2 The Use Of A Photographic Questionnaire

The use of public surveys is common in Canada as input to the planning and management processes in parks and protected areas (Rollins *et al.*, 1992). The reliability of visitor responses has been studied (Robertson, 1986) and results indicate that responses are on the whole accurate, with greatest error in the estimation of continuous measures on interval scales, for example distance.

3.2.1 Reliability Of The Questionnaire Approach

In US wilderness research studies based on questionnaire data, potential cumulative error has been shown to be quite high (Kroening, 1977). The reasons for this were attributed to the sampling method of sending post-back questionnaires to those users who registered at the start of the trail. It is common practice to obtain a permit to hike in a wilderness area in the USA which is filled in at the start of the trip at the trailhead (the beginning of the trail, usually at a car park) and is deposited in a box for collection by the ranger. Only one permit is required for each party and although the attitudes of party leaders and members are very similar, their socio-economic characteristics were shown to differ (Jubenville, 1971 in Kroening, 1977). There is therefore a non-registration bias, as well as a leader bias associated with samples of this nature (Lucas & Oltman, 1971 in Kroening, 1977). However, the sampling methods used for the mountaineering group in the current study do not suffer from these errors.

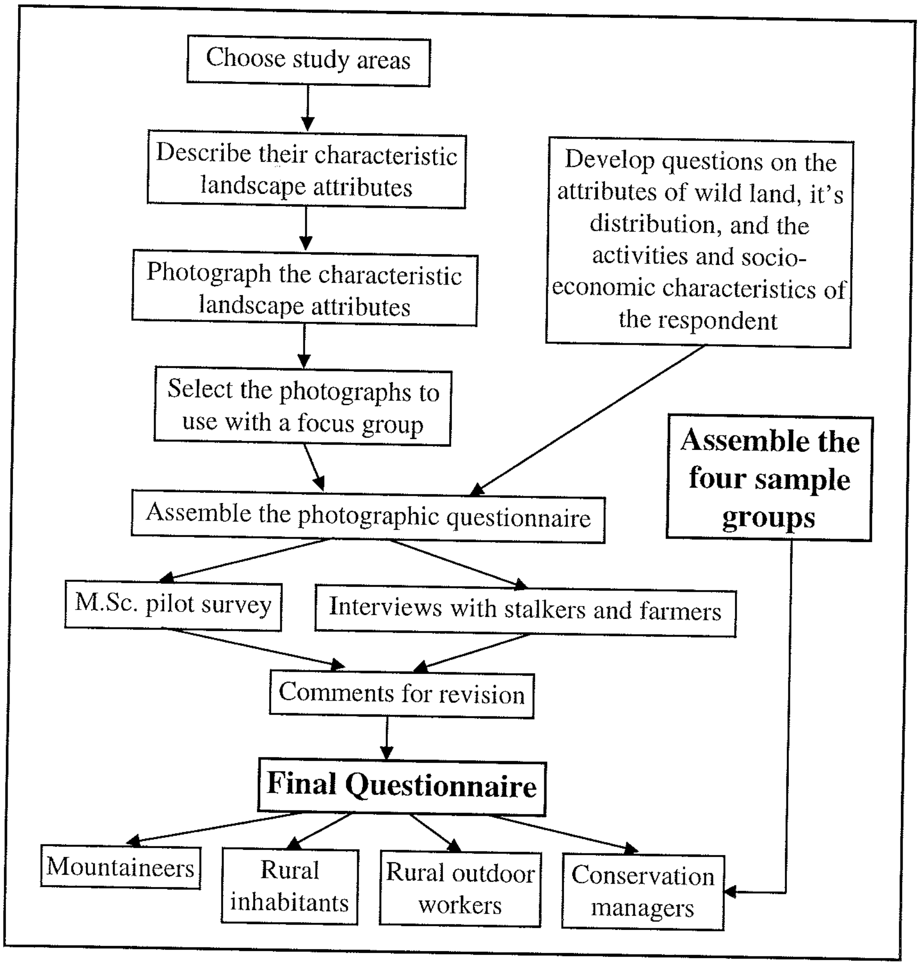


Figure 6 A flow diagram of the questionnaire development process and the administration of the survey.

There are several potential sources of error in questionnaires highlighted by Jensen, (unpublished manuscript: *Forest recreation in Denmark from 1976 to 1994*):

1. Sampling error: primarily non-response. To see if non-response affects the representativeness of the sample groups, the distribution of respondents over the most vital grouping factors (age etc.) can be compared to the distribution of the Scottish adult population and checks for significant differences made.
2. Measurement method: these are errors brought about by the accuracy of respondents answers. Answers regarding a respondents status are thought to be reasonably accurate. However, answers relating to behaviour e.g. activities and experience can

be subject to errors as a result of: 1. Difficulty in defining an activity, 2. Memory failure of the respondent or the urge to generalise (or exaggerate), 3. Limited possibility of checks, of which the respondent must be assumed to be aware.

On the whole, behavioural questions in the present study related to activities currently undertaken and therefore errors owing to memory loss would be small. The list of activities was developed with input from all the sample groups during the pilot survey, thereby ensuring the most comprehensive list possible. It is conceivable that the questionnaire was answered by someone other than the addressee. However, with the anonymity of returned questionnaires there is no way of checking.

Jensen (unpublished) comments that measurement errors are impossible to quantify objectively. In practice, error avoidance was practised by careful development of the questionnaire with comments from peers and the use of a pilot study and interviews. In addition an attempt to minimise the effect of non-response owing to social class was made by including a return envelope with the questionnaire and using a Freepost address for responses. An appraisal of specific issues relating to the questionnaire used is given in Chapter 8.

3.2.2 Perceptions Of Wild Land From Photographic Simulations

Studies of how people experience the environment have shown that there is a great deal of reliance on the visual aspects of their surroundings and in attempting to understand more about these relationships, visual materials and methods are most valuable (Kaplan & Kaplan, 1989). Short of taking people to particular areas in order to carry out an assessment of their visual experience of "wild land", surrogate material must be used. Such surrogates have been classified as perceptual simulations (McKechnie, 1977), these are two and three dimensional representations or imitations of the visual, physical landscape. The use of slides and prints, either in colour or black and white are common and studies investigating the limitations and validity of such media have found that they are very good at simulating the actual environment (Pitt & Zube, 1987; Zube *et al.*, 1987; Stamps III, 1993). Other studies have looked into the validity of these media as surrogates for on-site evaluations and to simulate on-site experiences (Zube *et al.*, 1987; Stamps III, 1993). Dunn (1976) conducted an experiment in England that compared preferences of photographs to preferences of the same landscapes by people actually there. Dunn (1976) concluded that photographs can be used to represent landscapes effectively. This is one of the assumptions of the Q-sort method (Pitt & Zube, 1979), a psychometric test used to study people's perceptions of the visual quality of a landscape. Other assumptions of such tests that aim to predict the perceptual response to the landscape are:

1. that the assessment of visual quality (the concept under study) can be explained predominantly in terms of the physical attributes of the landscape;
2. that perceptions are consistent across all socio-economic and cultural classes (Pitt & Zube, 1979).

It was found that, in the case of judgements of air clarity, photographs provide a good representation of the visual environment (Stewart *et al.*, 1984). In addition Stamps' (1993) review and meta-analysis of studies based on simulations for environmental preference work, found that there was a high correlation between the use of real environments when compared with colour slides and prints. These findings were based on a total of 185 pairs of stimuli (slides etc.) and gave a correlation coefficient of 0.83, with a 0.05 confidence interval of $0.79 < r < 0.87$. Similar levels of agreement were found between slides and digitised slides (Stamps III, 1993; Vining & Orland, 1989). Using 309 pairs of stimuli, the correlation coefficient was 0.84, with a 0.05 confidence interval of $0.80 < r < 0.87$ (Stamps III, 1993). The ability with which landscape assessment ratings can be constantly and reliably reproduced using photographic simulations has also been tested and found to be justified (Zube *et al,* 1987). However, some studies have shown that sound and motion can also influence judgements of scenic beauty where there is a dynamic element to the landscape such as a river (Hetherington *et al.*, 1993).

There appears to be no difference between responses to the use of colour or black and white photographs, as with the use of slides versus prints (Kaplan & Kaplan, 1989). One advantage of black and white is that it can be reproduced in printed form with minimal cost. Colour slides were chosen for use in the current study, as a result of the photograph selection method used at a later stage in the project. People were asked to view images and comment on their content for which the use of a projector and slides was the most efficient and cost effective method available.

Methods based on photographic simulations have been used in the study of viewer characteristics and preferences for various landscape attributes. Zube *et al* (1987) reviewed studies that have used prints and slides, in either black and white or colour, for the study of recreational landscapes. The data produced by such studies have been used to develop methods for quantifying scenic beauty, two examples are: a) the Scenic Beauty Estimation methodology (Daniel & Boster, 1976) and b) the Natural Landscape Predictive Model (Shafer Jr. *et al.*, 1969; Shafer Jr. & Brush, 1977). The latter method has been criticised and suggestions for improvements made (Weinstein, 1976; Kreimer, 1977). The review by Zube *et al.* (1987) also covered the ability of photographic media to simulate landscapes reliably and validly and concluded that it is a highly effective tool for landscape evaluation, with the following caveat from Dearden (1981) "*if used with caution, photographs can provide a useful means of measuring landscape preferences*" (p. 12).

The use of photographs to provide precise quantitative indices based on people's perception of stimuli (Hull IV *et al.*, 1984) as psychometric indicators have been reviewed by Zube *et al.* (1982), Zube *et al.* (1987) and Stamps III (1993). These reviews indicate that they are widely used to evaluate scenic beauty and landscape quality in general and examples include Shafer Jr. *et al.* (1969), Daniel & Boster (1976), Pitt & Zube (1979), and Culbertson *et al.* (1994), and more specifically in forest settings (Hull IV *et al.*, 1984; Hull IV *et al.*, 1987; Jensen, 1993). In addition, these methods have been used to show that landscape preferences differ between children (11 years old) and adolescents (16 years old) (Bernáldez *et al.*, 1995), and that the influence of people and man-induced conditions reduces preference for outdoor recreation landscapes (Carls, 1974; Hodgson & Thayer Jr., 1980). Furthermore psychophysical approaches have shown that familiarity with, and preference for, natural landscapes are positively correlated (Hammitt, 1979) and that perceived mystery in rural environments can be assessed and mapped (Lynch & Gimblett, 1992). These methods have also been applied in the prediction of landscape quality as a result of changes in land use (Simpson *et al.*, 1997) and new developments (Sheppard, 1986).

Difficulties with the interpretation of psychophysically-based scenic beauty estimates were discussed by Hull IV (1989) who suggested anchoring the estimates to known landscapes. This technique helps to identify the range of scenic beauty that is relevant to the study in question, i.e. that which is under the control of the management body conducting the study. Additional advice is provided by Clamp (1981) who advises calibrating the method for a particular landscape and stating the accuracy of the estimate.

Methods of analysing responses to photographic media are commonly used in the United States, although there are examples of such studies conducted in Scotland. One of these has used an Internet based questionnaire to obtain landscape preference ratings for a series of photographs as a forerunner to developing a predictive landscape preference model (Wherrett, 1998). Another studied the value people attach to the conservation benefits of an Environmentally Sensitive Area (ESA), and the importance which they assign to specific elements of the visual landscape. This study (Hanley *et al.*, 1996), used photographs that displayed the present condition of two landscape types and what they would look like if ESA policies were introduced to the area. The stated preference method was used to ask respondents to rank particular attributes of the landscape such as woodland, heather moorland and grassland, and to choose between 8 policy options. In one of the study areas, Breadalbane, the landscape attributes were ranked in the order mentioned above, woodland being the most valued. Hanley *et al.* (1996) suggests that the study design is crucial in order to produce statistically valid results.

Kaplan & Kaplan (1989) put forward a basic methodology that can be used in a large number of situations to establish relationships between various landscape attributes. In this method, people are asked to judge photographs of real environments for preference. A 5-point scale is used, with 1 meaning "don't like at all" to 5, meaning "like a great deal". This work is based on results of studies that show perception and preference to be closely related, the former being a key element of the latter. Such studies have highlighted that people have a strong preference for, and sensitivity toward, the natural world (Kaplan & Kaplan, 1989). Measurement of preference allows an examination of the perceptual process.

This section has put forward the justification for the use of colour slides to obtain measures of people's perception of their wild land content. The measure used was a variation of the one suggested by Kaplan & Kaplan (1989), a rating scale from 1 (not wild) to 5 (wild). The location of these photographs is discussed in the next section. The wildness ratings for these photographs were then used to develop predictive models of the wildness of a location, based upon the surrounding landscape attributes and this is the subject of Chapter 5.

3.3 Study Areas

There are many parts of Scotland that could potentially be perceived as being wild owing to the occurrence of certain landscape attributes. Inevitably, some are more popular and well known than others because of the ease of access by road from the central belt of Scotland. For the purposes of this study, which is based on the visual qualities of the landscape, it was thought that a comparison between areas that differ in these qualities would help to bring out the most important landscape attributes of wild land in Scotland.

In dealing with the concept of wild land one important factor that is used as an indicator of wildness is remoteness from roads or habitation (Lesslie *et al.*, 1988). The central mountain core of the Cairngorms fits these criteria by Scottish standards, although many of the areas along the west coast are criss-crossed by roads and dotted with small coastal settlements. The largest expanse of remote upland along the west coast is in Wester Ross. The Cairngorms and Wester Ross both contain some of the remotest land in Scotland and are therefore able to supply the longest landscape continuum from areas currently inhabited to those areas furthest from roads in Scotland. In the Cairngorms a transect from Glen Dee to Glen More cuts across the Cairngorm plateau. In Wester Ross, transects from Kinlochewe to Dundonnell, or Poolewe to Garve, cross equally remote land, if not as high as the Cairngorm plateau. Both areas contain the largest difference between land heavily influenced by humankind, i.e. a 'cultural' landscape, and land which has been relatively undisturbed, which could be labelled a 'natural' landscape.

Many of the differences in the visual landscape of these two areas can be explained by the contrast in climate and geology. The Cairngorm area has a greater seasonal temperature range than Wester Ross. It is also drier, but is covered in snow for longer periods, while Wester Ross is warmer and wetter, with snow only staying for short lengths of time on the mountains.

Both areas featured in *The Mountain Areas of Scotland* report (Countryside Commission for Scotland, 1991) because of the quality and wildness of the mountain core areas. These areas therefore have considerable inter and intra-area contrast in terms of landscape character. A comparison between the wild land attributes of these two remote and mountainous regions provides an insight into those landscape attributes which are location specific and those which are transferable between areas.

3.3.1 General Description Of The Wester Ross Study Area

The study area is bounded by the A832 and the A835 and is shown in Figure 7. The geology of Wester Ross is composed of two mountain groups, the Fisherfield and the Fannichs, formed from different rock types. The Fisherfield mountains are primarily sedimentary, with sandstone and grit, pipe-rock and basal quartzite, and the metamorphic quartzose felspathic schistoze flags. The Fannichs are composed of the metamorphic mica-schist, quartzose felspathic schistoze flags and intermediate and undifferentiated ortho-gneiss. Adjacent to the Fisherfield mountains and stretching down to the coast is an area of intermediate and undifferentiated ortho-gneiss, with epidiorite and hornblende schist lying in thin linear crests perpendicular to the coast.

The climate of the area is dominated by high rainfall, reaching 3200 mm per annum over the mountains, and 1600mm along the coast and further inland (Meteorological Office, 1989). Temperatures vary significantly with height and also distance from the coast. On the coast at sea level the mean daily minimum and maximum in January is 1.5 °C and 6.5 °C respectively, while inland it is 0.0 °C and 5.5 °C. In July these figures increase at the coast to 10 °C and 16.0 °C respectively.

The following deer forests are located within the study area: Strathnasheallag, Fisherfield, Letterewe, Kinlochewe, Lochrosque, Corriemoillie, Kinlochluichart, Braemore and Dundonnell. The location of the study area boundary (Figure 7) ensures a full continuum of wild land, from inhabited areas with road access, to areas remote from roads. There is also a continuum from beaches on the west and north-west coastal sections of the study area to high mountain tops at the centre. A transect placed within that framework allows the full altitudinal variation in the landscape to be studied.

The influence of human activity generally decreases towards the centre of this area. At the periphery of the area are numerous coastal and inland settlements along road and rail corridors with power lines nearby. The centre of the area is characterised by bulldozed tracks, conifer plantations (alongside the A835), mountain bothies (e.g. Shenavall in Strath na Sealga), farm houses (e.g. Heights of Kinlochewe) and the Loch Fannich reservoir and its dam. The obvious signs of cultural influence decline towards the centre of the area although there are occasional reminders that this has not always been the case as several shielings, field boundaries and old peat cuttings are still in evidence. Examples of these are found in Strath na Sealga.

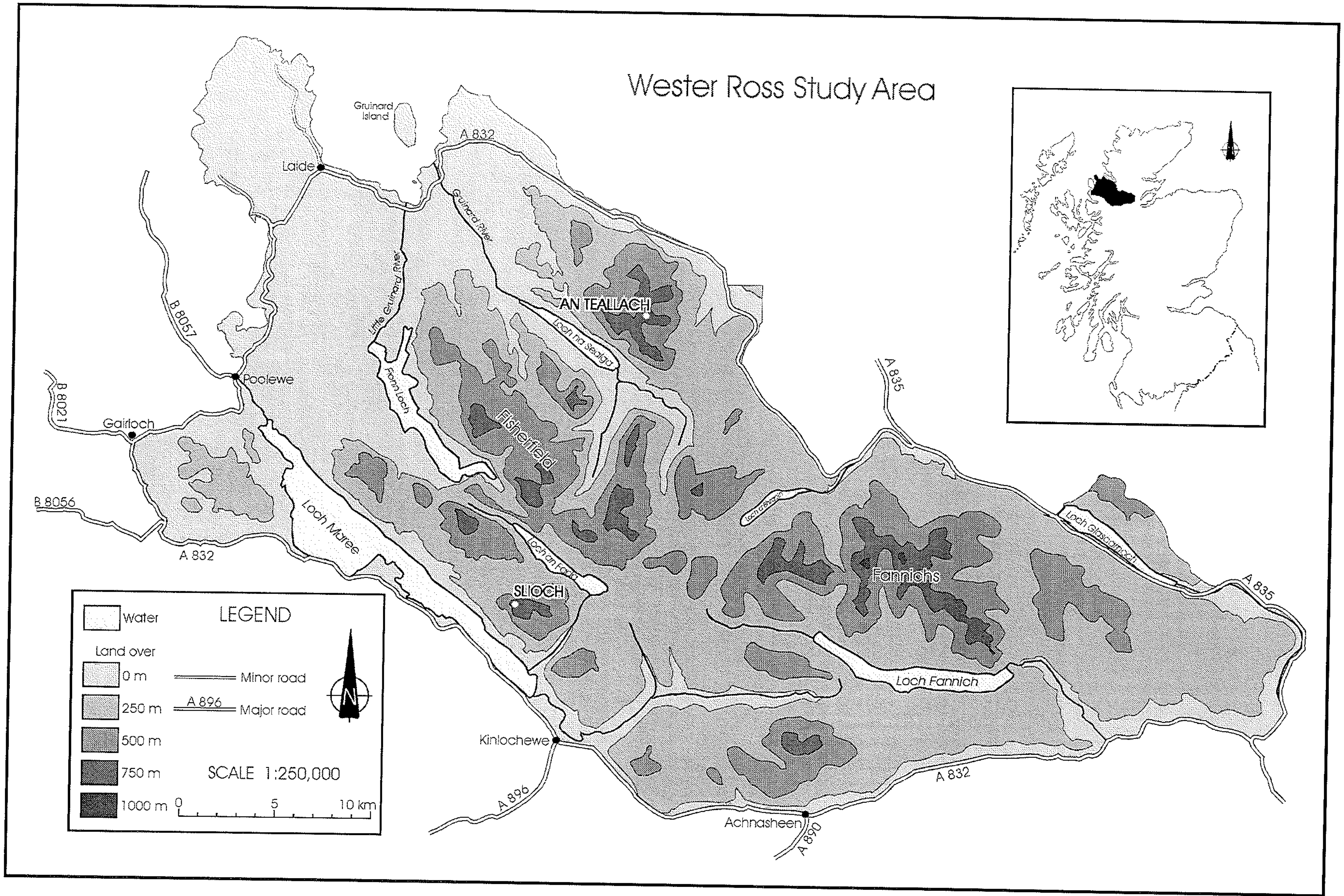


Figure 7 Location map of the Wester Ross study area.

3.3.2 General Description Of The Cairngorm Study Area

Figure 8 shows the Cairngorm study area which is bounded by the A9, A93, B976, A939, B970 and the water sheds of the River Feshie, and the River Dee to the south of Braemar. The Cairngorms are almost entirely made up of granite, surrounded by the metamorphic undifferentiated schists and gneisses. The bounding straths contain large deposits of sand and gravel. The climate of the area is dominated by a drier regime than in Wester Ross. Mean annual rainfall is 1200 mm in the straths and 3200 mm over the mountains (Meteorological Office, 1989). Temperatures within the study area vary significantly with height. Figures reduced to mean sea level indicate a mean daily minimum and maximum in January is -1.0 °C and 5.5 °C respectively. In July these figures increase to 10 °C and 19.0 °C respectively. Temperatures on the summit of the mountains will be 5 °C to 7 °C lower for the minimum and maximum recordings respectively. The colder winter temperatures hold any snow cover for longer into the year than in Wester Ross.

The area contains the following deer forests: Glenfeshie, Mar, Glenavon, Abernethy and the Queen's. As with Wester Ross a full wild land continuum exists, from inhabited areas with road access, to areas remote from roads which are in general the highest mountain tops in the centre of the area. A decrease in human influence on the landscape is evident towards the centre of the Cairngorm study area. The Highland villages and agricultural landscapes are located on the periphery of the area with conifer plantations on the higher and steeper slopes (Glen Dee and Glen More) along with areas of muirburn such as those in Glen Derry. The centre of the area is characterised by bulldozed tracks, deer fences, mountain bothies and ski developments in Coire Cas and Coire na Ciste. Evidence of past occupation of the landscape can be seen in the some of the remoter glens with shielings and old field patterns visible. In the very remote areas the principle evidence of human influence are the numerous footpaths which criss-cross the Cairngorm plateau and the intervening glens.

3.3.3 Landscape Attributes Of The Study Areas

This section outlines the landscape attributes of the Cairngorms and Wester Ross that were obtained with reference to Scottish Natural Heritage (SNH) landscape type and character assessments.

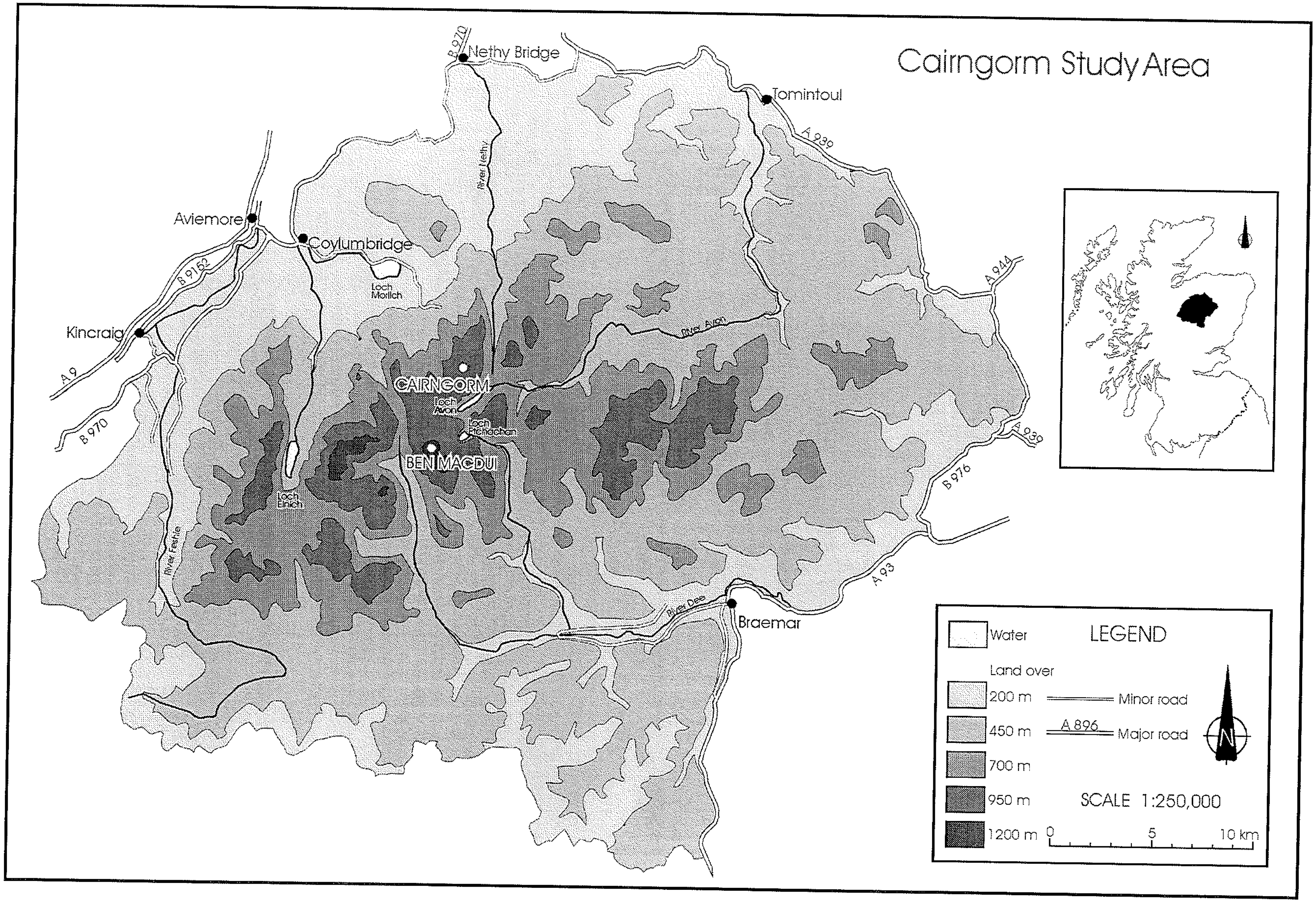


Figure 8 Location map of the Cairngorm study area.

The landscape attributes formed the basis of the photograph sites with the aim of obtaining a visual record, representative of the study areas. This method allowed the photograph set to include all of the characteristic landscape attributes of the two study areas providing a comprehensive and representative picture that could be used to assess perceptions of wild land. A random sampling approach, may not have given the comprehensive coverage of the characteristic landscape attributes required. In addition, random sampling could not have allowed specific features to dominate a photograph, a necessity if they were to be assessed in terms of wildness.

3.3.3.1 Landscape Attributes Of The Cairngorms

The report by Turnbull Jeffrey (1997) *Cairngorms Landscape Assessment* was the result of a project undertaken for the Research and Advisory Services Directorate, Landscape and Restoration Branch at Scottish Natural Heritage. The report classified the Cairngorm area into three broad landscape types primarily based on topography, simplified geology and land cover classification. These three categories were plateaux, uplands and glens, and straths. The study area was then split up into 21 landscape character areas with each one located entirely within the boundaries of one landscape type. This second tier of areas was identified by looking at more subtle differences in landform and drainage, vegetation cover and local settlement patterns.

Four of the landscape character areas identified by Turnbull Jeffrey (1997) fell within the study area boundary and for each one a list of landscape attributes was given, which taken together describe the definitive character of the area in question. The information in the Turnbull Jeffrey report along with the description of the Cairngorms given in 'The Mountain Areas of Scotland' (CCS, 1991), combined with personal observation and the use of the Ordnance Survey Landranger maps were integrated in Table 2 which shows all the attributes characteristic of the Cairngorm landscape.

Table 2 also defines the landscape attributes of the Cairngorms that were photographed for the purposes of this study. The list covers the entire height range from the straths to the mountain summits, the different types of vegetation in the area, and the range of geomorphological and geological features characteristic of the Cairngorms, ensuring a comprehensive and representative coverage of the area.

3.3.3.2 Landscape Attributes Of Wester Ross

A landscape character assessment for Wester Ross had not been published when this part of the project was undertaken but was due for completion in 1997 (SNH, pers. comm., 1996). As a result an alternative method was used to define landscape attributes that could be regarded as characteristic of the area. The *Mountain Areas of Scotland* (CCS, 1991) report, combined with personal observation and Ordnance Survey Landranger maps were used to develop the list of characteristic landscape attributes in Table 3. In addition, comparison with the landscape attributes for the Cairngorms highlighted the main categories which were required. Table 3 has been checked against the *Ross and Cromarty Landscape Character Assessment* following its publication (Ferguson McIlveen, 1998) and no major differences or omissions in the landscape attributes identified were noted.

3.4 Population Sampling Method

The purpose of this study was to assess the perceptions of wild land by representative members of groups undertaking different activities within rural areas of Scotland. On that basis the study aimed to increase theoretical understanding within a particular area of knowledge for specific sample groups rather than obtain a representative sample of the general public in order to generalise the study findings. The sampling frame for this project was defined from a population which includes people who live in Scotland and work, play or live in the Scottish uplands. This includes walkers, climbers, skiers, farmers, stalkers, conservation managers and local inhabitants. This sampling approach does not mean that other possible populations of respondents such as English and Welsh visitors are unimportant, but simply that resources were unavailable for seeking their views. Owing to the nature of the study a stratified sample was used in order to increase the precision of the data. The following strata were used: a) activity and b) experience and background; both of which have been shown to effect the perception of wilderness (Kearsley, 1990). Stratification of the sample produces a lower standard error by removing any between strata variation which may account for part of the total variation, the rest being explained by the within strata variation (Gilbert, 1993).

Table 2 Cairngorm Landscape Character Attributes

Landscape Character Attributes	Attribute Type
extensive undulating plateaux 800 - 1200m	Geological
rocky corries	
trough-like glens	
dark lochs - elongated or basin	
sheer rock faces	
summit tors	
broad ridges	
low, rounded summits 400 - 700m	
gentle slopes	
long smooth interlocking spurs	
long, curving strath 0 - 400m	
broad, open glens	
river marsh complex	Geomorphological
gravel and sand slopes	
boulder fields	
small burns	
wide, fast flowing rivers	
snow patches	Climatic
heather moorland	Land cover - vegetation
muirburn	
peat hags	
small broad-leaved woodlands	
rough grass and moss - lower and wetter slopes	
small scale plantations	
stands of even aged trees	
extensive woodland	
remnants of native pine woodland	
improved pasture	
plantations of Scots pine, larch and spruce	
deciduous woodland	
vehicular tracks	Human artefacts
upland farmhouses, estate lodges	
ruined buildings, shielings	
road, railway	
mountain bothies	
footpaths	
cairns	
ski lifts	
power lines	
deer fencing	
large country houses and castles	
Highland villages	

A two stage sampling strategy was employed with purposive sampling at the first stage in the selection of organisations and areas to sample. The first stage provided a sample of individuals from the electoral register, and the membership directories of certain organisations e.g. the Mountaineering Council of Scotland, and all of whom have some form of contact with rural areas of Scotland.

Table 3 Wester Ross Landscape Character Attributes

Landscape Character Attributes	Attribute Type
scattered individual mountains	Geological
small rocky summits 600 - 1000m	
rocky corries	
trough-like glens	
dark lochs - elongated or basin	
sheer rock faces	
narrow ridges	
low, rounded summits 400 - 600m	
narrow glens	
steep, narrow straths 0 - 400m	
gravel and sand slopes / scree	Geomorphological
boulder fields	
small burns	
beaches	
narrow, fast flowing rivers	
heather moorland	Land cover - vegetation
peat hags	
small broad-leaved woodlands	
rough grass and moss - lower and wetter slopes	
small scale plantations	
stands of even aged trees	
remnants of native pine woodland	
improved pasture	
plantations of Scots pine, larch and spruce	
vehicular tracks	Human artefacts
upland farmhouses, estate lodges	
ruined buildings, shielings	
roads	
mountain bothies	
footpaths	
cairns	
deer fencing	
power lines	
dams, reservoirs	
coastal settlements	

The second stage involved probability sampling to select randomly local inhabitants from the electoral register and the selection of individuals from the organisations identified in the first stage.

Local inhabitants, rural outdoor workers, mountaineers and conservation managers who would be affected directly by wild land management policies form the basis of the research population. More specifically this includes those people who have direct contact with the land in some way, e.g. the local inhabitants, those who work on the land, and the visitors to these areas. The reason for including the two groups of those who live, and those who work within sight of potential wild land areas is that they are most likely to be affected either directly (e.g. through the provision of jobs) or indirectly (e.g. as the result of an increase in visitors) by the implementation of a wild land management policy within such an area. The sampling frame is summarised in Table 4.

The visitor group includes those who have direct contact with remote areas of Scotland, including walkers, climbers, cross - country skiers, ski - mountaineers, and naturalists. The rationale for including visitors in the study is based on the remit of Scottish Natural Heritage (SNH) who recommend management strategies for certain areas of the Scottish uplands and mountains (e.g. National Nature Reserves (NNRs), Sites of Special Scientific Interest (SSSIs)), to provide for the quiet enjoyment of the countryside. In addition, should designation of wild land areas occur in the future, it would be funded from the public purse, which is another reason for the inclusion of the views of people not permanently living in an area. Other conservation bodies who own large tracts of the Scottish Highlands such as the National Trust for Scotland and the Royal Society for the Protection of Birds, often see recreation as an appropriate use for their land, and encourage access while protecting various habitats for endangered and rare species. A similar approach is taken in the USA, where public ownership of the land dictates that determining visitor preferences for wilderness conditions is an important source of information for wilderness management (Hollenhorst & Gardner, 1994).

The fourth group contains those who manage areas of countryside primarily for the conservation and protection of wildlife, and amenity values. Studies from the USA and Denmark have indicated that the perceptions of conservation managers differ from those of the general public (Hendee & Harris, 1970; Jensen, 1993; Peterson, 1974) with managers tending to have purer views of wilderness (Hendee & Harris, 1970; Peterson, 1974). As a result there is a need to assess the perceptions of managers so that any differences between their views and those of the general population, represented in this study by the rural inhabitant group, can be quantified.

Table 4 The first and second stages of the sampling strategy.

First stage	Second stage
Obtain electoral register listings for wards around Wester Ross and the Cairngorms	Randomly select individuals from the electoral register
Mountaineering Council of Scotland list of affiliated clubs	Individual club members selected by club secretary
List of stalkers and gamekeepers from *Heading for the Scottish Hills* (MCofS & SLF, 1996)	Assemble list of those willing to complete the survey
Scottish Wildlife and Countryside Link list of organisations	SWCL contact within each organisation selected the individuals to complete the survey

The study population identified above was subdivided into four sample groups to enable the testing of the hypotheses detailed in Chapter 2 and to aid the distribution of the questionnaires. All the sample groups were contacted by post. Other possibilities of contact were considered, for example, the mountaineering population could have been sampled by interviewing people within, or at the edges of, upland areas. The rural inhabitants and rural outdoor workers groups could have been contacted through a door to door survey. Interviewing members of environmental organisations would have entailed travelling to their workplaces. However with constraints of time and money, a postal questionnaire was considered the most efficient and effective method of obtaining a suitable sample size for the study.

3.4.1 Sample Size

The overall sample size was restricted to some degree by the funds available for the production of the questionnaire and the time required for the administration of a large postal survey. To accommodate these constraints and still obtain a sample large enough to be statistically valid the final number of questionnaires was set at 1000 which were divided between the four sample groups. The return rate was expected to be in the region of 50%, which is slightly lower than figures quoted for previous studies conducted in the USA which regularly achieve rates of 80% (Roggenbuck & Lucas, 1987) and where people are thought to be more obliging in completing questionnaires than in Scotland (Aitken, 1977). The expected return rate was in the region of 100 cases for each of the four sample groups.

3.5 Sample Groups

3.5.1 Mountaineers, Hill Walkers And Climbers

The Mountaineering Council of Scotland (MCofS) endorsed the questionnaire and allowed questionnaires to be distributed to their member clubs. Some problems with this sampling strategy have been raised by Aitken (1977):

1. The relationship between mountaineers who are club members and those who are not is unknown, and this may cause the sample to be biased against those who undertake mountaineering independently.
2. Clubs, by their very nature, contain members with certain social characteristics.

With regard to point 1, previous studies have shown that the percentage of mountaineers who are members of hill walking / mountaineering clubs is between 6 and 34 % (Rivington, 1994; Hunt & Wilkinson, 1995). A comparison of the socio-economic data on club mountaineers (Aitken, 1977), to data available from mountaineers in general (Hunt & Wilkinson, 1995; Davison, 1997) suggests that the two groups are very similar. These studies suggest that mountaineers are generally male, between 25 and 54 in professional or technical, full-time employment (Rivington, 1994; Hunt & Wilkinson, 1995; Davison, 1997). By sending questionnaires to all the clubs affiliated to the MCofS, the largest cross section of the population of mountaineering clubs was obtained.

In order to obtain a sample of at least 100 respondents and assuming a response rate of under 50 %, 2 questionnaires were sent to each of the 134 club secretaries, giving a grand total of 268 questionnaires. An article in the MCofS newsletter *'The Mountaineering Council of Scotland News'* (no. 31 - February 1997) was used to raise the profile of the issue of wild land and stimulate interest with the intention of increasing the return rate of the questionnaires.

3.5.2 Rural Inhabitants

The electoral register was used to provide a list of the inhabitants in and around the two study areas. A map of the electoral wards administered by the Assessors and Electoral Registration Office for Highland and Western Isles Council (Inverness), was used to select those wards that were located within the two study areas. The majority of the Wester Ross study area was covered by the Gairloch and Garve electoral ward. The Cairngorm study area included parts of the Kingussie and Kincraig, Aviemore, and

Carrbridge and Nethybridge electoral wards. 500 names were randomly selected for each study area from these wards. The number of names selected was based on the results of previous studies which indicated that the return rate would be low for surveys of the general public (Gilbert, 1993).

In an attempt to increase the potential return rate of this sample group, people were contacted by telephone and asked if they would be willing to fill in a questionnaire. This technique can help to save time and money by ensuring that the majority of questionnaires will be returned. However, this method can bias sampling to those with a telephone and a listing in the telephone directory. Therefore to reduce this degree of bias 70% of people in this sample group were contacted by telephone and the remainder were made up from those who were not listed in the telephone directory. In total 300 questionnaires were sent to this sample group.

3.5.3 Rural Outdoor Workers

This sample group was contacted with the help of *Heading for the Scottish Hills* (Mountaineering Council of Scotland and the Scottish Landowners Federation, 1996). The publication contains boundary maps for most of Scotland's estates especially those in the Highlands and those further south in upland areas and provides a contact number and / or address for each. The majority of the contacts listed are estate workers (e.g. stalkers, ghillies and gamekeepers) although some are estate owners or factors. The people listed were contacted by telephone and asked if they would be prepared to take part in the study. In some cases a telephone number was not available although a full postal address was given in which case they were sent a questionnaire. A total of 254 questionnaires was posted to members of this sample group.

3.5.4 Conservation Managers

The Scottish Wildlife and Countryside Link (SWCL) is an umbrella organisation containing 35 voluntary wildlife, amenity and environmental protection groups working in Scotland. SWCL agreed that their members could be contacted and sent a memo of support with each questionnaire. Three questionnaires were sent to each organisation (a total of 105).

3.6 Creating The Photographic Database

The first stage in developing a photographic questionnaire is to gather a collection of suitable photographs from which the final selection can be taken. Having established the characteristic landscape attributes of the two study areas, the method used to record these using photographs is the subject of this section.

3.6.1 Criteria For Taking Photographs

The sampling of landscape attributes is very important when results are going to be used in generalising to other settings. In this study the wildness ratings of the photographs presented in the questionnaire were used to develop a GIS model, which was then used to predict the wildness of other locations within the two study areas. A non-random sampling procedure was used to ensure that the characteristic landscape attributes of the two areas were recorded. In any survey involving photographs there is the problem of how many can be used, as previous studies have found that there is an upper limit governing the number of pictures that respondents will look at. Four pages, each containing eight photographs are considered to be a reasonable number as are 60 slides when viewed in one sitting (Kaplan & Kaplan, 1989). With the layout and cost constraints of a paper questionnaire it was decided to use six pages, each with eight images, giving a total of 48 photographs as used by Steinitz (1990).

Previous studies have shown that for a representative sample several photographs of a particular setting are required (Kaplan & Kaplan, 1989), e.g. a mountain top view or a glen. The question of seasonal and climatic variation also had to be considered in the criteria for taking photographs, and this was especially important in Scotland with the country's reputation for fickle weather. In addition Zube *et al.* (1987) discussed the need for the careful control of all potential technical variables such as composition, framing, exposure, and random vs. non-random sampling. One study by Nassauer (1983) suggests that photographic framing, that matches strong horizontal or vertical orientations of scenic landscapes, has an effect on viewer ratings and therefore should be avoided.

Taking all the above factors into account the following method was used to take the photographs:

1. All pictures were taken using a 35mm Single Lens Reflex (SLR) camera with a 50mm lens. The camera was mounted and levelled on a tripod at a height as near eye-level as possible. The camera was levelled to allow the reconstruction of viewsheds later on during the GIS analysis.

2. Colour slide film was used to produce colour pictures for the questionnaire. The film type used was Fujichrome Velvia with a 50ASA rating. Velvia is a professional film and produces high resolution slides ideal for scanning.
3. To standardise light conditions as far as possible photographs were taken between 0900 hrs. and 1700 hrs. on predominantly cloudless days in the summer of 1996.
4. Each photographic frame had one dominant landscape feature taken from Table 2 and Table 3.
5. At each photograph location the following information was collected:
   a) The time and date.
   b) The camera position as a six figure OS grid reference using a hand held Magellan GPS unit.
   c) The altitude of the camera position using a Casio Weather Station wrist watch, double checked with reference to contours on an OS Landranger map.
   d) The magnetic bearing from the camera to the centre of the scene (located using the camera viewfinder) using a sighting compass.

3.6.2 Difficulties Encountered

Having to level the camera on the tripod before taking a photograph meant that the position from which a picture was taken was the main factor controlling composition. Using only a 50 mm lens to ensure consistency in the method required more ground to be covered in that landscape features that would have been readily accessible with a longer lens (e.g. 180 mm) had to be taken by either moving position, or capturing more landscape features in the picture than was initially intended. Patchy cloud on some days ensured a lot of waiting around for the picture in view to be evenly lit to avoid erratic shadows in the picture.

3.7 Selection Of The Final Slide Set

A total of 300 photographs were taken during the summer of 1996 in the two study areas. In order to generate a set of 48 slides for the questionnaire, a method of selecting the most appropriate scenes was required. Deciding on the number of types and instances of a particular scene involves a degree of arbitrariness (Kaplan & Kaplan, 1989), although a degree of objectivity was brought to the process through the use of a focus group.

To start with, any frames that were duplicated, out of focus, or contained optical reflections were immediately discarded. For the purposes of digitisation Orland (1994) emphasises the need for high colour saturation and high image contrast, criteria that were fulfilled by most of the slides because of the film type and the bright lighting conditions. The photographs had been bracketed to ensure a perfect exposure, this meant that there was usually one picture that was underexposed, one correctly exposed and another slightly overexposed. A test carried out with the slide scanner, used for the production of both the pilot study and the final questionnaires, produced clearer results with better colour resolution from slightly overexposed slides than with underexposed pictures. Therefore, where a choice was available, the slightly overexposed slide was chosen.

The tables of characteristic landscape attributes (Table 2 and Table 3) that were used when taking the photographs were used to check the ease with which the attributes could be mapped. Certain categories were excluded from further consideration because of the inability to incorporate them into a GIS database due to their omission from the OS 1:25,000 Pathfinder maps. The features discarded were peat hags, river marsh complex, long smooth interlocking spurs, small rocky summits between 600 and 1000m, narrow ridges (this feature was really only visible to those venturing onto such features, and not by those travelling through the surrounding landscape), steep narrow straths between 0 and 400m, and cairns. The following categories were also combined:

1. 'small scale plantations' and 'plantations of Scots pine, larch and spruce';
2. 'deciduous woodland' and 'small broad-leaved woodlands'.

Before choosing the picture categories which were to go into the final set of photographs, 4 broad "super" categories were developed. These were:

1. Cairngorms natural pictures,
2. Wester Ross natural pictures,
3. Human artefact pictures,
4. Land cover pictures.

These 4 categories were chosen on the following basis:

Categories 1 and 2 (Cairngorms and Wester Ross natural pictures) consisted of photographs of landscape attributes devoid of any evidence of human influence. They were chosen so that any difference in the perception of wild land resulting from the intrinsic landscape features of the two areas could be tested.

Category 3 (Human artefact pictures) included components of the built environment such as roads, skiing facilities, tracks and buildings. These were chosen to test the effect of human artefacts on the perception of wild land. These photographs were taken from both study areas as there appeared to be little, if any, difference between the artefacts found in both areas.

Category 4 (Land cover pictures) includes photographs of forestry plantations, muirburn and improved grassland. These were chosen to examine the effect of a 'managed landscape' on the perception of wild land. The responses to these pictures were compared with those from the more pristine, and less intensively managed upland areas and the high tops present in the 'natural pictures' categories.

3.7.1 Picture Test

After the first stage of the photograph selection process there remained a set of 119 slides which had to be reduced to a set of no more than 48 for inclusion in the questionnaire. In order to select the most suitable slides by ensuring that certain landscape features were represented in the final questionnaire, a short experiment was conducted to discover which were the dominant landscape features within each picture. By asking people what they saw in each image, it was possible to choose the most suitable slides. This choice required a test of how certain landscape features affected a persons perception of wildness, for which it was necessary to find out whether that feature was dominant within the photograph.

A total of 119 slides were shown for 2 seconds each to a group of 35 people comprising volunteers from the Department of Environmental Science at the University of Stirling. The viewers were asked to write down the two main landscape features in each picture. The data were collated for each photograph as frequency counts for specified landscape features. As not all landscape features were present in each photograph, the data was filtered to remove the blank cells and then sorted by frequency count. Bar graphs were then used to enable comparison of the responses to all of the photographs.

3.7.2 The Selection Process

The 119 graphs were divided into the 4 'super' categories based on visual inspection of the slides. Within each of these 'super' categories, those graphs relating to photographs depicting the same dominant landscape feature were grouped together for further comparison. Preliminary assessment of the data showed that a cut off point of 25 counts (or 71% of respondents) would identify around 12 slides from each category, the number needed for the final questionnaire. In some cases the cut off point was reduced to 21 counts (60% of respondents) in order to identify the required number of photographs. A summary of this analysis is presented in Table 5.

Table 5 Summary of the number of image categories and photographs achieving a certain frequency count for a dominant feature, for each of the 'super' categories.

Super categories	Number of categories	Images scoring >25	Images scoring >21
Cairngorms	11	13	17
Wester Ross	10	17	25
Land cover	8	8	16
Human Artefacts	18	20	25

Further rationalisation was required when there were more than 2 pictures with the same dominant feature scoring over 25. For example, in the Cairngorms natural pictures group, the loch category contained 5 images with scores over 25. In this case two dominant features in each image had been identified by the viewers: a loch and a mountain, so the sum of the counts for the two features in the 5 images were compared and the highest sum was selected. In some cases slides that would be selected on the basis of the above criteria, were subsequently rejected because the picture had slipped through the first selection round and was too cloudy or dark. The final selection of slides can be seen in the copy of the questionnaire (Appendix 1).

The locations of the photographs are shown for the Cairngorms in Figure 9 and for Wester Ross in Figure 10. Appendix 2 lists the exact locations and the magnetic bearing in which each photograph was taken.

3.8 Questionnaire Design

3.8.1 The Questions

In wilderness user research the type of questionnaire most often used is the self-completion postal type, as this has been shown to be an effective method for eliciting the views of a large sample of users and is also relatively cheap in comparison to face-to-face interviews. In general, two disadvantages of using questionnaires include a low response rate (less than 50%) and the illegibility of some answers (Gilbert, 1993).

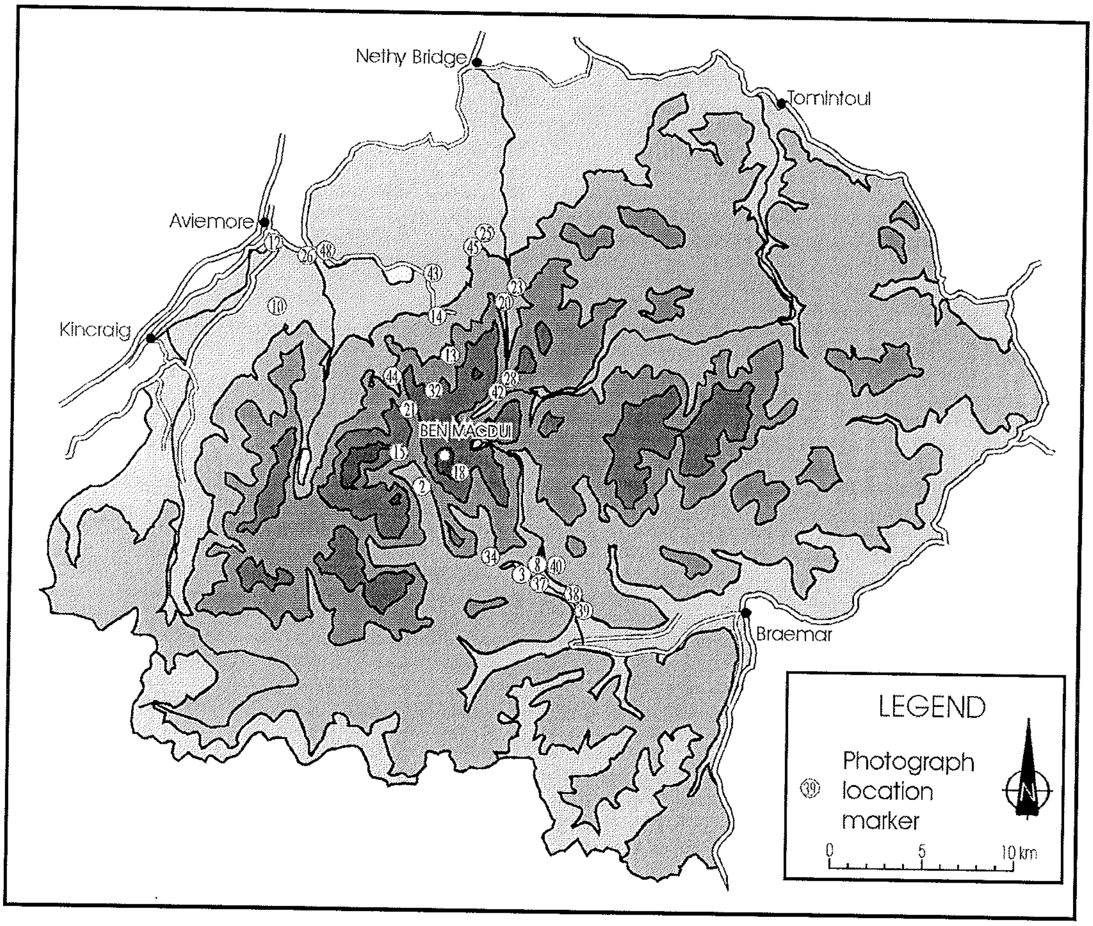


Figure 9 Points from which the questionnaire photographs were taken within the Cairngorm study area.

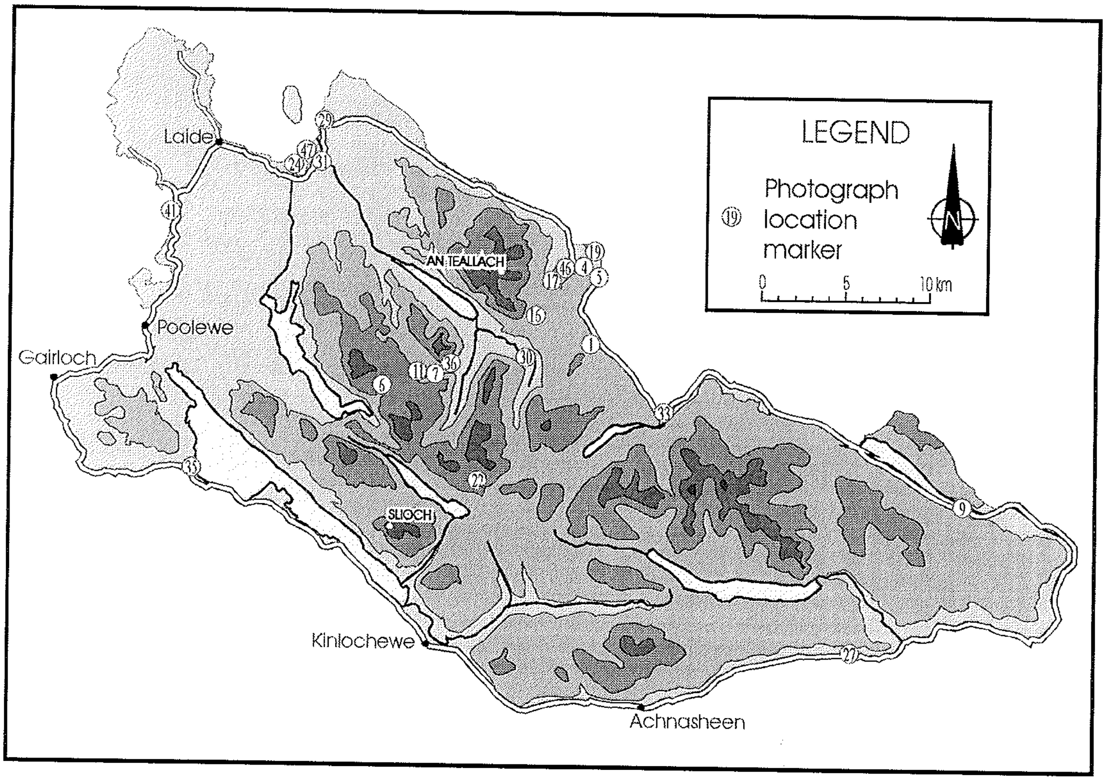


Figure 10 Points from which the questionnaire photographs were taken within the Wester Ross study area.

However, low response rate does not appear to be such a large problem for surveys focusing on wilderness areas and recreation with return rates of 80% and higher (Roggenbuck & Lucas, 1987). The reason for this high return rate can only be speculated at, although Blau's (1964) theory of social exchange could provide one reason. This theory argues that individual actions are motivated by the 'rewards' they are likely to receive from others. Wild land is a highly valued resource and as such instils a strong desire to help conserve it in some way. This desire may be partly satisfied by answering questions on the subject of wilderness if the research can be shown to be working towards this goal. The costs of time and mental energy spent by the respondent will have been rewarded with the feeling that their contribution may help protect the wild land resource (Blau, 1964).

The method of producing effective questions is based on Gilbert (1993). Based on the general hypotheses developed for the study (see Chapter 2), a series of questions were developed to cover the following aspects of the respondents and their perceptions of wild land in Scotland:

1. Activities:
   a) type,
   b) experience.
2. Attitudes:
   a) perception of wild land areas,
   b) distribution of wild land areas,
   c) wildness, naturalness, beauty and location of 48 scenes.
3. Socio-economic profile data.

The questions were presented in the order listed above (Appendix 1). Questions 1, 2, 4 and 5 asked about the activities people undertook in upland areas. The choice of activities listed in question 1 was developed from those used in previous studies (Rivington, 1994) and was chosen to reflect the likely range of pastimes in the four sample groups. Additions to the list were made following pilot tests. Experience has been shown to be a factor that can influence perceptions of wilderness (Henderson, 1992), and question 2 allowed this to be tested in a Scottish context. The list of organisations in question 3 was developed with the help of previous studies (Rivington, 1994) and results from the pilot survey. Data from this question helped test the discrepancy between membership of conservation organisations and wilderness users that was identified in the USA (Roggenbuck & Lucas, 1987).

Some of the questions used were taken from Aitken's 1977 survey to enable a comparison of the two data sets, separated by 25 years. Two unavoidable problems associated with the design of Aitken's questionnaire were therefore also present in the current study. The first was the decision to allow respondents to define 'wild' in their own terms, rather than give one or a selection of definitions for people to use which could then affect the manner in which responses were given. The second issue concerned the definition of the boundaries of upland areas in question 14 for which respondents were asked to specify whether or not they contained wild land. By indicating only the approximate position of the areas on a map, the specific boundary was left for the respondent to define. The problem with this approach is that respondents may define the boundary of an area differently and may consider different parts of that area to be wild. However, to reduce the effect of this problem all the areas listed were chosen for their readily defined boundaries (Aitken, 1977). The list of areas presented in question 14 is identical to that used by Aitken with the addition of Wester Ross.

Questions 6 to 12 ask the respondent about their views on what wild land is and where it might be found. These questions were developed to obtain an idea of the geographical nature of wild land and the influence of weather on perception of wild land.

Many questions were chosen so that the results would be comparable to existing data. This was particularly important for question 13 which is an adaptation of Stankey's (1972) wilderness purism scale, used by many authors including Kliskey & Kearsley (1993), Shafer & Hammitt (1995), Shultis (1991) in Kliskey & Kearsley (1993) and Warren (1986). This scale was developed to measure the extent to which a respondent's perception of wilderness coincided with the institutional objectives embodied in the US Wilderness Act (Stankey, 1972). This method categorises people as strong purists, moderate purists, neutralists or nonpurists depending on their responses.

Questions 17 to 22, which asked for socio-economic data, were chosen to allow comparison of respondents with socio-economic information from the last census in order to assess how representative they were of the general population of Scotland and how they compared to participants in previous wild land surveys. Requesting the first half of the postcode for the respondent's permanent home enabled the distribution of respondents throughout Scotland to be mapped. Census information is also available for all postcodes in the UK, including a rural - urban classification which was used in the analysis.

The section in which respondents were asked to rate 48 photographs was introduced by question 15. Three rating scales were presented beneath each photograph with the opportunity to state if the location was known to the respondent. This last point is important as it has been shown that familiarity can influence preference and interest for a location (Hammitt, 1979; Purcell, 1992). The rating scales were used to enable analysis of the relationships between the three factors of wildness, beauty and naturalness. Rating photographs on a wildness scale is something that does not appear to have been attempted before. However there are many studies in which respondents have been asked to rate photographs in terms of beauty (Culbertson *et al.*, 1994; Daniel & Boster, 1976; Hodgson & Thayer Jr., 1980; Hull IV & Bishop, 1988; Steinitz, 1990) and one in which a rating of naturalness was made (Lamb & Purcell, 1990).

3.8.2 Layout Of The Questionnaire

The layout of the questionnaire was designed to be computer readable. The layout was developed to be used with Remark Office OMR version 3.0a (Principa Products, 1996), a software package that uses a scanner with a sheet feeder to collate data from completed questionnaires. A template questionnaire was created in which an oval was drawn adjacent to each answer. These ovals were highlighted as data fields within the computerised questionnaire template. Responses to questions were indicated by shading the oval adjacent to the chosen answer. Completed questionnaires were scanned and compared to the blank template to highlight the chosen responses. The output from the software was a SPSS compatible spreadsheet containing the data from the scanned questionnaires. The software was capable of handling double sided, multiple page questionnaires and the scanner could take up to 50 sheets at a time (equivalent to approximately 8 questionnaires).

3.9 Pilot Surveys And Questionnaire Revision

The pilot study was used to focus the questions being asked and to develop the range of pre-coded answers offered in the closed questions. It also provided an opportunity to test the layout of the questionnaire, the wording of both the questions and the instructions, the quality and content of the photographs and to see how much time it required to be completed. To be effective it also had to be targeted towards the intended audience. An important part of this process involved undertaking a pilot survey of a sample of people taken from the population under study. For this purpose two pilot sample groups were chosen to represent the four groups already identified. The first of these was a class of M.Sc. Environmental Management students in the Department of Environmental Science at the University of Stirling. This group was assumed to resemble closely the conservation organisations group and included some backpackers and climbers, characteristic of the mountaineering group. The second group consisted of stalkers, estate workers and farmers, representatives of both the rural outdoor workers group and the rural inhabitants group.

3.9.1 M.Sc. Students

This group was chosen because of the ease with which they could be questioned and the representativeness of the sample group. Analysis of the results showed a wide age spread as well as a spread of interests. From this group 21 useable responses were obtained. Because of cost constraints, the photographs used in this exercise were shared, one copy between two students, and this increased the time needed to complete the questionnaire. In general the comments received were related mainly to the length of the questionnaire, it being too long for some people, and the number of photographs that were presented, which were thought to be too many.

3.9.2 Stalkers, Estate Workers And Farmers

A group of ten people were contacted and asked if they would participate in the pilot study. They were chosen because of their proximity to Stirling and therefore the ease with which it would be possible to visit them. The selection was made from a directory of estates and farms covering most of upland Scotland titled *Heading for the Scottish Hills* (MCofS & SLF, 1996). A copy of the questionnaire was sent to each person and subsequently followed up with a visit to discuss what the person thought of the questionnaire. The ten people were visited on the 7th and 9th of January, 1997. From talking to the respondents it became clear that many had a great deal of experience of working in other parts of Scotland. So although the people were chosen on the basis of a specific geographical location, their experiences represented a much greater area of Scotland than that in which they lived at present.

Comments from the visits were incorporated into the questionnaire and mainly referred to the absence of certain organisations of which the interviewees were members. Other points were related to the wording and ambiguity of certain questions and the quality of some photographs. Photograph no. 41 in particular, which shows a coastal scene in Wester Ross and includes a village, proved to be problematic as not everybody could distinguish the village and some people interpreted it as a pile of rocks. One person suggested that photograph 13 contained pipelines, when in fact the linear features are the snow fences in Coire Cas, Cairngorms. Several people suggested that photograph 42 of Loch Avon in the Cairngorms, was in fact a reservoir. One person suggested that the linear features in photograph 44 were walls and not footpaths as is the case. These discrepancies between what people had interpreted and what was actually depicted in the photograph highlighted the need for high resolution copies. The pilot study questionnaire was produced in house at the University, whereas the main survey was sent to printing firm, ensuring a higher quality product. The resolution of the photographs in the main survey were superior to those used in the pilot survey and therefore the problems associated with the quality of the photographs in the pilot study were not expected to pose a problem in the main survey.

3.10 The Main Survey

The six text pages of the questionnaire were created using Microsoft Word. The six pages of photographs were produced by scanning the selected slides using Adobe Photoshop and then importing the pictures onto pages created with Adobe Illustrator. The questionnaire was printed double sided to reduce the cost of both printing and postage, resulting in a six leaf, twelve page questionnaire. The text pages were produced at the University while the pages of photographs were handled by a local printing firm.

The questionnaire along with a covering letter and a return envelope was sent to the number of people in each sample group as outlined on page 59 on the 27th February 1997. Respondents were given until the 17th March to reply, after which a reminder was sent to those who had not replied. The return date specified on the reminder was the 7th April 1997. To give the respondents an incentive to complete the questionnaire, for those who wished, there was the chance to be entered into a prize draw to win a £25 book token. Copies of the questionnaire, examples of sample group covering letters and the reminder letter can be seen in Appendix 1.

3.11 Chapter Summary

In this chapter the method used to gather data on people's perception of wild land in Scotland was outlined. The data collection instrument used was a photographic questionnaire. The discussion regarding the validity and reliability of photographs as surrogates for real landscapes concluded that it is a successful technique and this is supported by many previous studies (Zube *et al.*, 1987; Stamps III, 1993). The Cairngorm and Wester Ross study areas were chosen because of their differences in visual character and the remoteness of the centre of each area. The characteristic landscape attributes of both study areas were photographed with reference to existing landscape surveys and the final set of 48 photographs selected with the help of a focus group. The questions used were designed to tackle the main components of wild land perception including the visual nature of wild landscapes, their distribution and location within Scotland, and the required social conditions for a 'wild land' experience. In addition, data were gathered in order to assess how representative the respondents were of the general public. The four sample groups selected are all connected by their direct contact with potential wild land areas, whether through their work, recreation or the location of their home. The reliability of the technique of using questionnaire surveys was discussed and the necessary checks and balances put in place to reduce potential sources of error. How the data from the questionnaire was analysed and what the results showed about perception of wild land in Scotland is the subject of the next chapter.

Chapter 4

Wild Land Questionnaire Analysis and Results

4.1 Introduction

The data from the returned questionnaires were collated and checked for errors before establishing the existence of perceived wild land in Scotland and how it differs between the sample groups. The analysis began with a detailed assessment of the landscape attributes of perceived wild land and the degree of social interaction people tolerate in the context of a wild land experience. This was achieved by testing the hypotheses developed in Chapter 2 regarding the potential relationships between people's perceptions of wild land and the physical makeup of the surrounding landscape. The socio-economic characteristics of the sample groups were explored to assess sample group representativeness of the Scottish population in general, as was the nature of their interaction with rural areas. In order to test the relativity of the wildness concept, the perceived wildness of different parts of Scotland is then presented. In conjunction with this analysis, the stability of wild land perceptions over the last 25 years was assessed. The analysis then moved on to explore the relationship between wildness, naturalness and beauty to establish the degree to which the concept of wild land is differentiated from the others. The influence of familiarity with a location on its perceived wildness is then considered as a possible explanation for perceptual differences between the sample groups. The nature of the photograph wildness ratings were assessed in terms of their similarity between the sample groups and the full range of photographs. The chapter finishes with a discussion of how the photograph ratings were organised prior to their use as input for the development of the GIS based wildness model for the spatial expression of perceived wildness.

4.2 Data Collation And Checking

The questionnaire was designed to be computer readable; the use of the Remark Office OMR version 3.0a (Principa Products, 1996) software saved a great deal of time in terms of data entry, given the 459 questionnaires that were returned. The completed spreadsheet was imported into SPSS for the data analysis. To ensure the software was performing correctly, a test of the accuracy and precision of the system was conducted prior to the collation of all the questionnaires.

4.2.1 Accuracy Of The Scanning Device

Two short experiments were undertaken to check the precision and accuracy of the scanning device. Firstly, 8 questionnaires were scanned into a spreadsheet and the results checked by eye. In some cases faint answer marks were not picked up by the scanner. The faint marks were the result of a pencil being used to tick boxes even though respondents had specifically been asked to shade in the boxes with a black or blue pen. Therefore, in any questionnaires where the answers were faintly marked, a black marker was used to shade in properly the respondent's highlighted answer before scanning. The second test checked the accuracy of the scanner by scanning the same questionnaire five times and then using the paper copy to confirm the answers in the spreadsheet. No anomalies were found in the scanned data.

4.2.2 Return Rate

There is general disagreement on acceptable response rates among social scientists (Dolsen & Machlis, 1991). In a study to examine the validity of a range of response rates, Dolsen & Machlis (1991) concluded by saying that rejecting study results with response rates between 35 to 50 percent may be justified. However, Hammitt & McDonald (1982) in a further study dealing with selected recreation samples, suggested that a return rate of 30 % was sufficient with few significant differences found between the views of respondents and non-respondents, or between early and late respondents. Nevertheless, the extent to which the findings from a study can be generalised depends, in part, on the representativeness of the respondents (Dolsen & Machlis, 1991). The overall return rate in this study was 49.5%, a detailed breakdown of responses is shown in Table 6. A total of 927 questionnaires were sent out and, of those returned, 459 were useable. By way of comparison the return rate for the Glencoe visitor opinion surveys was between 4% and 12.3% (Argyll Associates, 1993). Hence the return rate of the current study is relatively high for a postal questionnaire in the UK.

4.2.3 Data Quality Checks Prior To Main Analysis

In order to make sure that the data were 'clean' before beginning the main analysis, the whole data set was checked for errors. For each variable checks were carried out to ensure that the minimum and maximum values were within the allowed range and that combinations of answers were sensible, e.g. age and experience. The scanning software had previously checked for multiple responses to a question where only a single answer was required, but a manual check was also made of the combination of answers to questions allowing multiple responses. Any anomalies were cross checked with the original manuscripts and relevant corrections made.

Table 6 Final return figures for the questionnaire as a whole.

Sample Group	Number sent	Number returned	% of total sample	Cumulative %	% returned
Mountaineers	268	123	26.8	26.8	45.9
Rural Inhabitants	300	145	31.6	58.4	48.3
Rural Outdoor Workers	254	148	32.2	90.6	58.3
Conservation Managers	105	43	9.4	100.0	41.0
Total	**927**	**459**	**100.0**	**100.0**	**Mean: 48.4**

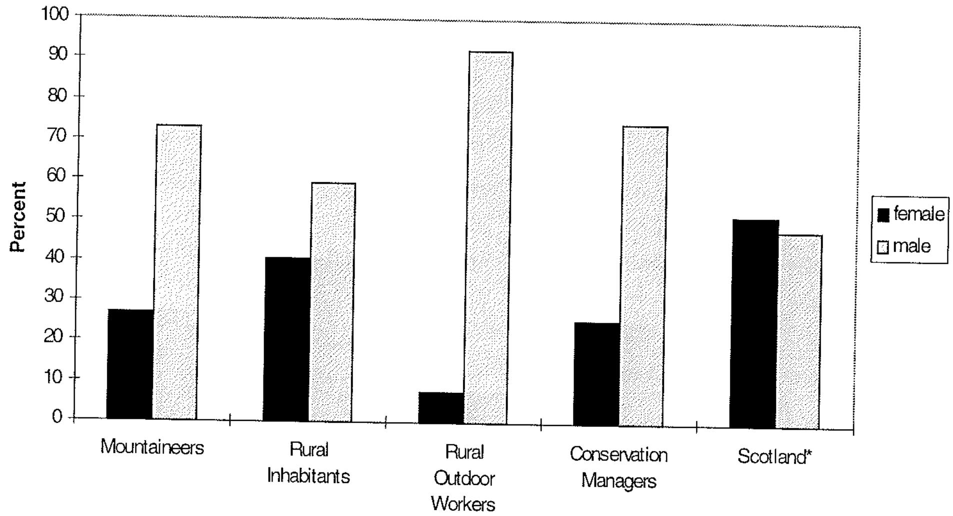
For each variable, missing values accounted for between 0 and 10% of the cases. No pattern in the distribution of missing data was found indicating that results would not be biased as a result of non-randomly distributed missing data. Missing data values were replaced in accordance with standard practice (Tabachnick & Fidell, 1996). For the ordinal variables the median value for each sample group was used to replace any missing values in that group. For the categorical (nominal) variables, the group mode was used to fulfil the same function.

4.3 Representativeness Of The Sample Groups

With reference to the Scottish census data (Government Statistical Service, 1997), it was possible to assess how representative the sample groups were of the general population of Scotland in order to identify the nature and extent of any bias, an important part of any questionnaire survey (Gilbert, 1993). This was useful in deciding which, if any, generalisations of the study findings could be made with reference to the Scottish population. The variables used to compare the sample groups to the Scottish population were gender, age, education, income and work status. In the case of each variable the census data provided the expected frequency counts for the Chi-square tests.

4.3.1 Gender

The results of the Chi-square tests presented in Table 7 show that there were significantly more men in each sample group than would be expected from the Scottish population. This was especially so for the rural outdoor workers group (see Figure 11).



*Note: Scottish data represents the estimated population on the 30th June 1995 (Government Statistical Service, 1997).

Figure 11 The male/female ratio of the four sample groups compared to the Scottish population.

However, previous surveys in Scotland have found that over 60 % of hill-walkers are male (Aitken, 1977; Rivington, 1994; Davison, 1997; Mather, 1997; Mather, 1998). Similar studies conducted in the USA have also indicated that 70 to 85 % of participants are male (Roggenbuck & Lucas, 1987; Warren, 1986). Conservation management has traditionally been a predominantly male occupation as have the established outdoor jobs of stalker, gamekeeper and ghillie. A survey of the latter group found 99.5 % of gamekeepers, stalkers and ghillies to be male (Scull, 1995).

Table 7 Frequency counts for the sexes between the four sample groups.

Gender	Scotland %	All cases	Mount-aineers	Rural Inhabi-tants	Rural Outdoor Workers	Conser-vation Managers
female	51.5	114	33	59	11	11
male	48.5	345	90	86	137	32
χ^2	-	113.0*	30.1*	6.8*	115.3*	11.6*

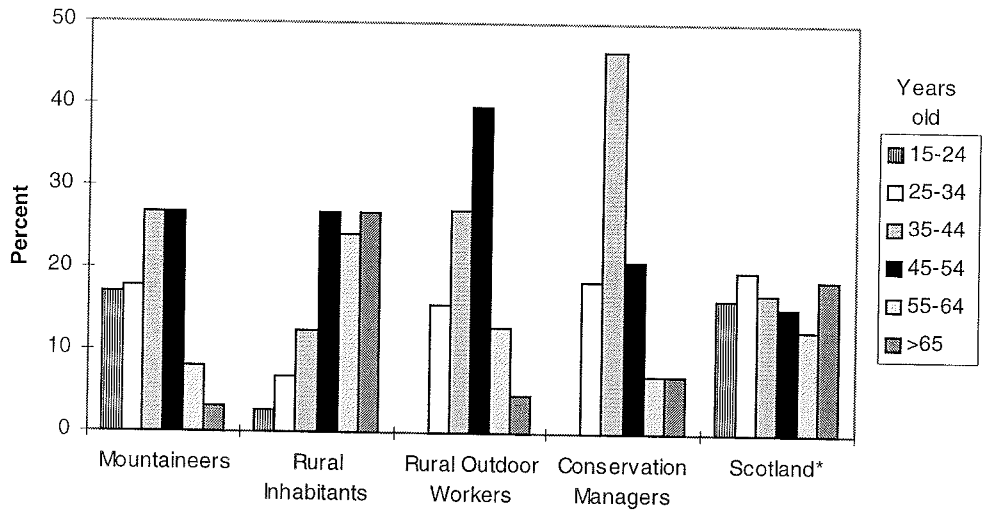
Note: * = $p \leq 0.05$

The male / female ratio of the rural inhabitant group, was expected to be comparable to the overall Scottish population, although some differences were noted

(Figure 11). Although the sample group was randomly selected, analysis shows that of the 167 men and 133 women were contacted in the sampling procedure, return rates were 66.9 % and 35.3 % respectively. Therefore in the rural inhabitant group, the difference in the proportion of male and female respondents appears to be mainly a factor of the difference in response rates between the sexes.

4.3.2 Age

Figure 12 shows the differences in age distribution between the four sample groups and the Scottish population as a whole. Figure 12 and the results of the Chi-square tests (Table 8) indicate that none of the sample groups have an age distribution similar to that of the Scottish population, and that each group is dominated by a different age range. For the mountaineering group there is a greater proportion of respondents below the age of 54 than found in the Scottish population. These results agree with previous studies showing that participants tend to come from the young to middle aged groups of the population both in Scotland (Aitken, 1977; Davison, 1997; Mather, 1997; Mather, 1998) and in the USA (Roggenbuck & Lucas, 1987; Warren, 1986).



*Note: The figures represent the population on the 30th June 1995 (Government Statistical Service, 1997).

Figure 12 Age distribution of the sample groups and the Scottish population.

For the rural inhabitant group there is a greater proportion of respondents over the age of 45 than is found in the Scottish population. The rural outdoor workers group and the conservation manager group had zero respondents in the 15-24 years category. For the Chi-square statistic this category was excluded from the analysis and the tests recalculated (bottom row of Table 8). This indicated that both the conservation manager group and the rural outdoor workers sample contained a greater proportion of people between the ages of 35 and 54 than is found in the Scottish population. This figure appears to be representative of rural outdoor workers, who had an average age of 41 in a survey of stalkers, gamekeepers and ghillies (Scull, 1995).

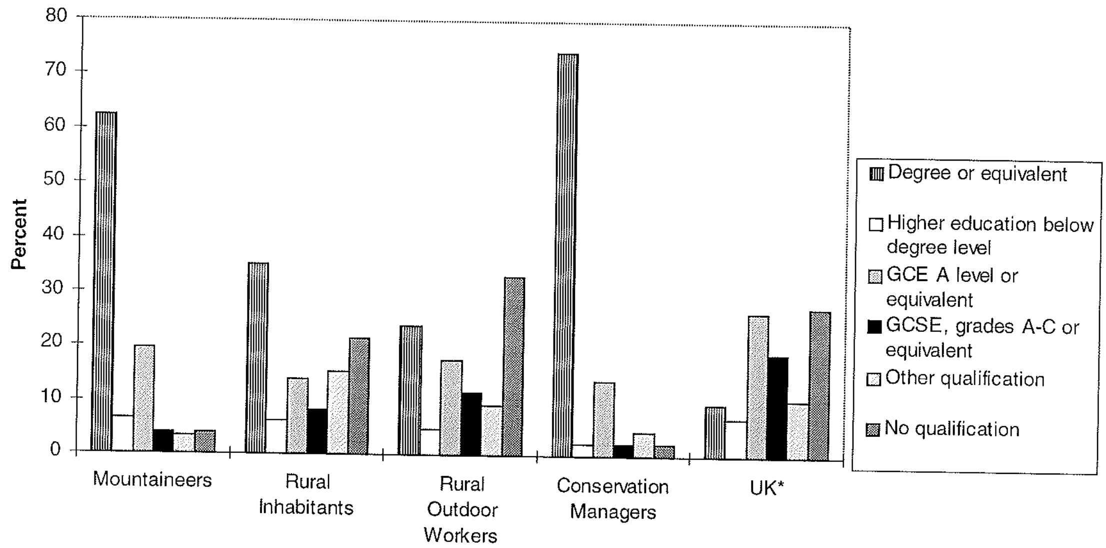
Table 8 Frequency counts and Chi-square results for the age distribution of the four sample groups.

Age (years)	Scotland %	All cases	Mount-aineers	Rural Inhabi-tants	Rural Outdoor Workers	Conser-vation Managers
15-24	16.2	25	21	4	0	0
25-34	19.8	63	22	10	23	8
35-44	17.2	111	33	18	40	20
45-54	15.3	140	33	39	59	9
55-64	12.8	67	10	35	19	3
>65	18.7	53	4	39	7	3
χ^2	-	137.8*	35.4*	63.1*	-	-
χ^2 (not inc. 15-24)	-	87.1*	35.7*	37.7*	66.0*	21.3*

Note * = $p \leq 0.05$

4.3.3 Education

In order to allow a comparison between data from the UK Census and from the current study, certain categories had to be combined (Table 9). Although the two sets of data used in the Figure 13 are not exactly the same, they are sufficient as an approximate guide to the educational level of the respondents. The Chi-square tests in Table 10 show that the mountaineering group has a greater proportion of graduates and a lesser proportion of respondents with no qualifications than is found in the UK population. This result agrees with previous studies which have indicated that mountaineers have a higher level of education and belong to socio-economic classes 1, 2 or 3: this can be demonstrated in Scotland (Aitken, 1977; Davison, 1997; Mather, 1998) and in the USA (Warren, 1986; Roggenbuck & Lucas, 1987; Lucas, 1989). The rural inhabitants have a greater proportion of respondents in the 'other qualifications' and 'graduate' categories than the UK population. For the rural outdoor workers there is a larger proportion of graduates and those with no qualifications, whereas the trend in the conservation manager group is similar to that in the mountaineering group in that there is a significantly greater proportion of graduates than is found in the UK population.



*Note: The UK data is for 1992 and is calculated for persons aged 16 to 59 (Central Statistical Office, 1994).

Figure 13 A comparison of the range of qualifications held by each sample group and the UK population.

Table 9 A description of how the education categories used in the current study were combined for comparison with the UK qualifications data.

UK data qualification label	Current study equivalent	Comment
Degree or equivalent	Undergraduate / professional qualification	A straight comparison.
Higher education below degree level	HNC / HND	A straight comparison, although the more specific current study equivalent encompasses a smaller proportion of the population.
GCE A level or equivalent	Higher / A level & technical qualification	The UK statistics include BTEC, City & Guilds and apprenticeships within the GCE A level or equivalent category.
GCSE, grades A-C or equivalent	O grade / GCSE / O level	A reasonable comparison, although the current study encompasses a larger proportion of the population as it includes grades lower than C.
Other qualification	None of the above	This comparison is made assuming the reason respondents ticked the 'none of the above' category was because their most recent qualification was not in the list provided.
No qualification	Left school at 16	This comparison is made assuming the reason that respondents entered themselves into this category was because they have none of the school leaving age exams listed (O grade / GCSE / O level or technical qualification (e.g. City & Guilds))

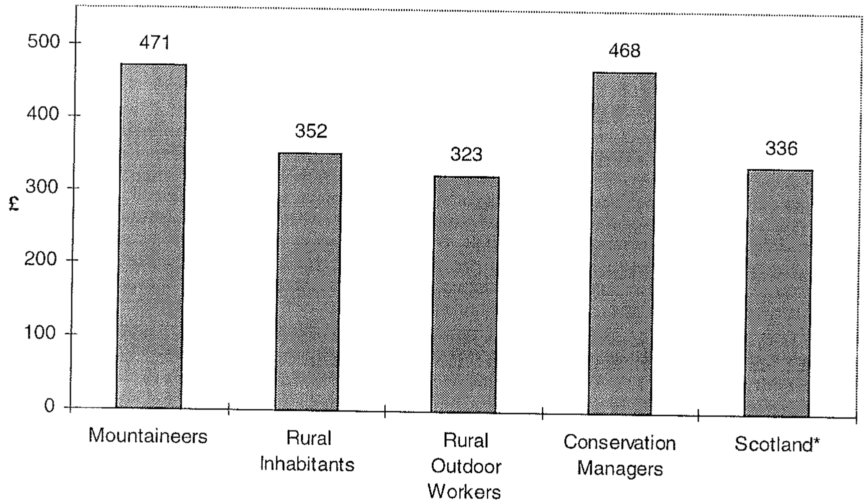
Table 10 Frequency counts for the education level of each sample group and the Chi-square tests results.

Level of education	Scotland %	All cases	Mount-aineers	Rural Inhab-itants	Rural Outdoor Workers	Conserva-tion Managers
Degree or equivalent	9.5	195	77	51	35	32
Higher education below degree level	7.0	25	8	9	7	1
GCE A level or equivalent	26.5	76	24	20	26	6
GCSE, grades A-C or equivalent	19.0	35	5	12	17	1
Other qualification	10.5	42	4	22	14	2
No qualification	27.5	86	5	31	49	1
χ^2	-	588.5*	412.1*	123.2*	42.9*	212.0*

Note: * = $p \leq 0.05$

4.3.4 Income

Data for the Scottish population equivalent to the income categories used in the current study were not available, and therefore the average weekly gross income per household was calculated from the survey data and compared to the figures published by the Government Statistical Survey (1997) (Figure 14). The lack of comparable data prevented the use of Chi-square tests to check the statistical significance of the distribution of respondents in the income categories. However, with the aid of Figure 14 and the frequency data presented in Table 11 it is possible to comment on the income levels of the sample groups. In all but the case of the rural outdoor workers, the sample groups have a higher average weekly gross income per household than the Scottish population. The low income of rural outdoor workers is confirmed by a survey of gamekeepers, stalkers and ghillies in which average incomes were £9,000 p.a., although many posts have additional benefits such as housing and vehicle provision which are not included in this figure (Scull, 1995). The high income of members of the mountaineering sample group relative to the general population has been highlighted in previous studies: in Scotland mountain users were found to come mainly from higher social classes which are assumed to have higher incomes (Mather, 1997; Mather, 1998). This is also the case in the USA (Roggenbuck & Lucas, 1987; Warren, 1986). The rural inhabitants group shows income levels similar to the Scottish population, whereas the conservation manager group has a higher income level, much closer to that of the mountaineering group.



*Note: The Scottish data represents the average weekly gross income per household in 1995/6 from a sample of 604 households (Government Statistical Service, 1997).

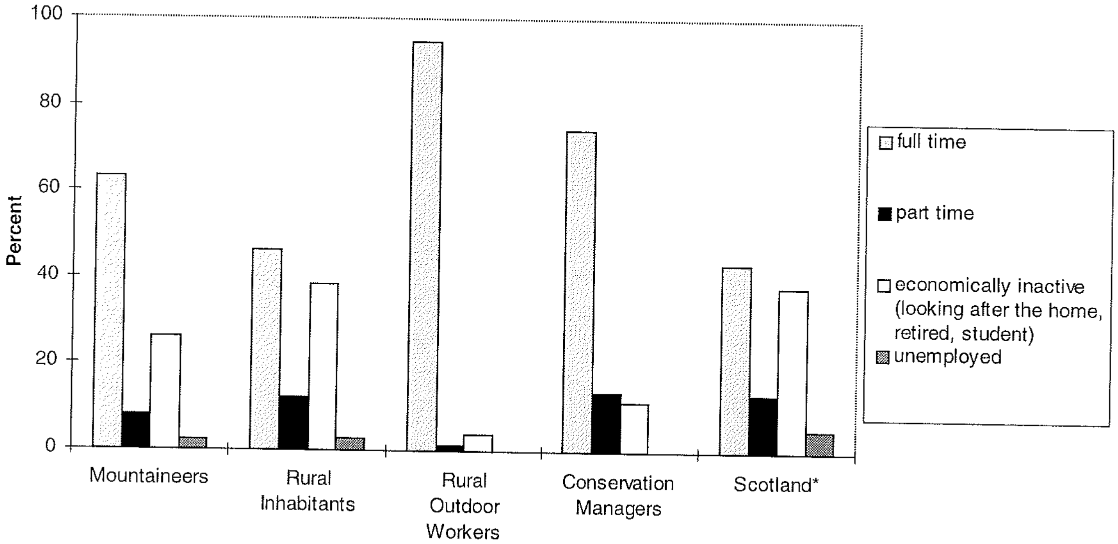
Figure 14 Average weekly gross income per household shown by the figure above each column for the four sample groups and the Scottish population.

Table 11 Frequency counts for the annual gross household income for each sample group.

Annual gross household income (£)	All cases	Mountaineers	Rural Inhabitants	Rural Outdoor Workers	Conservation Managers
< 5,000	26	11	11	3	1
5,000 - 9,999	48	5	18	22	3
10,000 - 14,999	98	13	25	57	3
15,000 - 19,999	86	16	37	24	9
20,000 - 24,999	54	9	18	16	11
25,000 - 29,999	45	22	12	7	4
30,000 - 34,999	32	9	10	9	4
35,000 - 39,999	25	17	2	2	4
40,000 - 54,999	25	11	6	4	4
> 55,000	20	10	6	4	0

4.3.5 Work Status

Figure 15 shows that the rural inhabitant group closely mirrors the Scottish population as a whole, and this is confirmed by the Chi-square test (Table 13).



*Note: The Scottish figures represent the economic activity of the population over the age of 16 in 1996 (Government Statistical Service, 1997).

Figure 15 The work status of the sample groups and the Scottish population.

Table 12 A description of how the work categories used in the current study were combined for comparison with the Scottish census data.

Scottish data labels	Calculation of the Scottish data	Current study
Full time	Sum of: self-employed (assumed to work full time) [225,000], people on Government training schemes (assumed to work full time) [30,000], and the full time sector of employees in employment [male 970,000, female 545,000].	Full time
Part time	Sum of: the part time sector of employees in employment [male 85,000, female 459,000].	Part time
Unemployed	Economically active people that are unemployed [215,000].	Unemployed
Economically inactive	Economically inactive: [1,558,000]	Sum of: those looking after the home, retired and full-time students.

In the other three sample groups, each is dominated by a larger proportion of respondents who work full time. This is to be expected for the rural outdoor workers and the conservation managers groups who were both contacted through trade forums. The mountaineering group has a younger age structure and therefore more members of a working age than the other sample groups. This characteristic has been shown in other surveys of hill-walkers and mountaineers in Scotland (Hunt & Wilkinson, 1995; Davison, 1997). The way in which the categories from the current study were grouped for comparison with the Scottish census data is described in Table 12. In the conservation managers and rural outdoor workers groups there were no unemployed respondents, so this category was left out of the Chi-square tests. However, this only excluded 1.5 % of the respondents and did not affect the significance of the test results.

Table 13 Frequency counts and Chi-square test results for the work status categories of the four sample groups.

Employment	Scotland %	All cases	Mount-aineers	Rural inhabit-ants	Rural outdoor workers	Conserva-tion managers
full time	43.3	317	78	67	140	32
part time	13.3	36	10	18	2	6
unemployed	5.3	7	3	4	0	0
economically inactive	38.1	99	32	56	6	5
χ^2	-	125.8*	20.5*	2.1	-	-
χ^2 (excluding unemployed)	-	108.6*	18.0*	0.3	142.5*	16.5*

Note: * = $p \leq 0.05$

4.3.6 Summary Of The Socio-Economic Characteristics Of The Sample Groups

In any sampling methodology certain constraints on the interpretation of the results will arise, which must be taken into account. In the current study, findings on the perception of wild land can only be extrapolated to people within the same sample groups. However, in terms of work status, income and to some extent education, the rural inhabitant group more closely resembles the Scottish population than any other sample group. The mountaineering group is male dominated, younger, more educated, wealthier and contains more full time workers than the Scottish population. This is typical for mountaineering groups (Aitken, 1977; Hunt & Wilkinson, 1995; Davison, 1997) and these have displayed little change in these characteristics over the last 20 years (Cole *et al.,* 1995). The rural outdoor workers group contains many more men between the ages of 25 and 54 who left school at the age of 16 and are in full time work and receiving low incomes, than is found in the Scottish population, a profile confirmed by other studies (Scull, 1995). The last sample group, the conservation managers, is male dominated, most of whom are 25 to 54 years old, have a degree, work full time and live in a household with an above average income.

4.3.7 Spatial Distribution Of The Respondents

The distribution of respondents throughout Scotland is shown in Figure 16. The map was constructed using the first half of each respondents postcode (the postcode sector) and shows the concentration of respondents in the two study areas, and an otherwise even distribution of respondents over the rest of the country. There is also a concentration of respondents in Edinburgh and Glasgow, the home of several mountaineering clubs and conservation organisations.

4.3.8 Overlap Between The Sample Groups

The sampling strategy employed resulted in some overlap between some of the sample groups (Table 14). However, the members of each sample group were selected for a particular characteristic which could be compared to their perceptions of wild land. Hence the mountaineering sample group is made up of people who go to rural areas for recreational purposes but some of whom also live in rural areas. The rural inhabitants group is exposed to rural landscapes on a daily basis but on the whole from an indoor perspective, although a fifth of this group are also rural outdoor workers. Many of the rural outdoor workers live in rural areas, but they can be distinguished from the other groups by their daily outdoor contact with rural areas. The professional interest of the conservation managers group in rural areas, distinguishes them from the other sample groups.

Table 14 Potential areas of overlap between the sample groups. Columns should be read top to bottom, with the figures representing the percentage of a sample group that potentially overlaps with another.

Sample groups =>	Mountaineers %	Rural inhabitants %	Rural outdoor workers %	Conservation managers %
Mountaineers[1]	-	8.3	4.7	30.3
Rural inhabitants[2]	35.8	-	87.2	48.8
Rural outdoor workers[3]	7.3	20.0	-	25.6
Conservation managers[4]	-	-	-	-

Notes:
1 Mountaineers in other sample groups were obtained from the preferred activity categories in Table 15. The backpacking and mountain sports categories are used as indicators of mountaineering activity.
2 Every postcode has an associated urban / rural classification in the 1991 census data that can be related to individual respondents. The classification is a scale of 1 (locality with 1000000 or more residents) to 5 (< 1000 residents), of which categories 4 (1000 to 9999 residents) and 5 were used to indicate a rural area.

3 Rural outdoor workers are identified from the answers to the working outside question (Table 19).
4 No data were available to check if respondents from other sample groups were also conservation managers.

The nature of these overlaps were taken into account when any generalisations of the study outcomes were made.

4.4 Sample Group Interaction With The Rural Landscape

Questions 1 to 5 asked respondents about the activities they were involved with in upland areas. The topics covered preferred activity, number of years of experience in that activity, membership of special interest organisations, whether they worked in upland areas, if they regularly worked outside, and the location of their permanent home. The results from these questions outline the nature and magnitude of the respondent's interaction with the rural landscape, and therefore possible influences on their perception of wild land. Cross-tabulations of the data for the four sample groups and each of the five variables in turn, along with the results of Chi-square tests, were used to describe the differences between the groups in terms of their interaction with the rural landscape (Table 15 to Table 19).

4.4.1 Preferred activity

Table 15 shows the distribution of respondents between the preferred activity categories. The chi-square statistic for the whole of Table 15 was not valid according to Cochran's rule and so only categories 1 to 6 were used giving $\chi^2 = 330.3*$. This analysis excludes a very small number of respondents (4.4 %) and indicates that there is a significant difference in the proportion of respondents falling into the preferred activity categories in comparison to the respondent population as a whole. Chi-square tests for each sample group in turn indicate an uneven spread of respondents across the activity categories. The mountaineering sample group has a significantly larger proportion of people who go day walking, back packing and participate in mountain sports than in the total respondent population. For the rural inhabitant group there is a significantly larger proportion of people who go for day walks and those who fish and shoot, than in the total respondent population. The rural outdoor workers group has a significantly larger proportion of people who go deer stalking or fishing and shooting than in the total respondent population.

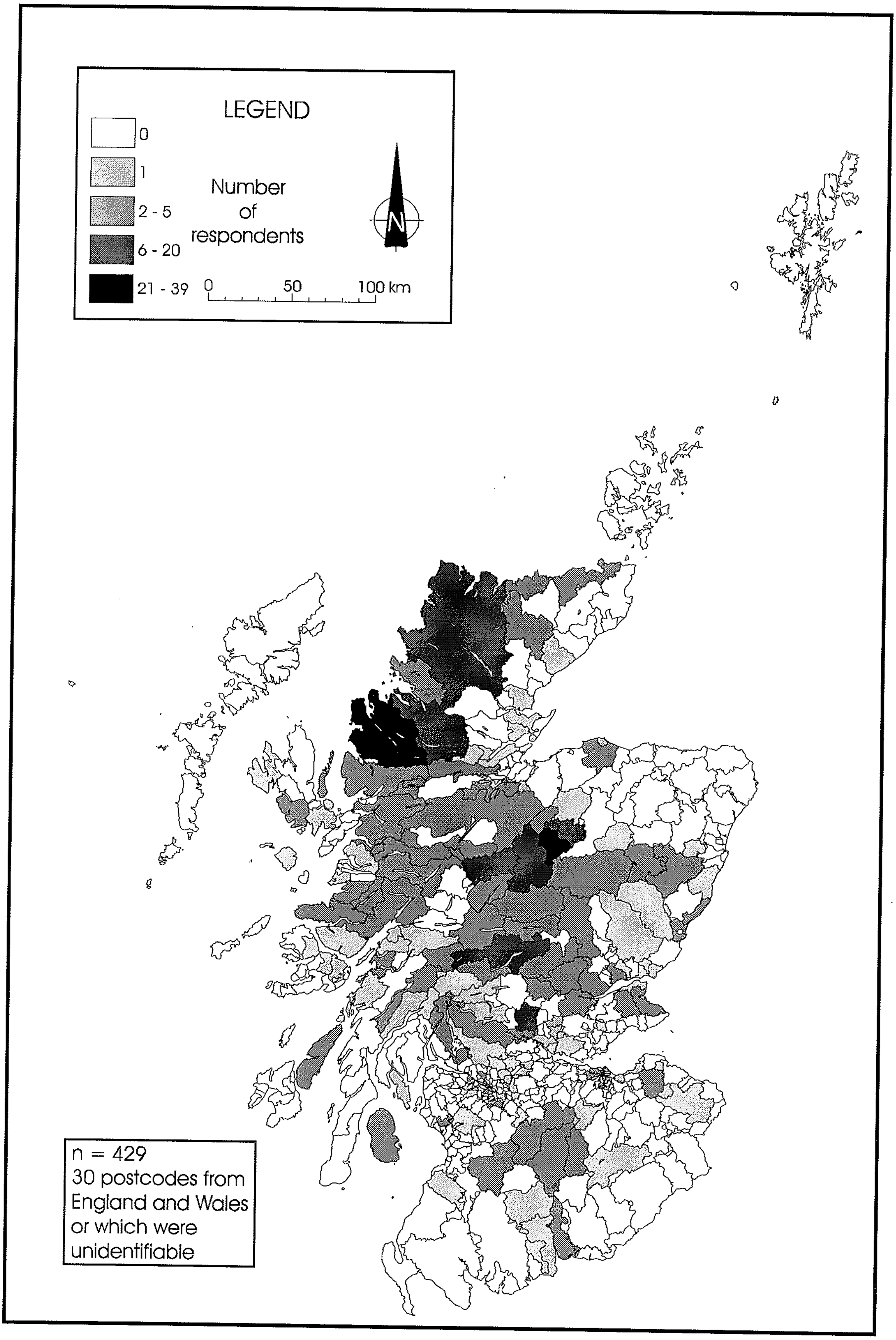


Figure 16 Distribution of questionnaire respondents by postcode sector boundary.

The conservation manager group data did not produce a valid Chi-square statistic, although Table 15 suggests that the main difference between this group and the others is a larger proportion of the group studying natural history on their trips to the hills. These data serve to support the assumptions made at the sampling stage about the character of the sample group members in terms of the nature of their interaction with the rural landscape.

Table 15 Frequency counts for the preferred activity categories for each sample group.

Preferred Activity	All cases	Mount-aineers	Rural Inhabitants	Rural Outdoor Workers	Conservation Managers
1. Day walking	207	74	90	18	25
2. Back packing	24	17	4	2	1
3. Mountain sports	52	29	8	5	10
4. Fishing / shooting	46	1	21	24	0
5. Deer stalking	83	0	3	80	0
6. Nature study	27	1	7	12	7
7. Other	9	1	3	5	0
8. None	11	0	9	2	0
χ^2 (categories used)	-	39.8* (1-4,6-7)	40.4* (1-6)	161.6* (1-6)	Not valid with 1,2,3 & 6, or 1,3 & 6.[1]

Notes: * = $p \leq 0.05$
[1] Cochran's Rule - In chi-square tests for which the degrees of freedom are greater than 1, a test is valid when no more than 20% of the cells have an expected frequency of less than 5, and no cell has an expected frequency of less than 1.

4.4.2 Experience Of Preferred Activity

Table 16 shows the distribution of respondents in the experience categories for their preferred activity for which the Chi-square statistic was not valid according to Cochran's rule. However, with the exclusion of category 6 (those who opted to skip question number 1), which was 2.4 % of the respondents, χ^2 = 65.6* indicating that there was a significant difference between the proportion of respondents in each experience category for the sample groups and the respondent population as a whole. Individual group analyses show that for the mountaineering group there is a significantly larger number of people with less than 20 years of experience in their preferred activity than in the respondent population as a whole, i.e. 63 % of mountaineers had more than 10 years experience, compared with the 'more than two-thirds' figure reported by Mather (1998) for mountain visitors to the East Grampians. For the rural inhabitant population there is a significantly larger proportion of people with more than 31 years of experience in their preferred activity than in the overall respondent population. In the case of the rural outdoor workers group there is a significantly larger proportion of people with 21 to 40 years of experience in their preferred activity than in the overall respondent population, agreeing with previous studies (Scull, 1995). The conservation manager group does not differ significantly from the overall respondent population in the proportion of respondents distributed between the experience categories. These results confirm the age profiles of the different sample groups highlighted earlier in this chapter.

Table 16 Frequency counts for experience categories of the preferred activity for each sample group.

Experience (years)	All cases	Mount-aineers	Rural Inhabitants	Rural Outdoor Workers	Conservation Managers
1. < 10	101	46	26	20	9
2. 11 - 20	101	37	28	24	12
3. 21 - 30	119	28	29	52	10
4. 31 - 40	86	11	29	38	8
5. > 41	41	1	24	12	4
6. skipped qu. 1	11	0	9	2	0
χ^2 (categories 1 - 5 only)	-	32.1*	13.2*	15.6*	0.8

Note: * = $p \leq 0.05$

4.4.3 Membership Of Organisations

Table 17 shows the frequency of respondents who were members of special interest organisations. For the whole of Table 17 χ^2 = 516.0* indicating that there are significant differences between the proportion of respondents in each of the organisation categories for the four sample groups and the overall respondent population. When the Chi-square test is repeated for each sample group in turn the result for the mountaineering group is that there is a significantly larger proportion of respondents who are members of climbing / mountaineering clubs and conservation groups or just the former. For the rural inhabitant group there is a significantly larger proportion of respondents who do not belong to any organisations than in the overall respondent population. Rural outdoor workers are more likely to be members of deer / game management groups and field sports clubs or just the former. In the case of the conservation manager group there is a significantly larger proportion of respondents who are members of conservation organisations and these plus climbing / mountaineering clubs than in the overall respondent population.

These results are not surprising as the sample groups were chosen on the basis of differences in the nature of the contact between respondents and rural landscapes. The results help to confirm that the main differences between the four sample groups are based on a combination of their affiliation to certain organisations and their experience of the leisure activities in which they prefer to take part.

Table 17 Frequency counts for membership to different special interest organisations or combinations of them, for each of the four sample groups.

Organisations	All cases	Mount-aineers	Rural Inhabi-tants	Rural Outdoor Workers	Conserv-ation Managers
1. No organisations	113	4	84	15	10
2. Conservation groups	49	1	21	7	20
3. Deer / game management body	30	0	1	29	0
4. Farming / fishing / forestry organisation	28	0	14	13	1
5. Field sports AND Deer / game management body	28	0	0	28	0
6. Climbing / mountaineering club	63	53	7	1	2
7. Climbing / mountaineering club AND conservation groups	62	49	2	3	8
8. Other combinations	86	16	16	52	2
χ^2 (Categories)	-	139.2* (1-2, 6-8)	99.9* (all except 5)	152.2* (1-8)	52.5* (all except 3, 5)

Note: * = $p \leq 0.05$

4.4.4 Working In Upland Areas

Table 18 shows the number of respondents in each sample group who work in upland areas. For the whole of Table 18 $\chi^2 = 250.56$* indicating that there are significant differences in the proportion of respondents who work in upland areas in the four sample groups as compared to the total respondent population. In the mountaineering sample group there is a significantly larger proportion of people who do not work in upland areas than in the overall respondent population. The same can be said for the rural inhabitants sample group. The opposite is true for the rural outdoor workers group which has a significantly larger proportion of respondents working in upland areas than in the total respondent population. In the case of the conservation manager group, there is no significant difference in the proportions of respondents in both categories in comparison to the overall respondent population.

Table 18 Frequency counts for the four sample groups as to whether or not respondents work in upland areas.

Work in upland areas?	All cases	Mount-aineers	Rural Inhabitants	Rural Outdoor Workers	Conservation Managers
no	223	101	102	4	16
yes	236	22	43	144	27
χ^2	-	55.3*	27.4*	124.8*	2.2

Note: * = $p \leq 0.05$

4.4.5 Working Outside

Table 19 shows the number of respondents in the four sample groups who work outside. For the whole of Table 19 $\chi^2 = 231.8$*, indicating that there are significant differences in the proportion of respondents who work outside in the four sample groups as compared to the total respondent population. In the mountaineering group there are significantly more people who do not work outside than is reflected in the overall respondent population. The same is the case for the rural inhabitant and conservation manager groups which both contain significantly more people who do not work outside than in the total respondent population. Only for the rural outdoor workers group is there a significantly larger proportion of respondents who work outside than would be expected from the total respondent population. This is expected given the nature of this sample group and indicates that working outside is a key differing characteristic between the groups.

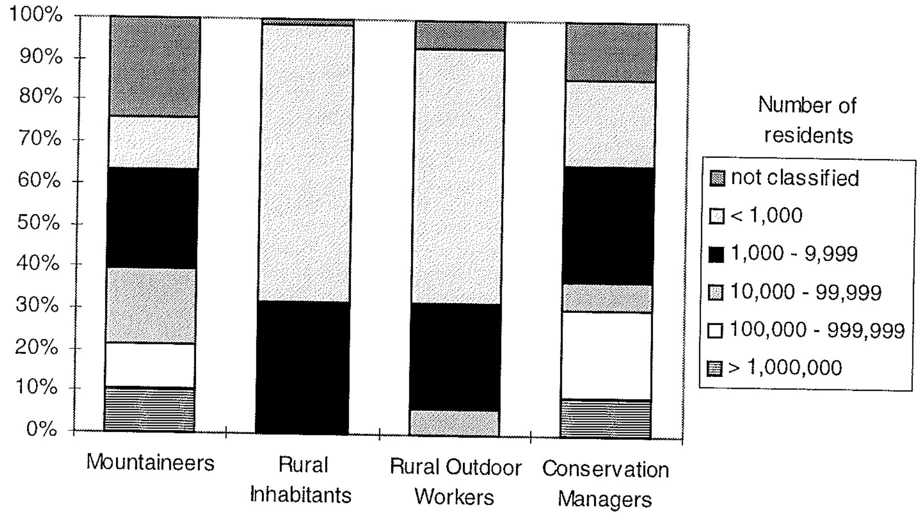
Table 19 Frequency counts for all four sample groups concerning whether or not people work outside for an average of three or more days per week.

Work outside?	All cases	Mount-aineers	Rural Inhabitants	Rural Outdoor Workers	Conservation Managers
no	283	114	116	21	32
yes	176	9	29	127	11
χ^2	-	21.7*	4.6*	218.0*	10.9*

Note: * = $p \leq 0.05$

4.4.6 Location Of Permanent Residence

Each respondent was asked for their postcode to allow an analysis of their permanent residence on an urban - rural continuum. In the 1991 census data-set every postcode is classified on an urban / rural scale of 1 to 5 (see page 84).



Note: 'not classified' results from incorrect postcodes and ones from England and Wales.

Figure 17 Percentage of respondents from each sample group living in localities classed according to the number of residents.

Figure 17 shows that people in the mountaineering and conservation managers groups live in similar types of locations. Both sample groups contain people living in the entire range of localities along the continuum. There is a also a similarity between the rural inhabitants and rural outdoor workers groups, who live in rural areas. These data describe the differences between these two sets of sample groups in terms of the place of residence of their members on the urban - rural continuum.

4.4.7 Summary Of Sample Group Interaction With Rural Scotland

The results presented in this section have shown the differences in the characteristics of the sample groups revealing a range of modes of interaction with rural Scotland. The mountaineering group has an interaction with wild land that is based on recreation and this is emphasised by affiliations to mountaineering and conservation organisations. The group is predominantly urban based and works in a lowland, indoor environment. The members of the rural inhabitant group are generally not affiliated to any organisation, are more experienced at their preferred activities of shooting, fishing and day walking and work indoors. The rural outdoor workers group is characterised by a majority of members with 21 to 40 years experience of deer stalking, fishing and shooting who are affiliated to deer and game management organisations and field sports clubs. This group predominantly works outside in upland areas. The conservation manager group has a greater number of members with an interest in natural history who are affiliated to conservation and mountaineering organisations. They work in upland areas, but indoors for the majority of the time and live mainly in urban areas.

The evidence presented here highlights the similarities between the mountaineering and conservation manager group on the one hand and the rural inhabitants and the rural outdoor workers on the other. The former are predominantly urban based while the latter live and work in rural areas.

4.5 General Perceptions Of Wild Land

Having established the socio-economic characteristics of the respondents and the nature of their interaction with Scottish rural landscapes, their perceptions of the existence, location and nature of wild land can now be considered.

4.5.1 The Characteristics Of Wild Land

In general, wild land is perceived to exist in Scotland by more than 86 % of all the sample groups (Table 20).

Table 20 Percentage answer of each sample group to the question 'do you consider there to be any truly wild land in Scotland?'

Response	Mountaineers %	Rural Inhabitants %	Rural Outdoor Workers %	Conservation Managers %
No	4.9	1.4	10.1	11.6
Yes	91.9	96.5	86.5	88.4
Don't know	3.2	2.1	3.4	0

Of the mountaineering group, 91.9 % thought that there was wild land in Scotland and this compares to 67.3% of those asked in a Ben Lawers hill walker survey (Rivington, 1994). The same question was repeated after the respondents had rated all of the photographs to see if the information provided in the pictures and having to think about the topic of wild land had altered their opinions on the occurrence of wild land in Scotland. The responses to the second question are shown in Table 21. Chi-square analysis for each sample group revealed no significant differences between the responses to the two questions.

Question 6 asked in which Scottish landscapes wild land might be found (Figure 18). The graph shows the strong similarities between the views of the mountaineering and conservation manager groups on the one hand and the rural outdoor workers and the rural inhabitants on the other. The general trend is an increase in perceived wild land from lowland areas, to mountainous areas or alternatively to the coast and islands.

Table 21 Percentage of each sample group in answer to the second question 'do you consider there to be any truly wild land in Scotland?'

Response	Mountaineers %	Rural Inhabitants %	Rural Outdoor Workers %	Conservation Managers %
No	7.3	2.8	13.5	11.6
Yes	90.2	95.2	82.4	86.0
Don't know	2.4	2.1	4.1	2.3

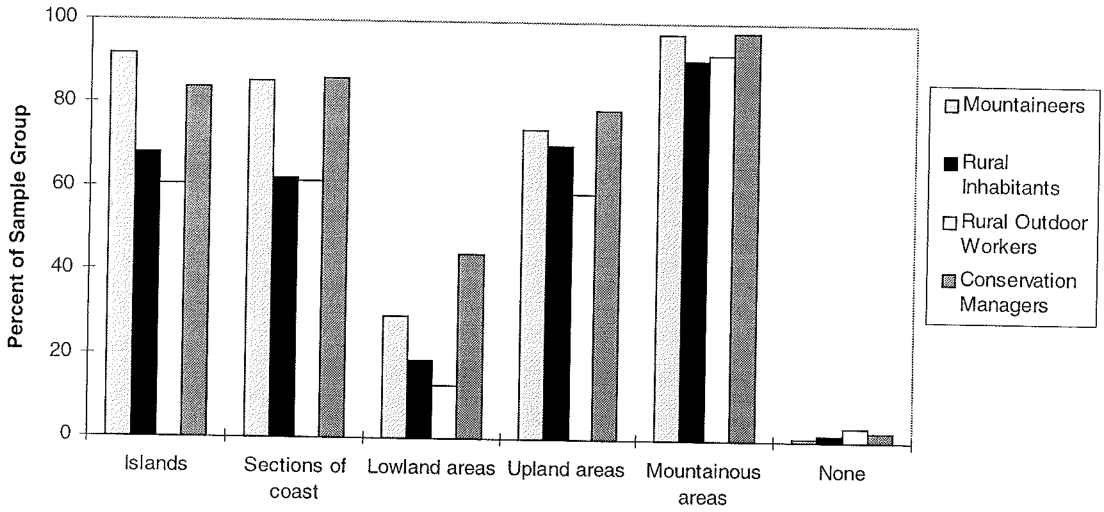


Figure 18 Perceived location of wild land in Scotland by landscape type.

Between 35 and 60 % of the sample group members regarded the time taken to reach wild land from the nearest surfaced road, as an unimportant factor (Figure 19).

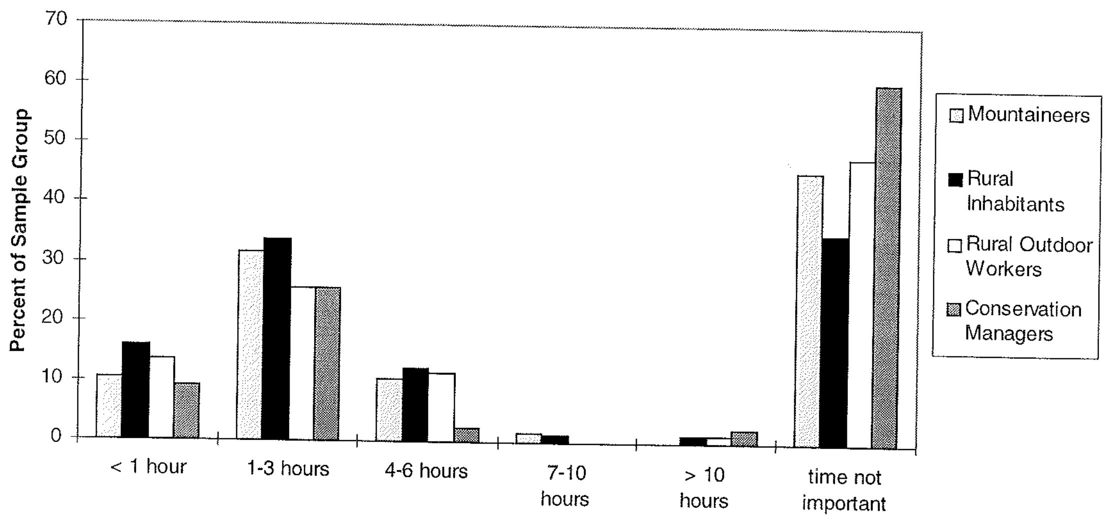


Figure 19 Time spent walking away from a surfaced road before people considered themselves to be in a wild land setting.

For those to whom increased time from the road was an important indicator of its wildness, the majority of responses across all sample groups showed that wild land could be reached in less than 3 hours.

The responses to question 8 (Figure 20) are similar to those in Figure 19, with 40 to 60 % of each sample group regarding the distance of an area from a surfaced road as unimportant in determining its wildness. For those who did think that the distance to a location from the nearest road had an influence on its wildness, 3 to 6 miles was the distance after which wild land could be reached. In both Figure 19 and Figure 20 it was the conservation managers group more than any other, which regarded time and distance to be unimportant in the location of wild land. This view along with the data in Figure 22 in which the majority of the conservation manager group regarded weather to have no influence on the wildness of a location, suggests that this group interpreted 'wild land' in more of an ecological sense than the 'perceptual' approach taken by the other sample groups.

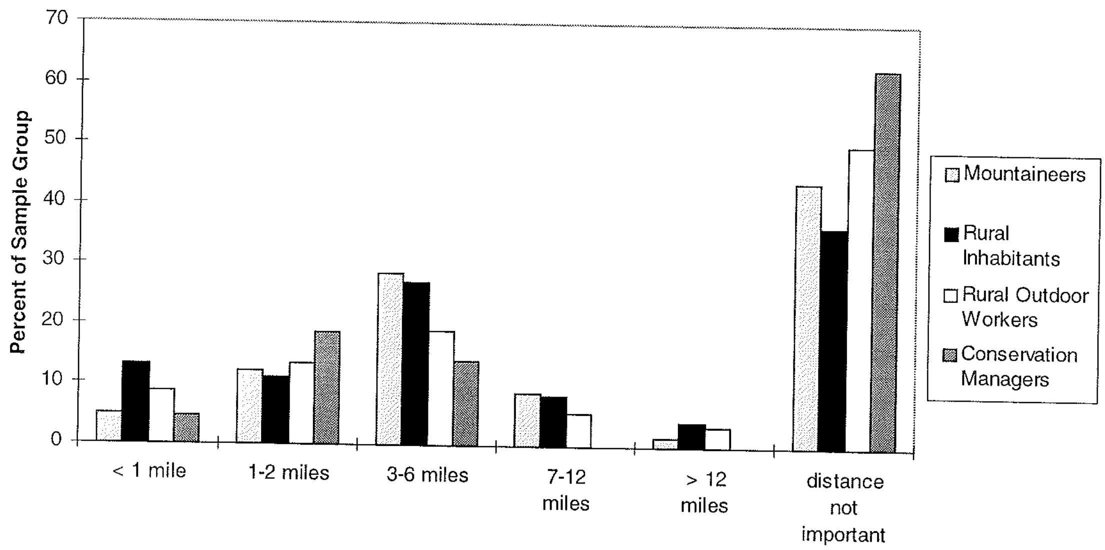


Figure 20 Distance walked from a surfaced road before people considered themselves to be in a wild land setting.

Figure 21 shows that what a person sees around them determines the perceived wildness of a location. Those who answered 'no' to the question 'are the landscape features that you can see from any particular point on your journey (on foot / ski) an important factor in determining whether you are in a 'wild land' area?' may be concerned with the other senses of smell, hearing, touch and taste. There is some evidence to suggest that the other senses do play a part in landscape evaluations: Anderson *et al.*

(1983) showed that evaluations of the aesthetic quality of outdoor scenes were enhanced using realistic sounds.

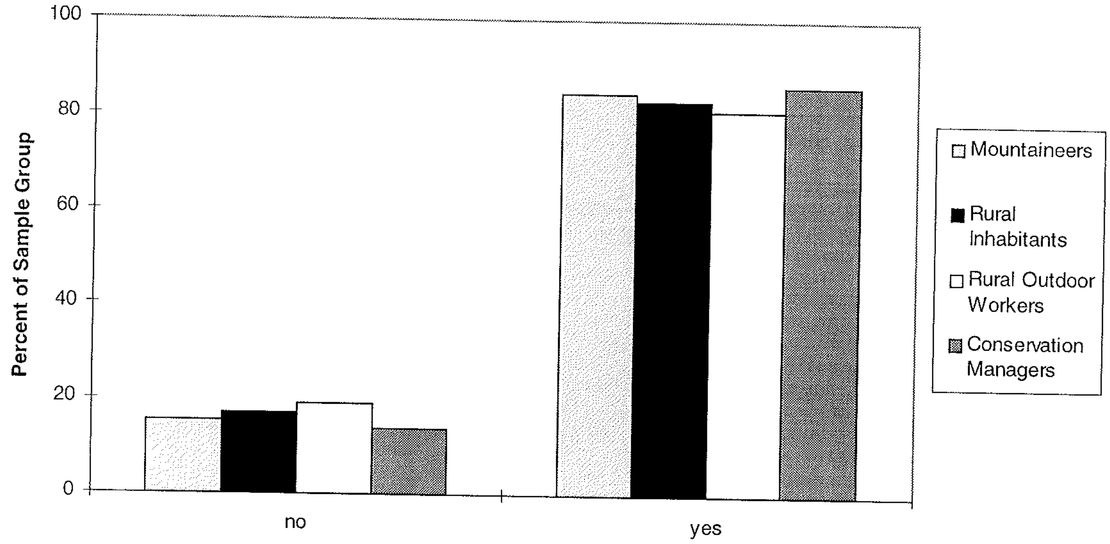


Figure 21 Importance of visible landscape features in determining the presence of wild land.

However, Figure 21 supports the assumption in this study stating that the 'visual' sense is the most important and heavily used (Kaplan & Kaplan, 1989).

Answers to question 9 showed that wild land perception is heavily based on the visual landscape. One factor that can quickly change the appearance of the visual landscape is the weather. Question 10 was included to assess, to some extent, the impact of weather on wild land perception.

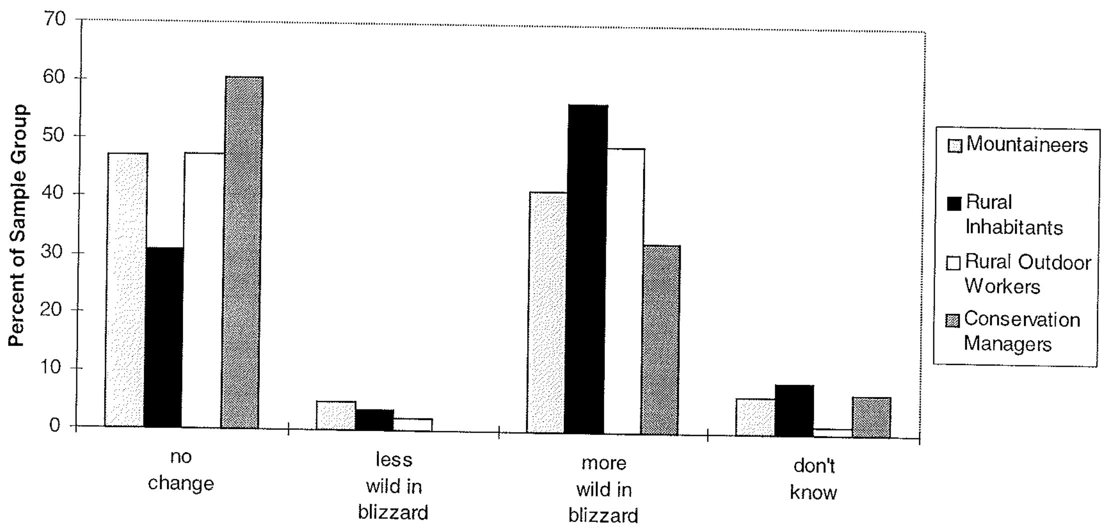


Figure 22 The effect of a blizzard on a person's perception of the wildness of a location having experienced the same place on a sunny day in summer.

Few in the conservation managers group considered weather to influence wildness, probably because of the more ecologically based definition of wild land than the other groups. The two groups most likely to have experienced blizzards, the mountaineers and rural outdoor workers, are in agreement with approximately 50 % saying that a blizzard increases the sense of wildness, while for the remainder it has no influence on their perception. In the rural inhabitant group, more people consider a blizzard to increase the wildness of a location than otherwise. There is also a greater number in this group in the 'don't know' category, possibly reflecting a lack of experience of this phenomenon on the summit of a mountain.

The only open question in the survey asked respondents 'what is the most important factor in your visual perception of wild land in Scotland?' There was a large variety of responses to this question, however the majority contained one of only a few underlying themes and the responses have been sorted into categories in Figure 23. It can be seen that the majority of respondents regarded wild land as a place free of any human impact or artefacts. For some of the categories there are close similarities between the views of the mountaineers and conservation managers, and also between the rural inhabitants and rural outdoor workers. The latter groups appear to place less importance on the absence of human artefacts than the former, but more importance on solitude, the presence of native flora and fauna and mountains.

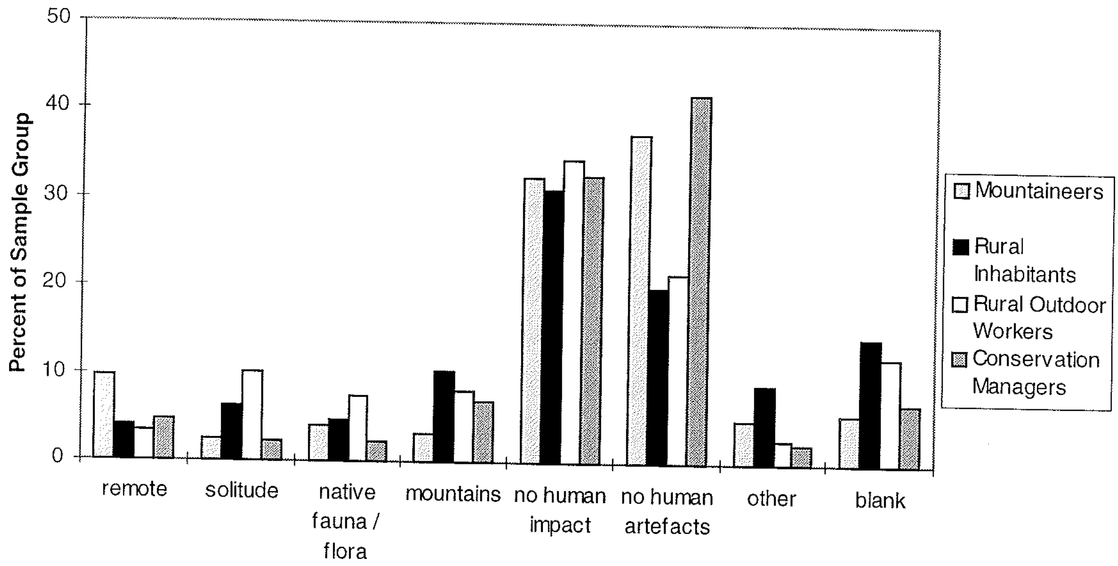


Figure 23 The most important factors in people's perceptions of wild land.

In other studies identifying consistencies in the perceptions, attitudes and preferences of wilderness users, the mountaineering and conservation manager groups have been defined as more purist than the other two groups, because of their attitude toward human artefacts in the landscape (Kroening, 1977).

Further similarities have been identified between the mountaineering and conservation manager groups on the one hand, and the rural inhabitants and rural outdoor workers on the other. Wild land is perceived to exist in Scotland, more so in mountainous areas, on islands and sections of coastline. There is a split in each of the groups concerning the influence of remoteness from roads, on the wildness of a location in terms of both distance and time. The weather experienced at a location is another point on which there is general disagreement within sample groups with only half of the respondents saying it does influence wildness. However, agreement is reached regarding the importance of the visual landscape in influencing decisions on wildness. The most commonly used indicators of wild land were shown to be the lack of obvious human impact and the absence of human artefacts in the landscape.

4.5.2 The Range And Distribution Of Wild Land Areas

In order to test the second hypothesis of this study that there is a range of wild land quality within Scotland's upland areas, in question 14 respondents were presented with a list of areas adjacent to a map showing their relative locations within Scotland and asked "in which of the following areas would you find wild land?" This was followed by the instruction 'Please answer the question for places that you have and have not visited'. The respondent was presented with a list of areas (Figure 25) and was asked to choose a response from the categories 'yes', 'no' or 'don't know'. Respondents were also asked to state whether or not they had visited the area in question, as familiarity is considered to have a large influence on a persons' perception of a particular area (Hull IV & Stewart, 1995). The wording of the question allowed those who had not visited an area but knew of it, to state their perception of it. The distinction between those who had and had not visited the areas is explored in more detail later in the analysis. Figure 24 shows the percentage of all respondents from each of the four sample groups who considered the areas listed to contain wild land.

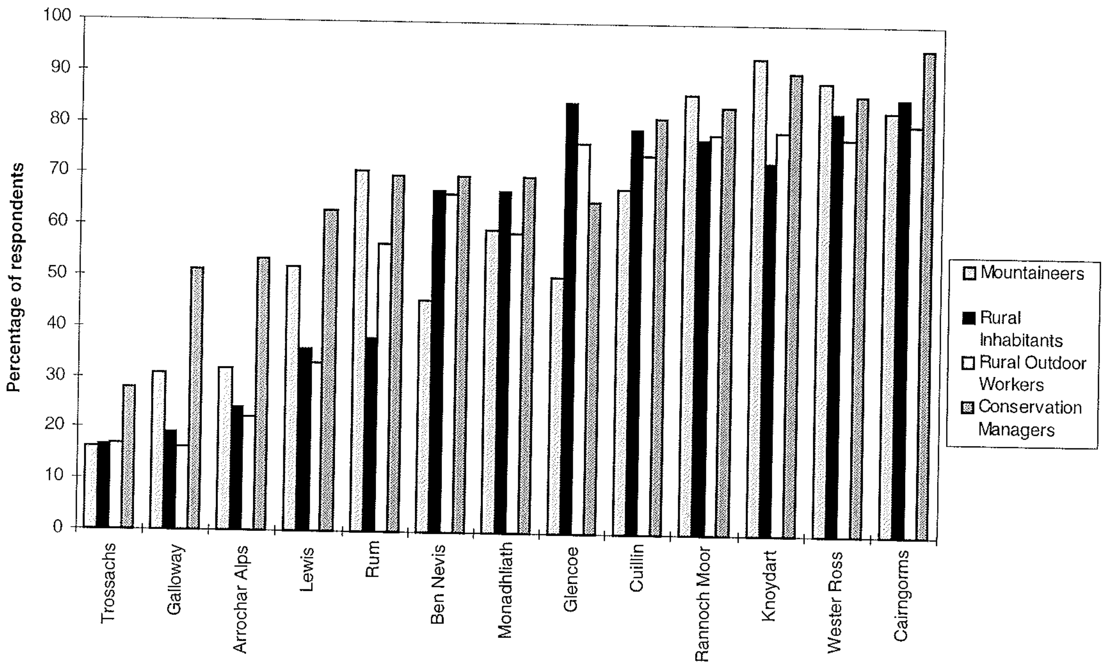


Figure 24 The percentage of respondents in each sample group who consider those areas listed to contain wild land.

To begin with, the differences between the number of people from each sample group who perceived the areas listed in question 14 to contain wild land, were considered. A chi-square test was carried out for each area in turn and for all six combinations of the four sample groups to find out the level of agreement between the groups regarding the perceived wildness of the areas in question. The results are displayed in Table 22 which highlights the differences between the views of the mountaineering group, and those of the rural inhabitants and rural outdoor workers. The latter two groups generally show good agreement as do the mountaineering and conservation manager groups. There are fewer differences between the views of the rural inhabitants and the rural outdoor workers, and those of the conservation managers group.

Table 22 The number of upland areas for which there were significant differences in their perceived wildness shown for each combination of sample groups. The sample groups are: 1) mountaineering; 2) rural inhabitants; 3) rural outdoor workers; and 4) conservation managers.

Sample Group Pairs =>	**1 + 2**	**1 + 3**	**1 + 4**	**2 + 3**	**2 + 4**	**3 + 4**
Number of areas (out of 13) showing significant differences ($p < 0.05$) in wildness counts (χ^2 test)	9	10	4	3	5	3

4.5.2.1 The Range Of Wild Land Perception By Visitors

The comparison of all the areas listed in Figure 25 is based on the percentage of visitors who perceived a given area to contain wild land. The areas have been sorted in ascending order of the percentage 'yes' responses when all cases are taken together.

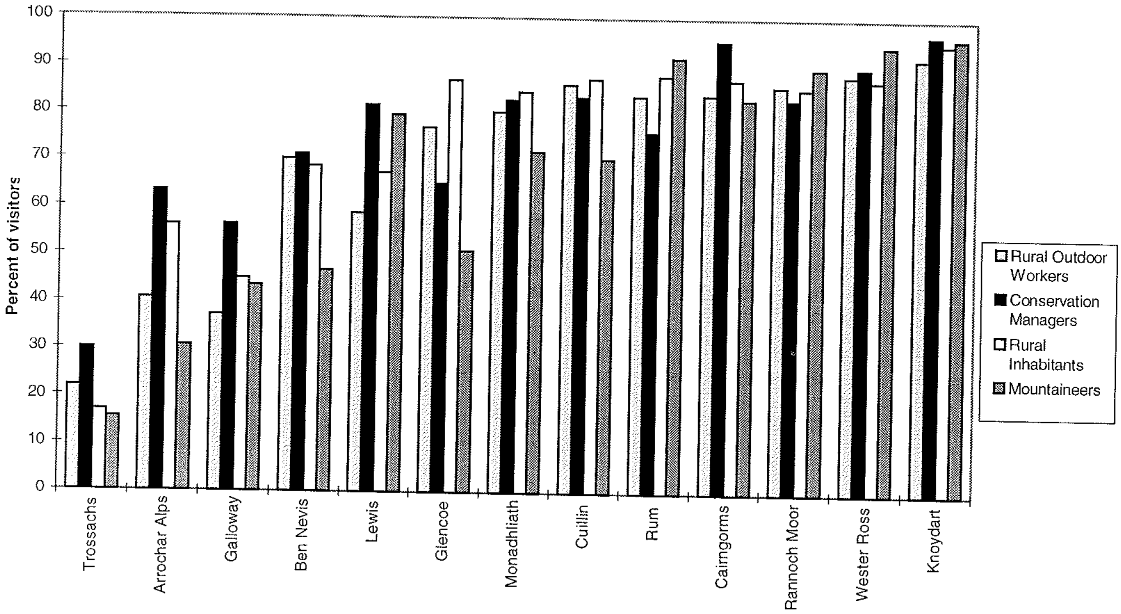


Figure 25 The percentage of visitors in each sample group who consider the Scottish areas listed to contain wild land.

The graph shows that there are large differences in the number of people who perceive an area to contain wild land between the different locations listed. Possible factors influencing this change in perception are size of roadless area, accessibility and popularity. Figure 25 also displays a trend of increasing wildness for large areas without roads (e.g. Cairngorms, Rannoch Moor, Wester Ross), with a trend to the less accessible areas (e.g. Rum, Knoydart) and thirdly there is also a discernible shift to the less frequently visited areas (e.g. the Monadhliath and Cuillin).

The majority of visitors to these areas are likely to come from urban areas: the Central Belt is where most Scots live and Glasgow is the country's biggest city. Figure 26 shows a linear relationship between the distance of an area from the centre of Glasgow, and the wildness of that area. The distance of an area from Glasgow influences its general accessibility and therefore to some extent its popularity which subsequently influences the perceived wildness of the area. Previous work has established that the perception that an area contains wild land can be negatively influenced by meeting other people while in that area (Hammitt, 1982; Roggenbuck *et al.*, 1993; Mather, 1997).

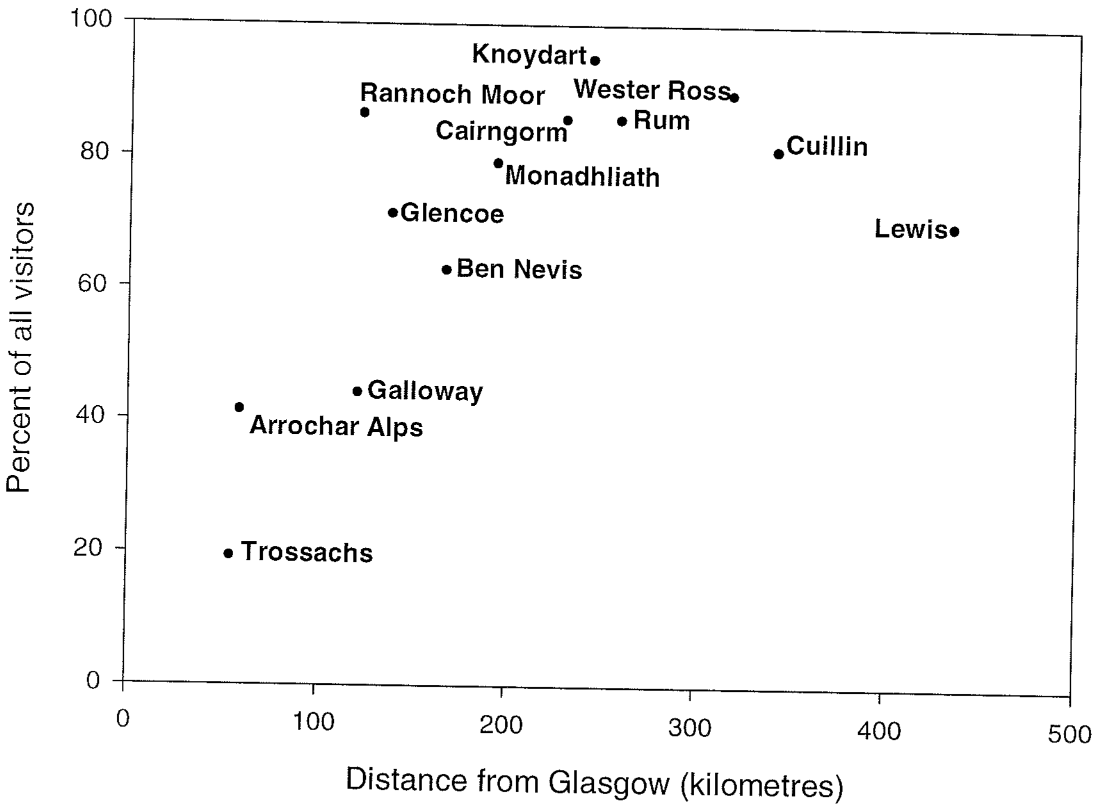


Figure 26 The relationship between the percentage of all visitors who considered an area to contain wild land and the distance of the area from Glasgow.

The Trossachs, Ben Nevis, Glencoe and the Arrochar Alps all contain some of the most visited mountains in Scotland (Countryside Commission for Scotland, 1991) and were perceived to be wild by fewer people than the less popular areas such as Rannoch Moor and the Monadhliath. The Isle of Lewis appears as an outlier in Figure 26 and is not perceived to be as wild as would be expected given its distance from Glasgow. However, Lewis has a relatively large population in comparison with the other areas listed which may contribute to its lower perceived wildness.

4.5.2.2 The Range Of Wild Land Perception By Non-Visitors

The above analysis concentrates on the views of those who had visited the areas in question. However, those who had not visited an area were also asked for their opinions as to the wildness of that location. Figure 27 shows the percentage of non-visitors from each of the sample groups who considered the areas listed to contain wild land. The data is rank ordered according to the views of all non-visitors combined. As is the case for visitors to the areas, there is a wide range of perceived wildness between the areas. Data for the mountaineering sample are missing for popular areas such as Ben Nevis, Cairngorms and Glencoe as every sample group member had visited them. The same is true for the conservation managers with respect to the Cairngorms, Glencoe and the Trossachs.

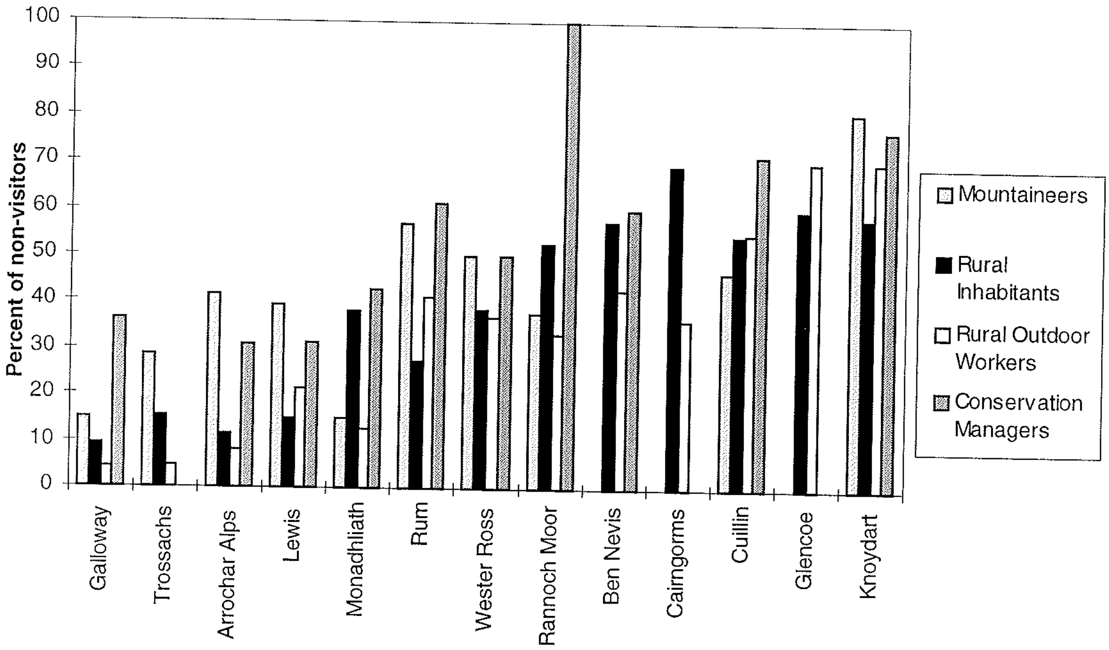


Figure 27 The percentage of non-visitors in each sample group who consider the range of Scottish areas listed to contain wild land.

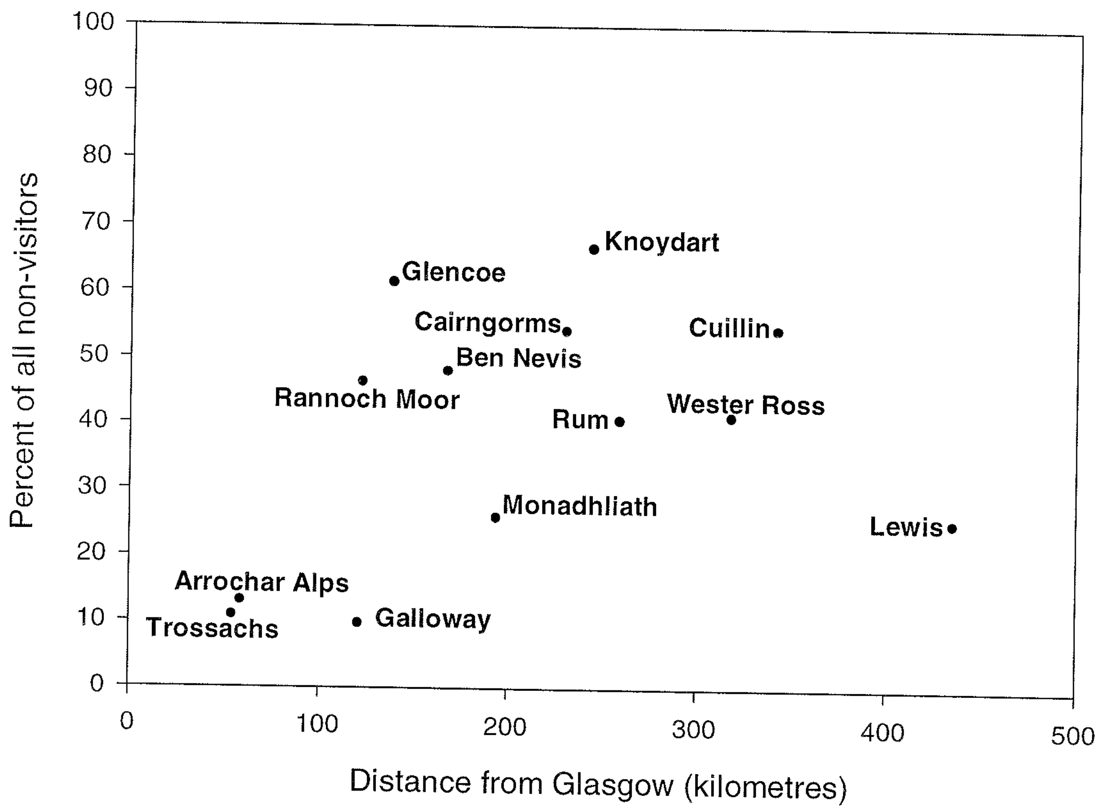


Figure 28 The relationship between the percentage of all non-visitors who considered an area to contain wild land and the distance of the area from Glasgow.

The relationship between perceived wild land and area popularity does not appear to be as strong for those who have not visited an area as was displayed in Figure 25 by the visitors. Key examples are Glencoe and Ben Nevis which have a higher wildness ranking with the non-visitor sample.

The relationship between the distance from Glasgow, and the perceived wildness of that area is shown for non-visitors in Figure 28. The relationship is not as strong for the non-visitor sample as was displayed in Figure 26 for the visitors. Lewis is still an outlier, and overall there are fewer respondents considering each area to contain wild land.

4.5.2.3 Comparison Of Visitor And Non-Visitor Perceptions Of Wild Land

Figure 29 shows the differences in the perceived wildness of the areas by both those who did, and did not, visit the area in question. This graph clearly demonstrates that more of those who have not visited an area 'don't know' if it contains wild land, as compared with the visitor sample. Visiting an area therefore increases people's willingness to make a decision concerning the occurrence of wild land. For non-visitors the perception of the presence of wild land in a given area must be based on information received from sources such as the media, maps, guidebooks and by word of mouth. The areas with the greatest uncertainty regarding their wildness appear to be those which are less well known mountain areas, which appear in the media less often, such as the Galloway hills, the Monadhliath, the Trossachs and the Isle of Lewis. In the case of each, non-visitors perceive it to contain less wild land than the visitors. Visiting an area appears to increase the likelihood that it is perceived to contain wild land.

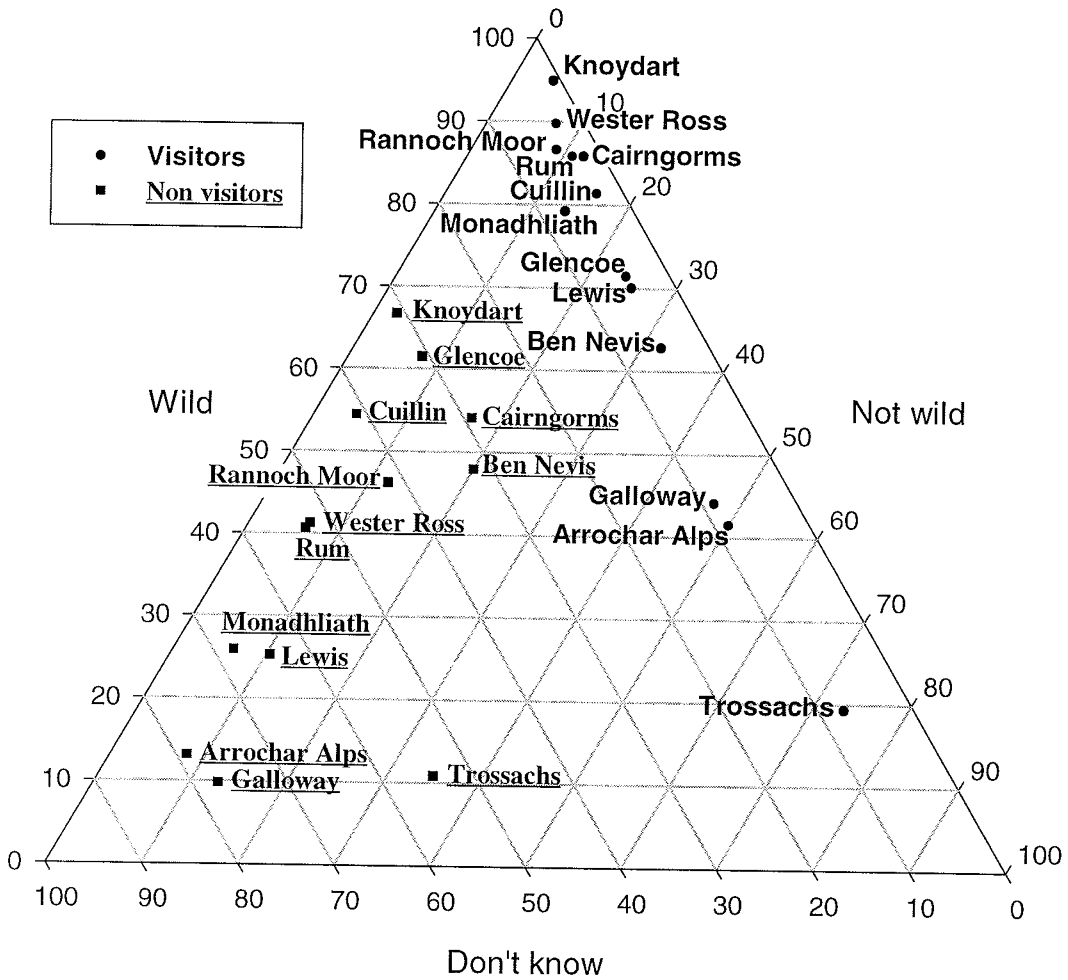


Figure 29 Comparison of the wildness of upland areas by those who have, and have not, visited the area.

4.5.3 Stability Of Wild Land Perception Over Time

The basis for question 14 came from Aitken's (1977) work and by comparing the 1977 data with that from the current study, an analysis of the stability of wild land perception over the last 25 years can be made. Aitken's (1977) survey consisted solely of a sample of mountaineers and therefore to maintain comparability, the mountaineering group only from the current study was used in the comparative analyses. Figure 30 summarises changes in the number of people who considered a given area to contain wild land between 1972 and 1997 for all the areas surveyed. Because of the differences in the views of visitors and non-visitors as shown above, the data-set was split between these two groups and analysis of changes in perception over the 25 year period were then conducted.

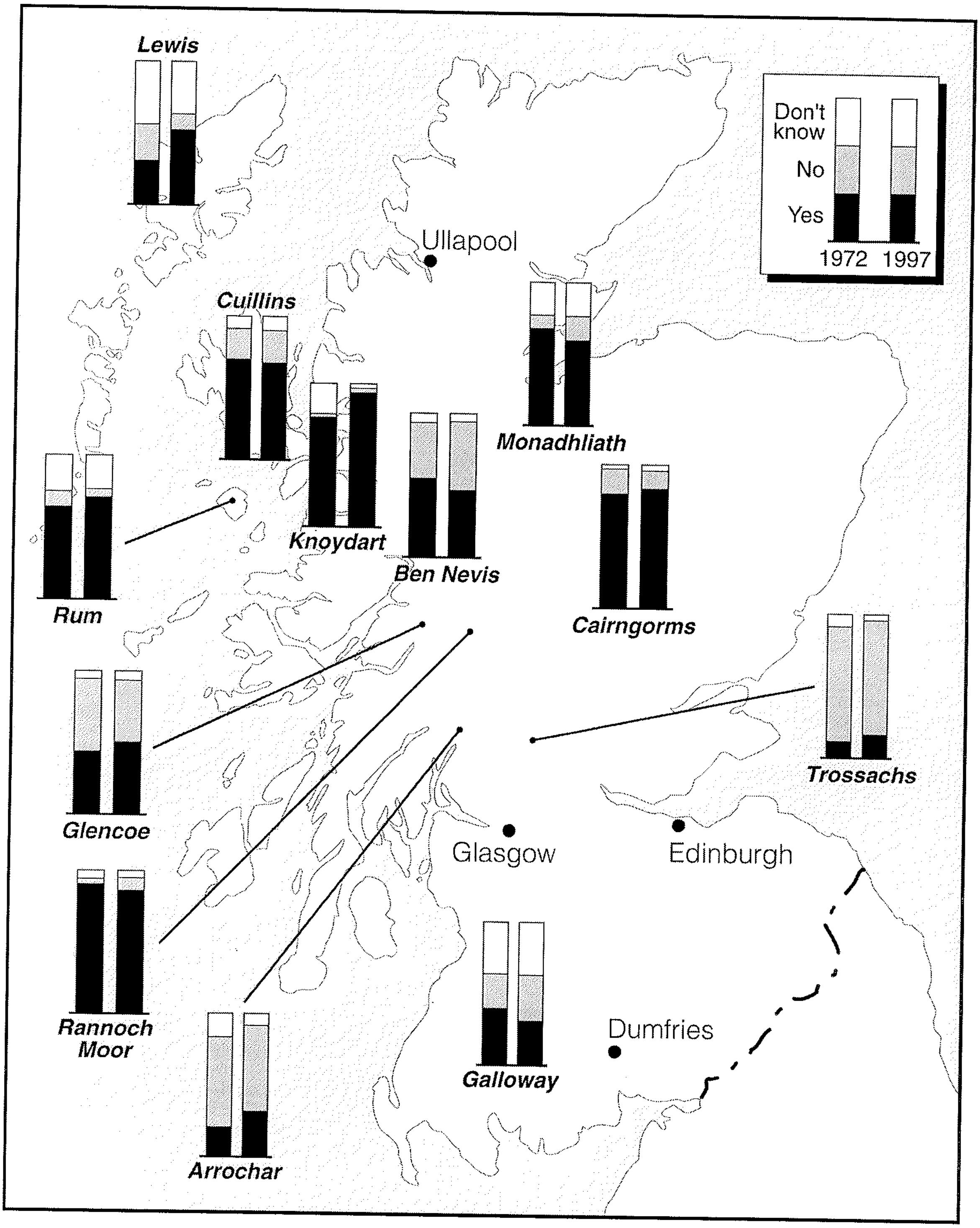


Figure 30 The change in the percentage of responses for mountaineers between 1972 and 1997 to the question: do you consider there to be wild land in this area?

Figure 30 shows that for most of the areas very little change in the proportion of respondents who consider it to contain wild land have occurred between 1972 and 1997.

4.5.3.1 Change In Visitor Perception Of Wild Land

To check the statistical significance of the relationship between the 1972 and 1997 data, the chi-square statistic was used for those who had visited the area (Table 23).

Table 23 Raw count data and the results of the chi-square tests analysing changes in the perception of wildness for visitors to the following areas of Scotland.

Area	Study year	Does the area contain wild land? Yes	No	Don't know	χ^2	P	Cochran's Rule
Cairngorms	1972	510	111	14			
	1997	102	16	5	2.740	0.255	Valid
Glencoe	1972	280	332	27			
	1997	62	53	7	3.109	0.212	Valid
Ben Nevis	1972	344	253	30			
	1997	56	59	5	3.220	0.200	Valid
Knoydart	1972	373	14	9			
	1997	98	4	0	2.382	0.304	Not valid
Rannoch Moor	1972	528	23	16			
	1997	103	10	2	4.808	0.091	Valid
Rum	1972	176	24	6			
	1997	45	4	0	2.053	0.359	Not valid
Trossachs	1972	67	473	21			
	1997	18	96	2	2.159	0.340	Valid
Lewis	1972	91	77	20			
	1997	31	7	1	12.703	0.002*	Valid
Monadhliath	1972	341	41	15			
	1997	69	18	9	11.383	0.003*	Valid
Arrochar Alps	1972	119	370	24			
	1997	34	73	4	2.811	0.246	Valid
Cuillin of Skye	1972	399	119	15			
	1997	76	27	5	1.475	0.479	Valid
Galloway Hills	1972	215	93	24			
	1997	30	33	6	11.662	0.003*	Valid

Note: * $p \leq 0.004$

For the two areas that were not valid according to Cochran's rule, a further chi-square test was conducted after discarding the 'don't know' category (Table 24). The 'don't know' category was causing the low expected frequencies because there were no cases in the current study for either Knoydart or Rum and very few cases in Aitken's (1977) data (= 9). The Bonferroni correction for multiple tests is used and so the significance level is set at 0.004 (0.05/12) because of the comparison of the 12 areas. The results displayed in both Table 23 and Table 24 show that of the 12 areas tested, in 9 of these there is no statistically significant change in the proportion of mountaineers who perceived these areas to contain wild land. Of the three areas that did show a change in perception, Lewis, Galloway and the Monadhliath, only Lewis was perceived as wilder, while the other two areas were perceived to contain wild land by a greater proportion of people in 1997 than in 1972.

Table 24 Results of the re-run of the chi-square test to analyse for changes in the perception of wildness for visitors.

Area	χ^2	P	Cochran's Rule
Knoydart	0.021	0.885	Valid
Rum	0.580	0.446	Valid

It is clear that the perception of the wildness of many upland areas of Scotland by visitors has remained relatively stable over the last twenty-five years.

4.5.3.2 Change In Non-Visitor Perception Of Wild Land

While the above analysis has concentrated solely on those cases who indicated that they had visited the area in question, Table 25 shows results of chi-square tests for those who had not visited the particular area. Only 4 of the 12 areas tested produced useable chi-square statistics, with the low n value for the current data set causing the other 8 to be invalid according to Cochran's rule. Of the four areas with valid chi-square statistics, Rum, the Monadhliath and Galloway showed no change in the proportion of respondents who perceived these areas to contain wild land. For the Isle of Lewis there was an increase in the numbers of respondents over time who perceived the island to contain wild land, in agreement with the views of those who had visited the island. As for the visitor sample, these data suggest that the perception of the wildness of many upland areas of Scotland by non-visitors has remained relatively stable between 1972 and 1997.

4.5.4 The Wilderness Purism Scale

Question 13 is an adaptation of Stankey's (1972) wilderness purism scale (WPS). The WPS is a measure of attitudinal position rather than of behavioural position (Shafer & Hammitt, 1995) and in the current context provides an indication of important factors in landscape management policies for the maintenance or enhancement of the wildness of a given area. Each respondent was asked to indicate the desirability, on a scale of 1 to 5, of finding each of a series of landscape attributes in a wild land setting. Responses have been summed for each respondent. In the first instance, an analysis was conducted to look at differences in the responses to the individual WPS items by the four sample groups, then a comparison was made between the total WPS scores of the members of the four sample groups. Subsequently, an analysis of the variation in the total WPS scores was carried out with reference to the socio-economic variables and the degree of interaction with rural areas.

Table 25 Raw count data and the results of the Chi-square test analysing changes in the number of people who have not visited an area but who perceive that area to contain wild land.

Area	Study year	Does this area contain wild land? Yes	No	Don't know	χ^2	P	Cochran's Rule
Cairngorms	1972	82	21	8			
	1997	0	0	0	Not valid	-	-
Glencoe	1972	46	47	14			
	1997	0	0	1	6.258	-	Not valid
Ben Nevis	1972	61	38	20			
	1997	1	0	2	5.177	-	Not valid
Knoydart	1972	193	6	151			
	1997	17	0	4	5.445	-	Not valid
Rannoch Moor	1972	148	5	26			
	1997	3	1	4	10.192	-	Not valid
Rum	1972	301	56	183			
	1997	42	3	29	3.244	0.198	Valid
Trossachs	1972	16	126	43			
	1997	2	2	3	5.520	-	Not valid
Lewis	1972	137	115	306			
	1997	33	7	44	11.856	0.003*	Valid
Monadhliath	1972	163	30	156			
	1997	4	3	20	10.539	0.005	Valid
Arrochar Alps	1972	35	99	99			
	1997	5	1	6	8.375	0.015	Not valid
Cuillin of Skye	1972	122	42	49			
	1997	7	1	7	4.739	0.094	Not valid
Galloway Hills	1972	81	89	244			
	1997	8	7	39	3.657	0.161	Valid

Note: * $P \leq 0.004$

4.5.4.1 Analysis Of The Individual WPS Items

A Kruskal-Wallis test was used to analyse for differences between the 4 sample groups for each WPS item. This type of test takes into account all the original scores in calculating the test statistic. The last column in Table 26 shows those groups for which differences were found.

Table 26 Median desirability ratings (1 is high, 5 is low) of the wilderness purism score items shown for all cases and the four sample groups, and the groups which showed statistically significant differences.

Wilderness Purism Scale Items	All cases	Mount-aineers (1)	Rural Inhab -itant (2)	Rural Outdoor Workers (3)	Conser-vation Managers (4)	Group differ-ences[1]
o) Out of sight of cities or towns	1	1	1	1	2	-
b) Regeneration of native woodland	2	2	2	2	1	-
d) Solitude (not seeing many other groups of people)	2	1	2	2	2	-
g) Free from evidence of obvious human impact	2	1	2	2	2	-
t) Ruins (e.g. shielings) and other archaeological sites	2	3	2	2	3	-
e) Maintained footpaths	3	3	3	3	3	1>2
f) Bridges on footpaths	3	3	3	3	4	1>2
h) Stalking/shooting	3	3	3	2	4	1>3, 2>3, 3<4
i) Big enough to take at least two days to walk across	3	2	3	3	3	1<2, 1<3
l) Maintained bothies / refuges	3	3	2	3	3	2<3, 2<4
x) Evidence of muirburn (heather burning for grouse moor management)	3	3	3	2	3	1>3, 2>3, 3<4
a) Farm animals (sheep, cattle)	4	4	4	3	4	-
c) Road access to wild land boundary	4	4	3	4	4	1<3, 2<3, 2<4
j) Presence of plant and animal species not originally native to UK	4	4	4	4	4	1<3, 2<3, 2<4
m) Hydroelectric development (e.g. dams, power lines)	4	4	4	4	4	1>2
n) Reservoirs (draw down - the bare ground left after abstraction of water)	4	4	4	4	4	-
p) Downhill skiing area	4	5	4	4	5	1>2, 2<3, 2<4
s) Conifer plantations	4	4	4	4	4	1>2, 2<3, 2<4
v) Fencing (e.g. deer fencing)	4	4	4	4	4	-
w) Logging (timber removal operations)	4	4	4	4	4	-
k) Motorised travel by visitors (e.g. four wheel drive (4WD) or boats)	5	5	5	5	5	-
q) Commercial mining / quarrying	5	5	5	5	5	1>2, 1>3
r) Bulldozed tracks (for four wheel drive (4WD) vehicles)	5	5	5	5	5	1>3, 3<4
u) Human - made noise (e.g. traffic, aeroplanes, music)	5	5	5	5	5	-

Note: [1] > or < indicates which of the two groups has the higher score and therefore is more likely to regard the item as undesirable in a wild land setting.

The table also displays the median desirability ratings for each of the WPS items for each of the sample groups. The strong agreement between groups as to what is highly desirable in a wild land setting is shown by low scores for the first 5 items. As items are regarded as more undesirable, there is greater disagreement between groups, until high scores at the bottom of the table are given by each group. The information in Table 26 provides an indication of the relative desirability of the range of WPS items for each of the sample groups.

4.5.4.2 Comparison Of WPS Scores Between The Sample Groups

Using total WPS scores for each respondent, a comparison of the scores between the sample groups was carried out with the use of an one-way analysis of variance test. The normality assumptions of the data were tested and found to be valid. The one-way anova produced a F ratio of 14.6 and a probability of < 0.001 indicating that there was a significant difference in the distribution of the mean WPS score between the four sample groups. The *post-hoc* modified least-significance distance (Bonferroni) test was used to undertake multiple comparisons between the means. The Bonferroni test reported a significant difference between the following groups:

1. Mountaineering and rural inhabitants;
2. Mountaineering and rural outdoor workers;
3. Rural inhabitants and conservation managers;
4. Rural outdoor workers and conservation managers.

This indicates that the mountaineers and conservation managers have similar perceptions of what a wild land area should look like, as do the rural inhabitants and rural outdoor workers. Shindler and Shelby (1993), in a similar study, found differences in the views of a range of interest groups. Hunters, horse riders and scouts gave less support to management policies than hikers, Sierra Club members, and managers, who all appeared more preservation-oriented with more purist attitudes. This variation is illustrated in Figure 31.

4.5.4.3 Analysis Of The Variation In The WPS Scores

WPS total scores vary between respondents, from 63 to 116, with the possible minimum and maximum being 24 and 120 respectively. These figures are calculated as the sum of the scores (ranging from 1 to 5) for each of the 24 items in Table 26. Box and whiskers plots were drawn for each of the socio-economic and rural area interaction variables to indicate the amount of influence of the different variable categories. To check that each variable was suitable for an anova test, the normality of the data was assessed using the Kolmogorov-Smirnov statistic and associated Lilliefors significance level.

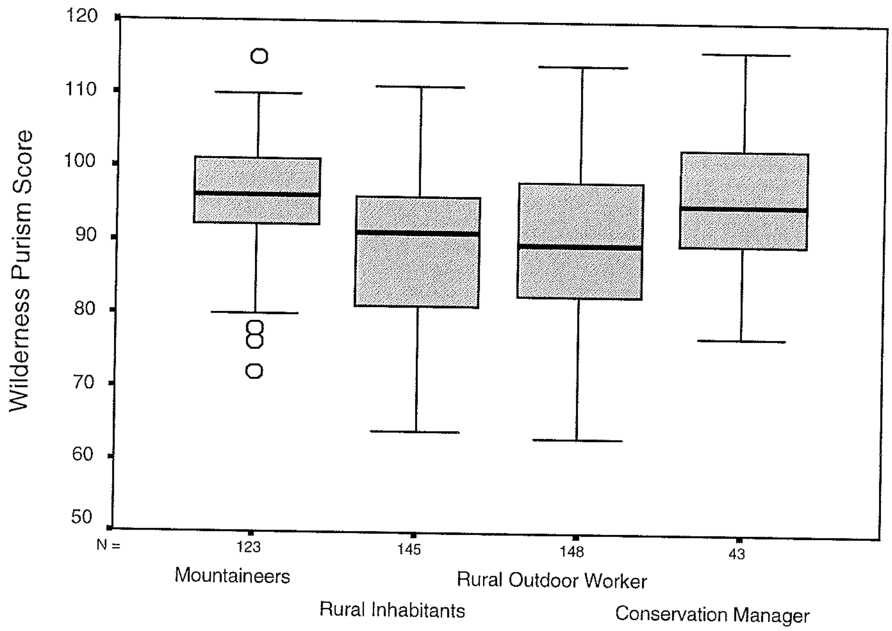


Figure 31 Variation in the WPS scores between the sample groups. The "boxes" contain the 50% of values falling between the 25th and 75th percentiles, and the "whiskers" are the lines that extend from the box to the highest and lowest values, excluding outliers. A line across the box indicates the median. Outliers (o) and extreme values are also indicated.

For all the socio-economic and rural area interaction variables which showed a significant difference between their individual categories in the anova test, ordinary least squares multiple regression was used to test their degree of influence on the WPS scores. To do this the original variable was transformed into a series of dummy variables before running the test. The result of these regression tests showed that none of the variables produced an R-square greater than 14.3 %, indicating that, at the resolution measured, these variables have very little influence on the WPS scores. The weak effects that were observed (the low R-square values) indicated that people with more education were likely to have more purist attitudes as were those who were members of climbing and mountaineering clubs or conservation organisations. In addition, those people who did not work in upland areas, or who did not work predominantly outside, tended to have a more purist attitude to wild land. However, the strength of these relationships were weak and in general the degree of wild land purism a person expresses did not appear to be greatly influenced by their socio-economic status or their degree of interaction with rural areas.

4.6 Visual Perception Of Wild Land

The 48 photographs which were used in the questionnaire were rated for wildness, beauty and naturalness on a five point scale and respondents were also asked if they were familiar with the location. These photograph data were analysed before being used as input for the development of the GIS wildness model. Initially, the data relating to the three rating factors were analysed to explore the relationship between them. The influence on wildness scores of respondent familiarity with the photograph locations were then explored. Taking all the photographs together, an analysis was conducted to assess the level of agreement between respondents, and between sample groups, with regard to photograph wildness ratings.

4.6.1 Relationship Between The Photograph Rating Factors Of Wildness, Beauty And Naturalness

A test of the agreement between the respondents ratings for the 48 photographs is shown in Figure 32. The graphs indicate the relationship between the mean wildness, naturalness and beauty ratings for each of the 48 photographs against the standard deviation for that particular picture. In each of the three graphs there is a trend towards greater agreement between respondents at the upper and lower ends of each rating scale. Those photographs in the middle of each rating scale have the greatest standard deviations, showing more disagreement between respondents. This type of rating response to photograph surveys has been noted by other authors (Steinitz, 1990).

It was important to establish any overlap between wildness and the concepts of beauty and naturalness in order to be able to define the concept of wild land. Figure 32 shows the similarity in the structure of the ratings for the three factors. A series of statistical tests was carried out to test if the concept of wild land was clearly differentiated from the concepts of naturalness and beauty by the respondents. The null hypothesis stated that there is no difference between the three rating factors of wildness, beauty and naturalness for the four sample groups. The Friedman two-way Anova was used to test for significant differences between the three related variables. The test was repeated for all 48 pictures, initially for all 459 cases, and then for each of the four sample groups. Alpha was set at the 0.05 level and a summary of how many photographs displayed significant differences between the rating factors is presented for all cases and each group in Table 27.

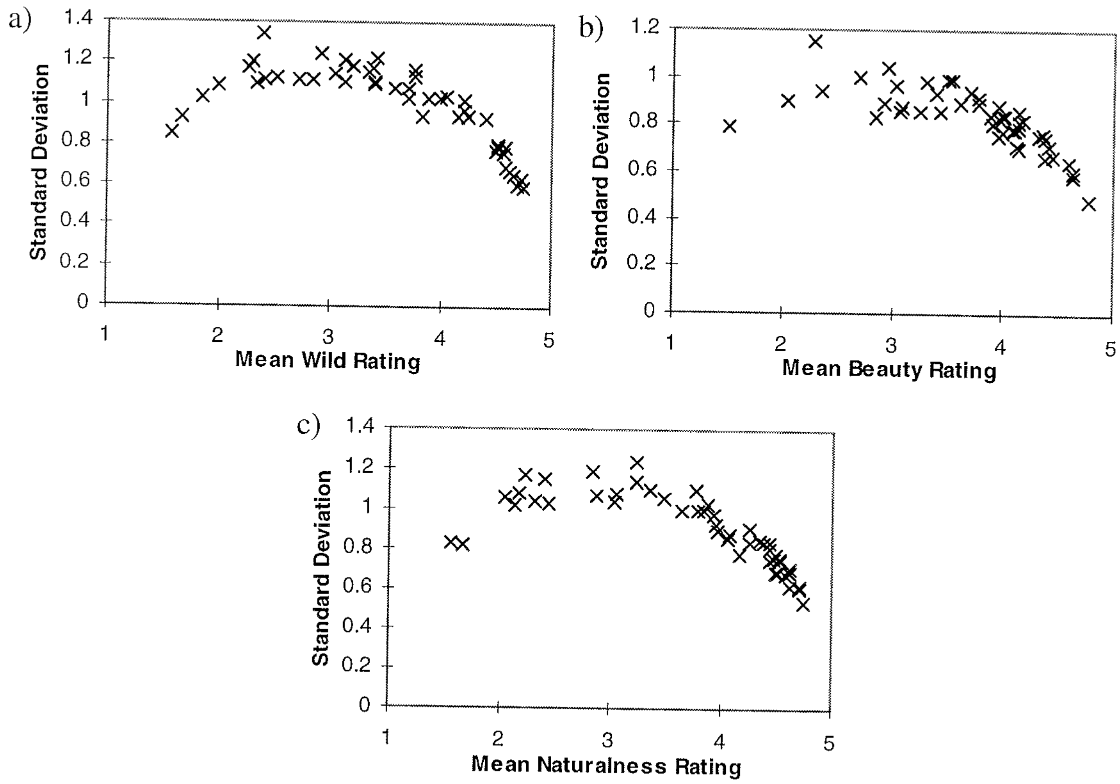


Figure 32 Standard deviation versus mean photograph ratings for a). wildness, b). beauty, and c). naturalness.

These results show that when all cases are analysed together, there is a significant difference between at least one pair of rating factors (wildness and beauty, or wildness and naturalness, or beauty and naturalness) for all 48 pictures. When the data is studied in turn for the four sample groups there is a significant difference between at least one pair of rating factors for all 48 pictures in the case of the rural inhabitant group and for the majority of pictures in the other three groups.

Table 27 Number of photographs with significant differences ($p < 0.05$) between the rating factors of wildness, naturalness and beauty for each sample group.

Sample Groups	Sample group size	Number of photographs (out of 48)
All cases	459	48
Mountaineers	123	46
Rural inhabitants	145	48
Rural outdoor workers	148	47
Conservation organisations	43	44

In general these results indicate that wildness, beauty and naturalness are separate concepts, between which respondents from all the groups differentiate.

What these results do not show is between which pair, or pairs, of factors the significant difference occurs. The following inequality test was used to test the significance of individual pairs of differences (Siegel & Castellan, 1988):

$$\left|\overline{R}_u - \overline{R}_v\right| \geq z_{\alpha/k(k-1)} \sqrt{\frac{k(k+1)}{6N}}$$

where $\left|\overline{R}_u - \overline{R}_v\right|$ = actual difference in average ranks (R) for a pair of factors u and v;
α = the significance level;
k = number of matched groups;
N = number of cases;
z = z score.

Results from the inequality test above are shown in Table 28. The test was calculated for those photographs in Table 27 which showed statistically significant differences between rating factors ($p < 0.05$). Data are presented for all cases and for each group in turn.

Table 28 The number of photographs for which the pairs of factors (wildness and beauty, wildness and naturalness, and beauty and naturalness) were significantly different (p < 0.05).

Pairs / Groups	Wildness and Beauty	Wildness and Naturalness	Beauty and Naturalness	Sample Group Size (n)
All cases	46	22	35	459
Mountaineers	34	16	27	123
Rural inhabitants	44	27	30	145
Rural outdoor workers	40	21	30	148
Conservation managers	19	9	19	43

A general pattern can be seen in Table 28, which is displayed by all the sample groups, and that shows that there are more instances in which wildness and beauty differ, fewer in which beauty and naturalness differ and least in which naturalness and wildness differ. These results emphasise the differences between the three concepts and show that wildness and beauty are concepts between which people clearly differentiate. In those instances where the result is significant at the 0.05 level, the null hypothesis can be rejected, and the alternative hypothesis that there is a difference between the three rating factors of wildness, beauty and naturalness can be accepted. This result supports the use of the term 'wildness' and reinforces it as a separate concept.

4.6.2 The Influence Of Familiarity On Perception Of Wildness

In a comparison of preference for the familiar, local or 'home' environment against an 'outside' and unfamiliar one, the latter was shown to be the preferred environment (Purcell, 1992). In terms of wildness, it has been hypothesised that people would perceive a familiar environment as less wild than people unfamiliar with the same environment. By comparing the wildness ratings of those respondents who were familiar with the location in a particular photograph, against the ratings from those who were not familiar with the same location, it was possible to test this hypothesis. Using the Mann-Whitney U test the ratings of these two groups were compared for all the photographs, (Table 29).

Table 29 Test results from assessing the influence of familiarity on wildness ratings.

Outcome	Number of photographs
No difference in wildness ratings	37
Familiarity = more wild	10
Familiarity = less wild	1
Total tested	48

Table 29 shows that there is some limited evidence to support the idea that familiarity with a location can influence a person's perception of its wildness. In the case of 11 photographs out of a total of 48 there were significant differences between the wildness ratings of those respondents familiar with a particular scene and those who were not. For 10 of these photographs, those familiar with the location regarded it to be wilder than those who were unfamiliar with it. The only case in which those who were unfamiliar with a scene rated it wilder than those who were familiar, was for the ski slopes in Corrie Cas in the Cairngorms. However, for the majority of cases, familiarity did not appear to influence wildness ratings.

4.6.3 Variation In The Wildness Ratings Of All The Photographs

In order to look at the variation in the wildness ratings for all 48 photos between each of the four sample groups, the Friedman two way anova test was used to rank the photos for each group. This is a nonparametric test used for establishing differences between k-related samples of ordinal data and thus was ideal for the photograph wildness scores. The four lists of photograph ranks produced are slightly different, in some cases the ranks were equal between the groups with the largest difference in rank position of only 12 places and the mean rank difference varying between 1.77 and 3.69 (Table 30).

Table 30 Rank differences between the photograph wildness ratings for all combinations of groups.

Group combination	Minimum	Maximum	Mean rank difference
Mountaineering and rural inhabitants	0	8	2.33
Mountaineering and rural outdoor workers	0	5	1.77
Mountaineering and conservation managers	0	9	2.75
Rural inhabitants and outdoor workers	0	6	2.08
Rural inhabitants and conservation managers	0	11	3.69
Rural outdoor workers and conservation mangers	0	12	2.85

The null hypothesis for the test is that the k-related samples come from the same population. The test statistic was not significant ($p > 0.05$), indicating that the null hypothesis could not be rejected. This result shows that when the photograph set is taken as a whole and ranked in terms of increasing wildness, it was not possible to establish significant differences between the sample groups. This result is to be expected as a mountaineer is just as likely to rate an image containing an unspoilt mountain plateau as very wild (value 5), as is a rural inhabitant. The same is true at the other end of the wildness spectrum, a picture containing a building and domesticated animals is likely to be scored as not wild (value 1) by all groups. Each person fits the wildness range of 1 to 5 to the whole set of pictures no matter which of the sample groups they belong to. The responses to the photographs are plotted in Figure 33 which shows that all four sample groups follow the same general trend in the mean wildness ratings for all 48 photographs.

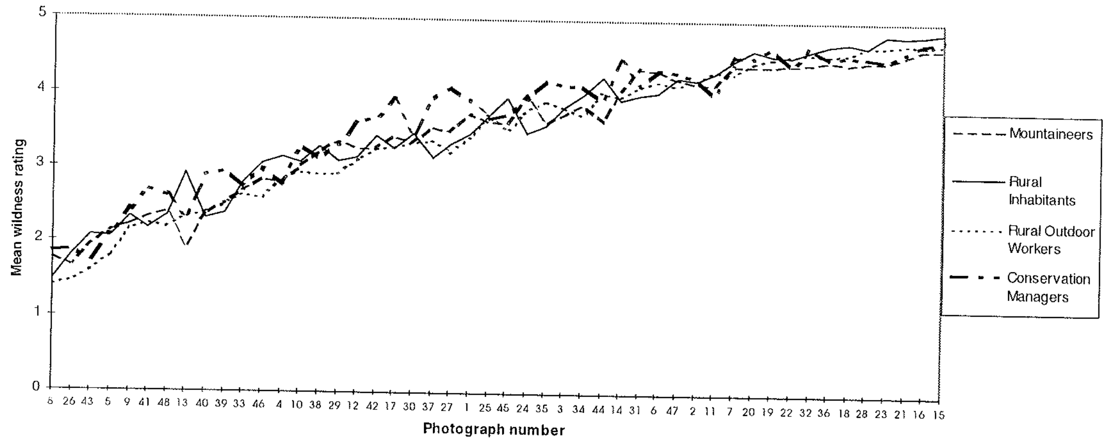


Figure 33 The mean wildness ratings displayed for each sample group for the 48 photographs.

4.6.4 Analysis Of Individual Photographs

By looking at one picture and seeing how the wildness scores for that image differ between the four sample groups an idea of the perceptual differences between the groups can be achieved. The test used is the Kruskal-Wallis one-way anova which tests for differences between k independent samples of ordinal data, such as the photograph wildness scores. The results from the Kruskal-Wallis test showed that there were 18 pictures for which some of the groups differed significantly in their wildness scores (Table 31).

In the 5 cases where rural inhabitants and rural outdoor workers differ in opinion (13, 38, 43, 45, 46), the rural outdoor workers always give lower wildness scores and this appears to be a response to the type of land management shown. These 5 photographs show areas of heather moorland, conifer plantations, rough grazing or skiing artefacts. For the 8 photographs that the conservation managers rated differently than any other group, except photograph 23, the conservation managers scored higher, indicating greater wildness. Of these eight pictures, six of them contain woodland or stands of Scots pine, one is a coastal shot and photograph 23 is a hillside with a faint path. The mountaineering group generally score photographs wilder than the two rural groups, except where footpaths and heather moorland are concerned which bring down the wildness ratings for the mountaineering group. The data presented only list those photographs for which there was a significant difference in the wildness scores between two or more of the four sample groups, there are a further 30 photographs for which none of the groups displayed significantly different scores.

Table 31 The photographs with significant differences between the wildness scores for the groups listed.

Picture number	Mountaineers *vs.* rural inhabitants	Mountaineers *vs.* rural outdoor workers	Mountaineers *vs.* conservation managers	Rural inhabitants *vs.* rural outdoor workers	Rural inhabitants *vs.* conservation managers	Rural outdoor workers *vs.* conservation managers
5		>[1]				
8	>	>			<	<
13	<			>		
17					<	<
23	<				>	
24	>					
27			<		<	<
29		>				
31	>					
35			<			
37	>				<	<
38				>		
40					<	
41					<	
43		>		>		
44	<	<				
45	<			>		
46				>		

Note: [1] < or > indicates which of the two groups in each column had the highest and lowest wildness ratings.

4.6.5 Within Photograph Variation

The wildness scores for each photograph were tested against independent variables (Table 32) in order to try and explain the variation both within each photograph and between photographs. The aim was to find groups of respondents who perceive wild land in a similar way. All photographs show the full range of variance of wildness scores, with cases scoring between 1 and 5 for every photograph when the whole sample is considered. This variation decreases as the population is split into the four sample groups. However each photograph has a peak wildness score and displays a definite trend. Table 32 shows the results of the Kruskal-Wallis One-Way Anova (k-independent samples) and Mann-Whitney U-Wilcoxon Rank Sum W (two independent samples) tests used to try and explain within photograph variation.

Table 32 The number of photographs for which there were significant differences between at least two of the categories in the variables listed.

Variable	Number of categories	Number of photographs
Preferred activity	6	5
Experience of preferred activity	5	2
Membership of organisations	8	5
Working in upland areas	2	2
Working outdoors	2	9
Sex	2	4
Age	6	10
Education	5	15
Income	10	6
Employment	5	7
Sample group	4	18

Table 32 shows that no one variable accounts for the significantly different groupings for all of the 48 photos. A respondent's sample group type accounted for the variation in the wildness scores of more photographs than any other distinguishing variable. In 15 photographs the variation in the wildness ratings could be explained by the different education categories. In general, the more education a person had received the more likely they were to rate a photograph as wilder.

4.7 Chapter Summary

This chapter has shown that there are significant differences between the four sample groups in relation to some of the socio-economic variables identified. Analyses confirmed that each sample group was representative of the population from which it was taken. Although a sample of the general public was not assessed for the purposes of this study, the rural inhabitants proved to be the group most representative of the Scottish population, despite having an older age structure, with more people holding degrees and containing slightly more men. In terms of the mode of interaction with rural parts of Scotland, for the mountaineering group it was predominantly recreational from an urban base, while for the rural outdoor workers it was wholly economic from a rural base. For the other two groups the distinction between economic and recreational interactions with rural areas was not as clear, with a combination of the two prevalent in both groups.

In general, wild land was perceived to exist by the majority of all sample groups, occurring anywhere except lowland areas. Approximately 50 % of respondents considered time and distance from a surfaced road to be unimportant in assessing the wildness of a location, while the majority of the remainder thought wild land could reached after 1 to 3 hours or 3 to 6 miles. The importance of the visual nature of wild land perception was emphasised, as was the absence of human impact and artefacts in a wild land area.

There is a range of perceived wildness or perceived wild land quality within Scotland's upland and mountainous areas. In general, areas are wilder with increasing distance from the Central Belt. Visits to the upland and mountainous areas in question enhanced the perceived wildness in comparison with the perceptions of those who had not visited the area. Greater numbers of non-visitors did not know whether an area contained wild land. The perceptions of wild land by mountaineers were shown to have not changed significantly over the last 25 years, despite increases in visitor numbers and a degree of landscape change. Stankey's (1972) Wilderness Purism Scale (WPS) showed the mountaineering and conservation manager groups to have similar and more purist attitudes towards the desirable attributes of a wild land setting, than the rural inhabitants and outdoor workers.

The concept of wild land was shown to be clearly differentiated from the concepts of naturalness and beauty. As with the WPS, there was greater agreement for all three rating factors at the upper and lower ends of the rating scales. Familiarity with a location only appeared to influence the wildness ratings to a small degree, in contrast to the findings of preference studies (Purcell, 1992). When the wildness ranks of all the photographs were compared between the sample groups none of the differences were statistically significant. Despite this finding, closer inspection of individual photographs showed that the wildness ratings for some differed between the groups, although for the majority of photographs, there were no differences. The variable which best explained these differences in wildness ratings was the sample group type, confirming the suitability of the sampling strategy used. The differences between the sample groups for many WPS items, which contrasted with very few differences in perceptions of wildness in the photographs, show that there is a significant difference between the influence of individual features on perceived wildness as opposed to a wildness assessment of the whole landscape, as in the case of the photographs.

All the cases were combined before calculating the median wildness figure of each photograph because of the general agreement displayed by the four sample groups regarding the wildness of the 48 photographs. These figures were used to develop the GIS model to predict the wildness of a location based on the surrounding landscape attributes, the subject of the next chapter.

Chapter 5

Identification of Landscape Parameters of Wildness

5.1 Introduction

This chapter develops the link between the photographed landscapes and their wildness ratings. This is based on the development of a wildness model built on the landscape attributes visible within each of the photographs. The use of a GIS provides an efficient and accurate method of quantifying and analysing the landscape attributes of all 48 photographs. Using a sub-sample of the photographs, models are developed to explain the variation in the wildness ratings in terms of the landscape attributes present using multiple linear regression analysis. The remaining photographs are employed to test and validate the models developed.

A GIS approach enables the application of the validated models within the Cairngorm and Wester Ross study areas. The output from the models is presented in the form of wildness maps which are discussed in the next chapter.

5.1.1 GIS And The Wildness Of The Surrounding Landscape

Up until now it appears that little has been published on evaluating the wildness of a location based upon people's visual perception of the surrounding area. However, much published work exists in the evaluation of scenic beauty or visual quality with the aid of a GIS for planning purposes (Hadrian *et al.*, 1988; Amir & Gidalizon, 1990; Steinitz, 1990; Selman *et al.*, 1991; Bishop & Hulse, 1994; Culbertson *et al.*, 1994; Lange, 1994), from which the present study has borrowed methods of data collection and analysis. Studies from this body of work can be categorised by the GIS methods used to evaluate scenic beauty, into those which use GIS in a 2-dimensional (2D) manner, and those which attempt a 3-dimensional (3D) approach to their analysis of the landscape. Falling within the first category is Culbertson *et al.* (1994) in which the scenic beauty ratings of photographs leads to the creation of spatial variables and subsequent visual quality maps with the aid of GIS. A major feature of many of these studies is the use of multiple regression analysis to develop a predictive model of visual landscape quality (Vining & Stevens, 1986; Steinitz, 1990; Hammitt *et al.*, 1994). Bishop & Hulse (1994) describe how scenic beauty was evaluated using mapped data in a GIS to produce predictive variables directly based on the surrounding terrain, which falls into the 3D category. Miller (1995) also used a 3D approach to characterise the nature of a view and its structure to allow observer based appraisals of scene quality.

The analysis of the actual photograph, as in the 2D method, would appear more appropriate than analysis of 3D space using the GIS. Using the 2D approach, areas or lengths of features in the photograph can be easily calculated, and they are direct representations of what is seen by the observer. However, with the 3D method, the value of the actual surface area of a forestry plantation for example, bears little resemblance to the value which would be calculated by the 2D method . This is especially true for measurements of features on shallow angled slopes where the actual surface area is much greater than the area which it takes up on a photograph.

Use of the 2D method lends itself to the production of visual quality maps based on the overlay of weighted geographic layers, such as land cover types and water features. These maps assign a visual quality value to a location based on the combined values given to the landscape features from a certain point. This approach does not take into account the surrounding landscape, visible from that point.

In contrast to the 2D approach, Bishop & Hull IV (1991) suggest that using a raster based GIS and a terrain model with appropriate data and modelling tools, it should be possible to calculate values for visual quality directly and assign them to every raster point. In addition, a study by Schroeder (1988) has shown reasonable predictions of visual quality based on measurements taken from aerial photographs, tested against ratings of eye-level photographs. Bishop & Hulse (1994) detail two other studies that have shown how maps can be used for gathering information about the visual landscape. Brown's (1990) study analysed maps to calculate estimates of the variables that can be determined from photographs. Regression analyses showed that land cover ratings identified from photographs were important in explaining variance in the photograph preference ratings. Similarly, land cover indices developed from base maps of the photograph viewsheds could explain a similar degree of variance as the photograph preference ratings (Brown, 1990). Iverson (1985) studied the visual magnitude of landscape features, predicted from data derived from GIS parameters such as distance, slope and aspect measures. Bishop & Hulse (1994) also describe a study in which ratings of 360° video panoramas were used to test a predictive model based on the measurement of landscape features taken directly from a GIS. This study predicted scenic beauty values with an adjusted R^2 of 80%. This integration of photographic and

GIS technology for the purposes of managing change in the visual environment has been described in detail by Bishop & Hull IV (1991).

Transferring these ideas of 3D analysis to the problem of wilderness perception indicates that values of the visual landscape, including wildness, can be predicted from GIS based data sources. A 3D approach provides a versatile and holistic method as it can take into account all that can be seen from one location, and does not just rely on a selective view. A model developed from a GIS based 3D approach can be applied anywhere within the study area without the need to take more photographs, as would be required with a 2D approach. Hence a 3D approach is used in the development of the wildness models in the current study.

5.1.2 Method Overview

The GIS used in this study is ARC/INFO version 7 running on HP and Sun workstations. The first stage of the GIS based analysis is to conduct a visibility analysis for each photograph, after which the variables representing the visible landscape can be quantified. These data are then used to develop a model of wildness for a given location based on the surrounding landscape features. The wildness model is tested and validated using the original photograph ratings before it is applied to predict wildness ratings of areas of the Cairngorm and Wester Ross study areas. Final output includes wildness maps. The GIS procedure is illustrated in Figure 34.

5.2 Input Data

The data sets which were used for the GIS analysis are described below.

5.2.1 Base Line Data

The necessary data sets were kindly loaned by the Scottish Office, Edinburgh. Study area boundaries were used to 'clip' the relevant sections from the following data sets:

1. 1:50,000 Ordnance Survey Panorama contour data with contours at 10m intervals.
2. 1:250,000 Ordnance Survey Strategi data. This includes infrastructure, cities, towns and settlements, woods and land use, and hydrological systems.
3. 1:25,000 Land Cover of Scotland 1988 polygon, point and arc data, referred to as LCS88. The method of classification for areas in the Land Cover of Scotland 1988 data set assigns two values to all polygons. The first is one of 1501 land cover codes, the second is one of 34 display codes which are assigned to the land cover codes.

Including all 1501 LCS88 categories in the visibility analysis would introduce a large number of unnecessary variables into the study and so only the 34 display categories, known as VAL34, are used here. A total of thirty-four potential variables is still a large number, but owing to the nature of the study areas, only half of this number of categories appear in significant quantities. The differentiation between land cover types made by respondents to the questionnaire, is comparable to the names given to the 34 categories e.g. broad-leaved trees, conifer plantation, montane.

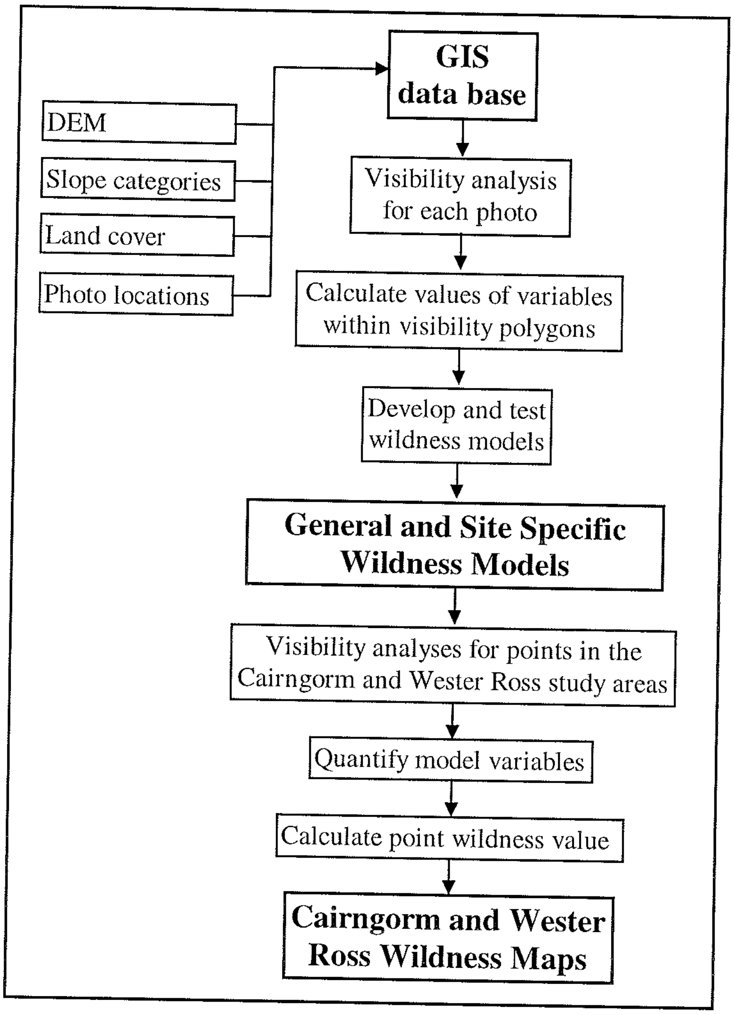


Figure 34 A flow diagram of the GIS analysis and model development process.

All data sets used the Ordnance Survey (OS) coordinate system to correspond with the photograph locations: these were recorded as six figure OS grid references.

5.2.2 Study Area Boundaries

The two study area boundaries were digitised from 1:50,000 OS maps. Boundaries were slightly altered so to include all photograph location points and the full viewshed of each photograph. In Wester Ross, where the road runs very close to the coast, the coast was used as the boundary thereby including the road within the study area. In addition, where a photograph was taken from a location outside of the original study area but looking into the study area, the photograph location was also included within the study area boundary. These alterations to the boundary were created by following watersheds, the coastline and OS gridlines.

5.2.3 Photograph Locations

The first step in setting up the database was to construct point coverages of the photograph locations so that these could be overlaid on a Digital Elevation Model (DEM) in order to undertake visibility analysis. A single coverage for each study area containing all the photograph locations was first created in order to ensure that all the points fell within the boundary. This was confirmed by close inspection of the photograph location coverages.

For visibility analysis, individual point coverages had to be created for each photograph location. This was done to avoid the creation of any visibility polygons that would be shared by two photograph locations. In this way each photograph location produced a unique set of visibility polygons. In total, 48 photograph location coverages were produced, all of which fell within the study area boundaries.

5.2.4 Digital Elevation Model

The contour data for each study area were converted from an arc coverage into a DEM in the form of a grid using the TOPOGRID command, and the contour height values provided the grid z values. The use of the TOPOGRID command ensures that work is carried out as close to the source data as possible. This grid, also known as a floating point lattice, provides a 3D surface on which the visibility analysis can be conducted. In an elevation grid, errors in the resulting surface needed to be corrected. These errors are usually in the form of depressions in the surface model not present on the ground (sinks). False peaks can also occur but are less common. Actual sinks are generally restricted to glacial areas where they take the form of kettle holes and cirques, and in limestone areas of karst topography (Mark, 1988). The sinks found in each study area DEM were filled. The correction process involved filling the sinks to the ground surface level using a standard Arc/Info procedure.

5.2.4.1 Assigning Heights To The Tree Categories

The screening effect of vegetation, especially trees, had to be taken into account, as it restricted the area of view in many of the photographs. The inclusion of digital representations of buildings and vegetation has been shown to increase dramatically the accuracy of line of sight analyses (Dorey *et al.*, 1998). This is achieved by overlaying the lattice used to calculate the visibility polygons with a polygon coverage, such as land use, where each type of vegetation has an associated top height above the ground surface. The combined ground surface and tree height values can then be taken into account when conducting a visibility analysis. Within the 34 land cover categories were the following areas of vegetation that required a height value: recent planting, conifer plantation, seminatural conifers, mixed woodland, broad-leaved trees and scrub. The first of these, recent planting, was included owing to the 10 year interval between the digitisation of the LCS88 data and its use in this project. The problem of young plantations that did not appear in the LCS88 data set is illustrated by the omission of such an area in the field of view of photograph 39. The heights in Table 33 have been used for the two study areas.

Table 33 Vegetation heights within the two study areas.

Category (VAL34)	Cairngorms (m)	Wester Ross (m)
Recent planting (10)	3	3
Conifer plantation (11)	25	20
Seminatural conifers (12)	15	15
Mixed woodland (13)	15	15
Broad-leaved trees (14)	10	10
Scrub (15)	5	5

These height values were obtained from the Forestry Commission (Wallace, R., pers. comm., 1998) and are no more than general estimates for mature woodlands and forests, or plantations at felling age, with the exception of the recent planting category. The LCS88 data were converted to a grid using the POLYGRID command with the item THEIGHT creating a flat surface with only the trees protruding on the surface. This tree grid was then added to the elevation grid (in GRID) to produce a DEM of the ground surface, included areas of trees, and this was used in further visibility analyses. As there are very few buildings within the two study areas and little available information on these, representations of these features were not included in the DEM.

5.2.5 Slope Categories

Slope is one of the variables to be tested in the regression of landscape attributes and wildness ratings because of its influence on landscape perception shown in previous studies (Bishop & Hulse, 1994). For each of the two study areas a slope polygon coverage was created using the LATTICEPOLY command. The resulting coverages used the default slope categories in ARC/INFO (Table 34). Other studies have used slightly different values, Bishop & Hulse (1994) used 4 categories with the following ranges: 1-9% [0.57 - 5.1°]; 10-18% [5.71-10.20°]; 19-27% [10.76-15.11°]; >28% [>15.64°].

Table 34 The slope categories used in the classification of the Wester Ross and Cairngorm study areas.

Slope category	Range (Degrees)	Wester Ross m^2	Cairngorms m^2
1	0 < slope <= 0.57	75710000	15742500
2	0.57 < slope <= 1.23	28225000	43815000
3	1.23 < slope <= 2.66	84300000	108695000
4	2.66 < slope <= 5.71	189325000	261142500
5	5.71 < slope <=12.13	345082500	507480000
6	12.13 < slope <= 24.89	310175000	429250000
7	24.89 < slope <= 45.00	104015000	90272500
8	45.00 < slope <= 90.00	4875000	1537500
Total area	=	1141707497	1457935000

5.2.6 Errors In The GIS Data

All GIS data contain some errors relative to the actual terrain (Burrough, 1986; Huss & Pumar, 1997; Heuvelink, 1998) and Aspinall & Pearson (1995) list many studies that describe uncertainties in the thematic and geometric properties of categorical maps. This is acknowledged, although the aim of the current project is to explore the development of a method for application to a specific issue. The project is hence more of a first attempt at solving this problem. If the findings of this project were to be used in the public domain as a decision support tool then a clear assessment and quantification of the errors associated with the input data would be required to assess the accuracy and reliability of all GIS analyses (Aspinall *et al.*, 1991). However, at present this would be a difficult task as there is not a single, generally accepted theory for handling error and error propagation in GIS (Heuvelink, 1998). The main source of unseen errors is natural spatial variation in the original data (Burrough, 1986) and the LCS88 is also subject to this. The accuracy of the LCS88 data is known to vary, particularly in upland areas such as those with which this project is concerned, and this is due to the absence of features which are identifiable on both photographs and maps (Aspinall *et al.*, 1991), and which are necessary for the geometric correction and rectification of the aerial photographs used as the original data source. Aspinall & Pearson (1995) defined and quantified the accuracy at the main class level of the land cover key (VAL34) and showed that there was considerable variation between classes. For example, the montane category has a mean accuracy of 82.6 % (95 % C.I. = 75.8 - 87.8 %), while for the heather moor category the figure is 33.3 % (95 % C.I. = 22.5 - 46.3 %) (Aspinall & Pearson, 1995). These errors associated with input data are compounded during the stages of data processing and therefore need to be taken into consideration in the interpretation of the output of the wildness models. However, it is likely that the uncertainty in the photograph wildness ratings is a greater source of error than the GIS datasets.

5.3 Land Cover And Position Data Checks

The visibility polygons for each photograph were used to CLIP land cover data from the LCS88 data set. An initial look at the land cover data contained within the visibility polygons of each of these photographs showed that:

1. In some cases, trees visible in a photograph were not represented in the land cover data set.
2. In other cases the land cover type immediately in front of the point from which the photograph was taken was not the same as that visible in the photograph.

Data are displayed on screen as one of the 34 VAL34 categories, which have broad definitions such as 'heather moorland'. However, each of these display codes also represents many other land cover codes that are more detailed such as 'heather moorland with scattered trees, no bare rock and burning'. In some cases the lack of trees in the visibility polygon areas was because of the underlying land cover category having been given a non-tree display code. Where, on closer inspection, the land cover category was found to contain trees, it was reclassified into one of the tree display codes for the subsequent visibility analysis (see Table 35).

On close inspection some areas were not represented by trees, even in the land cover codes. The one case where this happened was because of conifer planting which was perhaps undertaken after the LCS88 data were digitised. The LCS88 data were updated by adding the plantation from the Strategi data set after which LCS88 classes were reassigned to the area concerned (see Table 35).

The second observation of the original photograph locations, obtained from single fix readings of a GPS unit, showed that some were likely to be inaccurate. By looking at the relative positions of boundaries between land cover types and the location of roads and rivers, it was found that in some cases photograph locations were in error by up to 100 m, with a maximum error of 250 m. This error is due to a location error of the hand held Magellan GPS unit used, that rarely exceeds 100 m (Magellan). This error is a function of the standard positioning service used by the unit which is intentionally degraded and has a 95 % predictable accuracy of 100 m horizontally (Dana, 1998). Therefore to double check the position of the photograph location, a surface view for each photograph was generated using the DEM and the output was compared with the original photograph. If the two were identical then no further corrective action was required. If some discrepancy was evident then the view was altered to generate the correct parameters for the final visibility analysis. This method also checked the accuracy of the photograph bearings. Errors were corrected by moving the photograph location to its 'true' position (see Table 35).

Table 35 Data set corrections for photograph locations and viewable land cover.

Photo	Error	Correction
		Cairngorm Study Area
2		Moved to 297521, 797801
3	No trees in LCS88 data Position out	LCS88 category 111 (dry heather moor, no rock outcrops, no burning, scattered trees) moved from VAL34 category 6 (moorland) to category 12 (semi-natural conifers) Moved to 303355, 793339
8	No trees in LCS88 data Position out	Polygon (rec. # 3471) added with the following characteristics: LCS88 category 73, VAL34 category 12. Semi-natural conifers. Moved to 304219, 793063
10	Position out	Moved to 289727, 807839
12	Position out	Moved to 289500, 811250
12	Offset too low	Photograph taken from a bridge, OFFSET A increased by 10m to 11.5m
14	No trees in LCS88 data	LCS88 category 131 (undifferentiated heather moor, no rock outcrops, no burning, scattered trees) moved from VAL34 category 6 (moorland) to category 12 (semi-natural conifers)
14	On top of trees	CAIRCANO grid edited at photograph location point, height value reduced by 15m (height of trees).
21	No trees in LCS88 data	Polygon attributes altered in WESTLCSR2, THEIGHT given value 15, VAL34 = 26 moved to VAL34 = 12, LCS88 = 950, ID = 2328, # = 2329.
21	Position out	Moved to 297166, 802270
23	Position out	Moved to 302242, 808309
25	Position out	Moved to 300662, 811558
26	Position out	Moved to 291777, 810777
32	Position out	Moved to 298130, 803106
37	Position out	Moved to 304279, 793580
38	Position out	Moved to 306003, 792048

Photo	Error	Correction
39	No trees in LCS88 data Position out	Conifer plantation added code 5611, added from Strategi data set, assigned VAL34 category 10 (Recent planting) Moved to 306425, 791299
40	Position out	Moved to 304423, 793589
42	Position out	Moved to 301952, 803296
43	Position out	Moved to 298027, 809481
44	Position out	Moved to 295988, 803961
45	Position out	Moved to 300622, 811483
48	No trees in LCS88 data	LCS88 category 735 (coniferous plantation) moved from VAL34 category 34 (other mosaics) to VAL34 category 11 (conifer plantation)
48	Position out	Moved to 291758, 810800
		Wester Ross Study Area
1	Position out	Moved to 212769, 879970
4	No felled area in LCS88 data Position out	An area of approximately 200m * 200m was placed in front of the photograph location and assigned LCS88 category 393 (recently felled forestry) and VAL34 category 9 (felled woodland). Moved to 212203, 884528
5	Position out	Moved to 212588, 884422
7	Position out	Moved to 203619, 878372
16	Position out	Moved to 209441, 881700
17	Position out	Moved to 210702, 883877
17	Position on top of trees	Square polygon added around the point to WESTLCSR2, THEIGHT given value 0, VAL34 = 14, LCS88 = 76, ID = 1562, # = 300.
19	Position out	Moved to 212549, 884825
24	Position out	Moved to 195404, 890870
27	Position out	Moved to 228323, 861645
27	Position on top of trees	WESTCANO grid edited at photograph location point, height value reduced by 10m (height of trees).
29	Position out	Moved to 196592, 893156
31	Position out	Moved to 196481, 890680
33	Position out	Moved to 217124, 875978
35	Position out	Moved to 188925, 872370
46	Position out	Moved to 210878, 884172
47	Position out	Moved to 195225, 890798

5.4 Visibility Analysis

Previous studies have found that there is about a 20 % error in the area classified as 'visible' (Felleman, 1982). However more recently work has been conducted in an attempt to quantify the uncertainty of actually being able to see a point in a real landscape, that has been identified as visible within a GIS created viewshed (Fisher, 1991; Fisher, 1992; Huss & Pumar, 1997). This uncertainty is generated from errors in the compilation of the original maps and the production of the DEM from the map (Fisher, 1991). The main points are:

1. In general, the viewshed is an overestimate of the actual area seen from a given point (Fisher, 1991; Huss & Pumar, 1997).

2. The reliability of visibility predictions increases with increasing terrain roughness (Huss & Pumar, 1997).
3. The accuracy of intervisibility calculations is a function of the terrain resolution (Barr & Mansager, 1996).

Viewsheds produced by different software packages but based on the same data have also been compared (Fisher, 1993). Results showed that the number of cells included in the viewshed for one test site varied from 1780 to 2610, a difference of 830 cells. ARC/INFO was one of the packages tested and in both cases this package produced a value between the two extremes noted.

The two study areas of the current project are both mountainous and hence have a high degree of terrain roughness and this increases confidence in the visibility polygons produced. The problem of overestimating the area visible from any one point is accepted. However, in order to take this into account, a visual check can be put in place to estimate the scale of the problem (see the section 5.4.4 Error Checking). Overestimates of the viewshed area are often caused by the absence of certain features in the DEM such as trees or buildings, which can seriously affect visibility (Sansoni, 1996; Dorey *et al.*, 1998). The influence of trees on visibility has been taken into account by including trees as part of the DEM surface.

The body of work concerned with viewshed uncertainty recommends the use of a probabilistic representation of a viewshed, which is more acceptable than the binary product conventionally used (Fisher, 1992; Fisher, 1993; Sansoni, 1996; Huss & Pumar, 1997). However, at the time of the analysis, there was no option available in ARC/INFO V 7 to produce a probabilistic viewshed and the binary option was used. In addition, terrain resolution had to be set at 50 m because of the scale of the available contour data (1:50,000).

5.4.1 Distance Zones

Kliskey & Kearsley (1993) have shown that the presence of human artefacts can have a detrimental effect on the wildness of an area. However, little information exists concerning the influence of human artefacts which are visible from a distance. On a clear day from the summit of a mountain in Scotland it is possible to see a long way and it is very likely that a number of human artefacts will be seen, e.g. a village or a road. The wildness of that summit may be drastically affected by the sight of that village even though it is a long way away. If this is the case, then the final wildness maps may classify some of the mountain summits as not being wild because of these distant features, while the mountain slopes, from which the village perhaps cannot be seen, may be classed as very wild. Evidence suggests that the further the observer is from a particular feature, the lower the impact of that feature on the observer (Hull IV & Bishop, 1988). Hull IV & Bishop (1988) provide evidence of a distance decay function for the scenic impact of electricity transmission towers. The relationship between distance and scenic impact was shown to be non-linear, and was inverse. Hence scenic impact rapidly decreased with increasing distance from the transmission tower. A similar relationship is used by Miller *et al.* (1994) in a model used for the local analysis of scenery in the Cairngorm mountains. The function incorporated into the model is the inverse of the squared distance from the viewpoint i.e. $\left[\frac{1}{D^2}\right]$, where D = distance from viewpoint. If it is assumed that there is a similar relationship between the wildness of a location and the distance to the surrounding features, then it is necessary to take this distance into account when calculating the values of the landscape variables for each photograph. Each photograph has a series of visibility polygons associated with it. The distance range covered by these polygons can vary from 1m to several kilometres from the observer. To accommodate the influence of distance on wildness, the area visible from each photograph is split up into foreground (less than 250 m), mid-ground (250 m to 750 m) and background (more than 750 m) zones (Bishop & Hulse, 1994).

5.4.2 Controlling The Visibility Command

The ARC/INFO command used to produce visibility polygons is VISIBILITY. Various aspects of the VISIBILITY command can be controlled including the horizontal and vertical angle limits to the visibility scan, and the height of the observer above the ground surface. In order to control the visibility command so that the visibility polygons identified were as realistic as possible, the following items were included in the Point Attribute Table (PAT) for each photograph location:

1. AZIMUTH1 and AZIMUTH2 - these specify the horizontal limits to the visibility scan. The sweep proceeds in a clockwise direction from AZIMUTH1 to AZIMUTH2. Values are given in degrees from 0 to 360, with 0 oriented to the north. For each photograph, the magnetic bearing for the centre of the frame was recorded.

4° was subtracted from this magnetic bearing to give a grid bearing - the type required by the items AZIMUTH1 and AZIMUTH2. The 50 mm lens that was used to take the photographs has an angle of view of 45° (The Focal Encyclopedia of Photography, 1969), although the ARC/INFO help system recommends the use of 20° either side of the grid bearing to replicate a 50 mm lens. Therefore AZIMUTH1 = grid bearing - 20°, and AZIMUTH2 = grid bearing + 20°.

2. VERT1 and VERT2 - these items specify vertical angle limits to the scan. The value of VERT1 sets the upper limit of the scan and VERT2 sets the lower limit. As all the photographs were taken with a level camera, the angle above and below the horizontal is half of the angle of view of the lens, i.e. 22.5°. However, 22.5° is a larger angle than is actually recorded on the film plane in the camera. The ARC/INFO help system recommends the use of 14° to replicate the field of view obtained from a 50 mm lens. VERT1 was set at 14° and VERT2 at -14°. This parameter was included for all photograph locations, and was particularly important for those locations where the upper horizon is on land and does not include any sky.
3. The OFFSETA item indicates a vertical distance in surface units to be added to the surface height (z value) of the observation point. Surface units are in metres and so OFFSETA was set to 1.5 metres, roughly the height of the camera above the ground for each photograph location.

The complete list of photograph positions and angles of view is presented in Appendix 2.

5.4.3 Conducting The Visibility Analysis

A visibility analysis was conducted for each photograph location using the surface lattice. By overlaying the resulting visibility polygons on the contour map it was possible to check that everything visible in the photograph was included within the visibility polygons. This was true for all photographs except picture 26. Image 26 contains distant hill tops that are outwith the study area boundary and the available data. These hilltops make up a very small part of the photograph and the main focus of attention is the sheep in the foreground with some trees and improved grassland, the loss of the distant hill tops in a visibility analysis was considered insignificant and the photograph included in further analysis. Visibility analyses were repeated using the surface lattice which includes the tree heights and was automated using Arc Macro

Language (AML) programs, CAIRNVIS.AML (see Appendix 3), which undertakes visibility analysis for the fore, middle and back ground within all photographs in the Cairngorm study area, producing coverages containing visibility polygons and WESTVIS.AML (as for CAIRNVIS.AML but for the Wester Ross study area).

5.4.4 Error Checking

Maps of visibility polygons were used to check that the output was realistic and that it agreed with the visible features of each photograph. Each photograph was compared to its equivalent surface view, generated by the series of SURFACE commands, to check that the result was reasonable. A surface view attempts to replicate what is seen from a particular point, and should therefore replicate the photograph. From the surface views of each of the 48 photographs, the following observations could be made:

1. The most realistic surface views were produced with landscape scale photographs with little foreground detail. Examples include questionnaire photographs 6 and 19 (Figure 35).

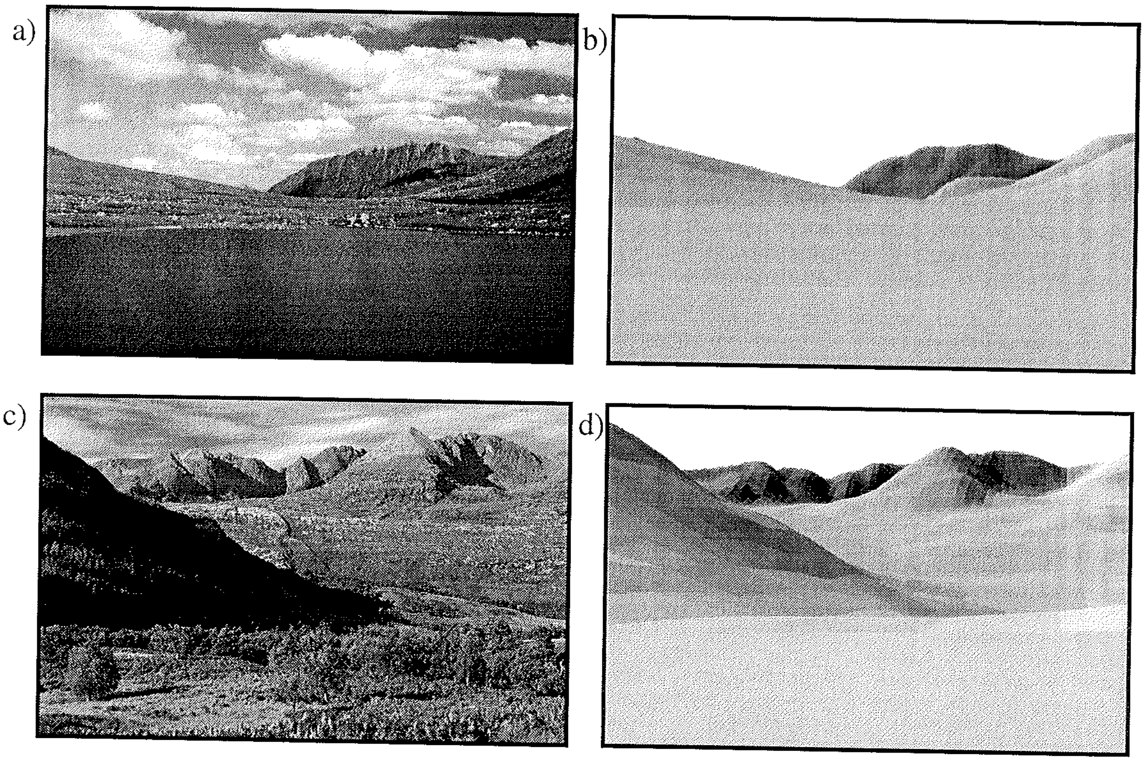


Figure 35 Examples of close similarity between questionnaire photographs number 6 (a) and 19 (c), and their respective ARC/INFO surface views (b) and (d).

2. The replication of a photograph containing nothing but foreground detail was not achieved. This was a result of the 50 m resolution of the DEM used. Figure 36 shows the difficulty associated with surface views for foreground subjects.

a) b)

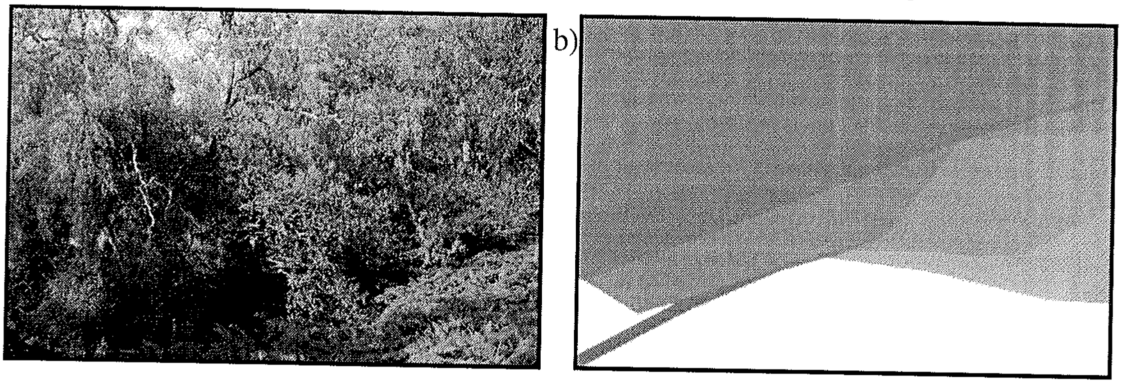


Figure 36 The problem of an unrealistic surface view (b) in comparison with the original photograph (questionnaire number 27) (a).

3. With tree heights included in the DEM, greater accuracy in the production of surface views was possible (Figure 37).

a) b) c) d)

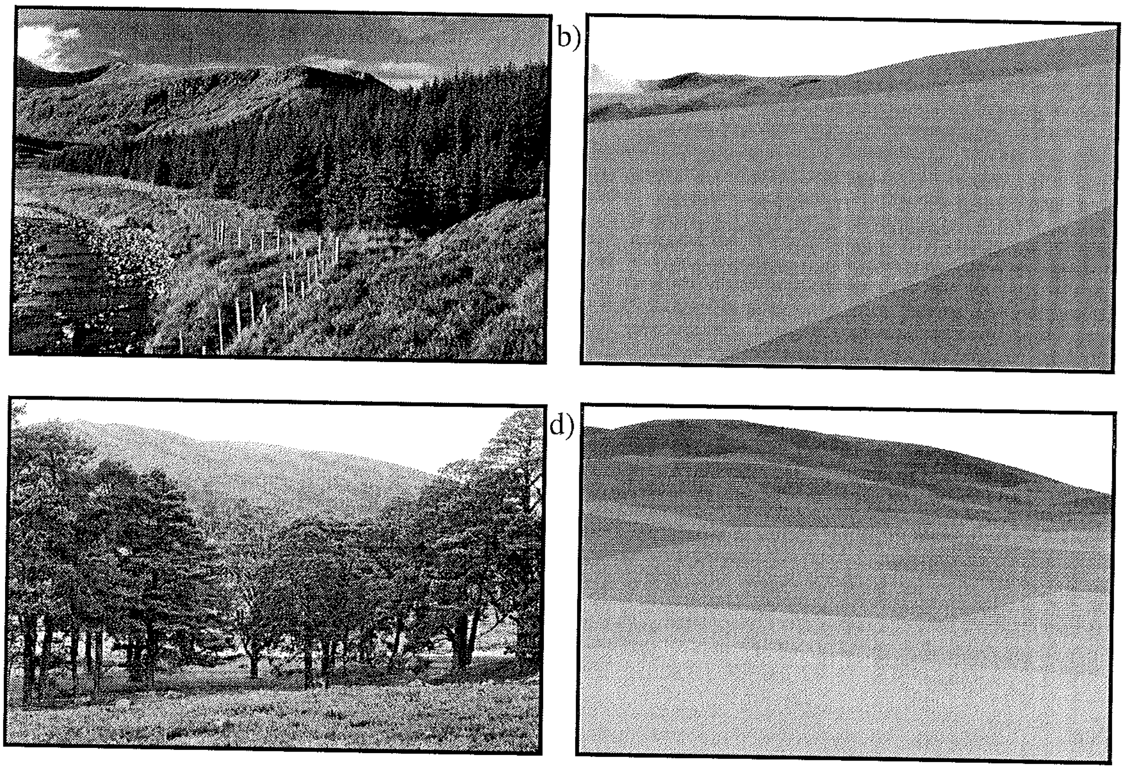


Figure 37 The effect of incorporating the height of trees into the DEM, displayed for photographs 33 (a) and 37 (c) and their respective surface views (b) and (d).

4. The blocks of trees produced to fit onto the DEM are impermeable and hence information from within and occasionally beyond the woodland is lost (Figure 38).

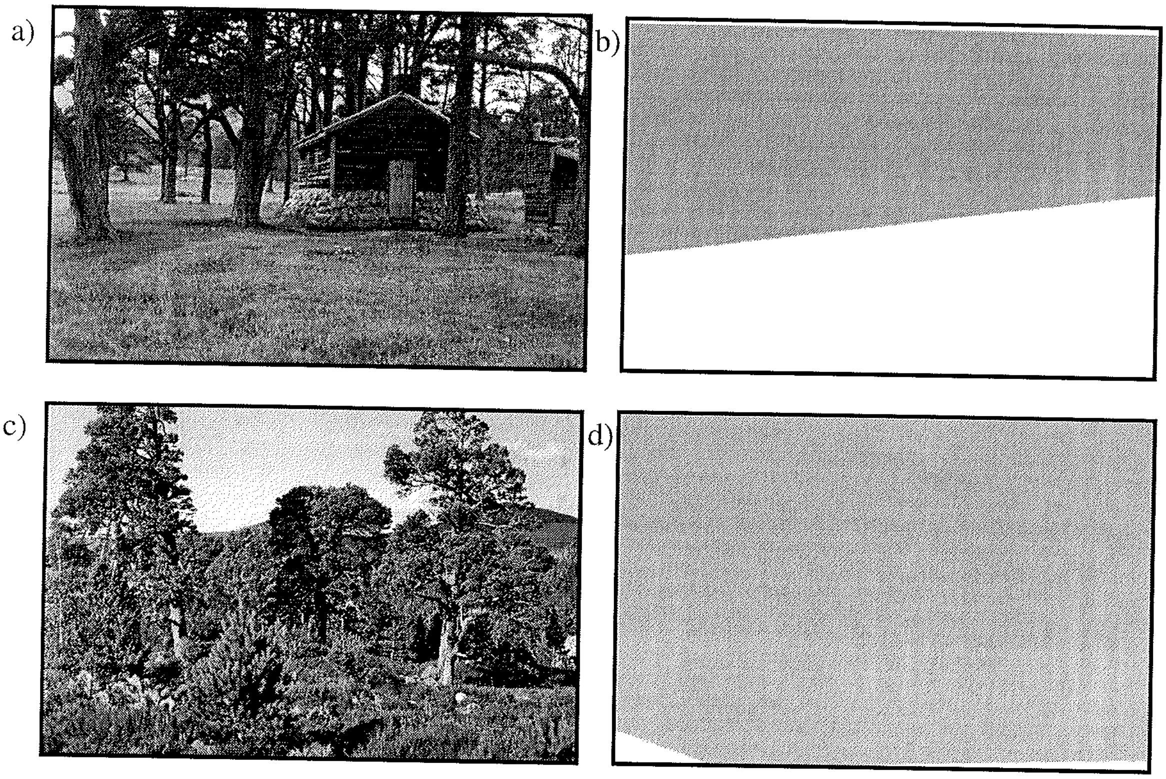


Figure 38 The inability of surface views to 'see through' a stand of trees as shown by questionnaire photographs 8 (a) and 14 (c) and their respective surface views (b) and (d).

As the surface views are complementary to the visibility polygons and are used to check the validity of any visibility analysis compared to the photograph, it is not possible, nor essential that all surface views must replicate their respective photograph. However, they are useful extra information that can be used to minimise the number of errors present in the data set. A qualitative rating of the similarity of a surface view to its equivalent photograph is shown in Table 36.

Table 36 Similarity of surface views to actual photographs.

Rating of surface view	No. of photographs	Example
good	32	Figure 35
fair	8	Figure 37
useless	8	Figure 36 and Figure 38
Total	**48**	-

Surface views provide a reasonable method of checking the parameters used to produce the visibility analysis output.

5.5 Measurement Of Landscape Parameters

For each of the three distance zones at each photograph location, a series of variables was quantified. The variables used have been chosen to meet each of the following criteria:

1. The variables chosen must be able to be represented by an algorithm in the GIS database (e.g. an area of Scots pine can be easily defined, but 'human made noise' and other ephemeral attributes of a location cannot be easily quantified for mapping within a GIS database).
2. The availability of suitable baseline data must be taken into account (e.g. quantifying variables such as slope angle is possible using the DEM available, although, to try to map areas of varying 'solitude' would require baseline data that does not presently exist and is outside the scope of this project).

These criteria were used to quantify the variables shown in Table 37.

Table 37 Variables quantified within each distance zone and their source.

Feature Type	Variables	Data source
Area	Land cover type (m^2) Slope category (m^2)	LCS88 DEM
Point	Farmsteads / water / built-up land / semi-natural coniferous woodland / undifferentiated broad-leaved woodland / undifferentiated mixed woodland (number of a particular point feature occurring within each distance zone).	LCS88
Line	Paths / hill roads / roads / built-up land / conifer plantation / semi-natural coniferous woodland / undifferentiated broad-leaved woodland (length of variable within each distance zone - m)	LCS88
Viewer	Elevation of the observer (m)	DEM

The specific method of measurement for the variables listed in Table 37 is described in the following paragraphs. A full list of all the variables measured is given in Table 38.

1. Area Features:
   a) Land cover - the AML CALCSVAL.AML (see Appendix 3) was written to extract land cover data for each of the visibility polygons and calculate the area of the different land cover types (m^2), storing the result in a watch file. A similar AML was written to undertake the same task for the Wester Ross study area (WELCSVAL.AML).

b) Slope categories - the AMLs used are CASLPVAL.AML (see Appendix 3) which extracts the slope data for each of the visibility polygons and calculates the area (in m^2) of the different slope categories in each of the photographs within the Cairngorm study area, storing the result in a watch file. WESLPVAL.AML does the same operation for the Wester Ross study area.

2. Point Features - the AMLs used are CINTSECP.AML (see Appendix 3) which intersects the LCS88 point coverage for the Cairngorm study area with the visibility polygons for each photograph location, and INTSECP.AML does the same for the Wester Ross study area.
3. Line Features - the AML used is CLCSLENG.AML (see Appendix 3). This program calculates the length of the different types of land cover (LCS88) lines within the visibility polygons for each photograph location in the Cairngorm study area and writes the results (in metres) to a watch file. WLCSLENG.AML conducts the same analysis for the Wester Ross study area storing the result in a watch file.
4. Viewer features - the elevation of the observer was calculated using the LATTICESPOT command to assign a height value to each of photograph locations. This process was repeated once for each study area.

Table 38 All of the variables measured.

Variable Name	Description
1. ARLCS2A	Area of improved grassland in the foreground
2. ARLCS3A	Area of good rough grassland in the foreground
3. ARLCS4A	Area of poor rough grassland in the foreground
4. ARLCS6A	Area of heather moorland in the foreground
5. ARLCS7A	Area of peatland in the foreground
6. ARLCS8A	Area of montane in the foreground
7. ARLCS9A	Area of felled woodland in the foreground
8. ARLCS10A	Area of recent planting in the foreground
9. ARLCS11A	Area of conifer plantation in the foreground
10. ARLCS12A	Area of semi-natural conifers in the foreground
11. ARLCS13A	Area of mixed woodland in the foreground
12. ARLCS14A	Area of broad-leaved trees in the foreground
13. ARLCS18A	Area of dunes in the foreground
14. ARLCS20A	Area of fresh water in the foreground
15. ARLCS21A	Area of cliffs in the foreground
16. ARLCS22A	Area of rural development in the foreground
17. ARLCS24A	Area of missing / obscured data in the foreground
18. ARLCS25A	Area of heather / peatland mosaic in the foreground
19. ARLCS26A	Area of poor rough grassland / heather mosaic in the foreground
20. ARLCS27A	Area of good rough grassland / heather mosaic in the foreground
21. ARLCS28A	Area of peatland / montane mosaic in the foreground
22. ARLCS32A	Area of poor rough grassland / peatland mosaic in the foreground
23. ARLCS34A	Area of other mosaics in the foreground

Variable Name	Description
24. ARLCS2B	Area of improved grassland in the mid-ground
25. ARLCS3B	Area of good rough grassland in the mid-ground
26. ARLCS4B	Area of poor rough grassland in the mid-ground
27. ARLCS6B	Area of heather moorland in the mid-ground
28. ARLCS7B	Area of peatland in the mid-ground
29. ARLCS8B	Area of montane in the mid-ground
30. ARLCS9B	Area of felled woodland in the mid-ground
31. ARLCS10B	Area of recent planting in the mid-ground
32. ARLCS11B	Area of conifer plantation in the mid-ground
33. ARLCS12B	Area of semi-natural conifers in the mid-ground
34. ARLCS13B	Area of mixed woodland in the mid-ground
35. ARLCS14B	Area of broad-leaved trees in the mid-ground
36. ARLCS18B	Area of dunes in the mid-ground
37. ARLCS20B	Area of fresh water in the mid-ground
38. ARLCS21B	Area of cliffs in the mid-ground
39. ARLCS22B	Area of rural development in the mid-ground
40. ARLCS24B	Area of missing / obscured data in the mid-ground
41. ARLCS25B	Area of heather / peatland mosaic in the mid-ground
42. ARLCS26B	Area of poor rough grassland / heather mosaic in the mid-ground
43. ARLCS27B	Area of good rough grassland / heather mosaic in the mid-ground
44. ARLCS28B	Area of peatland / montane mosaic in the mid-ground
45. ARLCS30B	Area of improved / good rough grassland mosaic in the mid-ground
46. ARLCS32B	Area of poor rough grassland / peatland mosaic in the mid-ground
47. ARLCS33B	Area of heather / montane mosaic in the mid-ground
48. ARLCS34B	Area of other mosaics in the mid-ground
49. ARLCS2C	Area of improved grassland in the background
50. ARLCS3C	Area of good rough grassland in the background
51. ARLCS4C	Area of poor rough grassland in the background
52. ARLCS6C	Area of heather moorland in the background
53. ARLCS7C	Area of peatland in the background
54. ARLCS8C	Area of montane in the background
55. ARLCS10C	Area of recent planting in the background
56. ARLCS11C	Area of conifer plantation in the background
57. ARLCS12C	Area of semi-natural conifers in the background
58. ARLCS13C	Area of mixed woodland in the background
59. ARLCS14C	Area of broad-leaved trees in the background
60. ARLCS19C	Area of marsh in the background
61. ARLCS20C	Area of fresh water in the background
62. ARLCS21C	Area of cliffs in the background
63. ARLCS22C	Area of rural development in the background
64. ARLCS23C	Area of urban development in the background
65. ARLCS24C	Area of missing / obscured data in the background
66. ARLCS25C	Area of heather / peatland mosaic in the background
67. ARLCS26C	Area of poor rough grassland / heather mosaic in the background
68. ARLCS27C	Area of good rough grassland / heather mosaic in the background
69. ARLCS28C	Area of peatland / montane mosaic in the background
70. ARLCS30C	Area of improved / good rough grassland mosaic in the background
71. ARLCS31C	Area of good rough grassland / bracken mosaic in the background
72. ARLCS32C	Area of poor rough grassland / peatland mosaic in the background
73. ARLCS33C	Area of heather / montane mosaic in the background
74. ARLCS34C	Area of other mosaics in the background
75. LENLC16A	Length of paths in the foreground
76. LENLC17A	Length of hill roads in the foreground

Variable Name	Description
77. LENLC71A	Length of coniferous plantation in the foreground
78. LENLC74A	Length of semi-natural coniferous woodland in the foreground
79. LENLC16B	Length of paths in the mid-ground
80. LENLC17B	Length of hill roads in the mid-ground
81. LENLC71B	Length of coniferous plantation in the mid-ground
82. LENLC77B	Length of undifferentiated broad-leaved woodland in the mid-ground
83. LENLC16C	Length of paths in the background
84. LENLC17C	Length of hill roads in the background
85. LENLC21C	Length of road in the background
86. LENLC29C	Length of built-up land in the background
87. LENLC71C	Length of coniferous plantation in the background
88. LENLC77C	Length of undifferentiated broad-leaved woodland in the background
89. SLOPE1A	Area of slope > 0° and <= 0.57° in the foreground
90. SLOPE2A	Area of slope > 0.57° and <= 1.23° in the foreground
91. SLOPE3A	Area of slope > 1.23° and <= 2.66° in the foreground
92. SLOPE4A	Area of slope > 2.66° and <= 5.71° in the foreground
93. SLOPE5A	Area of slope > 5.71° and <=12.13° in the foreground
94. SLOPE6A	Area of slope > 12.13° and <= 24.89° in the foreground
95. SLOPE7A	Area of slope > 24.89° and <= 45.00° in the mid-ground
96. SLOPE1B	Area of slope > 0° and <= 0.57° in the mid-ground
97. SLOPE2B	Area of slope > 0.57° and <= 1.23° in the mid-ground
98. SLOPE3B	Area of slope > 1.23° and <= 2.66° in the mid-ground
99. SLOPE4B	Area of slope > 2.66° and <= 5.71° in the mid-ground
100.SLOPE5B	Area of slope > 5.71° and <=12.13° in the mid-ground
101.SLOPE6B	Area of slope > 12.13° and <= 24.89° in the mid-ground
102.SLOPE7B	Area of slope > 24.89° and <= 45.00° in the mid-ground
103.SLOPE1C	Area of slope > 0° and <= 0.57° in the background
104.SLOPE2C	Area of slope > 0.57° and <= 1.23° in the background
105.SLOPE3C	Area of slope > 1.23° and <= 2.66° in the background
106.SLOPE4C	Area of slope > 2.66° and <= 5.71° in the background
107.SLOPE5C	Area of slope > 5.71° and <=12.13° in the background
108.SLOPE6C	Area of slope > 12.13° and <= 24.89° in the background
109.SLOPE7C	Area of slope > 24.89° and <= 45.00° in the background
110.SLOPE8C	Area of slope > 45.00° and <= 90.00° in the background
111.PTLC1B	Number of isolated farmsteads and other buildings, with no trees in the mid-ground
112.PTLC19B	Number of point water features in the mid-ground
113.PTLC75B	Number of point semi-natural coniferous woodland features in the mid-ground
114.PTLC78B	Number of point undifferentiated broad-leaved woodland features in the mid-ground
115.PTLC81B	Number of point undifferentiated mixed woodland features in the mid-ground
116.PTLC1C	Number of isolated farmsteads and other buildings, with no trees in the background
117.PTLC2C	Number of isolated farmsteads and other buildings, with trees in the background
118.PTLC19C	Number of point water features in the background
119.PTLC29C	Number of built-up land points in the background
120.PTLC75C	Number of point semi-natural coniferous woodland features in the background
121.PTLC78C	Number of point undifferentiated broad-leaved woodland features in the background
122.ELEVATIO	Elevation of the observer

5.6 Developing Models Of Wildness

5.6.1 General Model

The values for all the variables measured were entered into a spreadsheet, for analysis with SPSS v7.5.1 and Minitab v11.12. This spreadsheet was then split in two as described below to produce a training data set and a test data set (testset).

5.6.1.1 Splitting The Sample

In order for the regression model to be developed and then tested, the original set of 48 photographs was split into a training set and a test set. The training set is used to develop the model and this is then tested with the second set. In order for there to be sufficient photographs to develop the model, approximately 75 % of the sample was assigned to the training set. The remainder (approximately 25 %) was assigned to the test set. The random number generator in Excel was used to create a Bernoulli distribution, characterised by a probability of success (p value) on a given trial. A distribution was generated for which p = 0.75. Those photograph numbers assigned the value of 0 were assigned to the test set (14 photographs), while those with the value of 1 made up the training set (34 values) (see Table 39).

Table 39 The photograph numbers assigned to the training and test data sets.

Training Set (questionnaire #)	Test Set (questionnaire #)
1,2,3,4,6,7,8,10,13,14,15,17,18,21,22,25,26,27,28 ,29,30,31,32,34,35,36,37,38,39,42,43,46,47,48	5,9,11,12,16,19,20,23,24,33,40, 41,44,45

5.6.1.2 Multiple Linear Regression

Initial exploration of the 122 variables in the training and test data sets revealed the following issues:

1. Many of the variables contained very few non zero values. Because of the large number of variables measured, especially those relating to land cover, some variables had non-zero values for only one or two cases. For example, sand dues, as a land cover category, only appear in two photographs. In addition each land cover category is subdivided into the three distance zones of foreground, mid-ground and background and this also serves to distribute the data between the variables.
2. Thirteen of the variables contained only zero values. This is also because many of the variables in the whole data set (before splitting) contained very few non zero values. As a result there is a chance that those cases with the non-zero values are now in the

test data set, leaving only zero values in the training data set. These 13 variables cannot add anything to the model and have been deleted from further analysis. The variables which have been deleted are: ARLCS9B, ARLCS30B, ARLCS2C, ARLCS19C, ARLCS23C, ARLCS30C, ARLCS31C, LENLC77B, LENLC29C, LENLC71C, PTLC1C, PTLC2C, PTLC29C. Table 38 has a description of the specific variables.

3. If any variables in the test data set that contain all zero values are selected for the model, they will contribute nothing to the calculation of predicted wildness values. A total of 33 variables fall into this category and are therefore excluded from the multiple linear regression.

To develop a model to predict the wildness of a location based on the surrounding landscape attributes, multiple linear regression was used. The dependent variable, wildness, is the median value of the 459 ratings for a particular photograph. Correlations of wildness ratings between the four sample groups are high, therefore the ratings were combined before the median was calculated. The mean and median values are very similar and so the median value was used. Plots of wildness versus each of the predictor variables revealed some weakly linear relationships.

5.6.1.3 Developing The Model Using The Training Data Set

Initially a stepwise multiple regression procedure was used with all 76 predictor variables. The following variables were selected with a R^2 (adjusted) of 31.1%:
SLOPE7B, ARLCS13A .... Regression 1

This result indicates that the majority of the variables measured are not useful predictors of wildness. One reason for this is the low number of non-zero values and this is the result of the large number of variables. In order to reduce the overall number of variables used and to increase the number of cases with non-zero values, some of the land cover categories were combined to produce more generalised variables. This assumes that people in general will not distinguish between, for example, good rough grassland (ARLCS3A) and poor rough grassland (ARLCS4A). The combined variables are as follows:

ARLCS2A + ARLCS3A + ARLCS4A + ARLCS29A + ARLCS30A + ARLCS31A = ARLCS35A - Grassland, an indicator of grazing activity.
ARLCS6A + ARLCS7A + ARLCS25A = ARLCS36A - Heather / peatland areas.

ARLCS8A + ARLCS21A = ARLCS37A - Montane / cliffs, an indicator of rugged, high altitude terrain.
ARLCS9A + ARLCS10A + ARLCS11A = ARLCS38A - Felled woodland / recent planting / conifer plantations - an indicator of forestry activity.
ARLCS12A + ARLCS13A + ARLCS14A = ARLCS39A - Semi-natural conifers / mixed woodland / broad-leaved trees - woodland.

This was repeated for the mid and background coverages respectively (B and C). A rerun of the stepwise regression with the reduced set of 60 variables produced a R^2 (adjusted) of 41.2 %, with these variables:

SLOPE7B, ARLCS36A, SLOPE3A .... Regression 2

The entry requirement for variables to a stepwise regression is their F value, initially set at 4, this was reduced to 3 and then 2 to see which were the next most important variables. At $F = 2$ the following variables produced an R^2 (adjusted) of 60.5 %:

SLOPE7B, ARLCS36A, SLOPE3A, LENLC17B, SLOPE 7C, ELEVATIO, ARLCS37C .... Regression 3

The regression analysis showed that all of these variables except SLOPE7B are statistically significant ($p < 0.05$). For SLOPE7B $p = 0.062$. Rerunning the regression analysis without SLOPE7B produced a R^2 (adjusted) of 56.4 %.

A different approach to amalgamating variables, combining the three distance zones into one for all the original variables, was also used. The 42 subsequent variables were entered into a stepwise regression producing a R^2 (adjusted) of 19.4 % with these variables:

LENLC71, LENLC17 .... Regression 4

Further improvement to this model by decreasing the F-to-enter statistic was attempted but was not achieved. By combining land cover categories for the set of 42 variables used in Regression 4, a set of 33 predictors was created. When entered into a stepwise regression procedure, the same result was obtained as shown for Regression 4. This shows that the variables representing the combined distance zones, including the amalgamated land cover categories, are not good predictors of wildness. The larger R^2 values in Regressions 1, 2 and 3 compared with Regression 4, indicate that retaining information regarding the distance to landscape features from an observer, in the form of the three distance zones, improves the prediction of wildness.

In order to see which of the original and amalgamated variables were the best predictors of wildness, they were all entered into a stepwise regression. From the 132 variables entered, the following three were selected with a R^2 (adjusted) of 38.9 %:

SLOPE7B, ARLCS13A, ARLCS36A .... Regression 5

Reducing the F value identified the next most important variables in the model, although these variables were not statistically significant and regression 5 could not be improved.

Stepwise regression enables the most important variables to be identified, but may miss an equally good model because of the stepwise inclusion of variables. An alternative procedure is best subset regression in which a one-predictor regression model giving the largest R-squared is first produced. Minitab prints information on this model and the next best one-predictor model and continues this process with the next. The process continues until all the predictors specified have been used. The best subset method has not been used until now because there is a limit of 20 variables that can be entered into the analysis at any one time. This limit is set by the Minitab software. However, by taking the predictor variables identified first by the stepwise regressions and using them in a best subset regression procedure, a more predictive model should result. A total of 19 variables were entered as free predictors into the best subset regression procedure. The best model indicated from this analysis was identical to Regression 3. The only variable that was not statistically significant was SLOPE7B. However, this variable was the first to be selected, suggesting it is significant and should be retained in the analysis. The results are presented in Table 40 and Table 41. The regression equation is:

WILDMEDN = 2.70 -0.000090 SLOPE3A +0.000019 SLOPE7B +0.000001 SLOPE7C + 0.00149 ELEVATIO +0.000082 ARLCS36A -0.000001 ARLCS37C -0.00167 LENLC17B .... Regression 6

Table 40 Results of the multiple linear regression for the general wildness model.

Predictor	Coefficient	SD	T	P
Constant	2.70020000	0.27620000	9.78	0.000
Area of slope between 1.23° and 2.66° in the foreground (SLOPE3A)	-0.00008962	0.00003079	-2.91	0.007
Area of slope between 24.89° and 45.00° in the mid-ground (SLOPE7B)	0.00001935	0.00000992	1.95	0.062
Area of slope between 24.89° and 45.00° in the background (SLOPE7C)	0.00000115	0.00000037	3.13	0.004
Altitude of the observer (ELEVATIO)	0.00148680	0.00051470	2.89	0.008
Area of heather / peatland in the foreground (ARLCS36A)	0.00008192	0.00002174	3.77	0.001
Area of montane habitat / cliffs in the background (ARLCS37C)	-0.00000073	0.00000033	-2.23	0.035
Length of hill road in the mid-ground (LENLC17B)	-0.00166580	0.00066400	-2.51	0.019

S = 0.7455 R^2 = 68.8% R^2 (adj) = 60.5%

Table 41 Results of the analysis of variance for the general wildness model.

Source	DF	SS	MS	F	P
Regression	7	31.9318	4.5617	8.21	0
Error	26	14.4505	0.5558		
Total	33	46.3824			

Figure 39 shows a roughly even distribution of points either side of the mean, indicating constant variance, in line with the assumptions of multiple linear regression.

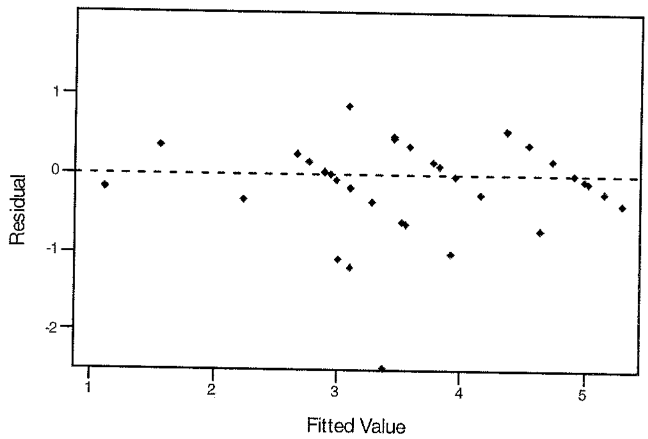


Figure 39 Residuals versus the fitted values for Regression 6.

Figure 40 confirms that the residuals are normally distributed.

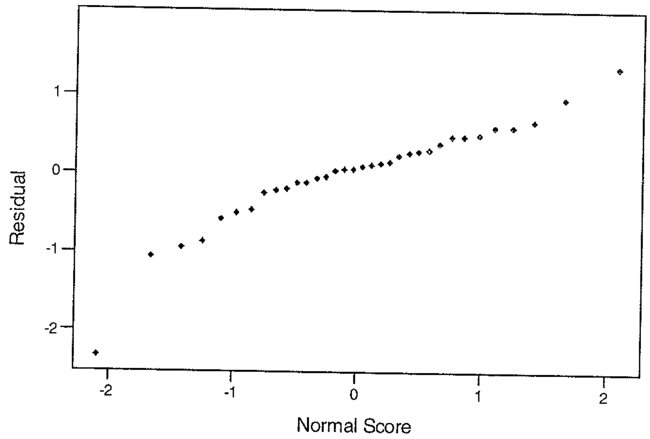


Figure 40 Normal probability plot of the residuals for Regression 6.

The assumption of linearity was also tested by plotting the residuals versus the explanatory variables (Figure 42 to Figure 47). These plots show a roughly even scatter of points around the zero residual line, indicating that the assumption of linearity has been met.

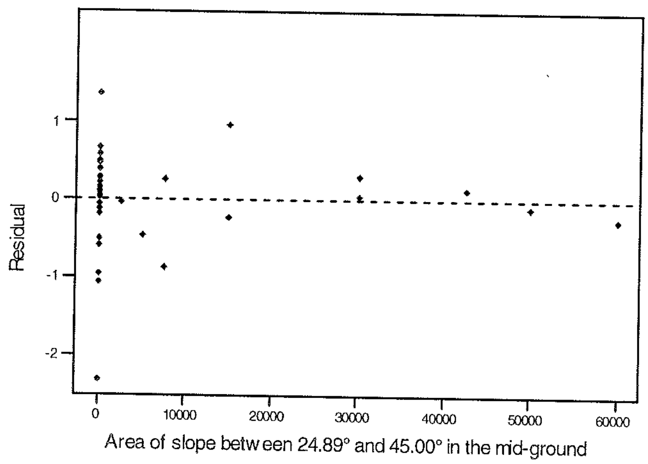


Figure 41 Residuals versus area of slope between 24.89° and 45.00° in the mid-ground.

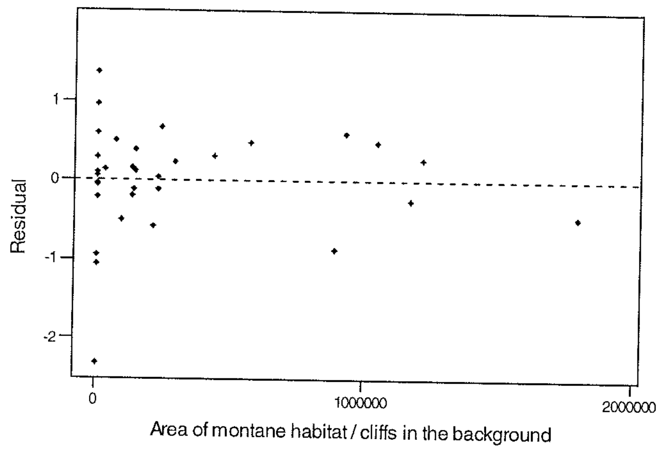


Figure 42 Residuals versus area of montane habitat / cliffs in the background.

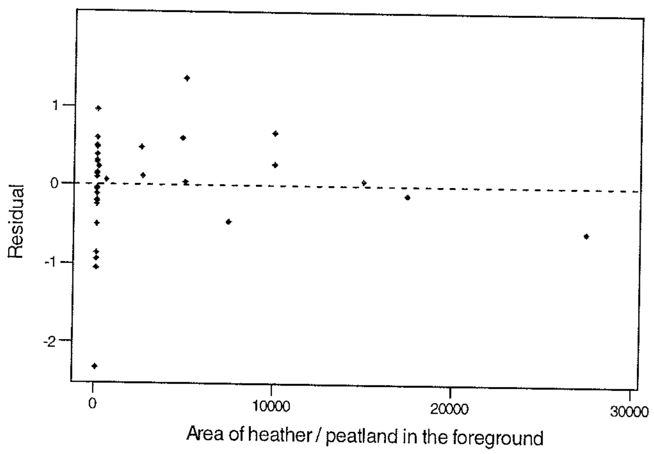


Figure 43 Residuals versus area of heather / peatland in the foreground.

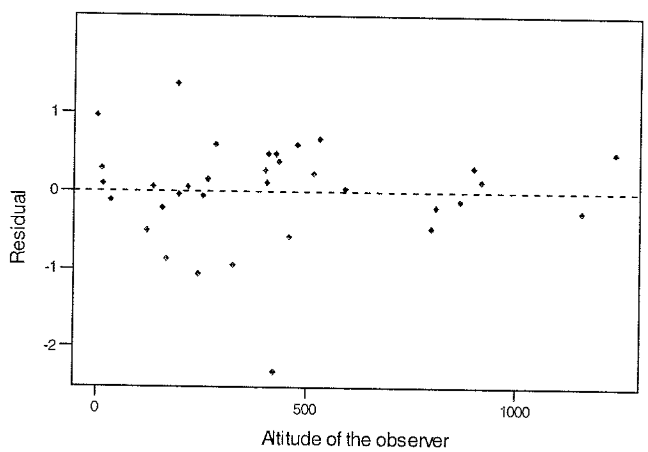


Figure 44 Residuals versus altitude of the observer.

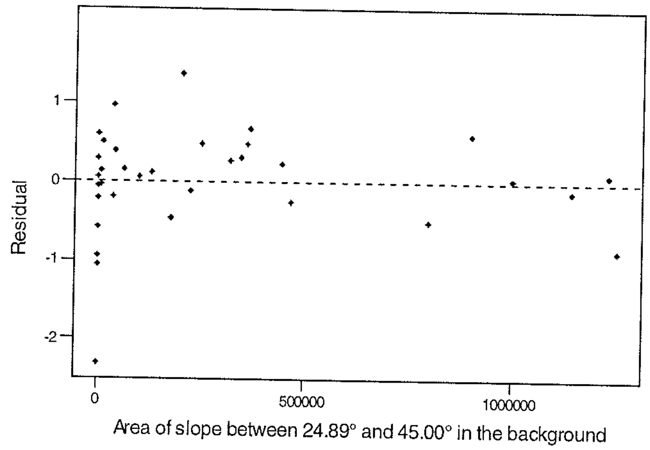


Figure 45 Residuals versus area of slope between 24.89° and 45.00° in the background.

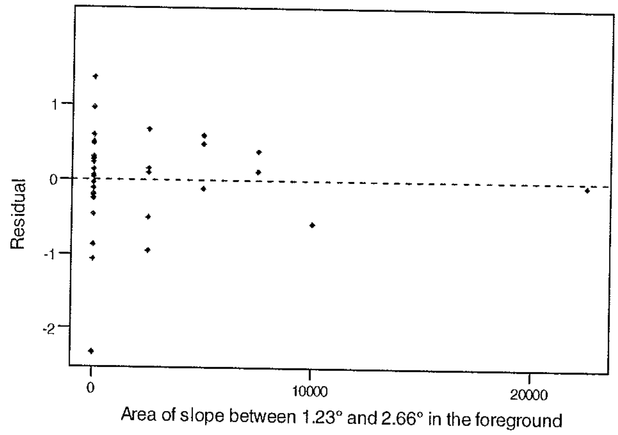


Figure 46 Residuals versus area of slope between 1.23° and 2.66° in the foreground.

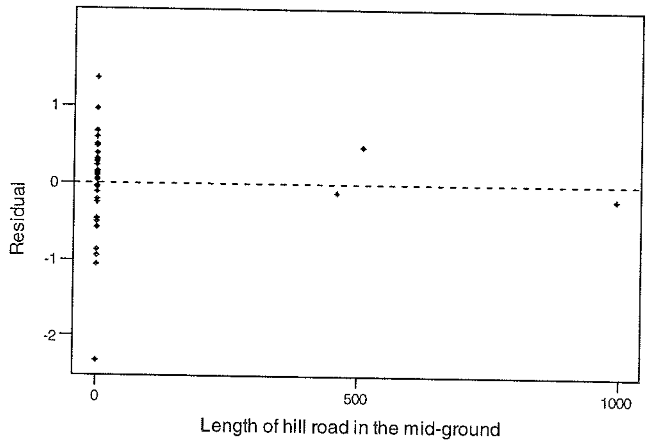


Figure 47 Residuals versus length of hill road in the mid-ground.

Regression 6 is the best model explaining 60.5 % of the variation in wildness. The coefficients of each variable identified in Regression 6 show the positive and negative influences of that variable on wildness perception. The first term in the equation, SLOPE7B, representing the area of slope between 24.89° and 45.00° in the mid-ground of the photograph has a positive coefficient. ARLCS36A, the area of heather and peatland in the foreground of the photograph, has a positive coefficient. SLOPE3A is the area of slope in the foreground between 1.23° and 2.66°. SLOPE3A has a negative coefficient indicating that gentle slopes in the foreground appear to detract from the wildness of a location. The other slope variable included in the equation is SLOPE7C which has a positive coefficient, indicating steep slopes in the background, between 24.89° and 45.00°, enhance the wildness of a location. The altitude at which the photograph was taken is the variable ELEVATIO and has a positive coefficient. This suggests that the higher the observer, the wilder the location. LENLC17B represents the length of hill roads visible in the mid-ground of the picture and has a negative coefficient. This shows that hill roads are seen as a detractor of wildness. The last term in the equation is ARLCS37C, representing montane habitat and areas of cliffs, which is regarded as an indicator of rugged, high altitude terrain. This term, unexpectedly, has a negative coefficient indicating it to be a detractor of wildness. However, it also has the smallest influence of all the variables in the equation. A possible explanation for the negative influence of this term lies in the origins of this variable as an amalgamation of the area of montane habitat and the area of cliffs. In general the area of cliffs is very small in comparison with the area of montane habitat especially so in the Cairngorm area where most of the photographs containing montane habitat were taken. The majority of the montane habitat occurs on the Cairngorm plateau which is made up of low angled slopes that have been shown to have a negative influence on the wildness of a location.

5.6.1.4 Validating The Model Using The Test Data Set

To test the accuracy and precision of the model, the equation for Regression 6 was used to calculate the wildness values for the photographs in the test data set. The correlation between observed and predicted wildness values is 0.696 ($n = 14$) and a scatter plot of these variables is presented in Figure 48.

To check that the predicted values are accurate a one sample t-test was conducted on the difference between the predicted and observed values. H_0 is that $\mu = 0$

versus H_1 that $\mu \neq 0$. Table 42 indicates that H_0 cannot be rejected, suggesting that the predictions are accurate.

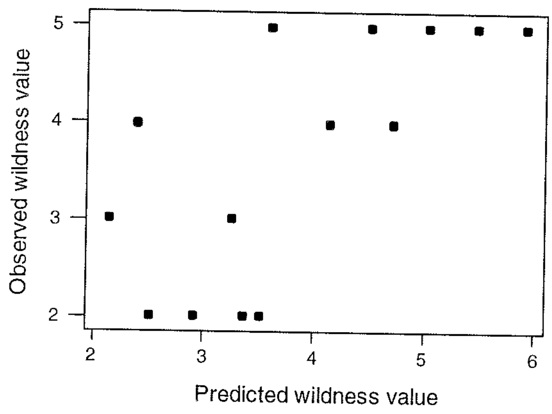


Figure 48 Scatter plot of observed versus predicted wildness values.

Table 42 Results of a t-test on the difference between the predicted and observed wildness values (wildif11).

Variable	N	Mean	SD	SE Mean	T	P
wildif11	14	-0.173	0.962	0.257	-0.67	0.51

The precision of the predicted wildness values can be assessed by considering the spread of the differences tested above (Figure 49). For the range of wildness values in this study, from 1 to 5, the differences between observed and predicted values vary from -1.51 to +1.62. This suggests that the predicted values are not very precise.

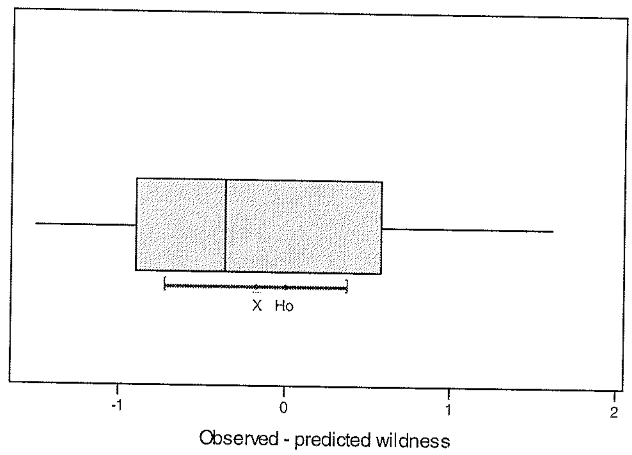


Figure 49 Boxplot of the differences between predicted and observed values (with Ho and 95% t-confidence interval for the mean).

The regression equation only explains 60.5 % of the variation in wildness, showing that other unmeasured factors influence the wildness value of a location. These are discussed in more detail in Chapter 8. Incorporation of these factors would, however, help to increase the precision of the model.

The general model produced here explains 60.5 % of the variation in the median wildness ratings for photographs taken in the Cairngorms or Wester Ross.

5.6.2 Site Specific Models

The last section has dealt with the development of a general model, using data from two separate regions of Scotland. This section develops a model for one region, for example the Cairngorms, and attempts to transfer it to the other study area, Wester Ross. This approach requires the Cairngorm and Wester Ross cases to be separated, creating two new data sets.

5.6.2.1 Cairngorm Model

The Cairngorm data set was used to develop and test a predictive model of wildness, while the Wester Ross data set was used to test the transferability of the model. As in the case of the general model the data set was split into a training data set and a test data set using the Bernoulli distribution, resulting in the allotment of photograph numbers as shown in Table 43.

Table 43 Photographs assigned to the Cairngorm training and test data sets.

Training Set (questionnaire #)	Test Set (questionnaire #)
2,3,8,14,15,20,21,23,25,26,28,32, 34,37,38,39,40,42,44,45,48	10,12,13,18,43

The problems of non-zero values identified in section '5.6.1.2 Multiple Linear Regression' were dealt with in the same way: all variables that would add nothing to the predictive power of a model were removed from further analyses. A similar approach was used to develop the Cairngorm model as was used for the general model. The original variables were entered into a stepwise regression procedure identifying the following variable with as important (R^2 (adjusted) = 37.1 %):

ELEVATIO .... Regression 1

Reducing the F-to-enter statistic did not produce a better model. In the next step, the amalgamated land cover variables were entered into a stepwise regression procedure producing a model with a R^2 (adjusted) of 83.3 % with these predictors:

ELEVATIO, ARLCS20B, SLOPE4B, SLOPE1A, ARLCS36A, SLOPE3B
.... Regression 2

Again, reducing the F-to-enter statistic did not identify any other predictors to improve the model. Removing distance information by using the variables which had been amalgamated over the three distance zones was the next approach. A stepwise regression produced the same result as Regression 1. Lowering the F-to-enter statistic to 3 identified the following predictors with a R^2 (adjusted) of 56.8 %:

ELEVATIO, ARLCS25, SLOPE1 .... Regression 3

The next combination of variables to be tested by the stepwise regression procedure were those that had been amalgamated over the distance zones and the land cover categories. By reducing the F-to-enter statistic to 3 and removing the not statistically significant variable, slope1, from the first equation, a regression equation with a R^2 (adjusted) of 60.9 % and the following variables was produced:

ELEVATIO, ARLCS36, SLOPE3 .... Regression 4

Reducing the F-to-enter statistic further did not add anything to the model in Regression 4. As with the general model, a best subsets regression procedure was also used with the variables identified by the above stepwise regression procedures. It was hoped that the more powerful best subsets procedure would improve on the best of the regression models above. This produced a model that explained 83.3 % (R^2 adjusted) of the variance in the wildness scores using the following variables:

ELEVATIO, ARLCS20B, SLOPE1A, SLOPE3B, SLOPE4B, ARLCS36A
.... Regression 5

However, inspection of the plots of residuals versus explanatory variables for ARLCS20B revealed that it contained only 1 non-zero value and was therefore statistically unsatisfactory. Best subset regression procedure was rerun without the variable ARLCS20B, producing a model explaining 68.2 % (R^2 adjusted) of the variance in the wildness scores.

The results are presented in Table 44 and Table 45 and the regression equation is:

WILDMEDN = 1.82 + 0.00305 ELEVATIO +0.000069 SLOPE4B +0.000057 ARLCS36A-0.000478 SLOPE1A -0.000067 SLOPE3B .... Regression 6

Table 44 Results of the multiple linear regression for the Cairngorm model.

Predictor	**Coefficient**	**SD**	**T**	**P**
Constant	1.81590000	0.53420000	3.40	0.004
Altitude of the observer (ELEVATIO)	0.00304930	0.00077640	3.93	0.001
Area of slope in the mid-ground between 2.66° and 5.71° (SLOPE4B)	0.00006866	0.00002406	2.85	0.012
Area of heather / peatland in the foreground (ARLCS36A)	0.00005737	0.00002667	2.15	0.048
Area of slope in the foreground between 0° and 0.57° (SLOPE1A)	-0.00047750	0.00015070	-3.17	0.006
Area of slope in the mid-ground between 1.23° to 2.66° (SLOPE3B)	-0.00006713	0.00002376	-2.82	0.013

S = 0.7664 $R^2 = 76.2\%$ R^2 (adj) = 68.2%

Table 45 Results of the analysis of variance for the Cairngorm model.

Source	**DF**	**SS**	**MS**	**F**	**P**
Regression	5	28.1429	5.6286	9.58	0
Error	15	8.8095	0.5873		
Total	20	36.9524			

The assumptions of multiple linear regression must be met for the above equation to be valid. Figure 50 shows a scatter of points around the 0 residual line, indicating that the residuals have constant variance.

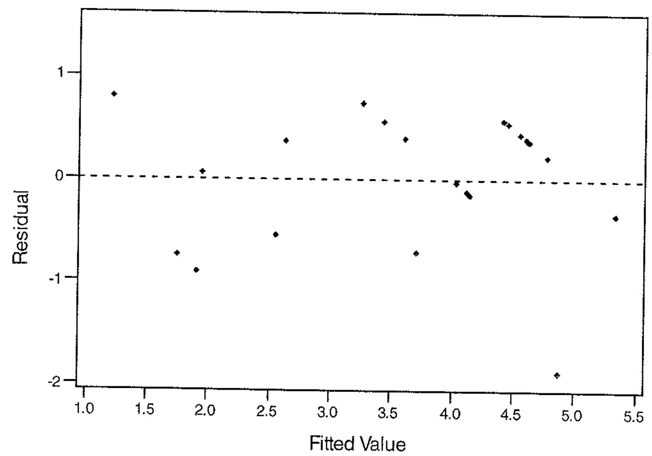


Figure 50 Scatter plot of residuals versus fitted values.

Figure 51 shows that the residuals are normally distributed.

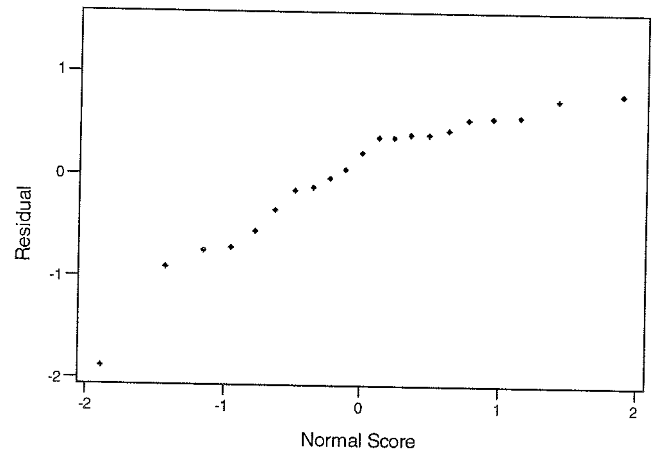


Figure 51 Normal probability plot of the residuals.

A linear relationship between the explanatory variables and the residuals is demonstrated in Figure 52 to Figure 56.

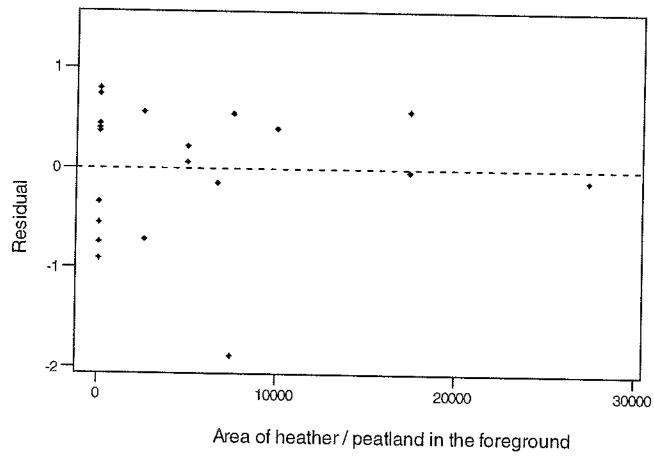


Figure 52 Residuals versus area of heather / peatland in the foreground.

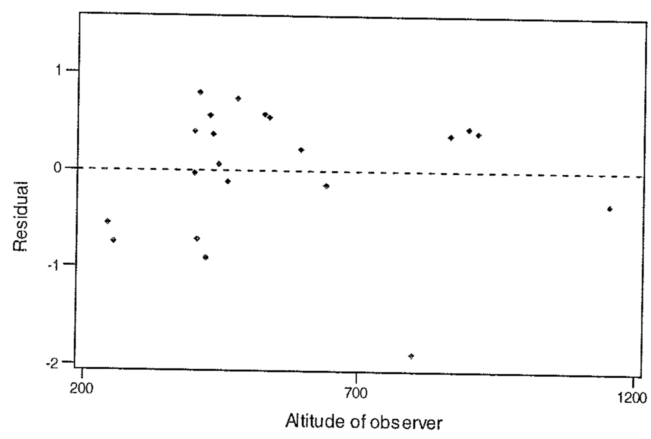


Figure 53 Residuals versus altitude of the observer.

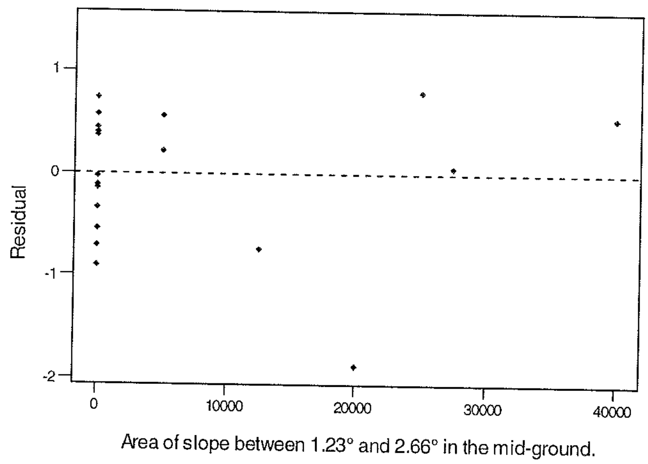


Figure 54 Residuals versus area of slope in the mid-ground between 1.23° to 2.66°.

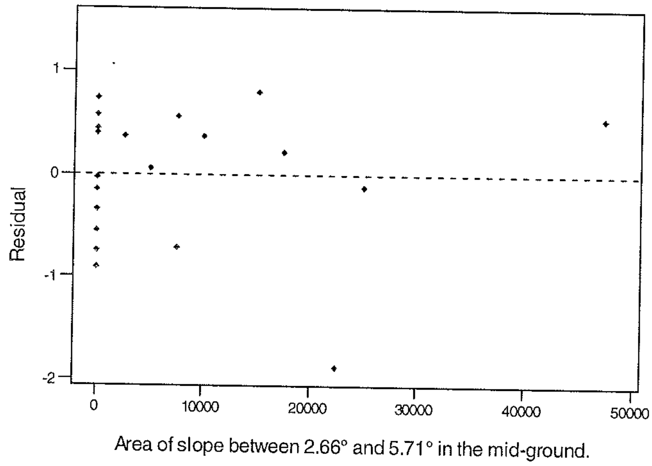


Figure 55 Residuals versus slope in the mid-ground between 2.66° and 5.71°.

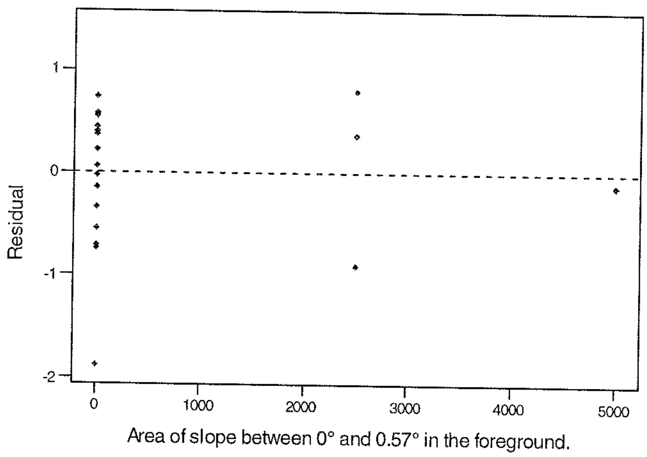


Figure 56 Residuals versus area of slope in the foreground between 0° and 0.57°.

The coefficients of each variable identified in Regression 6 show the positive and negative influences of that variable on perception of wildness. The first term in the regression equation is ELEVATIO, which represents the altitude at which the photograph was taken and has a positive coefficient indicating that the higher the altitude, the wilder the location. SLOPE4B is the second term and represents the area of slope in the mid-ground between 2.66° and 5.71°. This term has a positive coefficient showing that as its area increases so does the wildness of a particular location. ARLCS36A represents the area of heather and peatland in the foreground of the photograph and has a positive influence on the wildness of a location. The remaining two terms represent areas of differing slopes. The lowest slope range of 0° to 0.57° in the foreground of the photograph, variable SLOPE1A, has a negative affect on wildness. The same applies to SLOPE3B representing the area of slopes between 1.23° and 2.66° in the mid-ground, with a negative influence on wildness. Thus, there appears to be a transition zone around 2.66° for slopes in the mid-ground, above which they appear to have a positive influence on wildness.

Validating The Model Using The Test Data

The regression equation above was tested using the Cairngorm test data set. The correlation between the observed and the predicted wildness values was 0.383 (Figure 57). This value is rather low and can be partly explained by the small number of values in the test data set: there were only five photographs remaining with which to test the model.

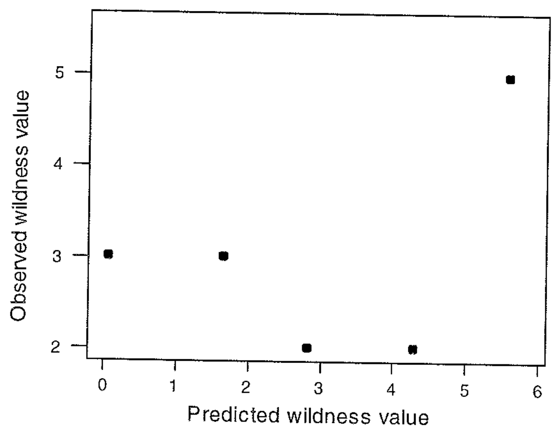


Figure 57 Scatter plot of observed versus predicted wildness.

To check the accuracy of the predicted values, a one sample t-test was conducted on the difference between the observed and predicted values for the H_0 that $\mu = 0$ versus H_1 that $\mu \neq 0$. H_0 could not be rejected, indicating that the predicted wildness values were reasonably accurate (Table 46).

Table 46 Results of the one sample t-test for the differences between the observed wildness values and those predicted with the Cairngorm model (wildif1).

Variable	N	Mean	SD	SE Mean	T	P
wildif1	5	0.121	2.041	0.913	0.13	0.9

The spread of the differences between observed and predicted wildness values is shown in Figure 58 and indicates that the prediction of values was not precise with differences ranging from -2.29 to 2.94.

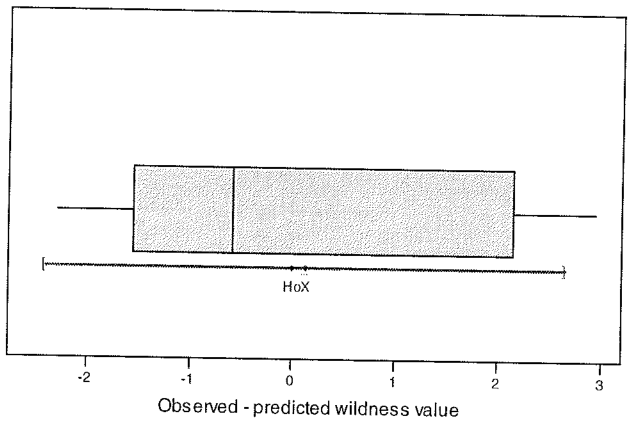


Figure 58 Boxplot of the differences between the predicted and observed wildness values for the Cairngorm model using the test data set (with Ho and 95% t-confidence interval for the mean).

Testing The Model With The Wester Ross Data Set

The Cairngorm model was used to calculate the wildness of the Wester Ross photographs (n=22) in order to test the transferability of the model to another area. The correlation between the observed and the predicted wildness values was -0.058 (see Figure 59) indicating that the Cairngorm model is not transferable to the Wester Ross study area.

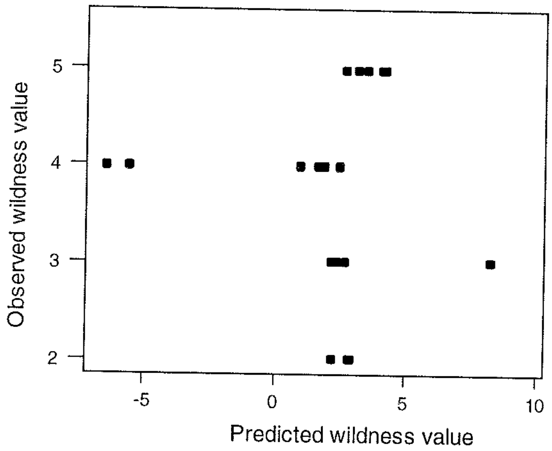


Figure 59 Scatter plot of observed versus predicted wildness.

To assess the accuracy of the predictions a one sample t-test was conducted on the difference between the observed and predicted values for the H_0 that $\mu = 0$, versus the H_1 that $\mu \neq 0$. The results are displayed in Table 47.

Table 47 Results of the one sample t-test for the differences between the observed wildness values and those predicted with the Cairngorm model for the Wester Ross photographs (cawldif1).

Variable	N	Mean	SD	SE Mean	T	P
cawldif1	22	1.616	3.214	0.685	2.36	0.028

The result was a p value of 0.028 indicating that the mean value of differences was not zero and therefore that the predicted wildness values are not accurate.

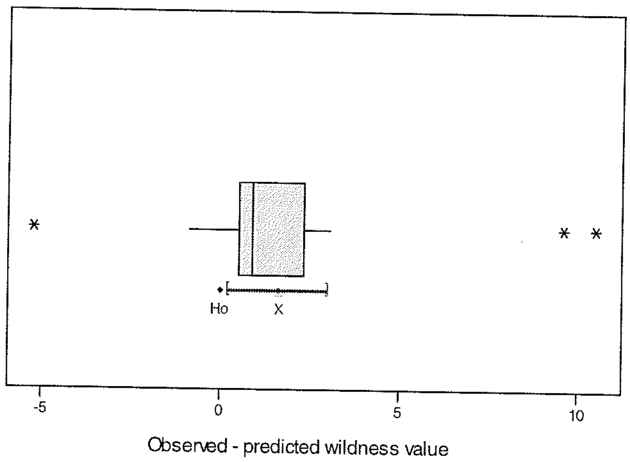


Figure 60 Boxplot of the differences between predicted and observed wildness values for the Cairngorm model (with Ho and 95% t-confidence interval for the mean).

The spread of the differences between the observed and predicted wildness values is shown in Figure 60. The differences range from -5.23 to 10.50 and indicates that the prediction of values is not precise. There is also a tendency to underestimate the observed value.

The three outlying points exert considerable influence on statements of the precision and accuracy of the other 19 points (Figure 60). By removing the three outlying points the correlation between the observed and predicted wildness values increased to 0.363. However, the differences between observed and predicted values were not accurate as the H_0 that $\mu = 0$ was rejected in favour of the H_1 that $\mu \neq 0$ ($p = 0.0004$) (Table 48).

Table 48 Results of the one sample t-test for the differences between the observed wildness values and those predicted with the Cairngorm model without the outlying points (cadif2).

Variable	N	Mean	SD	SE Mean	T	P
cadif2	19	1.088	1.096	0.252	4.32	0.0004

The range of the differences contracted to -0.90 to 3.05, increasing the overall precision of the values. However, the spread of values was again biased towards underestimating the observed value. The Cairngorm model is therefore better at predicting wildness values for the Cairngorm area than for the Wester Ross area, although the predictions of the Cairngorm values could not be demonstrated to be precise.

5.6.2.2 Wester Ross Model

The alternative method to using the Cairngorm data for developing a model to predict wildness, is to use the Wester Ross data set. The Cairngorm data set can then be used to test the transferability of the model. As in the case of the general and Cairngorm models, the data set was split into a training data set and a test data set using the Bernoulli distribution, resulting in the allotment of photograph numbers as shown in Table 49.

Table 49 Photographs assigned to the Wester Ross training and test data sets.

Training Set (questionnaire #)	Test Set (questionnaire #)
1,5,7,9,11,16,17,19,22,24,27,33, 35,36,41,46,47	4,6,29,30,31

As with the development of the previous two models, any variables that contained all zero values in either the test data set or the training data set were not used in the regression analysis. The first stepwise regression procedure used all the original variables and produced a R^2 (adjusted) of 26.7 % with only one variable:

SLOPE6B .... Regression 1

In an attempt to improve on regression 1, the F value for entry to the regression was reduced but no improvement was achieved. Next, the amalgamated land cover variables were used in a stepwise regression, producing similar results to Regression 1. Reduction of the F value did not improve this model. The next stepwise regression used all the variables that had been amalgamated over the three distance zones. However, no valid regression equations could be obtained from this data and so the next level of generalisation was attempted. This combined the amalgamated distance variables for certain land cover categories. Again, no valid regression equation could be produced with this data. The last attempt at a stepwise regression procedure used all the variables together but again, no statistically valid regression equation was produced.

Using all of the variables highlighted in the previous regression analyses, whether or not statistically valid, a best subsets regression procedure was carried out to find a better model. The following regression equation was produced with a R^2 adjusted of 83.6 %.

WILDMEDN = 2.67 +0.000009 ARLCS27 +0.000097 ARLCS6A +0.000001 ARLCS21C+0.000022 ARLCS28C -0.000071 SLOPE1C +0.000001 SLOPE4C
.... Regression 2

Table 50 Results of the multiple linear regression for the Wester Ross model.

Predictor	Coefficient	SD	T	P
Constant	2.67370000	0.17480000	15.30	0.000
Area of good rough grassland / heather mosaic (ARLCS27)	0.00000857	0.00000262	3.27	0.008
Area of heather moorland in the foreground (ARLCS6A)	0.00009711	0.00001734	5.60	0.000
Area of cliffs in the background (ARLCS21C)	0.00000140	0.00000058	2.42	0.036
Area of peatland / montane mosaic in the background (ARLCS28C)	0.00002178	0.00000407	5.36	0.000
Area of slope between 0° and 0.57° in the background (SLOPE1C)	-0.00007127	0.00002291	-3.11	0.011
Area of slope between 2.66° and 5.71° in the background (SLOPE4C)	0.00000142	0.00000062	2.28	0.046

$S = 0.4518 \quad R^2 = 89.7\% \quad R^2\,(adj) = 83.6\%$

Table 51 Results of the analysis of variance for the Wester Ross model.

Source	DF	SS	MS	F	P
Regression	6	17.8411	2.9735	14.57	0
Error	10	2.0412	0.2041		
Total	16	19.8824			

Checking the assumptions of the multiple linear regression test, Figure 61 shows the residuals are normally distributed. The scatter of points in Figure 62 shows that there is constant variance of the residuals. Figure 63 to Figure 68 show a scatter of points around the zero residual line, indicating roughly linear relationships between the residuals and explanatory variables.

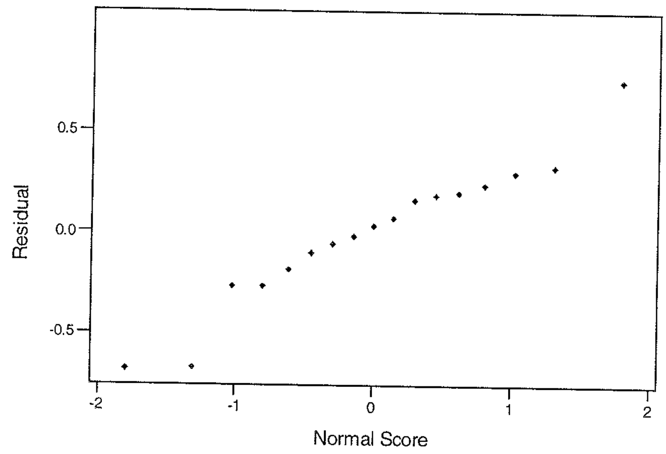


Figure 61 Normal probability plot of the residuals from the Wester Ross model.

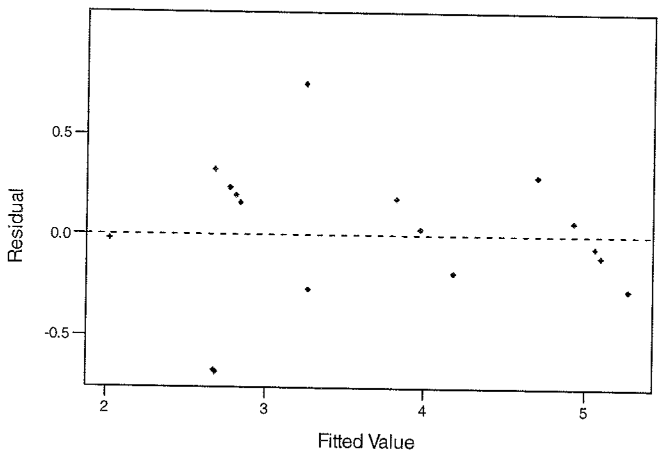


Figure 62 A plot of residuals versus the fitted values.

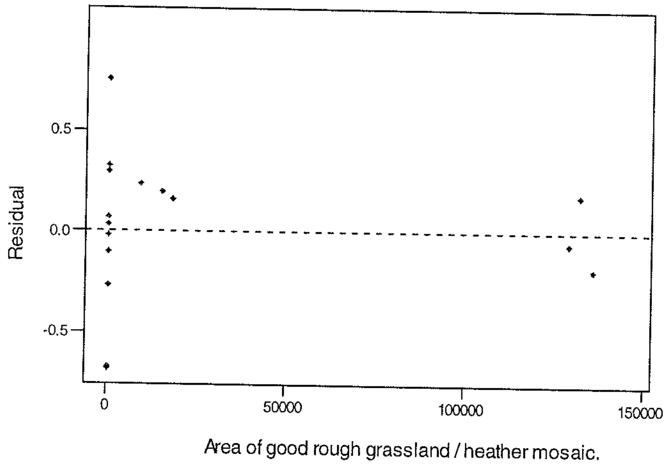


Figure 63 Residuals versus total area of good rough grassland / heather mosaic.

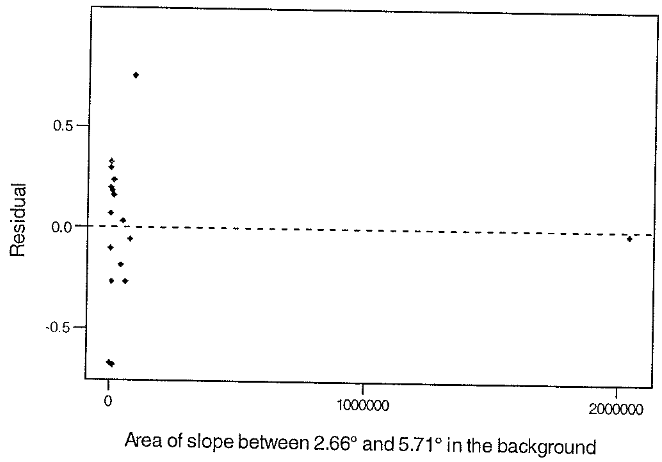


Figure 64 Residuals versus area of slope between 2.66° and 5.71° in the background.

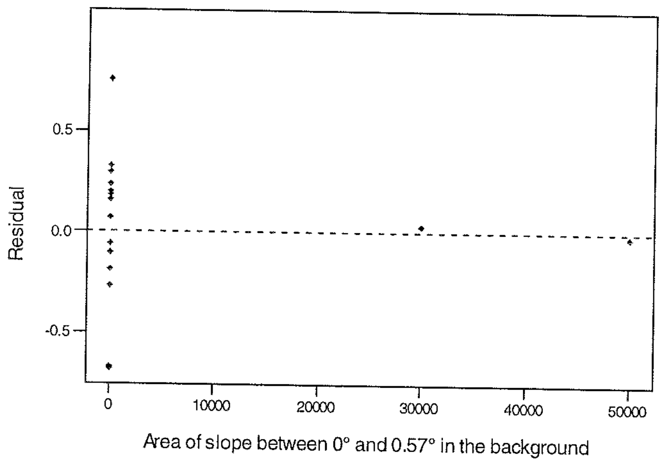


Figure 65 Residuals versus area of slope between 0° and 0.57° in the background.

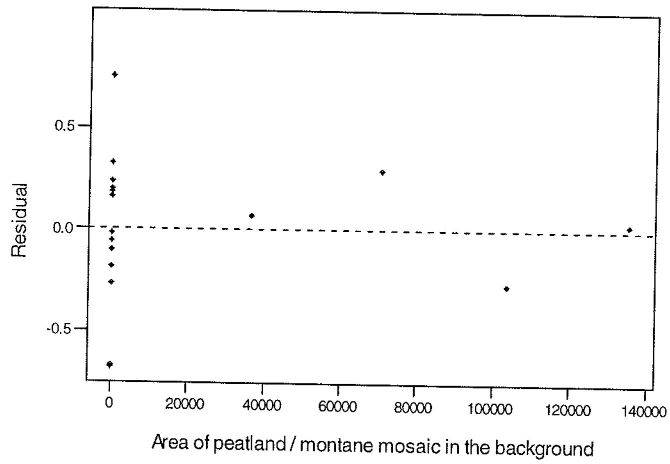


Figure 66 Residuals versus area of peatland / montane mosaic in the background.

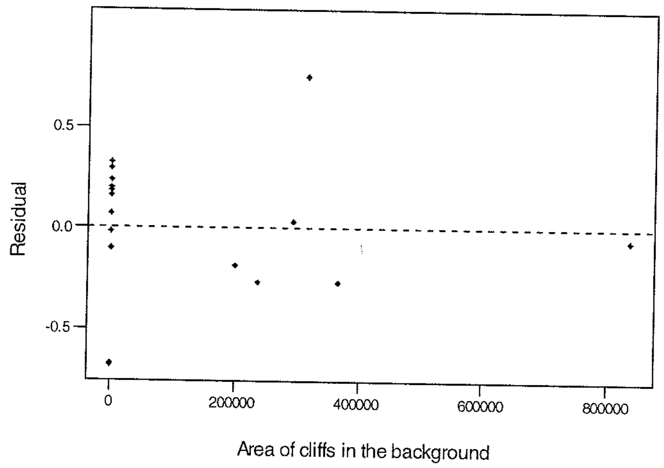


Figure 67 Residuals versus area of cliffs in the background.

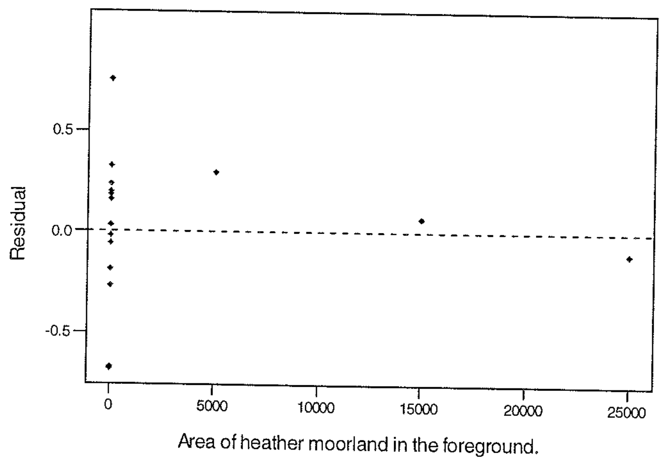


Figure 68 Residuals versus area of heather moorland in the foreground.

The final model developed using the Wester Ross data explains 83.6 % of the variation in the observed wildness scores. The terms that make up the regression equation include ARLCS27, the total area of good rough grassland / heather mosaic which has a positive coefficient. The second term, ARLCS6A, represents the area of heather moorland in the foreground of the photograph and also has a positive coefficient. The area of cliffs in the background of the photograph has a positive influence on wildness, as does ARLCS28C, the area of peatland / montane mosaic in the background. The last two terms in the equation both refer to the area of slope in the background of the photograph. SLOPE1C, the area of slopes between 0° and 0.57° is the only term with a negative coefficient. SLOPE4C, the area of slopes between 2.66° and 5.71°, has a positive influence on wildness.

Validating The Model Using The Test Data

The above regression model was tested using the Wester Ross test data set. Wildness values were predicted for the 5 photographs in the data set and correlated against the actual wildness values, giving a Pearson correlation of -0.410 (Figure 69).

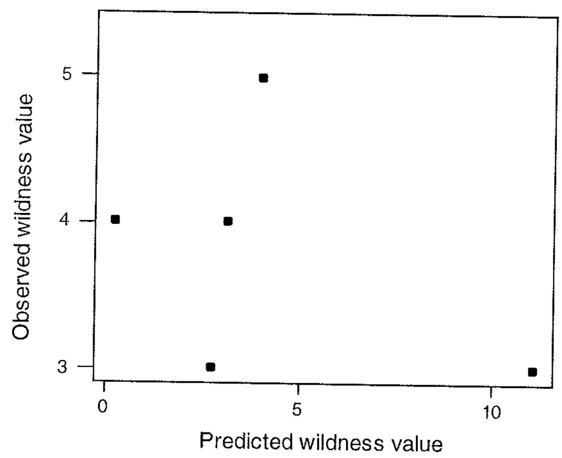


Figure 69 Scatter plot of observed and predicted wildness values for the Wester Ross model.

To test the accuracy of the predicted values, a one sample t-test of the differences between the observed and predicted wildness values was conducted for the H_0 that $\mu = 0$ versus H_1 that $\mu \neq 0$ (Table 52).

Table 52 Results of the one sample t-test for the difference between observed wildness values and those predicted with the Wester Ross model (wildiff1).

Variable	N	Mean	SD	SE Mean	T	P
wildiff1	5	-0.42	4.47	2	-0.21	0.84

The p value of 0.84 indicates that the H_0 could not be rejected and that the predicted wildness values were accurate. The spread of the differences between observed and predicted wildness values is shown in Figure 70 and indicates that the prediction of values is not precise with values ranging from -8.04 to 3.76.

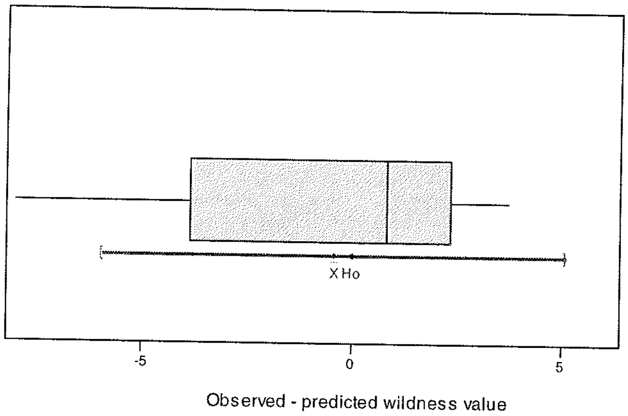


Figure 70 Boxplot of the differences between the predicted and observed wildness values for the Wester Ross model using the test data set (with Ho and 95% t-confidence interval for the mean).

The predicted wildness value for photograph 30 was 11.04, by far the largest of all the values. Removal of this point increased the correlation to 0.319; the H_0 could not be rejected with a p value of 0.15 indicating that the predicted wildness values were accurate. The spread of values was reduced to the range 0.87 to 3.76 indicating that the predicted values were lower than the actual values, but to varying degrees confirming the imprecise nature of the predictions.

Testing The Model With The Cairngorm Data Set

The accuracy and precision of the Wester Ross model at predicting the wildness values for the Cairngorm data set was tested. Using Wester Ross Regression 2 to predict the wildness values of the Cairngorm pictures a correlation of 0.227 (n = 26) between observed and predicted wildness values was produced. A scatter plot of these values is shown in Figure 71.

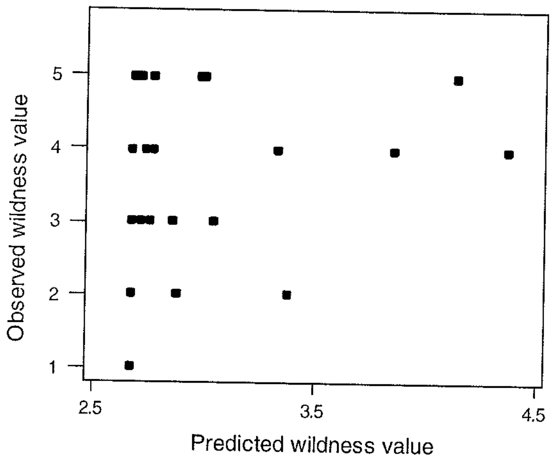


Figure 71 Scatter plot of the observed and predicted wildness values for the Cairngorm data set using the Wester Ross model.

A one sample t-test was used to test the differences between observed and predicted wildness values (Table 53).

Table 53 Results of a one sample t-test for the differences between the observed wildness values of the Cairngorm photographs and the values predicted with the Wester Ross model (wes_dif1).

Variable	N	Mean	StDev	SE Mean	T	P
wes_dif1	26	0.538	1.31	0.257	2.09	0.047

The p value of 0.047 led to the rejection of the H_0, indicating that the predicted wildness values were not accurate. The boxplot in Figure 72 shows that the spread of differences goes from -1.67 to 2.32, suggesting that the predicted values are not precise.

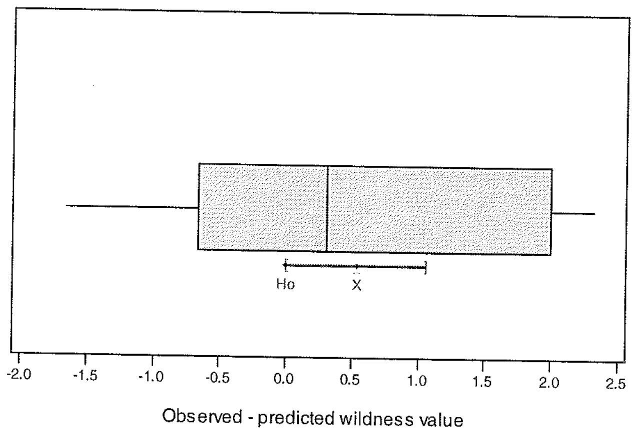


Figure 72 Boxplot of the differences between the observed and predicted wildness values from the Wester Ross model for the Cairngorm data (with Ho and 95% t-confidence interval for the mean).

Hence the Wester Ross model of wildness cannot be transferred to the Cairngorm study area with any degree of confidence.

5.7 Model Results Summary

To conclude, the general wildness model appears to be the most reliable, accurate and precise of the three presented. It explained 60.5 % of the variation in the wildness scores of the photographs. When tested, the correlation between observed and predicted wildness scores was 0.7. A t-test showed the predicted values to be accurate while they were precise to approximately ±1.5 wildness values. The Cairngorm site specific model explained 68.2 % of the variation in the wildness scores in the Cairngorm study area but when tested produced a low correlation of 0.4. However, a t-test showed the predicted values to be accurate. The differences between observed and predicted wildness scores ranged from -2.29 to +2.94 showing the Cairngorm model to be less precise than the general model. Finally, the Wester Ross model explained more of the variation in the wildness scores in the Wester Ross study area than the general wildness model with an R^2 of 83.6 %. However, when tested a very low correlation of -0.4 indicated the model was unreliable, with a large range of differences between observed and predicted wildness values. Both the Cairngorm and Wester Ross models, when applied to photographs taken in the other study area, did not predict the wildness scores accurately or precisely. The general model proved to be the most reliable, accurate and precise of the three wildness models developed. The reason for this lies in the statistical method used to create the three models. In the case of the general model, the number of photographs used in the development process was 34, while for the Wester Ross and Cairngorm models it was 17 and 21 photographs respectively as a result of the method used to select the photographs. The use of a greater number of photographs for the development of the site specfic wildness models would help to increase the accuracy and precision of their predictions.

5.8 Chapter Summary

The focus of this chapter was to develop the link between the photographed landscapes and their ratings. This was achieved through the development of wildness models using measures of the landscape attributes visible in each of the photographs. The landscape attributes were quantified using specially developed procedures for the ARC/INFO GIS environment. These GIS procedures were employed in the application of the models developed in this chapter to produce wildness maps of the Cairngorm and Wester Ross study areas. All three models explain different degrees of the variation in the wildness ratings in terms of the attributes of the landscapes in which those photographs were taken. The general model is the most reliable, accurate and precise of the three models as a result of the statistical development process. Both of the site specific models were accurate in their wildness predictions of each area although neither was reliable with both models yielding low correlations between observed and predicted values. In terms of precision the Cairngorm model was better than the Wester Ross model. Neither site specific model proved to be transferable to the other study area. The application of the general and two site specific models within the two study areas is the subject of the next chapter.

Chapter 6

GIS Based Predictions Of Wildness Within The Cairngorm And Wester Ross Study Areas

6.1 Introduction

A major objective of this research project has been to develop a model that can predict the wildness of a location based on the attributes present in the surrounding landscape. The last chapter described in detail how the alternative models were developed and tested using the photograph wildness scores. The models developed take into account the perceptions of all those questioned as there were found to be few differences between the sample groups in a comparison of the photograph wildness scores (Chapter 4).

A further research objective is to apply the models within the two study areas and evaluate the spatial distribution of wildness. Through the application of the models, an assessment of their value in land use management decisions can be made. The present chapter describes how the models were applied within the two study areas and presents an assessment of the reliability of their output.

6.2 Using GIS To Apply The Wildness Models

The approach of using the visual impact of the surrounding landscape to predict the wildness of a location is supported by Bishop & Hulse (1994): they suggested that the visual impact of development should be based on its effect on locations rather than on views. The concentration on viewpoints for modelling and simulating the impact of new development can over-emphasise the importance of the chosen view at the expense of the panorama around the viewer (Bishop & Hulse, 1994). Therefore in this study the application of the wildness models was carried out by first conducting a full 360° visibility analysis for all the points to be assessed for wildness. In developing the models, the photograph visibility analyses only covered what was visible in the photograph, equal to a 40° arc or one ninth of a full revolution. If a repeat analysis was to be conducted for the same spot, covering the full 360°, a different wildness value would result as more of the surrounding landscape would be taken into account when calculating the final wildness score. This means that everything that is seen around a spot is taken into account and this has the effect of producing a more reliable map of wildness than the view approach.

For example, if a person stands at the side of a road looking into a mountainous area, from the visual perception of the field of view alone, it could be argued that this location has a high wildness value. However, the sound of the cars passing behind the observer and existence of the road, could reduce the actual wildness of the same location, particularly if their effect on the other senses, such as hearing, were taken into account. In the 40° photograph visibility analysis, the influence of that road would not have been taken into account. In contrast, if a full 360° analysis had been conducted at the same location, the visual impact of the road would have been taken into account resulting in a lower wildness value for that point. By using surrogate variables, the quantification of those variables that are difficult to assess (e.g. the noise of passing cars using the surrogate of the location of the road), the analysis acknowledges the importance of the fact that the observer knows that there is a road just behind them and the resulting wildness assessment for that location is likely to be more accurate.

This discussion emphasises the limitations of the 'view' approach in favour of a complete 360° analysis. This point has been stressed by Bishop & Hulse (1994) in a study that used 360° video panoramas.

In practice, predicting wildness based on the surrounding landscape is a three step process:

1. evaluating what can be seen from each point in a grid covering the area of interest,
2. quantifying the variables in the wildness model and,
3. running the model and assigning a wildness value to that point.

The first of these steps is an extension of the photograph specific visibility analyses that were discussed in Chapter 5. An example of a study in which a visibility analysis for each point was conducted, is an analysis of the scenery of the Cairngorm mountains which used the intervisibility method for what the authors termed 'wide area analysis' (Miller *et al.*, 1994). The result of this work was a binary map of low and high visibility pixels. However this type of analysis in which a calculation of intervisibility is undertaken for each point is very time consuming. Miller *et al.* (1995) reports that a visibility census for an area of Scotland that equated to 900000 cells (approximately 562.5 km^2), took over 30 days of CPU (central processing unit) time on a Sun Sparc 10 using ARC/INFO software. In another study using GRASS software on a Sun Sparc 20/50, Lake *et al.* (1998) suggested that for the total area of Islay (390 km^2), processing would take over 1000 days working 24 hours per day. The processing time was reduced to about 24 hours with the use of a specially written C program and random sampling of the landscape of interest. The current project used ARC/INFO and the limitations of processing time in the visibility analysis by the computer hardware had to be taken into account.

To complete the second step of quantifying the variables that make up the wildness models, it was necessary to edit the AML programs used to measure the landscape attributes in the model development stage. The original versions of the AML programs are listed in Appendix 3.

To assign a wildness value to a point, the desired model was run for that location using Minitab and the resulting value imported to ARC/INFO. In ARC/INFO, the wildness value was linked to the location of the point through the Point Attribute Table (PAT) associated with the sample points coverage.

6.2.1 GIS Constraints

The aim of this study was to produce maps of wildness covering each of the two study areas. However as the method of assigning a wildness value to a point based on what can be seen from that point is very time consuming, a test was carried out in an attempt to calculate the total time that would be required to undertake a complete visibility analysis of the two study areas. For a coverage containing 15 points within the Wester Ross study area, the Sun Sparc5 took over 36 minutes to calculate the areas visible from each of the points. If this type of analysis was to be conducted for the Cairngorm study area, containing 2563201 points (at a resolution of 50m), it would take more than 11 years. For Wester Ross with 1922801 points the figure would be over 8 years. However these times will be rather conservative and the actual times are likely to be longer because of the need to split each of the study areas into coverages containing 16 points (the most that the VISIBILITY command can handle at any one time), which for the Cairngorms would mean a total number of 160201 coverages. Processing times of this magnitude are impractical (Miller *et al.*,1995; Lake *et al.*, 1998).

In order to produce a map of wildness for each study area it was therefore necessary to find an alternative method. There were three possibilities:

1. Use the model at the original resolution of 50m but only on a small section of each of the study areas. The area which could be analysed in a reasonable amount of time would be about 1 km^2 (400 points ≈ 16 hours processing time).
2. Use a larger resolution, e.g. 500 m instead of 50 m spacing between points. This would mean that an area covered by 400 points would be about 100 km^2.
3. Cover the whole of each study area with a grid of 400 points. For the Cairngorms with an area of 1458 km^2, each point would represent 3.7 km^2. For Wester Ross with an area of 1142 km^2, each point would represent 2.9 km^2. Cells with areas of this magnitude would produce a very coarse wildness coverage.

Option 2 was chosen as a compromise between the two opposing factors of a) wanting the map to cover as large an area as possible and b) the resolution of the map. With hindsight this option worked well as the scaling experiments in Section 6.3 showed that data from the 500 m grid could be interpolated reasonably accurately to a 50 m resolution grid. In addition Section 6.4 showed the spatial dependence of the wildness ratings to be greater than 2 km, dependent on the underlying topography of the study area concerned.

6.2.2 Wildness Maps For The Two Study Areas

A section from both study areas was chosen to be mapped on the basis that each contained the range of relief and general landscape characteristics representative of each study area. Altitude is one factor that influences several of the variables in the general model, such as area of heather / peatland, the area of montane habitat / cliffs and the elevation of the observer. The two areas chosen for the production of the maps were:

1. For the Cairngorm area (Figure 73) - from Glen Dee west of Braemar, northwards to Carn a' Mhaim (a 500m grid from OS grid reference 297000, 788000 to 306500, 797500). This area contains a large elevation range, roads and a range of land cover types.
2. For the Wester Ross area (Figure 74) - from the A832 southwards to An Teallach and Beinn a' Chlaidheimh (a 500m grid from OS grid reference 201500, 876500 to 211000, 886000). This area contains a large elevation range, hill roads and a range of land cover types.

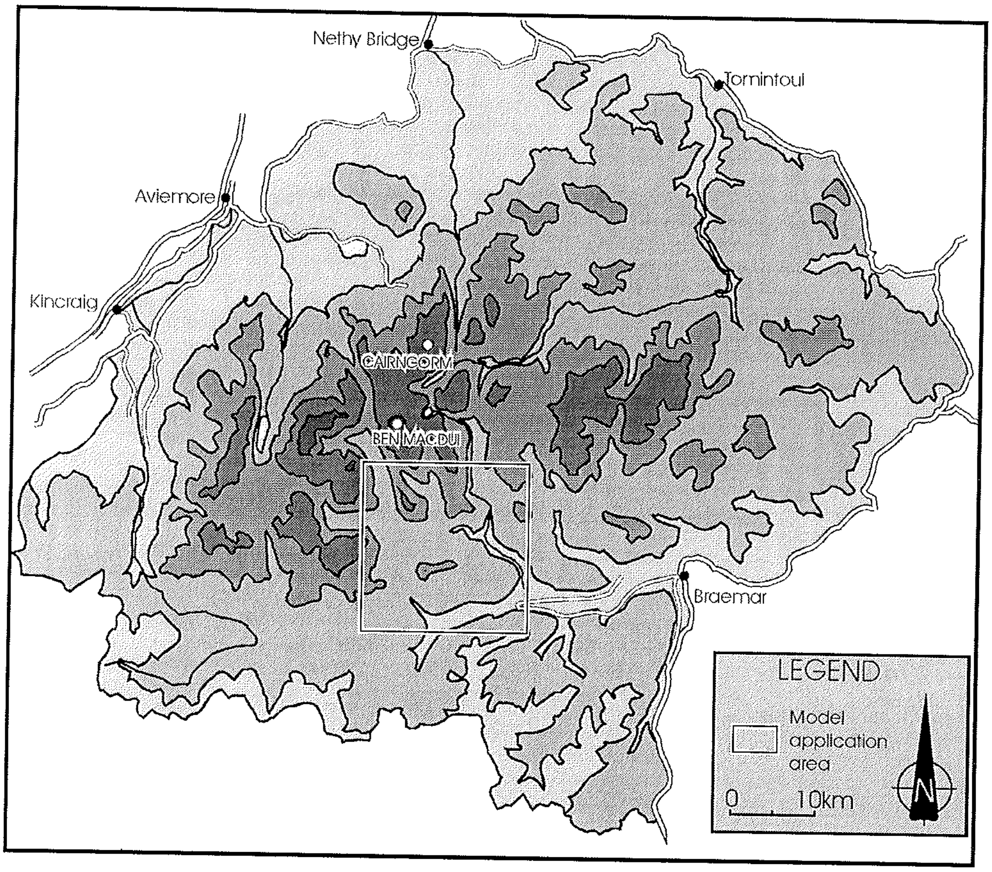


Figure 73 Location map showing the area in which the wildness models were applied within the Cairngorm study area.

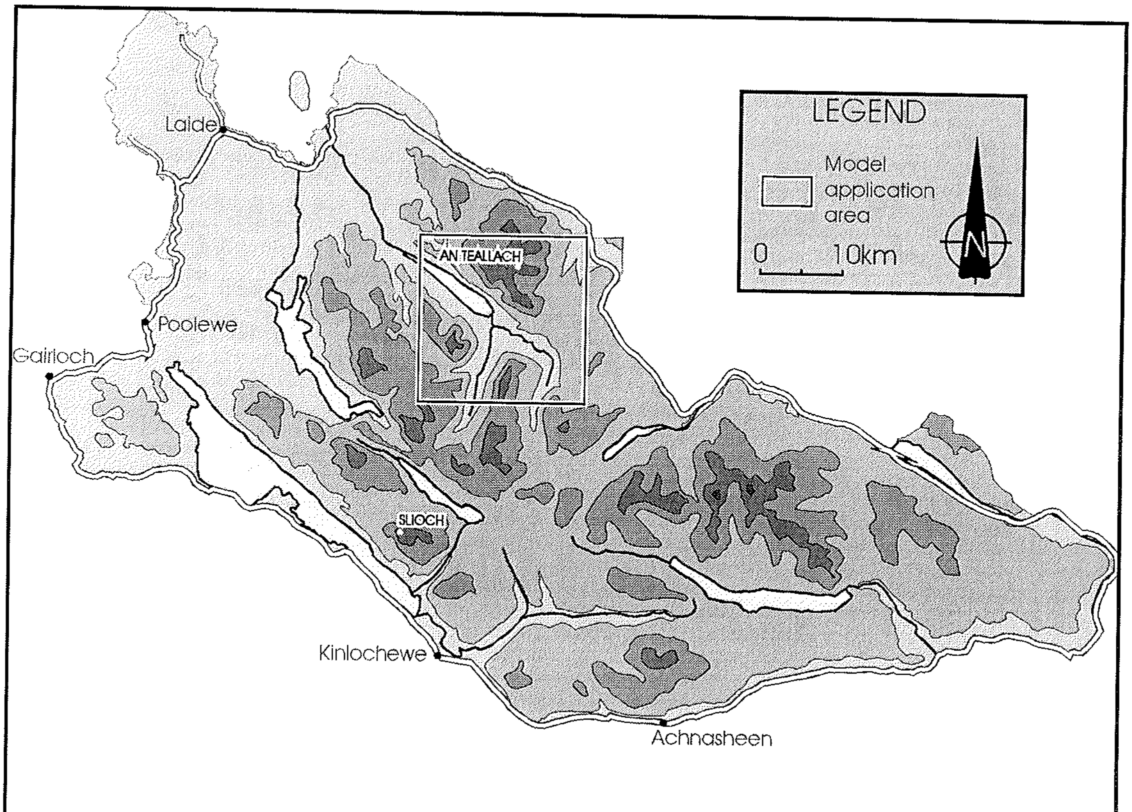


Figure 74 Location map showing the area in which the wildness models were applied within the Wester Ross study area.

6.2.3 Reliability Of The Wildness Model Output

Of the three models developed in Chapter 5, the general model is the most transferable (Table 54). With further development including more detailed testing in each area, the two site specific models would probably increase in reliability, accuracy and precision. All the models fail to predict a certain amount of the variation in the wildness scores. This is a problem associated with this method and has been noted by Dunn (1976) with regard to measurements of landscape quality. In addition, with the use of multivariate models, the best that can be expected is to discover that the sign of a parameter is significant (Price, 1987). As the wildness models have all been developed using multiple linear regression techniques they can only be applied to the areas in which they were developed, application elsewhere would require further development (Heuvelink, 1998). However, the level of prediction achieved with the general model is reasonable given the exploratory nature of these models.

Table 54 Percentage of variance explained by each regression model (column 2), and the reliability of the three models expressed as the correlation between the observed and predicted values for the test data (column 3), and the correlations for the site specific models tested using data from the other study area (column 5).

Model	R^2 (adjusted) of the regression model	Pearson correlation coefficient	n	Pearson correlation coefficient	n
General	60.5	0.696	14	-	-
Cairngorm	68.2	0.383	5	-0.058	22
Wester Ross	83.6	-0.410	5	0.227	26

The general model is the most useful in terms of accuracy and precision and was run for both study areas. The site specific models were run in their respective study areas. The output from the models were classified to aid the presentation and interpretation of the results. All systems of classification involve a degree of generalisation and as Burrough (1986) points out, the choice of class intervals are critically important for the message that the map conveys. Here, idiographic class intervals were used as this is one of the more robust approaches available (Burrough, 1986). The raw values were normalised to a scale of 1 to 5 by categorising the values into quintile ranges, to correspond with the original photograph ratings. Figure 75 shows a grid based representation of the general model output for the Cairngorm area, and Figure 76 shows the output from the Cairngorm model for the same area.

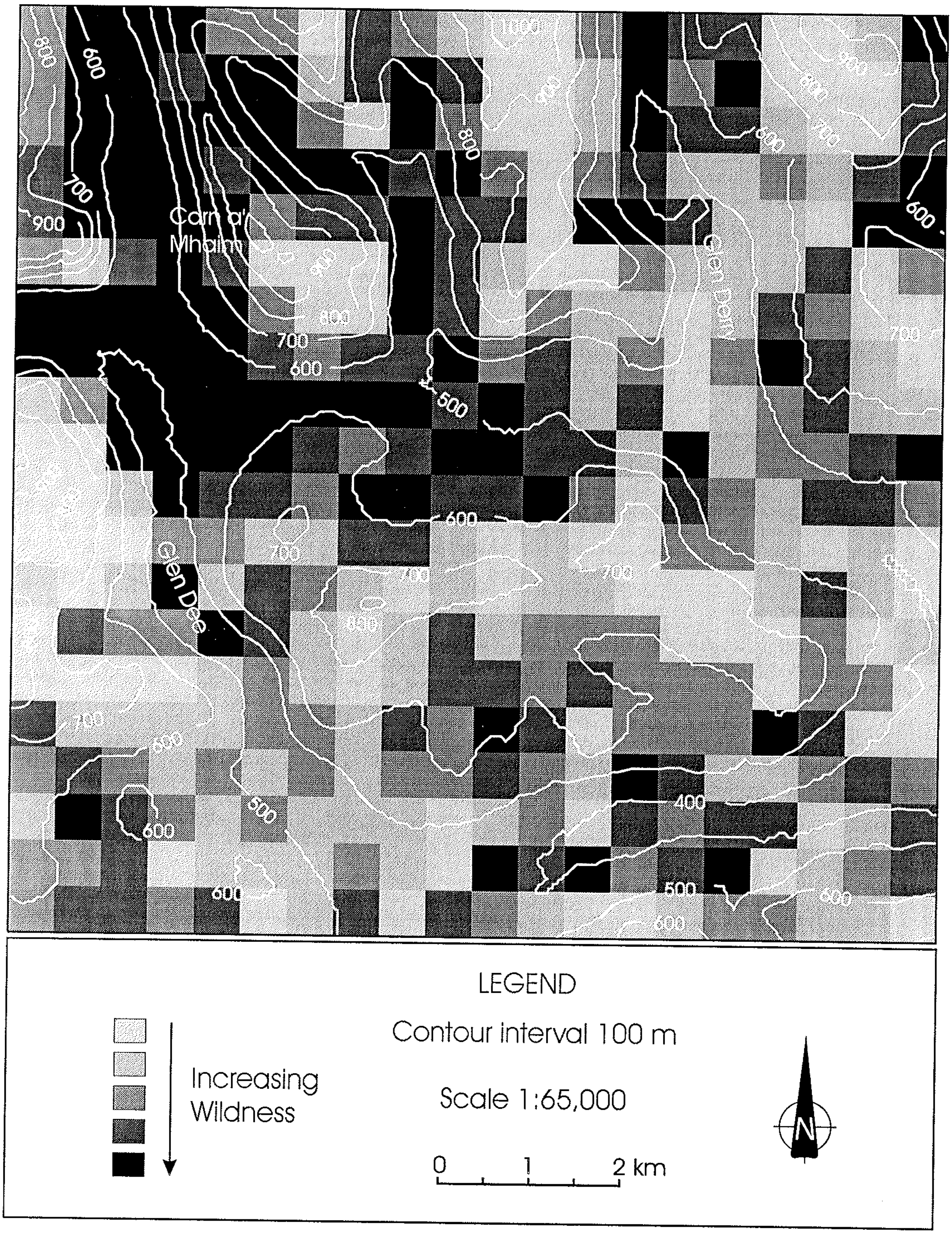


Figure 75 Predicted wildness for the Cairngorm area using the general model.

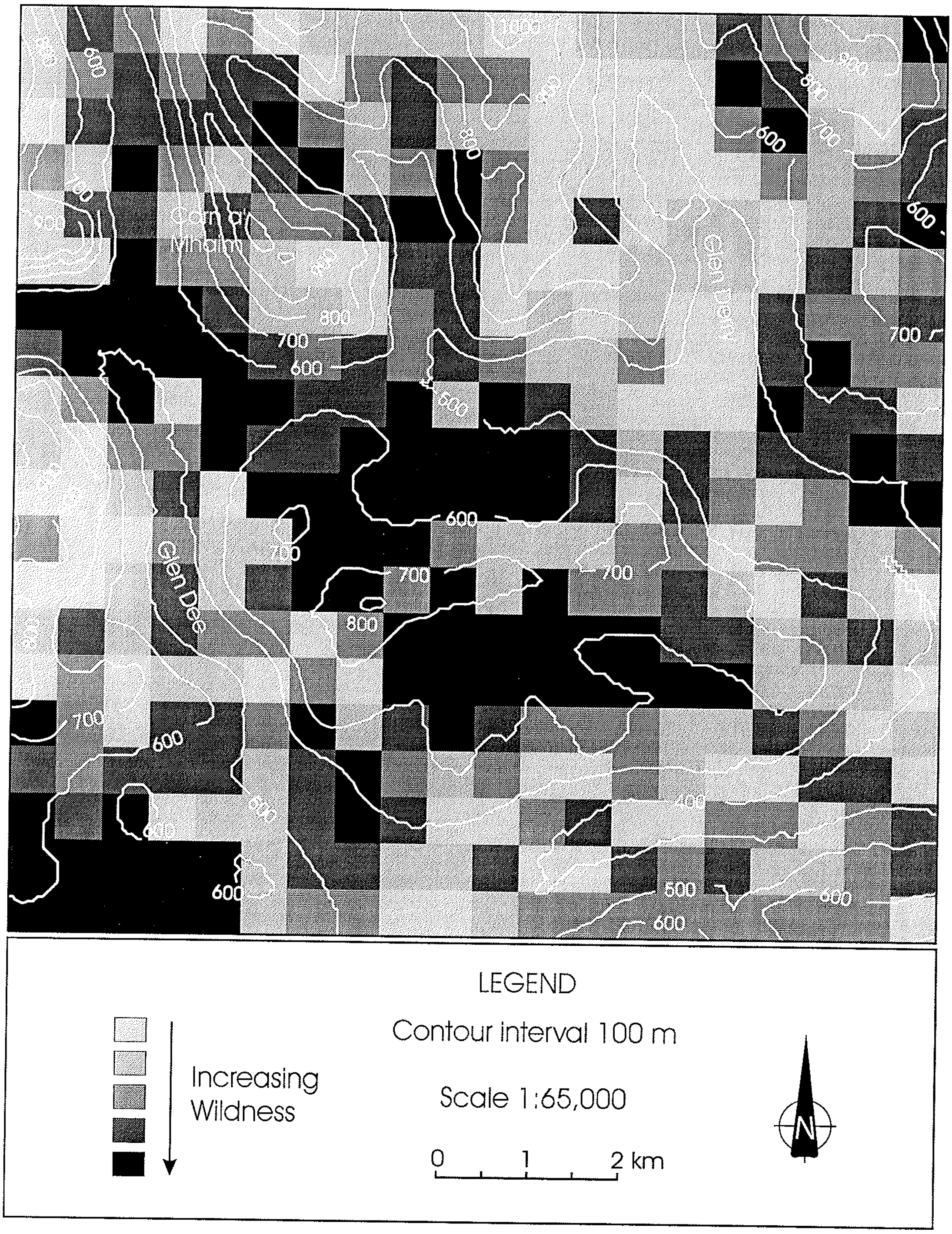


Figure 76 Predicted wildness for the Cairngorm area using the site specific model.

For the Wester Ross area, the general and site specific model outputs are shown in Figure 77 and Figure 78 respectively.

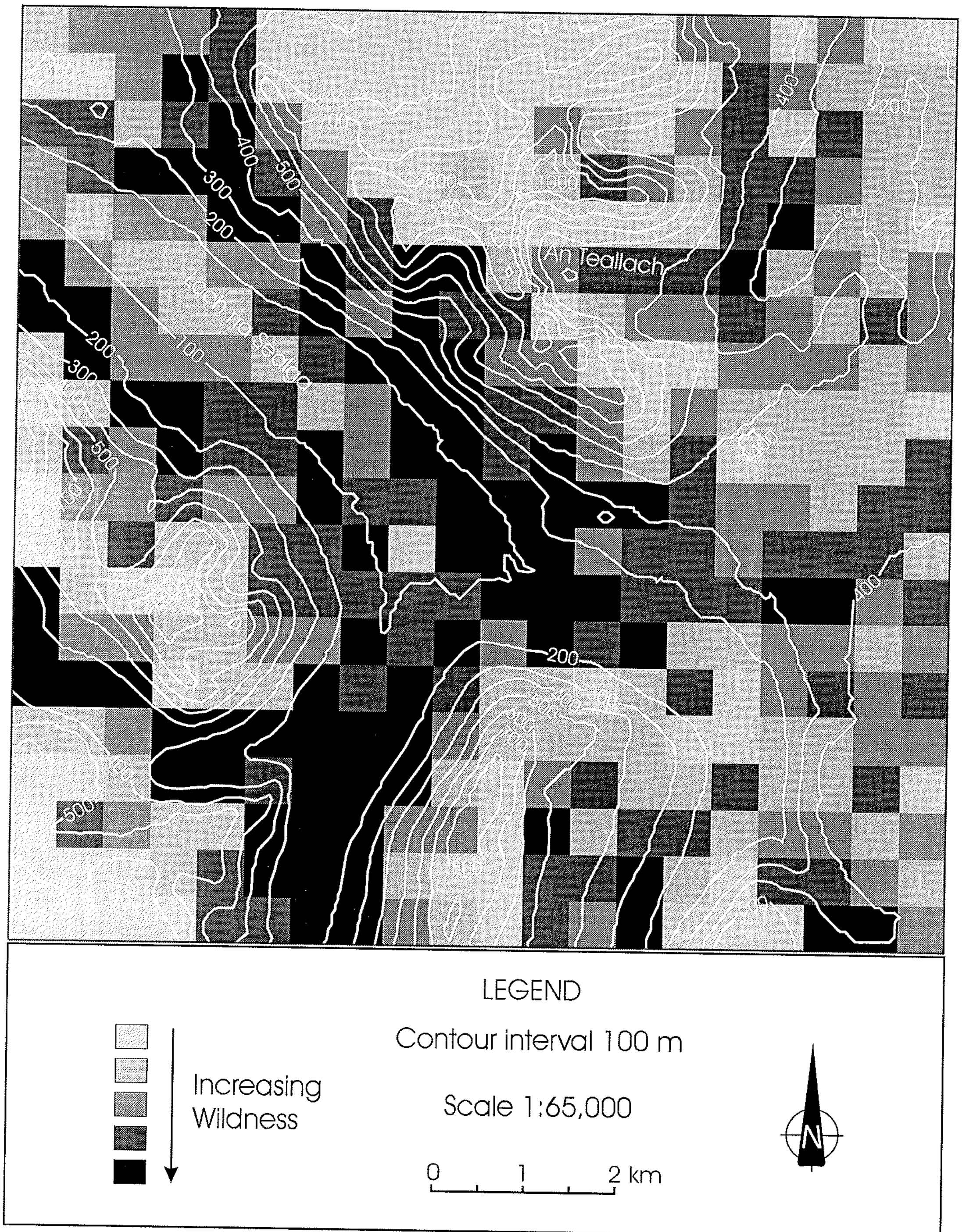


Figure 77 Predicted wildness for the Wester Ross area using the general model.

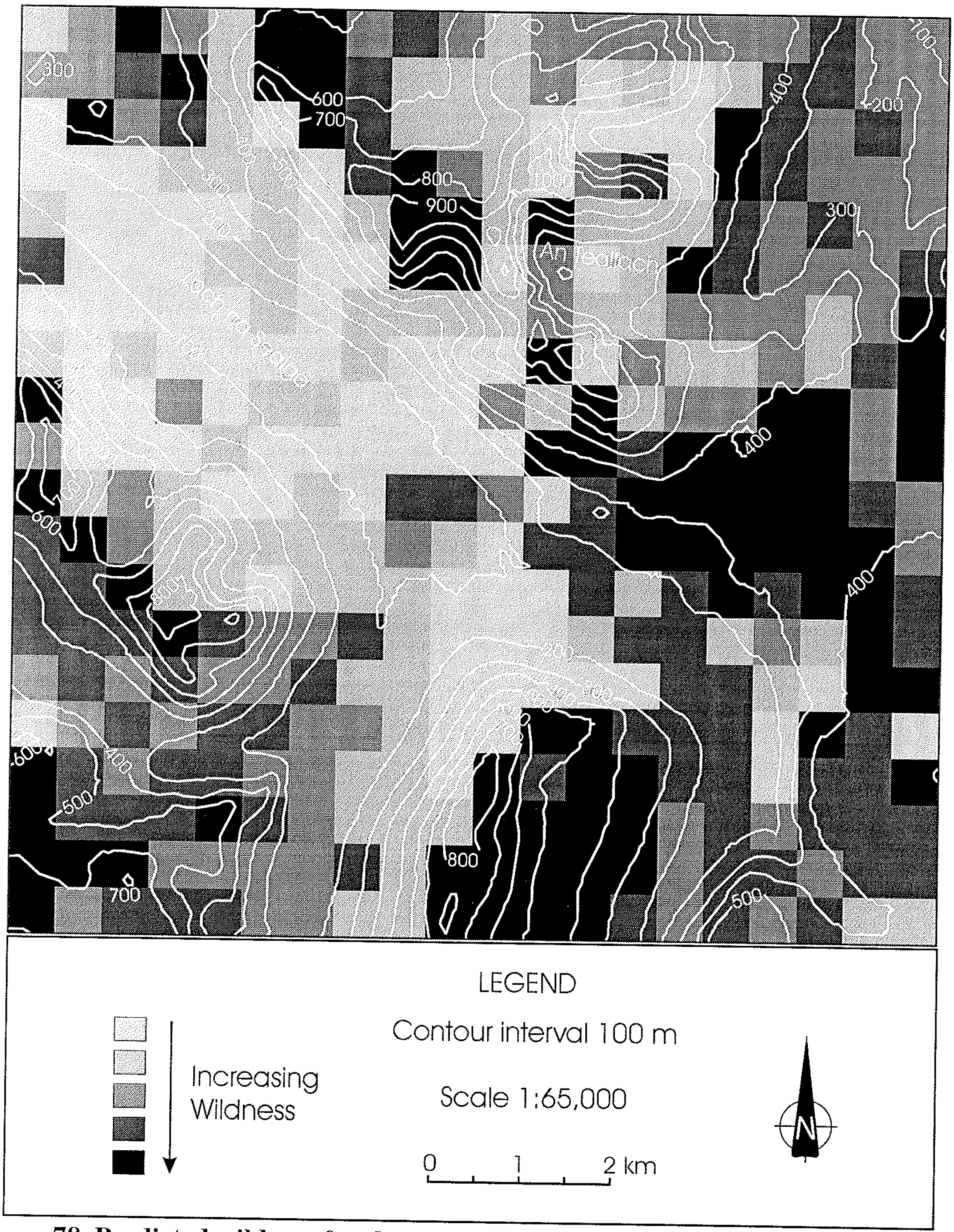


Figure 78 Predicted wildness for the Wester Ross area using the site specific model.

6.2.4 Assessing Error In The Wildness Model Output

In any presentation of results it is important to indicate the degree of error associated with those values (Davidson, 1978). A measure of the uncertainty associated with the results and the robustness of those results is needed to help prevent what Openshaw (1993) describes as a type 2 GIS crime. In its most extreme form this is unnecessary and measurable harm caused to others as a result of the misuse of a GIS leading to ill informed decision making (Openshaw, 1993). Figure 75 to Figure 78 show the output from the wildness models and display the wildness values as a category from 1 to 5 representing increasing wildness.

The wildness values produced by the three models for each test area within the two study areas had a much larger range of values than the photographs used in the validation exercise for each model. The ranges of values produced are displayed in Table 55. These large value ranges are expected as the model is being used to predict wildness values over a much larger area.

Table 55 Raw wildness data ranges for the different models displayed for each study area.

Study Area	General Model	Site Specific Model
Cairngorms	-6.89 to 30.09	2.83 to 55.63
Wester Ross	1.05 to 28.47	-318.97 to 192.10

The degree of precision in identifying these categories can be estimated from the results of the model testing exercises reported in the last chapter. The reliability of each model was tested by correlating the observed and predicted wildness values for a randomly selected group of photographs, a summary of these results is presented in Table 54. Had any of the models produced a perfect correlation ($r^2 = 1$) then complete confidence could have been placed in the values subsequently predicted using the same model. However, perfect correlations are rare and are never reported in studies dealing with environmental perception. As Table 54 illustrates, the correlations vary from -0.410 to 0.696 indicating that there is always a degree of uncertainty attached to the predicted values. An estimate of the magnitude of this uncertainty can be evaluated by noting the difference between the observed and predicted values (Table 56).

Table 56 Prediction errors expressed as the range in the difference between the observed and predicted wildness values for the three models.

Model	Difference range	n
General	-1.51 to 1.62	14
Cairngorm	-2.29 to 2.94	5
Wester Ross (after removal of 1 point)	-8.04 to 3.76 (0.87 to 3.76)	5 4

When considering the accuracy with which to report the results the original measuring instrument used to obtain the wildness ratings for the photographs is important, in this case, a simple scale from 1 to 5 (indicating increasing wildness). At best, the final results can only be reported to the level of precision of this scale, and the values in Table 56 show that the predicted values can deviate from the true value by different ranges depending on the model. Taking these points into account, all values are expressed as the wildness value ± an error term. The error term is expressed as the percentage of predicted values for which the 95 % upper and lower prediction limits were within ± 1 wildness point and is displayed in Table 57.

Table 57 Prediction errors for the different models displayed for each study area.

Area	General Model	Site Specific Model
Cairngorms	67.8 % ± 1	56.5 % ± 1
Wester Ross	45.0 % ± 1	94.0 % ± 1

These results show that the application of the Wester Ross model in that study area produced the most accurate results. This is because of the high predictive power of the Wester Ross model which has a R^2 of 83.6 %. For the Cairngorm area, the general model is the more accurate and has a R^2 of 60.5 %.

The areas in which the wildness models were applied included some of the locations from which the photographs were taken. A comparison of the wildness ratings of those photographs with the predicted wildness values produced by the models, could potentially provide another way of testing the validity of the models. However, on closer inspection this comparison proves to be inappropriate because the photograph wildness ratings are only based upon a view covering an arc of 40° of the landscape. This is in contrast to the model predictions which are based upon a complete 360° analysis of the landscape. Hence the wildness rating of a photograph and that of the surrounding landscape of the point from which it was taken are not the same and therefore not comparable.

6.3 Model Resolution At Two Scales

The scale at which the process being modelled operates is important in any modelling exercise. In the case of wildness, the concept operates at a landscape scale and this has been demonstrated in the development of the models. In order to understand the rate of change of wildness at the landscape scale, it is necessary to test the predictive ability of the site specific models at different resolutions. This was achieved by comparing the predicted wildness values of a 500 m by 500 m cell from the original 500 m sampling grid, with the values predicted at a resolution of a 100 m by 100 m grid. The results of this analysis are shown in Figure 79 and Figure 80.

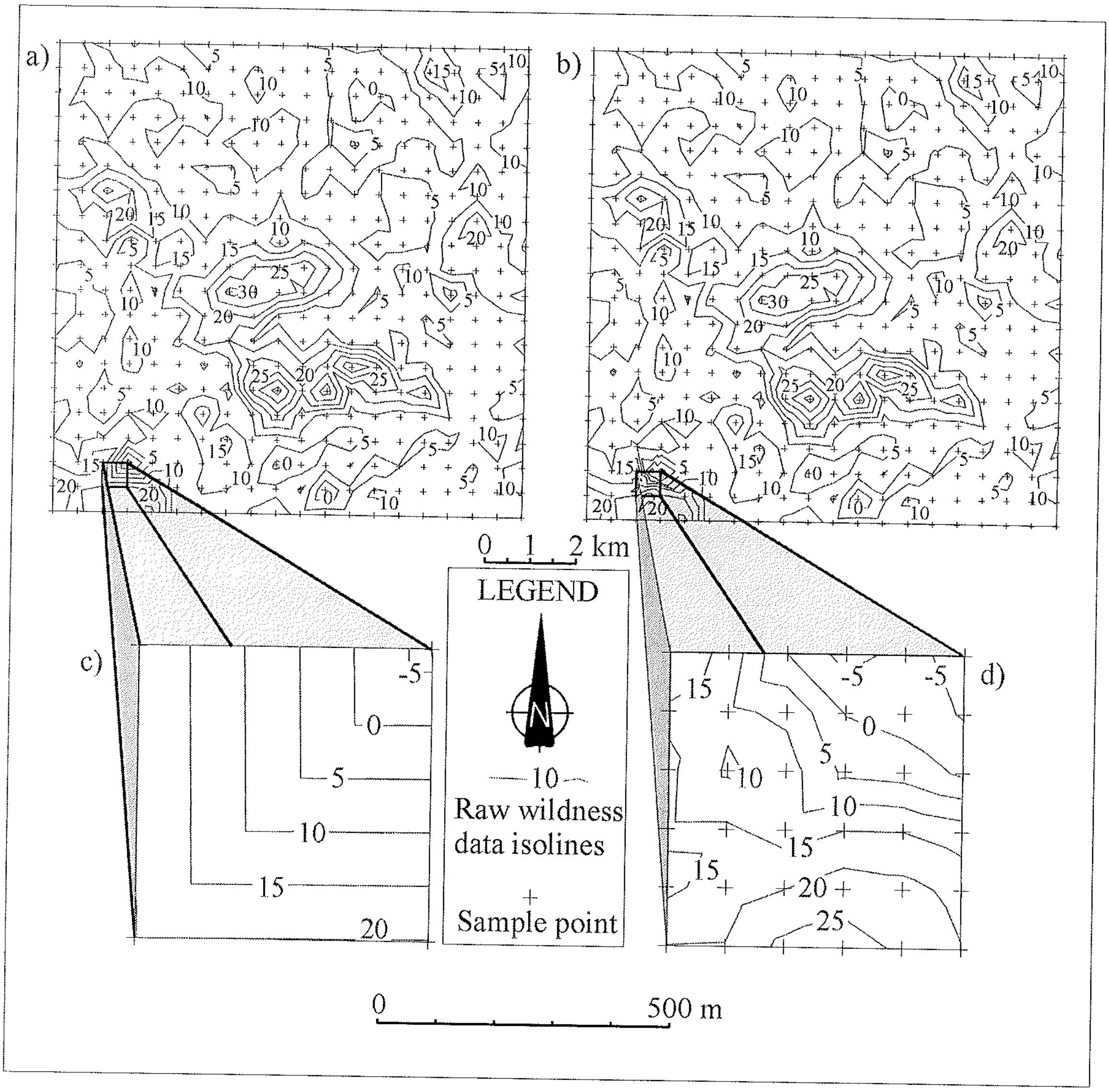


Figure 79 Wildness isolines at two scales for part of the Cairngorm area. a) 400 sample points at 500 m intervals; b) the same area with 432 sample points, representing additional sample points at 100 m intervals for one 500 m cell; c) an enlargement of the 500 m cell; d) the same area showing the 100 m sample grid and isolines.

Both Figure 79 and Figure 80 show wildness isolines calculated from the raw data output of the respective site specific models. Using this approach rather than normalised values ensures that the isolines at the two the scales are independent. If normalised values had been used, taking into account the median and quartile range, then the 100 m sample points may have influenced the values of the 500 m sample points and vice versa.

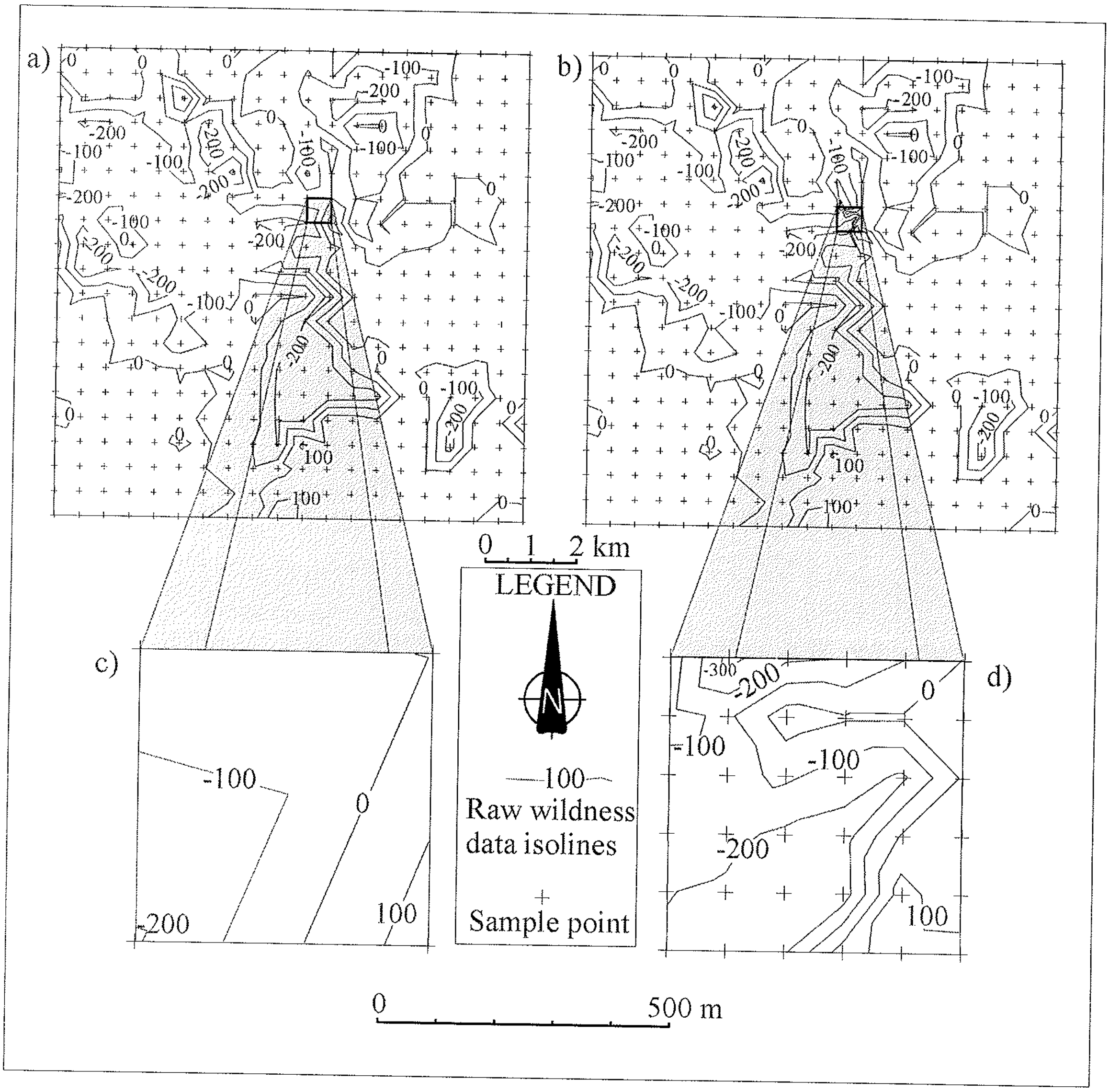


Figure 80 Wildness isolines at two scales for part of the Wester Ross area. a) 400 sample points at 500 m intervals; b) the same area with 432 sample points, representing additional sample points at 100 m intervals for one 500 m cell; c) an enlargement of the 500 m cell; d) the same area showing the 100 m sample grid and isolines.

The results of the analysis conducted at the higher resolution of a 100 m by 100 m grid shows that the site specific models can be successfully applied to an area at different resolutions. At the higher resolution, both models produce a wildness isoline coverage that is comparable to the general trend returned by the coarser scale analyses. Owing to the 50 m resolution of the DEM, it would not be appropriate to apply the models to a grid with a cell size smaller than 50 m by 50 m.

6.4 Spatial Variation Of Predicted Wildness

In order to examine the way in which the predicted wildness values were correlated with one another through space, an autocorrelation analysis was conducted. The software used for this was GS^+, *Professional Geostatistics for the PC*, version 2.3b (Gamma Design Software, Michigan, 1990-1995). The spatial variation for all the sample points is expressed as semivariance against different 'lag' distances between all pairs of points. The results of this analysis are displayed on a semivariogram. Because of the nature of the sampling grid, the minimum distance between two adjacent points is 500 m, giving the value for the active step size, that is, the distance between the lag classes. A visual check of the distribution of the normalised wildness values, indicated that the normality assumptions required for these tests had been met.

The resulting semivariograms (Figure 81) show how the spatial dependence of the predicted wildness values varies between the two sites and also between the models. In the case of the Wester Ross study area, with the general model (Figure 81a), there is spatial dependence up to a distance of about 2 km, whereas the site specific model (Figure 81b) indicates spatial dependence up to 3 km. The data for the Cairngorm study area from the site specific model (Figure 81d) shows spatial dependence up to about 4 km and then an apparent decrease in semivariance, whereas the wildness values from the general model (Figure 81c) show a continuous increase in variation with an increase in separation distance.

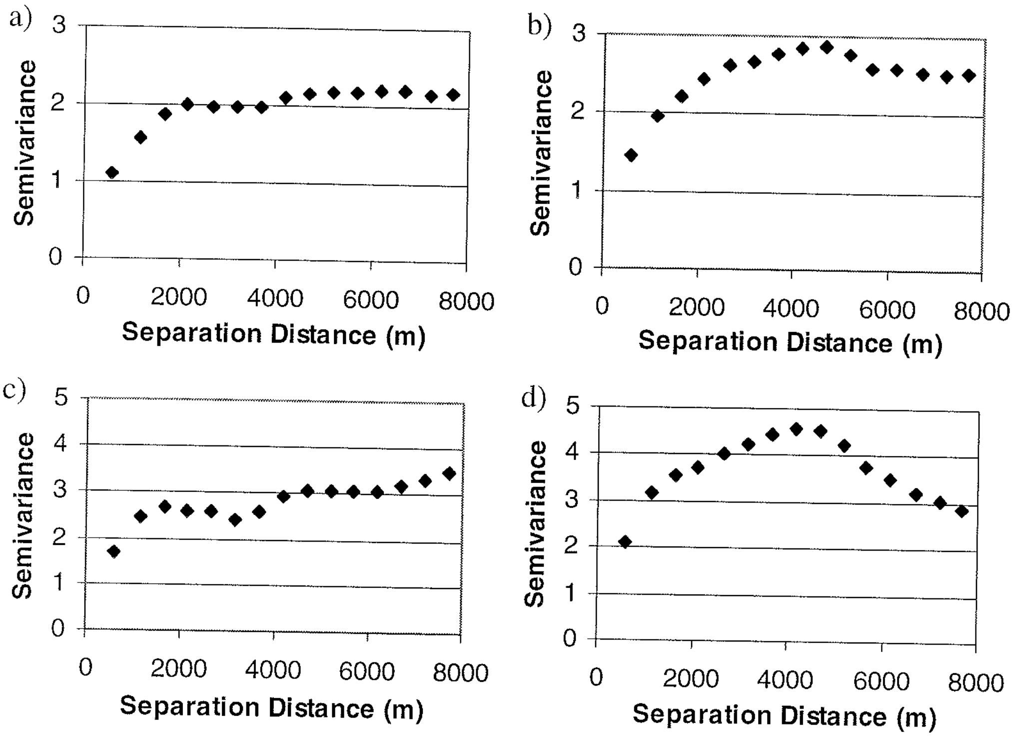


Figure 81 Semivariograms for the predicted wildness values for Wester Ross using the (a) general model, (b) site specific model, and for the Cairngorm area using the (c) general model and (d) site specific model.

This analysis of the spatial variance of the predicted wildness values shows that in general the distances over which values are correlated is less in the Wester Ross area than in the Cairngorm area. In other words, wildness values are likely to change more over the same distance in Wester Ross than in the Cairngorm area. As the models are based on the visibility of the surrounding landscape, these differences in the characteristics of wildness between the two areas can in part be explained by the difference in the nature of the two landscapes. The upland areas of Wester Ross are very rugged, with narrow glens and sharp ridges which characterise the landscape with a high degree of roughness. In contrast, the Cairngorm area, is more open, containing broad straths and montane plateau characteristic of a landscape with a higher degree of smoothness. Hence, there is a greater spatial topographic variability in Wester Ross than in the Cairngorms over the same distance, and this is mirrored by the rate of change of the predicted wildness values.

Wildness is therefore spatially dependent on the landscape in which it is predicted. The distance over which spatial dependence occurs increases with decreasing roughness of the topography.

6.5 Chapter Summary

In this chapter, the wildness models were applied to parts of the Cairngorm and Wester Ross study areas taking into account the whole of the surrounding landscape. The maps produced from each model indicated the wildness of a location on a scale of increasing wildness from 1 to 5 with a specified prediction error of ± 1 wildness unit. The site specific models were shown to operate effectively at resolutions of 500m and 100m cell sizes. The rate of change in wildness was demonstrated to be higher in Wester Ross than in the Cairngorms and this is a reflection on the difference in the landscape character of the two areas.

This chapter demonstrates how the wildness of an area can be predicted from the attributes of the surrounding landscape using the models developed in Chapter 5. The resulting maps define areas of wild land dependent upon the nature of the model used. The use of this work in developing a definition of wild land in Scotland is discussed in the next chapter.

Chapter 7

Discussion Of Study Results

7.1 Introduction

The work presented so far has described the methods by which people's perceptions of wild land in Scotland were measured and analysed to present a picture of perceived wild land and how this differs between the four sample groups. In addition, the way in which the perceptual data was used to create a GIS based wildness model has been described in detail. It is now appropriate to discuss how the verbal and visual perceptions of wild land compare between and within the sample groups, and the value of the wildness models developed. This is achieved by considering all the results from the questionnaire and the outputs from the GIS wildness models.

7.2 Sample Group Characteristics And Representativeness

An assessment of the representativeness of the views of the four sample groups is useful to put these views into the context of the general population of Scotland and to get an idea of their suitability for extrapolation outside of the study areas. To do this a picture of the general character of the sample groups needs to be formed in terms of their socio-economic status and the degree and mode of their interaction with rural landscapes.

7.2.1 Rural Inhabitants

The rural inhabitants group most closely matches the characteristics of the Scottish population in terms of work status, income and to some extent education. It would perhaps be most appropriate to extrapolate the views of this sample group to the wider rural population in Scotland. This group was characterised by the general absence of organisational membership, although a small number were associated with farming / forestry / fishing and conservation bodies. The preferred activity of the majority of the group was going for day walks, with a small number preferring fishing and shooting. There was an even distribution of experience related to the preferred activity. Only 30 % of the rural inhabitants worked in upland areas, and fewer than 20 % worked outside most of the time. The rural inhabitant group has a constant passive interaction with rural landscapes, as the backdrop to everyday life, which are also occasionally experienced in an active recreational manner.

7.2.2 Rural Outdoor Workers

The rural outdoor workers group is dominated by men aged between 25 and 54, who left school at the age of 16, are in full time work and receiving low incomes. The rural outdoor workers have a high degree of contact with rural landscapes, especially upland environments, with 85 % working outside, and 97 % working in upland environments. The preferred activities are field sports and deer stalking, supported by membership of deer and game management, or field sports organisations. The group is generally highly experienced at their preferred activity, with 70 % having over 20 years experience. Because of the sampling method employed, the rural outdoor workers group is dominated by Scottish gamekeepers and stalkers. Comparison to a study covering the whole of Great Britain, shows that the outdoor workers group is also representative of gamekeepers and stalkers in England and Wales (Scull, 1995). This group has a constantly active and professionally based interaction with rural landscapes.

7.2.3 Mountaineers

From comparison with past studies it is clear that the mountaineering sample group is representative of mountaineers and hill walkers in Scotland. In general, mountaineers are male, between 15 and 54 years old, educated to degree level and in well paid, full-time employment. Of the respondents in the mountaineering group, 95 % were members of climbing / mountaineering clubs and 46 % were members of conservation organisations. With regard to their preferred activities, 63 % of mountaineers had more than 10 years experience. The majority of mountaineers work in lowland environments (82 %), while 93 % of them work indoors. This groups' interaction with rural landscapes is through occasional, active recreation.

7.2.4 Conservation Managers

As for the conservation manager group, the manner in which they were selected through the SWCL ensures that they are representative of their profession in Scotland. Again, this group is male dominated, most of whom are between 25 and 54 years, were educated to degree level, work full time and live in households with above average incomes. Their preferred activities are day walking, mountain sports or nature study, of which respondents have a range of experience it being less than 30 years in 72 % of cases. Almost 70 % of the group are members of conservation organisations and mountaineering clubs. 63 % of conservation managers work in upland areas, but only 26

% spend most of their time working outside. On the whole conservation managers have a constant professional interaction with rural landscapes as well as an occasional one which is based on active recreation.

7.2.5 Overview Of Sample Group Characteristics

The overview presented in Table 58 takes into account the data relating to a respondents preferred activity, their membership of certain organisations, whether they work in upland areas and if they work outside. The similarity between the mountaineering and conservation manager groups is highlighted by both groups having a number of respondents who are members of both climbing / mountaineering clubs and conservation organisations. Both groups have an occasional active recreation style of interaction with rural landscapes, with additional professional use in the case of the conservation managers. These two groups have very similar distributions of the types of localities in which their members live, which covers the full range from the city centre to rural areas. In addition, socio-economically both groups are similar being highly educated, with above average incomes in full time work and predominantly male (75 %).

There are also some close similarities between the rural inhabitant and the outdoor worker groups, principally the location of permanent residence, their level of education, and their average household income.

Table 58 Overview of sample group interaction with rural landscapes.

Sample Group	Degree of interaction	Mode of interaction
Mountaineers	Occasional	Active - recreational
Rural Inhabitants	Constant Occasional	Passive - everyday life Active - recreational / little economic
Rural Outdoor Workers	Constant	Active - professional / recreational Passive - everyday life
Conservation Managers	Constant Occasional	Active - professional Active - recreational

7.3 General Perceptions Of Wild Land

The first hypothesis of this study was that the concept of wild land is applicable to Scotland. The results presented in Chapter 4 have shown that the concept of wild land is understood and used in a Scottish context by all four groups. This section generates an overall picture of the wild land perceptions of each of the four sample groups in turn. However, some of the characteristics of wild land varied little between the sample groups. The strong agreement (over 80 % of each group) that the visual sense is important in the assessment of the wildness of a location is particularly important in a study of the visual perceptions of wild land. However, other senses do complement the information received from the eyes although this information was not quantified in the current study. Finding ways to include sound or smell into landscape visualisations (Anderson *et al.*, 1983) would help to increase the realism of such surrogates and would provide more information on the factors influencing perceptions of wild land.

7.3.1 Rural Inhabitants

This sample group gave the most support to the concept of wild land with 96.5 % of respondents believing that wild land exists in Scotland. Wild land was perceived to occur in any landscape type, but was least likely in lowland areas, while all the other landscapes were perceived to contain wild land by more than 60 % of the group. More than any other group, the rural inhabitants considered the time spent walking or the distance from a surfaced road to be important in reaching a wild land area. Remoteness is therefore an important indicator of wild land for this group. Another important factor was the weather, with more rural inhabitants than any other group considering a blizzard to increase the wildness of a location. They also believed that wild land is also a place free of human impact and one which contains mountains.

7.3.2 Rural Outdoor Workers

Fewer of the outdoor workers considered there to be wild land in Scotland than any of the other sample groups, although the figure was still 86.5 % in favour of wild land. Fewer members of this group believed that wild land existed in all landscapes, except mountainous areas, compared to the other groups, although their views closely matched those of the rural inhabitant group. Around 50 % of the group considered time and distance to reach an area to be unimportant indicators of wild land while the majority of the rest indicated that 1 to 3 hours, or 3 to 6 miles can be enough to reach wild land. In terms of the influence of weather, the outdoor workers were evenly split between those who considered that there was no change in the wildness of a location in the presence of a blizzard, while the others considered there to be an increase in wildness. Defining characteristics of wild land for outdoor workers were the lack of human impact, and to a lesser extent artefacts, and the opportunity for solitude and the chance to see native fauna and flora. These aspects could perhaps reflect the type of work that this group undertakes.

7.3.3 Mountaineers

Of the mountaineering group, 91.9 % considered that there was wild land in Scotland. The 4.9 % of the group who did not, may be comparing Scotland to experiences of wild land elsewhere such as in North America, although there is no evidence to support this suggestion. The general location of wild land in any type of landscape was supported and followed the overall trend of the other groups. Mountainous areas were top of the list, considered wild by 97.6 % of mountaineers, and lowland areas were at the bottom with only 29.3 % saying they could contain wild land. In terms of time and distance to reach wild areas, the mountaineers had very similar views to the outdoor workers. More than 40 % considered it to be unimportant but of those who did, the majority considered 3-6 miles or 1-3 hours was sufficient time to reach a wild land area. The weather had no influence on wild land perception for more than 45 % of the mountaineers, while 42 % considered it to increase the wildness of a location. However, 5 % of mountaineers considered locations to be less wild in a blizzard, perhaps a result of the sense of isolation from the surrounding landscape features which occurs while experiencing a blizzard. Of any sense, vision influences perceptions of wild land the most, and being unable to see the surrounding landscape during a blizzard could been seen to reduce the sense of wildness. In general terms, wild land must be free of human artefacts, impacts and be remote according to this group.

7.3.4 Conservation Managers

Just over 88 % of conservation managers believed that there was wild land in Scotland, the second lowest number of the four sample groups. In terms of possible locations of wild land, the responses were very similar to those of the mountaineering group, with the exception of lowland areas which, more than any other group, the conservation managers considered could contain wild land. Over 60 % of this group regarded time and distance to be unimportant in finding wild land, more than any of the other groups. In addition, over 60 % of conservation managers considered the weather to have no influence on wild land perceptions. Wild land areas should be free of human impact and artefacts. The nature of these responses indicate that the wild land perceptions of the conservation manager group appear to be more heavily related to the intrinsic properties of a particular location. The responses suggest their definition of wild that is based more on ecological than perceptual terms.

7.3.5 Wilderness Purism Scale

The one section of the questionnaire that provided the most information about a sample group's perception of the characteristics of a wild land area was the WPS. There are no significant differences between the ratings of the mountaineering group and the conservation manager group for any of the 24 items used in the WPS. In each case where there is a difference between the conservation manager group and either the rural inhabitants or the rural outdoor worker group, the conservation manager group always regards the item as more undesirable, reflecting this groups tendency towards a more purist viewpoint.

In general, there are some commonly acknowledged characteristics of wild land between the groups and a definite idea of undesirable attributes. All groups agreed that wild land only existed outside cities or towns, should contain areas of native woodland regeneration, is a place where solitude can be found, is free from obvious human impact and can contain ruins and archaeological sites. Similar results were presented from the Ben Lawers hill walker survey, where increasing the amount of native woodland was seen as improving the landscape by 46 % of respondents (Rivington, 1994). Further confirmation of these desirable characteristics of wild land are provided by Aitken (1977) who showed that ruins were an acceptable part of a wild landscape perceived by mountaineers, despite the implication of associated historical land use. In addition, there is agreement between the sample groups as to what is undesirable in a wild land setting. Motorised travel and human - made noise are not acceptable, and to a lesser degree, fencing or logging operations.

Despite this general level of agreement, there is also disagreement between the sample groups over certain features in the landscape that influence their perceptions of wild land. These items appear to be closely related to the type of activity with which a particular sample group is associated. For example, the rural outdoor workers group considers stalking/shooting, the evidence of muirburn, the presence of farm animals and bulldozed tracks to be less undesirable in a wild land setting than the other groups. Commercial recreation facilities such as downhill skiing, and the presence of commercial mining and quarrying activities are seen as less undesirable by both the rural outdoor workers and the rural inhabitants, than by the other two groups. The mountaineering group considered it more desirable that a wild land area should be large enough to take at least two days to walk across than the other groups. The conservation manager group rated the regeneration of native woodland as very desirable, higher than any of the other groups, and rated several items as more undesirable, for example bulldozed tracks, non native species and road access. In all these examples, the attitudes of the respondents appear to be influenced by their mode of contact with rural areas, whether that be for economic, professional or recreational interest.

The general pattern of responses to the WPS indicates that developments in the past century have had an impact on the wild land resource of today. Such features include HEP development, reservoirs, skiing areas, conifer plantations, fencing, logging, mining / quarrying, bulldozed tracks and noise from ground and air traffic. Many of these items were regarded as intrusive in wild land areas in Aitken's (1977) study. Overall, there is a desire for wild land areas to remain as they are, without further development, except perhaps from the rural inhabitant group who favoured economic development.

With respect to their views on wild land reflected in the spread of the WPS scores, the rural inhabitants group are very similar to the rural outdoor workers group, both of which can be regarded as less purist than the mountaineering or conservation manager groups. The latter two groups had the two highest median WPS scores, indicating that they had a more purist attitude as to what is acceptable within a wild land area. The term 'more purist' refers to higher WPS scores, which equate to a lower tolerance of human artefacts and influence in a wild land setting. However, it is also clear from the boxplots in Figure 31, that the range of WPS scores is much larger for the two rural groups than for the mountaineers or conservation managers, indicating that consideration of the median scores only, omits information on the variation within the data. Similar differences in WPS scores have been found in the USA with hikers, Sierra Club members and managers getting higher scores than hunters, horse riders or scouts (Shindler & Shelby, 1993). In New Zealand, backpackers were found to have very purist perceptions of wild land and did not tolerate any human artefacts or signs of impact, whereas the public did concede some facilities, such as huts, bridges and toilets (Kearsley, 1990).

A difference in wilderness purism was identified in a study of wilderness recreational users in the USA, where backpackers were found to have more purist attitudes than day walkers (Shafer & Hammitt, 1995). This difference in purism is also illustrated in the difference between the WPS scores of the mountaineering and conservation manager groups and the rural inhabitants in this study: the former two groups were more associated with backpacking and mountain sports and the latter with day walking. The level of purism expressed by a respondent appears to be positively related to the amount of time they have spent in wilderness areas (Shafer & Hammitt, 1995). This relationship appears to hold in the case of recreational users, although in the case of the rural outdoor workers group which spends more time in upland areas than any of the other groups, the relationship seems not to hold. However, for the rural outdoor workers the majority of wild land contact is for work, rather than recreation as in the case of the mountaineering group and this difference in the nature and circumstance of contact with wild land appears to be important in wild land perceptions. Warren (1986) also found differences and similarities in the socio-economic characteristics, activities and attitudes to wilderness management of hunters and non-hunters in the Arctic National Wildlife Refuge, Alaska. The non-hunters were generally more purist in their attitudes to wilderness management, despite the similarity in socio-economic characteristics of both groups, being between 25 and 45 years old and highly educated. The main difference was that hunters had higher annual incomes on average (Warren, 1986). In general, the attitude of both groups was that new developments such as bridges, man-made trails and cabins were undesirable in wilderness areas.

In summary, the perceptions of the four sample groups as to what is desirable in a wild land setting follow a similar trend, although there are some differences between the groups. In particular the mountaineering and conservation manager groups have similar views and both have a more purist attitude than the two rural groups. Generally, all groups believe that wild areas should not contain contemporary human impacts or artefacts but can contain ruins and other archaeological remains. Each group generally regarded the landscape attributes associated with the activities in which they participated to be more desirable in a wild land setting than did the other sample groups. This suggests that there is potential for conflicting views on the same landscape resource and that multiple use management of wild land areas will be vital to reduce the possibility of land use disputes.

7.4 Summary Of The Factors Influencing General Perceptions Of Wild Land

There appear to be several factors that are important in shaping people's perceptions of wild land. Analyses in this study support the second hypothesis of this study that different groups of people, grouped according to their activities, experiences, attitudes and behaviour, will have different perceptions of wild land. The principal influential factors are place of residence, the degree and type of contact with rural landscapes and familiarity with a particular area. These three factors are heavily interconnected, for example, place of residence will affect mode of interaction with rural landscapes. Those who live in rural areas tend to have an economic connection to the surrounding landscape whether that be from an indoor or outdoor perspective and that is reflected in their perceptions of wild land, while those living in urban areas generally use rural settings for recreational activities. However, this is changing with more urban workers commuting from rural areas. In addition, the type of contact with rural landscapes influences the degree of familiarity, for example, the mountaineering group is familiar with a large range of upland areas, while the rural inhabitants are very familiar with a particular setting, but unfamiliar with many other parts of the country.

Differences in the landscape perceptions of urban and rural inhabitants have been linked to childhood place of residence (Penning-Rowsell, 1979). Local rural inhabitants who were born and grew up in the area gave the local landscape lower aesthetic evaluations than people who had moved into the area having grown up in urban areas (Penning-Rowsell, 1979). In the context of the current study, the information required to make this fine distinction within the rural inhabitant group is not available. However, in general the rural inhabitant group was less purist in terms of wildness perception than the mountaineers and conservation managers who were predominantly urban based.

In the case of recreational contact with rural landscapes, the degree of wild land purism increased for those people who spent more time in wild land areas. For example backpackers appear to have a more purist perception of wild land than day walkers. The type of economic or professional interaction with rural landscapes also influences definitions and therefore perceptions of wild land. This is reflected in the greater ecological emphasis which the conservation managers appear to place on defining wild land as opposed to a definition concerned more with the absence of human artefacts in the case of the other groups.

7.5 Range Of Wild Land Areas In Scotland

Having looked at the characteristics of perceived wild land for each of the sample groups and for the respondents collectively, these perceptions can now be related to the geographical distribution of wild land within Scotland. Supporting evidence for the third hypothesis of this project, that there is a range of wild land quality within Scotland's upland areas has already been presented in Chapter 4. However, the perception of wild land as a function of distance from urban areas is also important. In general the sample groups are similar in terms of the numbers of respondents who consider a particular area to contain wild land. The Trossachs is at the bottom of the wild land scale, while the Cairngorms is considered to contain wild land by more than 80 % of each sample group (Figure 24). However, there are some differences in opinion between the groups.

The only areas for which the sample groups had similar opinions on whether or not they contained wild land, were the Cairngorms and the Monadhliath. For another two areas, Rannoch Moor and Wester Ross, the only groups that differed in opinion were the mountaineers and rural inhabitants, and the mountaineers and rural outdoor workers respectively. These four areas had all been visited by more than 62 % of each sample group and are perceived to contain wild land by more than 59 % of each sample group. These figures increase to 75 % and 77 % respectively, when the Monadhliath is removed from consideration. Three of these areas, the Cairngorms, Wester Ross and the Monadhliath; contain rugged mountain landscapes, and are not crossed by any roads. This fits in with the sample groups' perceptions of wild land as containing no roads. However, Rannoch Moor is bisected by the busiest road in the west of Scotland and is not rugged, but instead is comprised of many small knolls and lochans. Hence Rannoch Moor could be perceived as wild land in a definition that conforms more to an older definition meaning a barren wasteland. This is similar to results presented by Aitken (1977).

The mountaineering and conservation manager groups differ in the case of only four areas: Ben Nevis, the Trossachs, the Arrochar Alps and the Galloway hills. In each case a higher percentage of the conservation managers than mountaineers considered the area to contain wild land. The first three of these areas are all popular mountain areas receiving large numbers of tourist visitors (CCS, 1991). This suggests that mountaineers are strongly influenced by the presence of others in relation to their own perceptions of wildness. This is supported by the mountaineers' responses to the WPS in which the median rank for solitude was 1 (very desirable), while for all the other groups it was 2 (desirable). In addition, work carried out in the East Grampians found mountain users to enjoy solitude (Mather, 1998). It has also been shown that meeting others in the Scottish hills can decrease the sense of wildness experienced (Rivington, 1994; Mather, 1997) and this appears to affect the perceptions of mountaineers in particular. Aitken (1977) found that mountaineers considered meeting tourists to have a negative influence on their perceptions of the wildness of an area, a similar result was reported by Lucas (1964) for canoeists in the Boundary Waters Canoe Area with respect to motor boaters.

However, the definition of wild land used by the conservation manager group appears to be more ecological than perceptual, and this may explain the larger number of respondents in this group who consider a particular area to contain wild land, especially in the more popular mountain areas. In addition, the conservation managers are more familiar with Galloway, with 74 % of them having visited it compared with only 56 % of mountaineers. This higher degree of familiarity may explain why the numbers of conservation managers considering the Galloway hills to contain wild land is greater than for mountaineers. A higher degree of familiarity was found to be associated with the perception of wild land in the comparison of perceptions of visitors and non-visitors for all areas.

The largest differences in wild land perception were between the mountaineering group and the rural inhabitants and outdoor workers. For the Galloway hills, the Arrochar Alps, Lewis, Rum, Rannoch Moor and Knoydart more of the mountaineering group considered these areas to contain wild land. For the Trossachs, Ben Nevis, Glencoe, and the Cuillin, all heavily visited mountain areas, more of the rural inhabitants considered these areas to contain wild land. With mountaineers being sensitive to the presence of others, these areas were not perceived to be as wild as the physical landscapes would suggest. In many of the cases where the mountaineers considered an area to contain more wild land than either of the two rural groups, the higher degree of familiarity with the area by mountaineers may be the main cause for the difference. This was the case for the Galloway hills, the Arrochar Alps, Rannoch Moor, Knoydart and Rum. The only exception is Lewis, which was visited by fewer mountaineers than rural inhabitants and similar numbers of outdoor workers. In this case, despite being less familiar with the island, the mountaineers still considered Lewis to be a wilder place. The absence of any Munros (mountains over 3000ft.) on Lewis probably explains why mountaineers are less familiar with the island and may also explain why its rural landscapes are perceived to be wild, as without visitors they would be a place to find solitude.

There are very few differences between the rural inhabitants and outdoor workers, only the landscape of Glencoe, Rum and Galloway were perceived differently in terms of wild land. In the case of Galloway, there was little difference in the number of respondents who considered the area to contain wild land, although fewer rural inhabitants had visited Galloway and consequently more of them did not know if it contained wild land. This resulted in the statistical difference identified. In the case of Rum, many more rural outdoor workers had visited the island, who were therefore more inclined to give an opinion on the presence of wild land there. Glencoe is the only area in which the rural inhabitant group considered there to be more wild land than any other with a figure of 84 %. All groups were familiar with Glencoe, with over 90 % of respondents having visited the area. This suggests that rural inhabitants perceptions' of wild land are the least affected by the presence of other people, in comparison with the other sample groups, and that rugged mountain scenery is an important component of their perceived wild land.

For the conservation managers and the rural outdoor workers, there were only three areas for which the groups differed in the percentage of respondents considering an area to contain wild land. The same three areas, Lewis, Galloway and the Arrochar Alps plus Rum and Glencoe were regarded differently by the rural inhabitants and the conservation managers. In the case of the rural inhabitants, Glencoe was perceived to contain more wild land than by any other the other groups. With respect to Rum, Lewis, the Arrochar Alps and Galloway, the conservation managers are more familiar with all of these areas than both of the other rural groups and coupled with their more ecologically based definition, results in more of them stating that these areas contain wild land.

In many of the differences in wild land perception identified between the sample groups, greater group familiarity with a particular area appears to increase the number of group members considering that area to contain wild land. In similar work, Hammitt (1979) found a positive link between familiarity and preference, but also found that greater familiarity with natural landscapes did not influence preference for those landscapes. There are two important points to note from these findings: visiting an area once is sufficient to make an assessment of its wildness, and the influence of familiarity is overridden by intrinsic properties of the area, for example landscape attributes and visitor numbers. Therefore, although mountaineers may be very familiar with Glencoe, a very popular destination, they do not perceive it to be a wild place because of the number of visitors and the main road passing through the glen.

The ranked order in which each upland area is placed in terms of perceived wildness are similar. The trends that are apparent in the ranked order show that those areas that most people thought to contain wild land are the largest in terms of roadless area e.g. the Cairngorms and Wester Ross, and are remote from large centres of population e.g. Rum, Knoydart, the Cuillin and the Monadhliath. In contrast, those areas thought to contain wild land by fewest respondents are those that are closer to large population centres and are heavily visited, such as the Trossachs, the Arrochar Alps, Glencoe and Ben Nevis. The scale and ruggedness of the terrain also influences wildness, with those areas such as Lewis and the Galloway hills, which are not as high or as rugged as the other mountainous areas, perceived to be less wild. Aitken (1977) noted that Rannoch Moor appears to be considered a wild land area in the terms of an older definition of wilderness based on images of a desolate wasteland and results from this study support this.

This discussion has concentrated on the views of all the respondents irrespective of familiarity with the area in question. Figure 29 shows that the views of those who did and did not visit an area differ considerably. In general the percentage of any sample group that had visited any of the areas in question, was higher than those who had not visited, the only exceptions being Rum and Lewis for all groups and Knoydart, the Arrochar Alps and Galloway for the two rural groups. The low number of non visitors, which in some cases was zero, made statistical comparisons between those who did, and did not visit, difficult to make in most of the areas studied.

The main difference between visitors and non-visitors is that greater numbers of the latter do not know if an area contains wild land. This is true for all the areas studied and indicates to the importance of first hand experience of the surrounding landscape in determining the wildness of a location. The degree of uncertainty varied between the areas, and was greater for those that receive less media attention, for example, Galloway, Arrochar Alps, Lewis and the Monadhliath. Non-visitors were much more certain about the wildness of the Cairngorms, Glencoe, Knoydart, Ben Nevis and the Cuillin all of which appear more regularly in the media.

The importance of first hand experience of a location by visiting an area, is linked to the idea of its remoteness from centres of population which is created en route. Comparison of Figure 26 and Figure 28 shows that the relationship between the wildness of an area and its distance from Glasgow is much stronger for those who have visited it, than for those who have not. This second point helps to emphasise the importance of personal experience in determining the wildness of a landscape. These findings lend further support to justifying the use of landscape photographs as a surrogate for first hand experience, in determining the wild land quality of an area.

7.5.1 Stability Of Wild Land Perceptions

It is clear that the perception of the wildness of many upland areas of Scotland by mountaineers has remained relatively stable over the last twenty-five years as shown by Figure 30. This is despite an increase in visitor numbers (Figure 82) and reductions in travel times to these areas (Figure 83) both factors that have been shown to have detrimental effects on the perceived wildness of given areas. This supports Palmer (1997) who found that the understanding and scenic perception of the residents of Dennis, Massachusetts, remained relatively stable over a ten year period, despite a degree of land use change over that time.

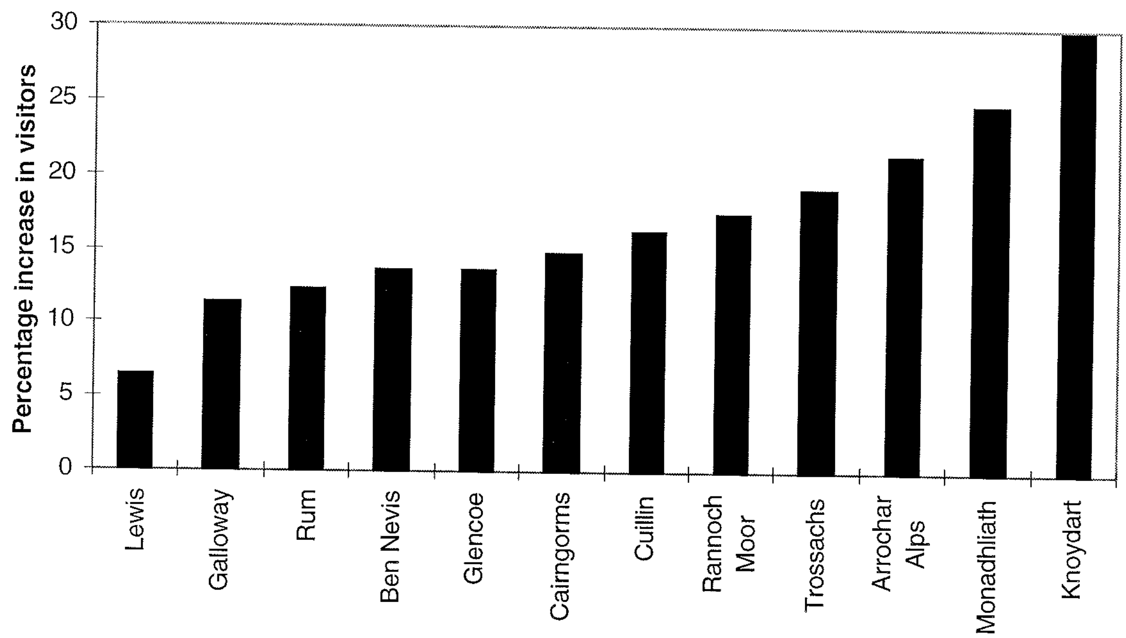


Figure 82 The percentage increase in respondents between 1972 and 1997 who had visited the upland areas of Scotland listed.

With no existing data available for the other three sample groups it is difficult to assess the stability of their perceptions of wild land over time. However, there is no evidence that the perceptions of conservation managers, rural inhabitants and outdoor workers would be any less stable than those of mountaineers.

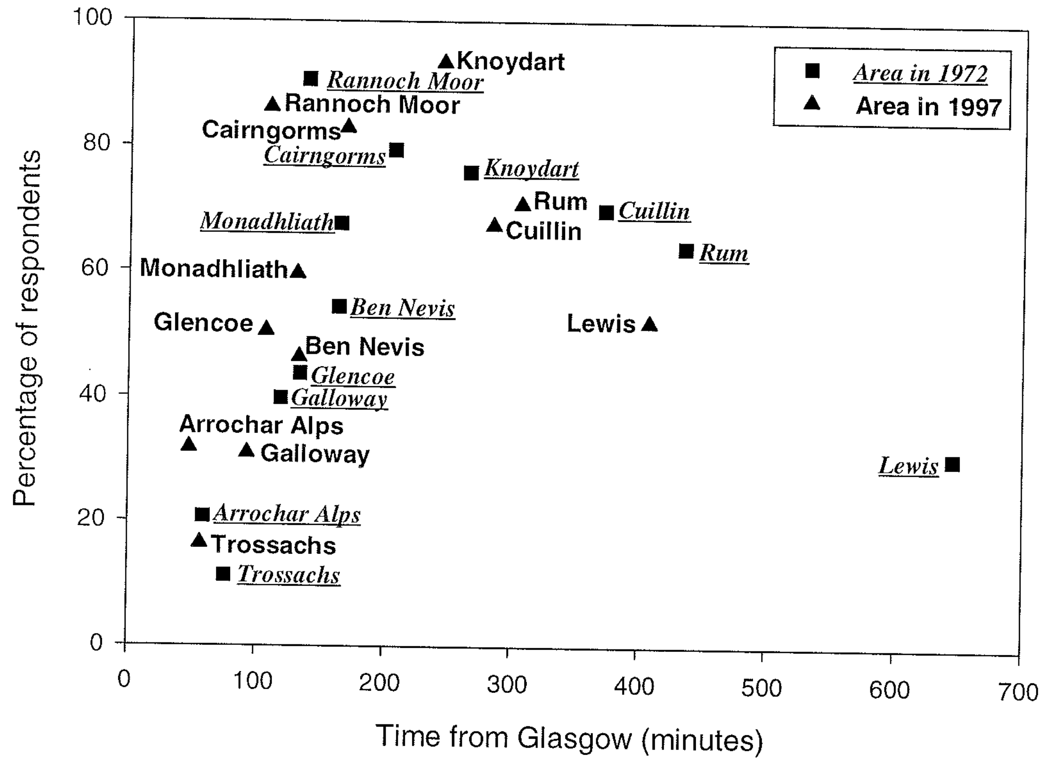


Figure 83 Change in travel time from Glasgow to a Scottish upland area vs. the percentage of respondents considering the area to contain wild land.

In general the equivalent proportion of mountaineers perceiving areas to contain wild land in 1997 and 1972 counters the argument that all the areas studied should be less wild because of the increased numbers of visitors. Previous work has established that the perception of wild land in an area can be negatively influenced by meeting other people while in that area (Hammitt, 1982; Roggenbuck *et al.*, 1993; Mather, 1997). The results detailed above suggest that the threshold, in terms of visitor numbers at which the number of people perceiving the area to contain wild land begins to decrease, has not yet been reached for those areas considered to contain wild land by most mountaineers, e.g. the Cairngorms, Rannoch Moor, Knoydart and the Cuillins. Equally, it appears that the 'wildness' threshold had already been reached for mountaineers in 1972 for the popular mountain areas such as Glencoe, Ben Nevis, the Arrochar Alps and the Trossachs. The previous section highlighted how fewer mountaineers considered these areas to contain wild land than any of the other sample groups in 1997. In addition, there was no relationship between the reduction in travel times to the areas and the predominantly static opinions of the wildness of the areas. It appears that reduced travel times, like an increase in visitors up to a certain threshold, has had no effect on perceived wildness. The reduction in travel times equates to a reduction in the remoteness of these upland areas from the Central Belt. However, remoteness within these upland areas has not changed over the last 25 years as no new roads have been built within their boundaries.

The stability of visitors' and non-visitors' perceptions of wild land were analysed separately as a result of the differences identified in earlier analyses. For those areas that produced useable chi-square statistics for the non-visitors there was no significant change in perceived wildness for the Island of Rum, Galloway or the Monadhliath. Galloway and the Monadhliath are less well known areas and appear in the media less often than do the other upland areas studied which may account for the majority of non-visitors being uncertain about the occurrence of wild land in these two areas. The static opinions of the non-visitors differ markedly from those of visitors to Galloway and the Monadhliath as the number of respondents considering these areas to contain wild land decreased over time. This suggests that changes in the visual attributes of the landscape (e.g. an increase in conifer plantations or the number of bulldozed tracks) might be responsible for this difference of opinion.

For the three areas that showed a change in the number of visitors who perceived them to contain wild land, Lewis, Monadhliath and the Galloway hills, there appears to be no clear relationship between the direction of change and any change in the total number of visitors to those areas. The same can be said for reduction in the travel times to these areas; they appeared to have no effect on perceived wildness. For both visitors and non-visitors there was an increase in the proportion who considered the Isle of Lewis to contain wild land. The Isle of Lewis is relatively inaccessible and remote when compared to the more popular mainland mountain areas and also has an absence of mountains over 3000 ft. high (Munros) which tend to attract more people than mountains below 3000 ft. In addition, Lewis received the smallest increase in visitor numbers. Both points suggest that the remoteness of Lewis defines the perception of the island as a place to experience solitude and therefore wildness.

The main factors influencing peoples perceptions of the wildness of different areas of Scotland are their familiarity with the area, the relative remoteness of the area from large centres of population, its popularity and the degree of human influence in the landscape. In addition, at least for the mountaineering group, the influence of these factors on their perceptions of wild land appear to have remained static over the last 25 years.

7.6 Visual Perception Of Wild Land

Discussion so far has concentrated on understanding the wild land perceptions of the four sample groups through the use of responses to textual stimuli. These have the advantage of being able to separate the various components of a landscape for individual analysis. The photographs used in the questionnaire bring together the various landscape elements, allowing a more holistic view of wild land perceptions to be analysed. This approach also enabled a comparison of the wildness of a scene to the other attributes of beauty and naturalness, in order to analyse any relationship between these concepts.

7.6.1 Wildness, Beauty And Naturalness

The fourth hypothesis of the study was that the concept of wild land is clearly differentiated from the concepts of naturalness and beauty. The results presented in Chapter 4 indicated that this was the case, with the greatest differences between wildness and beauty. Early work on wilderness areas in Scotland suggested that such areas should have high aesthetic and scenic beauty appeal (Murray, 1963; Scottish Countryside Activities Council, 1970, both in Aitken, 1977), something that was later found not to be the case (Aitken, 1977). Scenic beauty was less important for the purist group than for the rest of the sample, which led Aitken (1977) to conclude that wilderness need not be beautiful. This is supported by the current work.

In terms of wildness and naturalness, differences were not as pronounced, perhaps reflecting the importance of naturalness in people's definitions of wild land. This finding gives some justification to the wilderness quality mapping exercise undertaken in Australia, based on four main indicators including biophysical naturalness and aesthetic naturalness (Lesslie *et al.*, 1988). In the Scottish context the importance of naturalness has an important implication in that as people become more educated about the land use history of the country, then the amount and quality of perceived wild land is likely to decrease as the degree of human influence on the landscape becomes apparent.

7.6.2 Visual familiarity

A distinction is made here between familiarity with an area of upland, for example the Cairngorms, and visual familiarity with a particular scene as portrayed in a photograph. The discussion in Section 4.5.2 suggested that being familiar with an area as a result of having visited it, was more likely to lead to an assessment that that area contained wild land. In addition, data analysis relating to visual familiarity with the scenes in particular photographs and their wildness ratings, suggests that there appears to be a weak relationship between the two factors, indicating that familiarity will increase wildness ratings. However, there is also evidence suggesting that the influence of familiarity is not very significant and that other factors such as the presence of certain landscape features are more important. For example, in the case of the Corrie Cas ski area, the dominance of human artefacts are likely to have caused the lower wildness scores from those familiar with the area.

When results from this study are compared to the body of work concerned with the influence of familiarity on landscape preferences, there is some disagreement. Preferences have been found to be higher for scenes with which the respondent is unfamiliar (Purcell, 1992), although the converse has also been reported (Hammitt, 1979). The current study supports the latter viewpoint with higher wildness ratings from those respondents familiar with particular scenes than from those who are unfamiliar.

7.6.3 Photograph Wildness Ratings

The fifth hypothesis of this study was that visual perceptions of wild land are influenced by the presence or absence of certain landscape attributes. The importance of the visual sense becomes apparent from the ranked order of wildness of the photographs. A trend to increased wildness is marked by a decrease in the number of human artefacts and the degree of human influence in terms of land use management, visible in each of the photographs.

Analysis of the photograph wildness ratings indicated that there were very few differences between the four sample groups. The key differences between the groups are in the boundary region of wild land. This is supported by graph (a) (Figure 32) which shows greater differences between respondents in the transition zone between not wild and wild. Another way of visualising this difference between the sample groups is to arrange the lists of photograph ranks for the four sample groups side by side and then to place a mark next to those photographs that display significant group differences. This shows that the main area of difference between the groups is in the lower half of the mean wildness rank list. This suggests that in any upland area there is a wild core that is supported by all groups, surrounded by a peripheral area of variable size dependent upon variations in the perception of wild land. The more purist perception of wild land creates a smaller peripheral area whereas in comparison the non-purist perception produces a much larger area, containing a greater number of human artefacts and influence.

For the majority of the photographs there were no significant differences in the wildness scores of the four sample groups. In those cases where sample groups did differ in their views regarding the wildness of particular photographs, the results reflected the wild land perceptions of the individual groups. Hence, the rural outdoor workers with a knowledge of land management, regarded such features as conifer plantations, heather moorland and areas of rough grazing as decreasing the wildness of a location in comparison with the rural inhabitant group. For the conservation managers native woodland appeared to be a highly important factor in contributing to the overall wildness rating of a scene. This view re-emphasises the ecologically based definition of wild land held by this group. The ratings of the rural inhabitants suggest that they are less concerned about the presence of human artefacts, including those found in ski areas, giving photograph 13 for example, a higher wildness rating than any of the other groups. The wildness ratings of the mountaineering group appear to be negatively influenced by footpaths, skiing artefacts and to some extent heather moorland, although bothies do not detract from the wildness of a given area.

The variation in the wildness scores of each photograph was defined using a series of tests based on each independent variable. The result of these tests showed that the sample group to which a respondent belonged was the best predictor of their wildness scores. However, even the sample group could only explain the variance of 18 out of the 48 photographs. This finding highlights the complex manner in which the independent variables combine to shape a person's perception of wild land.

7.7 GIS Wildness Model Results

Chapter 6 presented the results of the general and site specific GIS wildness models for areas of the Cairngorms and Wester Ross. The uncertainty associated with these results was presented to indicate the confidence that can be placed in the wildness maps. At this point it is worth discussing the patterns of wildness shown in each of the maps presented in order to gain a better understanding of the strengths and weaknesses of the models.

Figure 75 shows the predicted wildness values for an area of the Cairngorms based on the general model. This map shows that the highest ground is not the wildest, but that the upper sections of the glens are rated as the wildest. The general model includes variables of slope, particularly steep slopes in the middle and background area of view which have a positive influence on wildness. The upper sections of glens in the Cairngorms have an enclosed nature because of the high plateau into which they cut. Such an enclosed location restricts the area of view to the immediate environs, which in this area of the Cairngorms are relatively undisturbed with the exception of footpaths, bridges and bothies. The higher the viewpoint, the larger the field of view and the more features that can be seen, including the negatively weighted hill roads, and low angled slopes in the foreground, especially so on the plateau.

Using the Cairngorm model for the same area, Figure 76 shows a slightly different distribution of wildness. In general the high tops are not as wild as might be expected although some areas are less wild and others more wild than predicted by the general model. This model stresses the importance of heather and peatland, which is reflected in the greater numbers of higher wildness values in the lower parts of the area than are seen with the general model. The lower reaches of both Glen Dee and Glen Derry have similar low to intermediate wildness values. Future work could study maps of the residuals between the values produced by the general and site specific models to futher explore the spatial differences between their outputs.

In the Wester Ross study area, there are greater differences in the prediction of wild land between the two models. In the general model, the lower ground in narrow straths has higher wildness values than the mountain tops (Figure 77). These locations are in close proximity to steep slopes which are an important component of the model. The higher locations have greater visibility of easy angled slopes and hill roads in the mid-ground leading to lower wildness values. However, with the Wester Ross model (Figure 78), there is a distinct change in the distribution of the wildest areas with a move to higher elevations. Of importance in this model is the area of heather moorland in the foreground which relates to the wilder locations being on the easier angled slopes. Large areas of peatland / montane mosaic and cliffs in the background of a view also increases the wildness value of a location, especially those in higher elevations.

Some of the predictions of the modelling exercise disagree with the general perceptions of wild land outlined in the earlier sections of this chapter. For example, the general model in particular produces low wildness values for some areas of high elevation. This is in contrast to the wildness ratings of the few photographs included in the questionnaire that were taken on the Cairngorm plateau or up high on the mountains of Wester Ross, and that were generally in and amongst those with the highest ratings of all 48 pictures. A reason for this discrepancy could be that there was an insufficient number of high elevation pictures used in the development of the general model. Appendix 2 shows that there are fewer photographs taken very high up with only seven taken above 700 m. This situation is the result of the photograph selection method used in which the other high elevation photographs were not selected for inclusion in the questionnaire because of a lack of a dominant landscape feature. The possible requirement for more high elevation photographs in order to improve the general model needs to be tested in future studies.

There are also factors that were not measured in the current study owing to the lack of suitable data, which may influence the wildness of a location. Although areas of fresh water are included in the LCS88 data set, the river system was not included at the time of the analysis. However the presence of water, including rivers, has been shown to be an important component of preferred outdoor scenes (Shafer Jr. & Brush, 1977; Steinitz, 1990; Bishop & Hulse, 1994). Hence the presence of an unconfined river as part of a relatively untouched landscape might be expected to influence wildness ratings. Further work needs to be done to improve the models before they are used to aid any decisions on land use management.

If the technique of using wild land perception models is to be employed as a decision support tool then its main value will be at the local level in the development of site specific models which give a detailed understanding of the local influences on the perception of wildness. Implementing the model at the local level requires a knowledge of the best resolution at which the model will work. From the two scales examined in Chapter 6 it is apparent that either the 500 m or 100 m resolution could be used. It would even be possible to apply the model at the 50 m resolution scale should the underlying DEM and other data sets also be at this scale. For both study areas, the use of the site specific models were shown to operate well at the 500 m and 100 m scales, producing comparable wildness isolines. However, the computer processing capability available needs to be taken into account when deciding the scale at which to apply the models as demonstrated in Chapter 6.

The spatial variation in the predicted wildness values of both study areas was tested in Chapter 6 and found to vary according to the nature of the underlying topography. In Wester Ross, with a greater rate of change in topography than in the Cairngorms, there was a greater rate of change in the wildness values indicated by a lower level of spatial dependence. This suggests that in any use of the model as a decision support tool, for example in zoning areas of wild land quality, the pattern of an area of strongly contrasting topography would be more complex than a less topographically diverse area.

Within the constraints of the wildness models, the next chapter considers their potential use in aiding the definition of wild land areas in order to protect their character for the enjoyment of present and future generations.

Chapter 8

Conclusion And Wider Implications

This study provides one means of identifying the wild land resource in Scotland. Through the combination of a complementary set of techniques not previously used together, and their application to a more detailed understanding of the concept of wild land, a more objective approach to defining wild land areas has been realised.

The work presented in this thesis has tested each of the hypotheses highlighted in Chapter 2. To conclude:

1. The concept of wild land is applicable to Scotland and assessments of wildness rely heavily on the visual sense.
2. People who are urban based and have a mainly recreational contact with rural areas of Scotland are more purist (less tolerant of human artefacts and impacts) in their perceptions of wild land than those who live and work in rural areas.
3. Within Scotland's upland areas there is a range of perceived wildness. The perceived wildness of an area increases with the size of the roadless area, the ruggedness of the landscape, the distance of the area from the Central Belt and, for mountaineers, as the popularity of the area decreases.
4. The concept of wildness is distinct from that of beauty. However the concepts of naturalness and wildness are more closely related.
5. Perceptions of wild land are heavily influenced, firstly, by the presence of human artefacts, and secondly as the result of certain types of land use management.
6. Certain landscape attributes surrounding a particular location can be used to assess the wildness of that location. When developed in the form of a GIS based wild land prediction model, maps of wild land quality can be produced at the local scale.

In general it can be concluded that there is agreement between all the sample groups as to the character of a core wild land area. It is a place that is out of sight and sound of towns, cities and roads, in which there is regeneration of native woodland, in which ruins and archaeological features are accepted, but free from modern human impact and where solitude can be found. Where the disagreement lies and where further development of the model can be of use, is in determining the location and nature of the wild land boundary which does differ between the sample groups. From the evidence presented, the more purist attitude of the mountaineers and conservation managers suggests that for the same upland area, the total area of wild land will be less for these two groups than for the rural inhabitants and rural outdoor workers. This finding suggests that there is a continuum of wild land in Scotland which varies depending on who is asked to define it, a view echoed in the work of Nash (1982) for the USA.

This study has produced evidence to support the view of Smout (1993) that there are two main strands of thought regarding the Scottish landscape. The first of these is labelled 'traditional' and sees the land from a utilitarian viewpoint as a source of livelihood (Smout, 1993). In the current study this group is characterised by the views of the rural inhabitants and the rural outdoor workers. The second is that of the post-Romantic who views the landscape from anything from a utilitarian to an intrinsic standpoint (Smout, 1993). The mountaineers and the conservation management groups represent the post-Romantic standpoint in the current study. However, there are some signs to suggest that these two standpoints are converging towards the idea of 'sustainable conservation'. Smout (1993) suggests that those holding the traditional standpoint do not view their surroundings as wild and yet there is evidence to suggest the contrary with both the rural inhabitants and the outdoor workers supporting the use of the concept in Scotland. All four sample groups indicated a desire to see the regeneration of native woodland which could be interpreted as the need for a resource base on which a sustainable economy can be built while at the same time providing conservation benefits. Understanding of the concept of wild land in Scotland has developed from Aitken's (1977) work to that presented here. As for the protection of wild land values, Scotland is no nearer agreeing a solution to this issue than it was in 1977, with the possible exception of a new National Park system, but the benefits that will bring remain to be seen.

Nevertheless, deciding whether or not areas identified as wild land should be set aside for protection cannot be achieved through the use of objective measures of wild land quality from a GIS predictive model. These types of decisions are made by the contemporary community, and are judgmental, involving the appraisal of the value of other land use options (Lesslie, 1991). To aid decisions in future, the potential land use applications of the wildness models are presented and their implications for landscape management highlighted. The role of the wildness models in future debate on the concept of wild land in Scotland is discussed and recommendations made to improve the scope and validity of the models in future work.

8.1 Management Applications And Implications

This study has shown that perceptions of wild land are influenced by place of residence, mode of contact with rural landscapes, previous experience of the area, weather conditions, visible landscape attributes, absence of human artefacts and impacts, and the popularity of the area. Many areas of Scotland are regarded as containing wild land, the size and quality of which will vary depending on who is asked to define them. A similar situation was found in New Zealand where many areas are accepted as wilderness, depending on the imagery and attitudes of the visitor (Kearsley, 1990). In terms of appropriate management of National Parks in New Zealand, visitors to Fiordland indicated that preservation, education and recreation were major goals of the park, whereas tourist and recreational development were not (Kearsley, 1990). A similar approach could be taken in Scotland with regard to the management of wild land areas and this would appear to be supported by the perceptions of many of the respondents in the current study.

The implications of these findings for the management of wild land areas are manifold. The findings suggest that by identifying public opinion and by using an education programme for visitors utilising the range of currently available management tools, it would be possible to evaluate and even direct people's perceptions of wild land. This approach would allow an exchange of information between land managers and the public with regard to the objectives of the former and the perceptions of the latter.

The primary need identified in this study was for an objective method of defining the wild land resource in Scotland. The main use of the GIS models developed in this work would be to aid the identification of wild land areas using a system of public participation, based upon the presence of specific attributes in the surrounding landscape of interest. It is a localised assessment of wild land quality, and therefore not suitable or practical for use at the national level.

8.1.1 Information And Education

The provision of information for public consumption is a passive way of influencing behaviour whereas education is a more active approach, although both are seen as a workable alternative to regulation and control and are welcomed by managers and users alike (Stankey & Schreyer, 1987). There are no right or wrong perceptions of wild land, they just exist, held by each person. However, perceptions develop from a range of inputs and it is the quality of this information that is important in any attempt to change perceptions and subsequent behaviour. In some cases wild land perceptions might be based on a romantic tradition that does not appear to be based on an understanding of the social and land use history of the Highlands and Islands of Scotland. Informing people of the land use history of much of the Highlands and Islands would perhaps change some people's perceptions of the wildness of some areas and could encourage an increase in the numbers supporting the restoration of certain components of a dynamic landscape. For example, the regeneration of native woodland was considered a highly desirable component of a wild land area by all sample groups. With better informed visitors holding perceptions based more on a pragmatic approach to land management, similar to that of the local people, fewer conflicts of interest are likely to arise and a partnership approach to problem solving could be encouraged. This approach will position wild land protection within a sustainable conservation framework (Budiansky, 1995; Guha, 1989).

Evidence is now available that shows that the recreational impact on the upland resource is less than that caused by deer and sheep grazing (Thompson *et al.*, 1987). By educating visitors in ways to reduce their own impact on the upland resource, visitor pressure could increase to encourage a change in other management practices, resulting in a reduction in their impact on the upland resource, including areas of wild land. Evidence from the USA shows that education of wilderness users, geared to reducing their impacts in wilderness areas, has made them even more sensitive to the surrounding conditions and has changed their perceptions of what is an 'acceptable' impact. This has led to more demanding standards, for example the presence of any litter is now deemed unacceptable (Stankey & Lucas, 1984). The authors have suggested that more research on understanding the variations in perceptions, the influences on it, and ways of altering the perceptions to make them fall into line with established management objectives is required. The current work has gone some way to increasing understanding of the first two of these factors, although more work is still required on the third item.

There are many examples of how a policy of educating visitors can serve to reduce the environmental impact of recreational use. Briefings to scuba divers were shown to reduce the amount of coral damage in Egypt (Medio *et al.*, 1997). In the USA the knowledge of minimum impact camping techniques increased between 1970 and

1982 in the Bob Marshall Wilderness complex as a result of a 'pack-it-in, pack-it-out' policy, with the effect of reducing impacts on the wilderness resource (Lucas, 1986).

Providing information is part of an indirect management approach which, as shown above, has worked well in the USA in reducing the impacts of recreational use. One problem which is likely to be encountered in Scotland, and which was identified in a Norwegian study, is how the information is given to the intended audience. In the USA hikers have to register at the start of a trail before going into the backcountry and this serves as a useful point of contact between users and management. This is not the case in either Norway or Scotland. Scotland has the added problem in many areas of linear access to hill land, which means that there are often no focused points of contact. However, this could be changed with the provision of better car parks and restricting parking to these areas. With known points of possible contact, information could be made available on notice boards, or in leaflets left on car windscreens. Clubs and mountain guides could also provide another route for the distribution of such information. There is evidence to suggest that mountain users would be responsive to the provision of such information, especially if it were combined with details of paths, routes and car parking facilities in the area. This was specifically requested by 30 % of walkers surveyed in Ross and Cromarty (Hunt & Wilkinson, 1995).

8.1.2 Use Of Stakeholder Opinion

In an established protected area system, one of the ways of monitoring the resource is contact with users, which is a successful technique for identifying new management concerns and identifying the type of information required by users (Schomaker & Lime, 1986). This study has shown how the opinions of those with direct contact with rural landscapes are important in the definition of wild land areas. However, user decisions are not the only basis for management decisions. The views of non-users should also be considered (Rollins & Rouse, 1992). Therefore other stakeholder groups should be contacted in future work dealing with defining the wild land resource. Wild land remains largely a function of human perception and people are therefore an important source of information. However, their attitudes and needs must match the opportunities available in areas of wild land. This assumes an equitable distribution of other types of recreational opportunities to meet the needs and desires of the recreationist not interested in wild land. It is not appropriate to try and manage wilderness for all (Stankey, 1972).

GIS has been used as an effective tool in the management of wilderness areas in the USA in support of the Limits of Acceptable Change (LAC) approach (Mercer, 1986). Using the LAC approach as a method of controlling development in Scotland has been suggested as a good way of incorporating public preferences into the decision making process (Sidaway, 1988). The LAC approach can take public participation forward from the definition stage of the current work to use in the management of wild land in the future.

8.1.3 Management Tools

Much literature is available on the management of recreation in wild land areas from the USA (e.g. Chilman *et al.*, 1990), including debate on treating the symptoms of recreation impacts rather than attempting to change behaviour (Cole, 1993). The state of wilderness management in the US has been reviewed with recommendations made for more input from interest groups, improved monitoring and research programmes, and a move to a more aggressive style of management (Cole, 1990). Previous studies from the USA have focused on many aspects of wilderness management for example, managing the satisfaction of campers (Connelly *et al.*, 1986). The management tools available to tackle these subjects include LAC (Watson & Cole, 1992; Roggenbuck *et al.*, 1993) which has been improved to include visitor opinion as to which wilderness indicators have the largest impact on their experience (Hollenhorst & Gardner, 1994). Another tool is the Recreation Opportunity Spectrum (ROS) which has also been applied outside the USA, to Svalbard, part of Norway (Kaltenborn & Emmelin, 1993). These management tools could all be tailored for future use in the wild land areas of Scotland, drawing on the existing knowledge base in the USA with respect to these techniques.

8.2 The Future Of Wild Land In Scotland

The current situation, as has been shown, reflects a country in which many areas are perceived to be wild but where primary wilderness has been completely replaced with human modified environments. That such areas are valued is also apparent from the amount of money people spend on travelling to and enjoying these areas. Evidence shows that scenery is the primary reason for coming to Scotland for approximately 70 % of visitors, and this is worth £2 billion a year to the tourist industry (Bryden, D., Highlands and Islands Enterprise, pers. comm., 1998). Although scenery is not the same as wild land, many scenic areas will also be perceived as wild. There already exist some designations to protect the scenic quality of an area e.g. NSAs, AONBs, but none to safeguard its wildness. It is conceivable that the location of such areas will be partly covered by existing designations, although their wildness value will not be specifically protected. Perhaps wild land could become the latest in a long history of designated areas.

8.2.1 Designated Wild Land Areas?

To date, any designated area, whether designation is to protect a particular landscape, habitat or species, has been defined in terms of tangible attributes, such as a series of specific land uses (ESA), the presence of an ecological community (NNR) or a particular habitat, endangered species or geological feature (SSSI). What the current study has shown is that it is also possible to define an area based upon its intangible attributes, in this case its wildness, and this study has provided a methodology for implementing such a process. The perceptual wild land models developed provide the opportunity for public input, unlike the more conventional wilderness mapping undertaken in Australia (Lesslie, 1991). With the significant finding that mountaineers' perceptions of the wildness of much of Scotland have remained static over the past 25 years, there is evidence to support a designation, of wild land for example, based a comprehensive survey of the views of the general population, and the different constituent groups. In any move to designate wild land areas, it is imperative that the purpose(s) underlying that decision are clearly stated, whether they be for ecological, recreational or other reasons (Stankey, 1983). Given the current number of landscape designations, it is unlikely that *de jure* wild land will be an option. What is more likely is *de facto* wild land, and in this respect the proposals for National Parks in Scotland provide the ideal opportunity to outline areas to be managed specifically to protect their wild land character. However, with National Parks not likely to be created in more than one or two areas, it would perhaps be more prudent to build wild land protection policies into the remit of existing landscape designations (Aitken *et al.*, 1995).

This study has shown that there is a range of perceptions of wild land in Scotland, which in turn govern what activities and attributes are, and are not, acceptable within wild land areas. Similar evidence for a wide range of visitor opinions of acceptable conditions within wilderness areas in the USA led Roggenbuck *et al.* (1993) to suggest a management approach using zones tailored to certain groups of users. In this case, the preferences of different user groups were used as a basis for defining the Backcountry Opportunity Spectrum. The preferences of the purist group i.e. those wanting the least human artefacts, could be used to define the characteristics of wild land areas (Rollins & Rouse, 1992). However, the Backcountry Opportunity Spectrum only takes into account recreational interests, rather than any other interests which may have an equally legitimate say in the use of the wild land resource. Implementing a system along similar lines in Scotland would also require the interests of the local inhabitants of the area to be taken into account, because of their different perceptions of wild land.

8.2.1.1 The Form And Function Of A Wild Land Area

Suggestions for a framework to protect wild land in Scotland have been made by several authors (Aitken 1977; CCS, 1991; Aitken *et al.* 1995; Taylor, 1995). The general model proposed for wild land areas would consist of a central core area with restricted access and no facilities, surrounded by a wilderness experience zone which is not as ecologically sensitive, a buffer zone of multiple use forest and finally an agricultural buffer zone containing agro-forestry and permaculture systems (Taylor, 1995). The core wild land area of this model is based on wilderness areas in the US which have low use intensity and little evidence of human impact, including litter and campsite deterioration (Stankey, 1972). The zoning approach has also been used in Arctic Norway with the implementation of 5 zones ranging from primitive to intensive-use areas (Kaltenborn & Emmelin, 1993). This system has allowed potentially conflicting activities to co-exist, and has been achieved by restricting snow mobile travel to specific parts of Svalbard, while directing the quiet enjoyment of the area by day walks or backpacking trips to other parts of the island.

Some elements of Taylor's (1995) proposal for a conservation framework would appear to be more controversial than others. Limiting access is one of the more controversial and one that is not likely to work in Scotland for two reasons, firstly, access to wild land areas is generally linear, from a road with an infinite number of possible access points. This is unlike the USA where access is generally from the road end acting more like a single access point. Policing a restriction on access in Scotland would be impractical. Secondly, there is a tradition of free access to the hills of Scotland

- as in Norway, restricting use would go against this tradition and is likely to face considerable opposition from hill walking / mountaineering / rambling / cross country skiing interests. The strength of feeling relating to this issue was highlighted in the East Grampians and Lochnagar Visitor Survey in which up to 60 % of mountain users agreed that 'as a point of principle nothing should be done to influence the numbers visiting these hills' (Mather, 1998). Norway has both protected areas of designated wild land and a common access law allowing free access. This is associated with an attached set of responsibilities including the 'no harm and no disturbance principle' (Hammitt *et al.*, 1992). However, when over-use becomes apparent some form of wild land recreation regulation and management is allowed for within designated areas (Hammitt *et al.*, 1992). At present it appears that mountain users in Scotland are not too concerned about the numbers of people visiting the hills, although a small percentage consider there to be 'too many people' (Mather, 1998). This suggests that the situation requires continued monitoring should a use threshold be reached and require management action.

Despite mountain users not being concerned with the present numbers of people encountered in the Scottish hills, the intrinsic nature of a wild land area can be altered as a result of the impact on wildlife populations from recreational pressure. As an example, hikers, joggers and mountain bikers were shown to have a detrimental effect on the habitat use of chamois in Switzerland (Gander & Ingold, 1997). These findings suggest that the use of a buffer zone and limits on use would be beneficial for some wildlife populations. Voluntary agreements are already in place in many areas of the UK to restrict the access of climbers to some cliffs during the nesting season (Sidaway, 1994). The system could be expanded if accompanied with an education programme to inform users of the reasons behind the restrictions.

Within the USA support for regulating use differs between recreational groups (Shindler & Shelby, 1993). Hunters, horse riders and scouts gave less support to management policies than hikers, Sierra Club members, and managers, who appeared more preservation-oriented (Shindler & Shelby, 1993). The presence of such differences in Scotland is difficult to assess and more research is required. However, previous cases have shown that, access restrictions have been vigorously opposed by the mountain user fraternity (McOwan, 1997). Other methods of wild land management are in use in Australia which has a National Code of Management for Wilderness Areas and which has helped to establish appropriate management practices for wilderness protection (Fuller *et al.*, 1990).

Experience from the USA has shown the need for buffer zones to maintain the wilderness character of an area immediately within the wilderness boundary (Kelson, 1998). In Norway several strategies are used for managing land adjacent to wild land areas (Teigland, 1990). The most successful of these has been to moderate unwanted activities through a process of 'horse trading' the most and least important land. This has been used in the development of new hydroelectric power (HEP) schemes, exploiting rivers of lower environmental quality in order to protect wild rivers (Teigland, 1990). This is another possible approach that could be applied in Scotland with respect to new tourism, agricultural, fishing or forestry developments.

Lastly, work in the USA has shown how designating a wilderness area can affect hiker attitudes (Fedler & Kuss, 1986). In general, hikers thought that physical impacts on the environment would increase while social impacts would decrease in a designated wilderness area (Fedler & Kuss, 1986). The implementation of a zoning system which provided information about the terrain and path network has been shown to help distribute and disperse use in the USA (Williams & Huffman, 1986). A similar system in Scotland could help achieve the same objectives. Zoning use in areas of Scotland however would need to be accompanied by a programme of education that clearly stated the objectives and underlying reasons for the policy.

8.2.2 Ecological Restoration

An image of wild land in Scotland in the future has been presented by several authors (Dennis, 1995; Tubbs, 1996). In general it is one in which much of the native fauna, which was exterminated in the last several centuries, including wild boar, beavers, brown bears, moose, lynx and wolves, are returned as part of a functioning ecological system (Dennis, 1995). One impetus for this image comes from the European Union 1992 Species and Habitat Directive which requires member states to consider the possibility of restoring extinct native species, including those above, to areas of their once natural range (Howells & Edward-Jones, 1997). The expansion of native woodland coverage is also seen as a prerequisite component of future wild land in Scotland (Dennis, 1995). There are signs that this is beginning to happen with the growth of high-altitude *Pinus sylvestris* in the Cairngorms (French *et al.*, 1997), and the possible reintroduction of the beaver, *Castor fiber* to parts of Scotland after a public consultation process (Halley, 1998). Studies have also been conducted on reintroducing wild boar, *Sus scrofa* to Scotland, but have concluded that sufficient suitable habitat is not available to maintain a minimum viable population (Howells & Edward-Jones, 1997). There have also been discussions of the reintroduction of the wolf (Spinney, 1995). However, the realisation of these proposals is dependent on contemporary policy makers and politicians. These changes would increase the wildness of many areas of Scotland. Wildlife, particularly native flora and fauna, is an important component of the wild land experience. This is reflected in results from the current and previous studies (Connelly *et al.*, 1986).

In the USA, there was a lack of support for actions taken to restore the natural conditions of a wilderness area (e.g. stop stocking fish) when it interfered with a preferred activity (e.g. fishing). There was also an increased desire for better trails / bridges (Cole *et al.*, 1995). These changes were interpreted as signals of a reduction in self reliance in users and of the preservation of natural conditions, as the primary aim of the policies of many managers (Cole *et al.*, 1995). It could be argued that a similar situation could develop in Scotland with the increasing number of projects to regenerate native woodland cover over much of the country. The effect of this on the experiences of hill walkers by impinging on potential views could in turn reduce their support for such projects. Evidence to support this suggestion was provided in a survey of the general public, visitors, birdwatchers and ramblers in the Borders of Scotland, in which respondents were asked to consider three alternative landscape scenarios based on different ESA policy options (Bullock, 1996). One of these options was of greatly increased agricultural extensification leading to considerable regeneration of heather, trees and scrub on hillsides. Although all groups preferred this option over the alternatives of less or no extensification, the majority of ramblers expressed a desire for only 'some more' of such landscapes as opposed to the other groups who all preferred to have 'many more' of such landscapes (Bullock, 1996).

8.3 Recommendations For Future Research

A fundamental question that needs addressing in the Scottish context is to study the range of values attached to wild land. Table 1 on page 11 summarised the values underlying the preservation of wilderness areas in the USA. A similar summary of knowledge would be required prior to any discussion on the designation of wild land areas in Scotland as it is the values of contemporary society that should underlie any decision to protect wild land quality.

A disadvantage of the questionnaire approach is the limited amount of information that can be presented to the respondent, and the fact that the type of information is restricted to what can be printed on a page. An improvement to a paper based questionnaire, would be the use of a computer based Internet survey making use of sounds as well as pictures. This approach has already been tested in a landscape preference survey and found to be a reliable way of obtaining responses (Wherrett, 1998). A further advantage of this approach would be the opportunity to use 360 degree panorama photographs, which could be rotated giving a better impression of the surrounding landscape. Along with the photographs sounds could be played to increase the realism of the surrogate landscape as this has been shown to be an important component of wildness perception (Anderson *et al.,* 1983). A computer based questionnaire would also allow the photographs to be displayed in a larger format than was possible with the paper based questionnaire. This problem was highlighted in the current study by several respondents.

A computer based approach would also have the potential to reach a larger audience and increase the study sample size, and this would increase the robustness of the statistical analysis. However, it is difficult to obtain a representative sample using the Internet when a specific audience profile is required (Bishop, 1997). Saying that, the Internet does provide a convenient medium for conducting perception experiments when a broad sample will suffice (Bishop, 1997).

The wildness models developed in this study are based on the assumption that perceived wild land is defined from a visual perspective. Although this approach was justified by over 80 % of the respondents from each of the sample groups, there remains the question of how visually impaired people might perceive wild land. Future work could tackle this aspect of defining wild land with the aid of alternative landscape surrogates making greater use of sound as demonstrated by Anderson *et al.* (1983).

The greater sensitivity of the WPS in comparison to the photograph wildness ratings showed the differences between the perceptions of individuals and groups, indicating that there is scope to improve the photograph wildness measure. Possibilities include increasing the size of the wildness scale, to 7 or 9 points, or alternatively utilising the Q-sort method to obtain interval measurements (Pitt & Zube, 1979). The wildness models generated by this work would benefit from further development and improvement with the inclusion of more detailed geographical data on human artefacts (buildings, pylons) and the river network to try and increase the predictive capability of the models. In addition, increasing the number of photographs used to develop the site specific models would help to improve their accuracy and precision. The area over which the model is applied could also be increased with developments in increased computing power with which to carry out the analysis.

At present, the notion of remoteness is not explicitly present in the wildness models. It is only implied in the application of the models to a specific area if the analysis of the surrounding landscape reveals the absence of human artefacts such as hill roads. However future work could focus on integrating a measure of remoteness into the model. The notion of remoteness, both from roads and from centres of population, has been shown to influence the perceptions of all four sample groups and of the mountaineering group in particular.

A possible route to achieving this goal would be a collaborative research programme combing the wildness perception model with the wild land continuum model based on remoteness and naturalness criteria developed by Fritz & Carver (1998). This approach would also be able to take into account the influence of topographic roughness, which affects the travel time to a location and the notion of remoteness and therefore wildness. The wilderness continuum work has utilised a Multiple Criteria Evaluation (MCE) approach in conjunction with GIS to map wild land quality (Carver, 1996; Fritz & Carver, 1998). One of the advantages of this approach is that it allows individuals to specify the relative importance of the range of factors influencing their perceptions of wild land (Carver, 1996). At present the wilderness continuum work takes into account remoteness from settlement, remoteness from mechanised access, apparent naturalness and biophysical naturalness. The surrounding landscape attributes could be added to these four criteria. The relative importance of those attributes could then be assessed using the wildness models developed in this study as the coefficients produced by the multiple linear regression analysis provide a source of weightings that can be applied to the measures of the surrounding landscape attributes. These localised wildness ratings in conjunction with the MCE values developed from the regional datasets would provide a more robust assessment of the wild land value of that location. Another possibility is the use of an automated multiple linear regression procedure based on the respondents individual wildness ratings for a sample of photographs taken in the area. This could be used to develop a wildness model specific to that person, which would then be incorporated in the GIS/MCE wilderness continuum model. This method would produce a wildness map specific to that person. Comparison of many individual wildness maps could lead to the development of consensus wild land areas.

The range of wild land perceptions identified between the four sample groups in the current study are similar to findings from studies conducted in the USA, both western cultures. Studies have shown some differences in the perceptions of Australian and American wilderness users (Stankey, 1986). Further work on how wild land perceptions differ between Scots and other Europeans or people from Asia or Africa would also be of value. Such work would help to identify those aspects of wild land perception that are culture specific and those that are of a more universal nature.

Long term research goals should be focused on exploring the influence of landscape change on wild land perception. The relationship between these two factors is uncertain given the relative stability of the wild land perceptions of the mountaineering group, despite a certain degree of landscape change over the intervening 25 years in some of the areas tested. This long term study would be most effective if it could assess the wild land perceptions of the same group of people over, for example a 25 year period, at intervals of say every 5 years. New models could be developed based on a revaluation of the original photographs and the resulting wildness map of a particular area compared to that produced with the models presented in this study. This approach would provide one way of measuring change in perception over time in relation to changes in landscapes. Such work would also provide valuable information on any changes in the wild land perceptions of the individual, something which has yet to be considered.

Finally, if some of the questions above can be answered and a more robust model of wild land can be created, there would be scope for using the new model as a decision support tool for planners in reducing the impact of new developments on the Scottish wild land resource.

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Appendices

Appendix 1

Covering Letters, Questionnaire And Frequency Data

As the covering letter differed slightly between the four sample groups, an example of the letter which was sent to each of the four sample groups is shown on the following pages. After the letters there is a copy of the 12 sided questionnaire. Due to thesis formatting regulations regarding margin size, the questionnaire has been presented in a smaller typeface than was actually sent to respondents, in order to maintain the original layout. The raw frequency data is presented for each question throughout the questionnaire.

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MRS SMITH,
CLUB SECRETARY,
NO NAME MOUNTAINEERING CLUB,
2 MARKET SQUARE,
TOWN,
COUNTY POSTCODE.

31/1/97

Dear MRS SMITH,

I am interested in your views on the subject of 'wild land' in Scotland. Your help would be greatly appreciated. It will only take about 30 minutes of your time.

This survey is designed to find out whether or not people think there is wild land in Scotland. The results from this survey will be used to quantify how 'wild' the Scottish countryside is. This research is part of a PhD project I am undertaking in the Department of Environmental Science.

The Mountaineering Council of Scotland are helping with the project by allowing me to contact their member clubs. The information you provide me with is very important and will be treated as strictly confidential. Your reply will be analysed along with other responses and none of your views will be tied to your name.

Please find enclosed two copies of the questionnaire. I would be most grateful if you could fill one in and give the second one to another member of your club. Alternatively, please distribute them both to other members. All you need to do is read through the questions and put a tick in the box that best corresponds with your answer. Please remember there are no 'correct' answers; it is YOUR opinion that interests me. When you have finished, please send the questionnaire back to me using the FREEPOST address printed at the end of the questionnaire (no stamp required) and the envelope provided. It would be very helpful if you could do this by the 17th March 1997.

If you wish to fill in the section requesting your name and address, then your name will be entered into a draw for which the prize will be a £25 book token.

I look forward to hearing from you in the near future.

Yours sincerely,

Dominic Habron

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MR MACDONALD,
ESTATE MANAGER,
COTTAGE,
TOWN,
POSTCODE

31/1/97

Direct Line: (01786)466544
Email: adh2@stirling.ac.uk

Dear MR MACDONALD,

I am interested in your views on the subject of 'wild land' in Scotland. Your help would be greatly appreciated. It will only take about 30 minutes of your time.

This survey is designed to find out whether or not people think there is wild land in Scotland. The results from this survey will be used to quantify how 'wild' the Scottish countryside is. This research is part of a PhD project I am undertaking in the Department of Environmental Science.

Your contact details were obtained from 'Heading to the Scottish Hills' published in conjunction with the Scottish Landowners' Federation. The information you provide me with is very important and will be treated as strictly confidential. Your reply will be analysed along with other responses and none of your views will be tied to your name.

All you need to do is read through the questions and put a tick in the box that best corresponds with your answer. Please remember there are no 'correct' answers; it is YOUR opinion that interests me. When you have finished, please send the questionnaire back to me using the FREEPOST address printed at the end of the questionnaire (no stamp required) and the envelope provided. It would be very helpful if you could do this by the 17th March 1997.

If you wish to fill in the section requesting your name and address, then your name will be entered into a draw for which the prize will be a £25 book token.

I look forward to hearing from you in the near future.

Yours sincerely,

Dominic Habron

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MR JONES,
COTTAGE VIEW,
VILLAGE,
NEAR TOWN POSTCODE.

31/1/97

Direct Line: (01786)466544
Email: adh2@stirling.ac.uk

Dear MR. JONES,

I am interested in your views on the subject of 'wild land' in Scotland. Your help would be greatly appreciated. It will only take about 30 minutes of your time.

This survey is designed to find out whether or not people think there is wild land in Scotland. The results from this survey will be used to quantify how 'wild' the Scottish countryside is. This research is part of a PhD project I am undertaking in the Department of Environmental Science.

Your contact details were obtained from a random sample of names taken from the electoral register. The information you provide me with is very important and will be treated as strictly confidential. Your reply will be analysed along with other responses and none of your views will be tied to your name.

All you need to do is read through the questions and put a tick in the box that best corresponds with your answer. Please remember there are no 'correct' answers; it is YOUR opinion that interests me. When you have finished, please send the questionnaire back to me using the FREEPOST address printed at the end of the questionnaire (no stamp required) and the envelope provided. It would be very helpful if you could do this by the 17th March 1997.

If you wish to fill in the section requesting your name and address, then your name will be entered into a draw for which the prize will be a £25 book token.

I look forward to hearing from you in the near future.

Yours sincerely,

Dominic Habron

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MR JOHNSON,
CONSERVATION GROUP,
TOWN,
COUNTY,
POSTCODE.

31/1/97

Dear MR JOHNSON,

I am interested in your views on the subject of 'wild land' in Scotland. Your help would be greatly appreciated. It will only take about 30 minutes of your time.

This survey is designed to find out whether or not people think there is wild land in Scotland. The results from this survey will be used to quantify how 'wild' the Scottish countryside is. This research is part of a PhD project I am undertaking in the Department of Environmental Science.

Scottish Wildlife and Countryside Link are helping with the project by allowing me to contact their member organisations. The information you provide me with is very important and will be treated as strictly confidential. Your reply will be analysed along with other responses and none of your views will be tied to your name.

Please find enclosed three copies of the questionnaire. I would be most grateful if you could fill one in and ask two of your colleagues to complete the others. Alternatively, please distribute all three to your colleagues. All you need to do is read through the questions and put a tick in the box that best corresponds with your answer. Please remember there are no 'correct' answers; it is YOUR opinion that interests me. When you have finished, please send the questionnaire back to me using the FREEPOST address printed at the end of the questionnaire (no stamp required) and the envelope provided. It would be very helpful if you could do this by the 17th March 1997.

If you wish to fill in the section requesting your name and address, then your name will be entered into a draw for which the prize will be a £25 book token.

I look forward to hearing from you in the near future.

Yours sincerely,

Dominic Habron

Serial #

'WILD LAND' IN SCOTLAND: A SURVEY

Instructions within the questionnaire are printed in italics. Please:

a) read through all the answers to a question before making your choice;

b) indicate your answer by shading in the oval next to your reply with black or blue pen, or writing in the space provided. Please darken the ovals completely, making your marks as follows:

Like this: ● *Not like this :*

When reading the questions below please limit your answers to reflect your experiences in Scotland.

I would first like to ask you some questions about the activities you are involved with in upland areas.

1. **When in the hills, which one of the following leisure activities do you most prefer at present?** (*Indicate only* **ONE** *answer*).

day walking	202
backpacking	24
rock climbing	5
snow/ice/mixed climbing	35
skiing - Nordic / cross-country	7
- ski-mountaineering	5
fishing	29
hunting/shooting	17
deer stalking	83
nature study (e.g. botany, ornithology)	27
other (*please write on the line below*)	9
none of the above (*Skip to question 3*)	11

2. **For how many years have you been undertaking the activity you indicated in question 1?** (*Indicate only* **ONE** *answer*).

less than 5 years	34
6-10 years	67
11-20 years	101
21-30 years	114
31-40	86
more than 41 years	41

3. **Are you a member of any of the following?** (*Indicate* **ALL** *those that apply to you*).

Climbing/mountaineering/walking organisation (e.g. a club/Mountain Rescue Team/British Mountaineering Co./Mountaineering Co. of Scotland)	151
Field sports organisation (e.g. British Assoc. For Shooting and Conservation, Salmon & Trout Assoc., Scottish Assoc. for Country Sports)	62
Farming/forestry/fisheries organisation (e.g. National Farmers Union/Scottish Crofters' Union)	72
Four wheel drive club (e.g. Landrover Club)	3
Deer/game management bodies (e.g. British Deer Society, Game Conservancy Trust, Deer Management Group)	98
Scottish Landowners' Federation	18
Conservation groups (e.g. National Trust for Scotland, John Muir Trust, Greenpeace)	137
Ski club	19
None of the above	113

4. **Do you ever work in upland or mountainous areas?**

yes	218
no	234

5. **Does your job involve working out of doors in the countryside for, on average, 3 or more days per week?**

yes	272
no	175

I would now like you to think about the concept of 'wild land' in Scotland. Please base your answers on your own definition of 'wild'.

6. **In which of the following locations might you find 'wild land' in Scotland?** (*Indicate* **ALL** *those that you agree with*).

off shore islands	338
sections of coast	323
lowland areas	101
upland areas (e.g. moorland)	314
mountainous areas	431
none of the above	9

7. **When in an upland/mountainous area, would you consider yourself to be in a 'wild land' setting if you had walked away from a surfaced road for......?** (*Indicate only* **ONE** *answer to the nearest hour*).

less than 1 hour	60
1-3 hours	137
4-6 hours	49
7-10 hours	4
more than 10 hours	5
time is not important	202

8. **When in an upland/mountainous area, would you consider yourself to be in a 'wild land' setting if you had walked the following distance away from a surfaced road?** (*Indicate only* **ONE** *answer to the nearest mile*).

less than 1 mile	40
1-2 miles	59
3-6 miles	108
7-12 miles	31
more than 12 miles	13
distance is not important	205

9. **Are the landscape features that you can see from any particular point on your journey (on foot / ski) an important factor in determining whether you are in a 'wild land' area?**

yes	78
no	378

10. **If you were on the summit of a mountain during a blizzard in winter, and then returned on a sunny day in summer, would your perception of how wild the setting was have changed?** (*Indicate only* **ONE** *answer*).

no change	198
less wild in the blizzard	14
more wild in the blizzard	217
do not know	26

11. **Do you consider there to be any truly 'wild land' in Scotland?**

yes	28
no	415
don't know	12

12. **What is the most important factor in your visual perception of wild land in Scotland?** (*Please write your answer clearly below*).

....
....
....
....
....
....

Please refer to the following list of items that might affect your perception of wild land in Scotland.

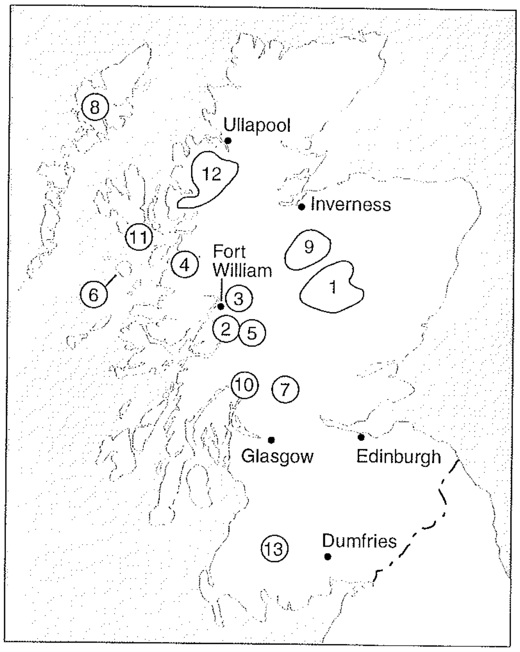
13. **How desirable are the following items in a wild land setting?** *(Fill the oval which shows your views on EACH of these items).*

Item	Strongly desirable	Desirable	Neutral	Undesirable	Strongly undesirable
a) Farm animals (sheep, cattle)	21	50	148	151	82
b) Regeneration of native woodland	182	184	65	13	10
c) Road access to wild land boundary	5	61	123	170	93
d) Solitude (not seeing many other groups of people)	205	160	63	14	12
e) Maintained footpaths	34	78	138	128	74
f) Bridges on footpaths	31	77	150	130	65
g) Free from evidence of obvious human impact	227	150	45	15	18
h) Stalking/shooting	64	71	170	84	65
i) Big enough to take at least two days to walk across	54	136	242	18	3
j) Presence of plant and animal species not originally native to UK	12	23	156	152	110
k) Motorised travel by visitors (e.g. four wheel drive (4WD) or boats)	8	8	26	110	302
l) Maintained bothies / refuges	50	159	160	60	27
m) Hydroelectric development (e.g. dams, power lines)	9	14	112	159	161
n) Reservoirs (draw down - the bare ground left after abstraction of water)	2	9	111	179	149
o) Out of sight of cities or towns	253	121	41	15	27
p) Downhill skiing area	3	13	106	146	187
q) Commercial mining / quarrying	2	4	47	107	295
r) Bulldozed tracks (for four wheel drive (4WD) vehicles)	2	6	39	110	296
s) Conifer plantations	10	52	85	178	127
t) Ruins (e.g. shielings) and other archaeological sites	56	180	188	21	10
u) Human - made noise (e.g. traffic, aeroplanes, music)	2	2	25	138	228
v) Fencing (e.g. deer fencing)	10	30	139	168	108
w) Logging (timber removal operations)	5	14	131	164	139
x) Evidence of muirburn (heather burning for grouse moor management)	44	67	166	115	64

14. **In which of the following areas might you find wild land?** Please answer the question for places that you have and have not visited (either by car/bus or on foot). *(Please indicate whether or not you have visited an area by filling in the yes or no oval. Please indicate if you think the area is wild by filling* **ONE** *of the yes, no or 'don't know' ovals).*

	Visited?		Wild?		
	Yes	**No**	**Yes**	**No**	**Don't know**
1. Cairngorms	424	24	370	57	16
2. Glencoe	421	26	309	106	28
3. Ben Nevis area	390	50	254	140	37
4. Knoydart	248	187	349	16	66
5. Rannoch Moor	375	67	354	43	46
6. Rum	153	275	234	36	147
7. Trossachs	342	92	81	272	77
8. Lewis	169	262	189	73	162
9. Monadhliath	292	143	259	52	120
10. Arrochar 'Alps'	224	184	129	138	152
11. Cuillin of Skye	330	112	319	60	56
12. Wester Ross	380	63	363	33	45
13. Galloway hills	193	234	112	126	186

The location of each of these areas is shown on the map below.



15. **Please look at the photographs on the next six pages. Indicate your answer to questions A to D below by filling in the relevant ovals below each photograph.**

A). **How wild is the landscape in this photograph?** *(Please fill in the oval which shows how wild you think the landscape is, on a scale from not wild to wild).*

B). **How beautiful is this landscape?** *(Please fill in the oval which shows how beautiful you think the landscape is, on a scale from ugly to beautiful).*

C). **How natural is this landscape?** Please take into account the amount of human influence visible in the scene. *(Please fill in the oval which shows how natural you think the landscape is, on a scale from unnatural to natural).*

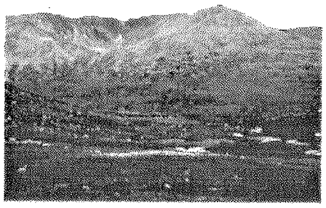
D). **Do you know, to within roughly one mile, the location shown in this photograph?** *(Please fill in the Yes or No oval).*

1

A) Not wild	28	41	111	176	80	Wild
B) Ugly	3	7	79	191	149	Beautiful
C) Unnatural	11	43	92	165	113	Natural

D) Location? yes 85 no 343

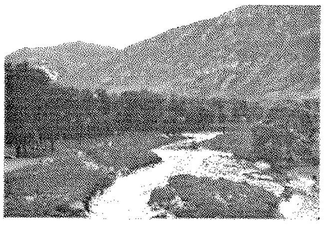
2



A) Not wild	15	22	46	143	209	Wild
B) Ugly	1	14	110	167	131	Beautiful
C) Unnatural	3	19	69	126	207	Natural

D) Location? yes 68 no 353

3



A) Not wild	11	26	102	178	109	Wild
B) Ugly	0	7	71	202	142	Beautiful
C) Unnatural	2	22	80	158	155	Natural

D) Location? yes 53 no 364

4

A) Not wild	72	100	110	86	59	Wild
B) Ugly	140	119	105	43	24	Beautiful
C) Unnatural	146	138	82	32	33	Natural

D) Location? yes 86 no 339

5

A) Not wild	185	106	86	36	12	Wild
B) Ugly	66	92	186	58	19	Beautiful
C) Unnatural	138	151	93	25	24	Natural

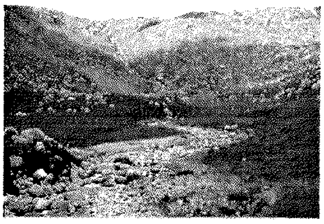
D) Location? yes 11 no 411

6

A) Not wild	17	16	53	142	195	Wild
B) Ugly	2	3	49	152	221	Beautiful
C) Unnatural	4	15	40	137	227	Natural

D) Location? yes 44 no 371

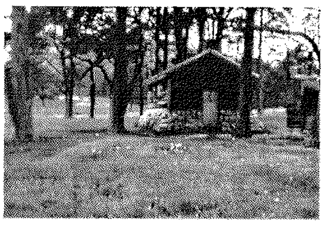
7



A) Not wild	13	11	31	123	257	Wild
B) Ugly	4	13	96	176	137	Beautiful
C) Unnatural	4	11	49	110	249	Natural

D) Location? yes 23 no 402

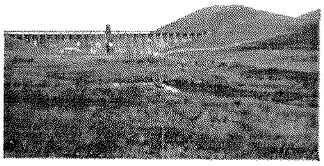
8



A) Not wild	260	97	58	11	3	Wild
B) Ugly	28	96	210	71	21	Beautiful
C) Unnatural	138	151	108	20	18	Natural

D) Location? yes 54 no 376

9



A) Not wild	141	134	82	51	25	Wild
B) Ugly	144	154	115	14	6	Beautiful
C) Unnatural	224	145	57	4	6	Natural

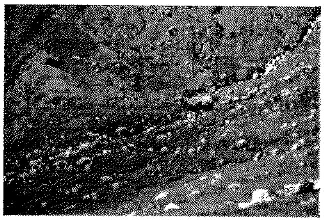
D) Location? yes 211 no 221

10

A) Not wild	52	83	145	97	51	Wild
B) Ugly	10	18	128	181	93	Beautiful
C) Unnatural	33	83	141	97	73	Natural

D) Location? yes 115 no 312

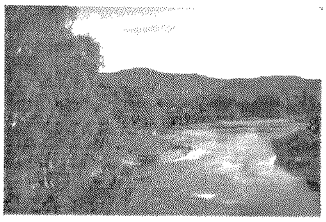
11



A) Not wild	10	13	62	135	208	Wild
B) Ugly	6	35	158	140	76	Beautiful
C) Unnatural	4	11	57	130	221	Natural

D) Location? yes 9 no 399

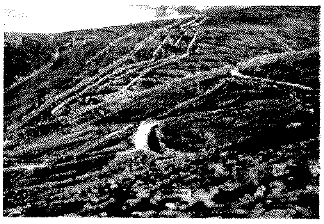
12



A) Not wild	44	76	118	101	76	Wild
B) Ugly	0	4	35	162	226	Beautiful
C) Unnatural	0	10	77	149	177	Natural

D) Location? yes 40 no 371

13



A) Not wild	153	110	63	57	48	Wild
B) Ugly	281	103	43	6	4	Beautiful
C) Unnatural	262	115	35	8	7	Natural

D) Location? yes 216 no 211

14

A) Not wild	16	28	60	142	181	Wild
B) Ugly	0	2	31	120	274	Beautiful
C) Unnatural	2	4	27	117	287	Natural

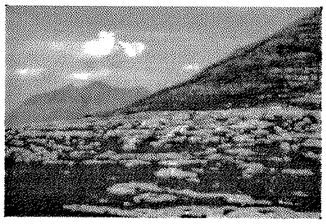
D) Location? yes 141 no 279

15

A) Not wild	4	1	10	74	352	Wild
B) Ugly	4	13	74	152	183	Beautiful
C) Unnatural	1	2	12	80	334	Natural

D) Location? yes 120 no 307

16



A) Not wild	4	4	10	76	346	Wild
B) Ugly	4	3	45	161	211	Beautiful
C) Unnatural	1	7	12	81	325	Natural

D) Location? yes 105 no 319

17

A) Not wild	35	63	119	121	91	Wild
B) Ugly	3	16	121	174	113	Beautiful
C) Unnatural	2	19	86	161	163	Natural

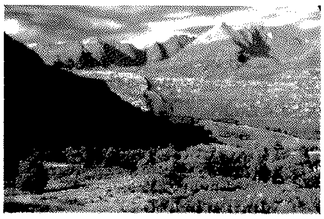
D) Location? yes 9 no 419

18

A) Not wild	7	5	29	88	229	Wild
B) Ugly	9	22	131	156	100	Beautiful
C) Unnatural	3	4	30	90	294	Natural

D) Location? yes 50 no 361

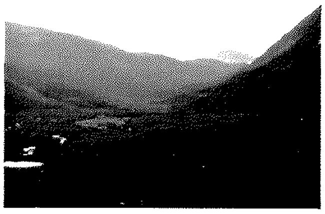
19



A) Not wild	7	8	25	121	268	Wild
B) Ugly	0	0	14	73	340	Beautiful
C) Unnatural	2	3	31	141	243	Natural

D) Location? yes 130 no 292

20



A) Not wild	5	6	31	128	255	Wild
B) Ugly	3	8	74	168	165	Beautiful
C) Unnatural	1	7	46	132	240	Natural

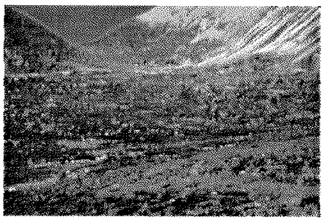
D) Location? yes 25 no 389

21

A) Not wild	2	4	11	95	321	Wild
B) Ugly	4	11	63	175	168	Beautiful
C) Unnatural	2	5	13	85	318	Natural

D) Location? yes 75 no 346

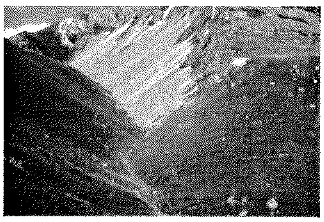
22



A) Not wild	5	8	31	120	268	Wild
B) Ugly	2	8	98	185	122	Beautiful
C) Unnatural	2	11	36	115	260	Natural

D) Location? yes 19 no 399

23



A) Not wild	2	4	21	95	319	Wild
B) Ugly	3	13	65	160	180	Beautiful
C) Unnatural	3	8	33	112	270	Natural

D) Location? yes 38 no 383

24

A) Not wild	29	37	94	125	144	Wild
B) Ugly	2	8	42	150	227	Beautiful
C) Unnatural	2	13	41	126	249	Natural

D) Location? yes 52 no 376

25

A) Not wild	19	37	109	167	101	Wild
B) Ugly	1	3	69	205	146	Beautiful
C) Unnatural	15	33	147	142	97	Natural

D) Location? yes 36 no 390

26

A) Not wild	233	113	62	12	8	Wild
B) Ugly	23	114	214	55	16	Beautiful
C) Unnatural	103	158	109	23	40	Natural

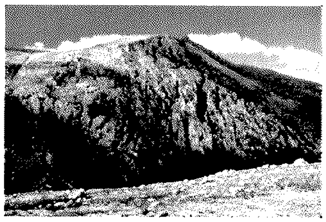
D) Location? yes 8 no 413

27

A) Not wild	40	56	120	100	108	Wild
B) Ugly	6	14	112	156	137	Beautiful
C) Unnatural	1	12	76	136	207	Natural

D) Location? yes 10 no 407

28



A) Not wild	3	5	16	117	291	Wild
B) Ugly	1	5	39	159	214	Beautiful
C) Unnatural	0	5	20	112	281	Natural

D) Location? yes 34 no 380

29

A) Not wild	63	61	119	125	58	Wild
B) Ugly	2	19	97	185	122	Beautiful
C) Unnatural	16	47	99	130	140	Natural

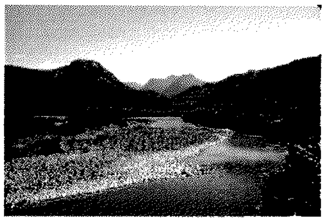
D) Location? yes 39 no 380

30

A) Not wild	31	56	126	135	72	Wild
B) Ugly	0	1	42	178	204	Beautiful
C) Unnatural	3	30	98	143	150	Natural

D) Location? yes 41 no 370

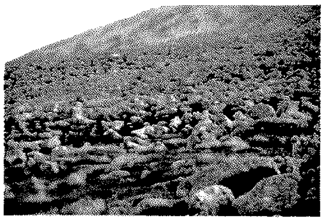
31



A) Not wild	10	22	46	167	185	Wild
B) Ugly	0	2	17	126	290	Beautiful
C) Unnatural	0	8	52	115	252	Natural

D) Location? yes 55 no 367

32



A) Not wild	6	5	24	110	297	Wild
B) Ugly	16	38	161	133	81	Beautiful
C) Unnatural	3	3	27	99	299	Natural

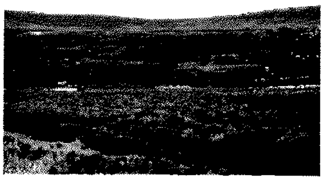
D) Location? yes 16 no 413

33

A) Not wild	79	108	136	83	25	Wild
B) Ugly	45	88	174	94	33	Beautiful
C) Unnatural	107	159	123	27	21	Natural

D) Location? yes 18 no 403

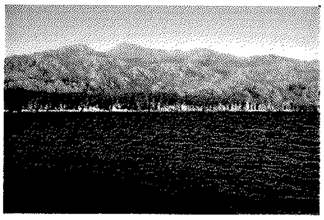
34



A) Not wild	13	35	87	149	146	Wild
B) Ugly	7	55	176	115	69	Beautiful
C) Unnatural	10	36	102	124	155	Natural

D) Location? yes 12 no 404

35



A) Not wild	28	36	83	152	128	Wild
B) Ugly	5	11	99	172	136	Beautiful
C) Unnatural	10	31	83	157	146	Natural

D) Location? yes 69 no 347

36

A) Not wild	4	3	19	131	282	Wild
B) Ugly	2	12	72	198	142	Beautiful
C) Unnatural	3	5	37	111	273	Natural

D) Location? yes 33 no 388

37

A) Not wild	29	51	138	132	78	Wild
B) Ugly	2	6	109	202	107	Beautiful
C) Unnatural	5	16	111	158	148	Natural

D) Location? yes 31 no 387

38

A) Not wild	42	76	147	110	53	Wild
B) Ugly	22	50	182	114	54	Beautiful
C) Unnatural	50	77	114	102	86	Natural

D) Location? yes 14 no 399

39

A) Not wild	92	131	127	56	28	Wild
B) Ugly	28	93	181	100	30	Beautiful
C) Unnatural	85	147	136	45	18	Natural

D) Location? yes 46 no 377

40

A) Not wild	109	133	118	57	20	Wild
B) Ugly	10	55	204	120	36	Beautiful
C) Unnatural	41	124	159	70	42	Natural

D) Location? yes 11 no 418

41

A) Not wild	151	105	96	58	24	Wild
B) Ugly	8	40	125	165	90	Beautiful
C) Unnatural	65	120	119	72	51	Natural

D) Location? yes 99 no 328

42

A) Not wild	35	68	109	129	76	Wild
B) Ugly	1	13	126	165	111	Beautiful
C) Unnatural	18	63	130	124	83	Natural

D) Location? yes 33 no 376

43

A) Not wild	204	122	66	23	13	Wild
B) Ugly	79	178	123	28	15	Beautiful
C) Unnatural	157	148	76	17	24	Natural

D) Location? yes 7 no 402

44

A) Not wild	10	37	76	145	168	Wild
B) Ugly	20	39	139	161	67	Beautiful
C) Unnatural	21	84	124	126	78	Natural

D) Location? yes 40 no 377

45

A) Not wild	21	43	98	165	108	Wild
B) Ugly	5	40	184	137	56	Beautiful
C) Unnatural	9	37	104	138	138	Natural

D) Location? yes 5 no 407

46

A) Not wild	62	105	145	80	37	Wild
B) Ugly	19	72	209	95	26	Beautiful
C) Unnatural	26	117	150	78	50	Natural

D) Location? yes 3 no 414

47

A) Not wild	14	14	50	151	204	Wild
B) Ugly	1	1	21	121	293	Beautiful
C) Unnatural	1	3	38	143	247	Natural

D) Location? yes 55 no 372

48

A) Not wild	122	128	120	53	16	Wild
B) Ugly	15	84	212	94	23	Beautiful
C) Unnatural	28	102	182	69	54	Natural

D) Location? yes 4 no 428

Having answered the last 15 questions and looked at the photographs, in order to see if this information has changed what you think about wild land in Scotland, would you like to change your answer to question 11? It is repeated here:

16. **Do you consider there to be any truly 'wild land' in Scotland?**

yes	395
no	38
don't know	13

For the purposes of better understanding the answers you have given I would now like to ask some questions about yourself. Please remember that any information you give is completely confidential and will only be used for the purposes of this research project.

17. **Sex of respondent**

Female	114
Male	339

18. **In which age category are you?**

Less than 15	0
15-24 years old	24
25-34 years old	63
35-44 years old	111
45-54 years old	137
55-64 years old	65
65-74 years old	37
75 years old or over	16

19. **Which of the following categories best describes yourself?** *(Indicate the* **ONE, MOST RECENT** *answer that applies to you).*

Left school at or before the age of 16	81
Did a technical qualification (e.g. City & Guilds)	33
Did O grade / G.C.S.E. / O level	35
Did Higher / A level	43
Did HNC / HND	25
Did an Undergraduate / Professional qualification	191
None of the above	42

20. **What is your household's approximate annual gross (i.e. before tax) income?** *(Please tick the* **ONE** *income bracket which applies to your household).*

Less than £5,000	26
£5,000 - £9,999	48
£10,000 - £14,999	83
£15,000 - £19,999	70
£20,000 - £24,999	53
£25,000 - £29,999	40
£30,000 - £34,999	32
£35,000 - £39,999	25
£40,000 - £44,999	12
£45,000 - £49,999	5
£50,000 - £54,999	8
£55,000 - £59,999	4
£60,000 - £64,999	3
£65,000 - £69,999	3
over £70,000	10

21. **Where is your permanent home?** *(Please write the first half of your* **POSTCODE** *below).*

....

22. **It is helpful for me to know what your employment is. Are you?** *(Indicate only* **ONE** *answer).*

In full-time work	310
In part-time work	36
Not working - unemployed	7
Not working - looking after the home	7
Retired	70
Full-time student	22

As mentioned in the covering letter there will be a prize draw. The prize is a £25 book token.

If you wish to enter the competition please fill this oval : ○

and write your name and address in the space provided below. This information is strictly confidential and will be destroyed once the draw has taken place.

....

....

....

....

Please return this questionnaire by the 17th March in the envelope provided using the FREEPOST address given below (no stamp needed):

Dominic Habron
Dept. of Environmental Science
University of Stirling
FREEPOST SCO1159
STIRLING
FK9 4BR

Many thanks for your time.

Yours sincerely,

Dominic Habron.

Reminder Letter

UNIVERSITY OF STIRLING

STIRLING FK9 4LA SCOTLAND
TELEPHONE 01786 473171

DEPARTMENT OF ENVIRONMENTAL SCIENCE
Professor D A Davidson BSc PhD FRSE
Head of Department

Professor D W Hopkins BSc PhD CBiol MIBiol
Professor M F Thomas MA PhD FGS FRSE

Telephone 01786 467840
Enquiries MSc 01786 467842
Facsimile 01786 467843
International Facsimile +44 1786 467843

MR MACDONALD,
A COTTAGE,
TOWN,
COUNTY,
POSTCODE.

24/3/97

Direct Line: (01786)466544
Email: adh2@stirling.ac.uk

Dear MR MACDONALD,

Many thanks if you have returned the 'Wild Land in Scotland' survey, you need not read the rest of this letter.

If you are still thinking about completing the survey could I please urge you to do so. The answers that you provide will be of tremendous importance to my Ph. D. research project that relies heavily on the goodwill of people, like yourself, taking half an hour to complete the questionnaire.

As I mentioned in the original letter, all you need to do is read through the questions and fill the oval that best corresponds with your answer. Please remember there are no 'correct' answers; it is YOUR opinion that interests me.

Your responses will be treated as confidential and none of your answers tied to your name. If you wish to enter the prize draw for the £25 book token then please fill in the questionnaire and complete page 12. To return the questionnaire you do not need a stamp, just use the FREEPOST address and the envelope I provided. Please could you do this as soon as possible or by the 7th of April at the latest.

May I thank you in advance for finding the time to be a part of this project.

I look forward to hearing from you in the near future.

Yours sincerely,

Dominic Habron

Appendix 2

Photograph Location Data

Photograph questionnaire number	X-coordinate	Y-coordinate	National Grid Sector	Altitude (m)	Magnetic bearing (°) to centre of photograph
1	212769	879970	NH	280	315.0
2	297521	797801	NN	600	327.0
3	303355	793339	NO	430	312.0
4	212203	884528	NH	155	277.0
5	212588	884422	NH	135	242.0
6	200300	877500	NH	525	84.0
7	203620	878372	NH	215	252.5
8	304219	793063	NO	440	339.5
9	234900	870500	NH	235	312.0
10	289727	807839	NH	250	140.0
11	203100	878300	NH	260	201.0
12	289500	811250	NH	255	174.0
13	299200	805100	NH	835	102.0
14	298400	807200	NH	510	358.0
15	296400	799800	NN	1120	40.0
16	209441	881700	NH	400	267.0
17	210702	883877	NH	195	71.0
18	299600	798700	NN	1235	330.0
19	212549	884825	NH	155	259.0
20	302200	808200	NJ	565	180.0
21	297166	802270	NH	865	289.0
22	206000	871800	NH	560	333.0
23	302242	808309	NJ	570	322.0
24	195404	890870	NG	20	324.0
25	300662	811558	NJ	400	218.0
26	291777	810777	NH	235	335.0
27	228323	861645	NH	195	282.0
28	302400	803800	NJ	910	321.0
29	196592	893156	NG	10	34.0
30	208900	879200	NH	125	181.0
31	196481	890680	NG	40	148.0
32	298130	803106	NH	915	74.0
33	217124	875978	NH	220	222.0
34	301900	793800	NO	450	165.0
35	188925	872370	NG	40	54.0
36	204300	878700	NH	170	250.0
37	304279	793580	NO	440	327.0
38	306003	792048	NO	410	256.5
39	306425	791299	NO	425	338.0
40	304423	793589	NO	440	358.0
41	187600	887600	NG	80	340.0
42	301952	803296	NJ	795	112.0
43	298027	809481	NH	365	35.0
44	295988	803961	NH	655	7.0
45	300622	811483	NJ	400	323.5
46	210878	884172	NH	160	84.0
47	195225	890798	NG	30	146.0
48	291758	810800	NH	230	89.0

Appendix 3

ARC/INFO AML Programs

CAIRNVIS.AML

```
/* CAIRNVIS.AML - undertakes a visibility analysis for the fore, middle and back ground
areas within all photographs in the Cairngorm study area.  This approach proved to be more
reliable than conducting one visibility analysis to then split into three sets of polygons.
When split into three sets of polygons these did not exactly match up unlike the individual
visibility analyses which did.

/* Written 10/2/98 by Dominic Habron.

&watch cairnvis.wat
projectcompare full

&do t = 1 &to 26 &by 1              /* This loop repeats the procedure for the visibility
                                    /* polygons of all 26 photographs.

 &setvar bcover := c%t%phlon        /* The file bcover is the basic point coverage of the
                                    /* photograph locations, including the radius1 and
                                    /* radius2 items which govern the area of visibility
                                    /* scan.

 &sv infofile = %bcover%.pat        /* This section assigns the values (in m) to the item
 &sv fvalue1 = 0                    /* radius1 and radius2 in the photograph location pat
 &sv fvalue2 = -250                 /* file to set the parameters for the foreground
                                    /* visibility analysis.
 &sv oldws = [show &wo]
 &wo info
 &data info
 ARC
 SELECT [translate %INFOFILE%]
 UPDATE
 1
 RADIUS1 = %fvalue1%
 RADIUS2 = %fvalue2%
         /* This line represents 'return' at the info prompt.
         /* This line represents 'return' at the info prompt.
 Q STOP
 &end
 &wo %oldws%
 &delvar oldws

 visibility cairncano2 %bcover% point c%t%visna    /* First iteration of the visibility
                                                   /* analysis for the foreground.
```

```
&sv mvalue1 = -250          /* This section assigns the values (in m) to the items radius1
&sv mvalue2 = -750          /* and radius2 in the photograph location pat file to set the
                            /* parameters for the mid-ground visibility analysis.

&sv oldws = [show &wo]
&wo info
&data info
ARC
SELECT [translate %INFOFILE%]
UPDATE
1
RADIUS1 = %mvalue1%
RADIUS2 = %mvalue2%
   /*  this line represents 'return' at the info prompt
   /*  this line represents 'return' at the info prompt
Q STOP
&end
&wo %oldws%
&delvar oldws

visibility cairncano2 %bcover% point c%t%visnb    /* Second iteration of the visibility
                                                  /* analysis for the mid-ground.

&sv bvalue1 = -750          /* This section assigns the values (in m) to the items radius1
&sv bvalue2 = -9999999      /* and radius2 in the photograph location pat file to set the
                            /* parameters for the background visibility analysis.
&sv oldws = [show &wo]
&wo info
&data info
ARC
SELECT [translate %INFOFILE%]
UPDATE
1
RADIUS1 = %bvalue1%
RADIUS2 = %bvalue2%
        /* This line represents 'return' at the info prompt.
        /* This line represents 'return' at the info prompt.
Q STOP
&end
&wo %oldws%
&delvar oldws

visibility cairncano2 %bcover% point c%t%visnc    /* Third iteration of the visibility
                                                  /* analysis for the background.

arcedit        /* Remove the boundary polygon for each of the 3 visibility analyses, save
               /* and build the resulting coverages.

&do let &list a b c
```

```
 edit c%t%visn%let%
 editfeature polygons
 select for c%t%visn%let%-id = 1
 delete
 save c%t%vis2n%let%
 build
&end            /* Ends the '&do let &list a b c' loop.
quit
yes
yes

&end            /* Ends the '&do t = 1 &to 26 &by 1' loop.

&watch &off

&return                 /* Finishes the AML.
```

CALCSVAL.AML

```
/* CALCSVAL.AML - This program extracts the area of the different land cover types that
/* fall within the visibility polygons of each of the fore, middle and background coverages.

/* Written by Dominic Habron on 2/3/98

projectcompare full

&do t = 1 &to 26 &by 1              /* This loop repeats the procedure for the visibility
                                    /* polygons of all 26 photographs.

&do v &list a b c                /* This loop goes through the fore, middle and back ground
                                 /* polygons.

 &setvar viscov := c%t%vis2n%v%

 identity %viscov% cairnlcsr4 c%t%lcs%v%

 &sv lcscov = c%t%lcs%v%

 &FULLSCREEN &OFF

 frequency %lcscov%.pat %lcscov%.dat    /* The frequency command creates a file
 visible-code                           /* containing the area of each land cover type
 val34                                  /* in that coverage.
 end
 area
 end

 &watch clcsarea.wat &append        /* The &TYPE command lists the land cover area
&TYPE [VALUE lcscov]                /* values and the coverage name to a watch file which
 list %lcscov%.dat                  /* can be imported into Microsoft Excel.
 &watch &off

 &end        /* ends the '&do v &list a b c' loop.

&end         /* ends the '&do t = 1 &to 26 &by 1' loop.

&return
```

CASLPVAL.AML

```
/* CASLPVAL.AML - Programme extracts the area of the different slope categories
/* that fall within the visibility polygons of the Cairngorm photos.

/* Written by Dominic Habron on 6/3/98

projectcompare full

&do t = 1 &to 26 &by 1          /* This loop repeats the procedure for the visibility polygons
                                /* of all 26 photographs.
 &do v &list a b c              /* This loop goes through the fore, mid and back ground
                                /* polygons.

  &setvar viscov := c%t%vis2n%v%

  identity %viscov% cairn_slope3 c%t%slp%v%      /* The identity command overlays the
                                                 /* visibility polygons and the slope
                                                 /* coverage, cutting out the sections
                                                 /* which can be seen.
  &sv slpcov = c%t%slp%v%

  &FULLSCREEN &OFF

  frequency %slpcov%.pat %slpcov%.dat            /* The frequency command provides a
  visible-code                                   /* table of the area of each slope
  slope-code                                     /* category in that coverage.
  end
  area
  end

  &watch cslparea.wat &append    /* Lists the area values and coverage name to a
  &TYPE [VALUE slpcov]           /* watch file.
  list %slpcov%.dat
  &watch &off

 &end          /* Ends the '&do v &list a b c' loop.

&end           /* Ends the '&do t = 1 &to 26 &by 1' loop.

&return
```

CINTSECP.AML

```
/*  CINTSECP.AML - This program intersects the LCS88 point coverage with the visibility
/* polygons for each photograph location in the Cairngorm study area.  The x and y
/* coordinates of the points visible are then added.

/* Written by Dominic Habron on 22/4/98.

&do n = 1 &to 26 &by 1        /* This loop repeats the procedure for the visibility polygons
                              /* of all 26 photographs.
&do c &list a b c             /* This loop goes through the fore, middle and back ground
                              /* visibility polygons.

 &sv viscov = c%n%vis2n%c%

 intersect capntlcs %viscov% c%n%pnt%c% point        /* The intersect command puts
                                                     /* the LCS88 point data which
                                                     /* falls with a visibility polygon
                                                     /* into a new file.
  &sv pntcov = c%n%pnt%c%

  cursor noreccur declare %pntcov% point ro
  cursor noreccur open
  &if %:noreccur.aml$nsel% gt 0 &then     /* Add the x and y coordinates of the visible
  addxy c%n%pnt%c% point                  /* points.
  cursor noreccur close
  cursor noreccur remove

 &end        /* Ends the '&do c &list a b c' loop.

&end         /* Ends the '&do n = 1 &to 26 &by 1' loop.

&return
```

CLCSLENG.AML

```
/* CLCSLENG.AML - This program calculates the length of LCS88 linear features within
/* the visibility polygons for each photograph location in the Cairngorm study area.

/* Written by Dominic Habron on 23/4/98.

&fullscreen &off

&do n = 1 &to 26 &by 1        /* This loop repeats the procedure for the visibility polygons
                              /* of all 26 photographs.
&do c &list a b c             /* This loop goes through the fore, middle and back ground
                              /* visibility polygons.
  &sv viscov = c%n%vis2n%c%

  intersect calinlcs %viscov% c%n%lin%c% line    /* Intersect creates the new coverage
                                                 /* of LCS88 linear features falling
                                                 /* within the visibility polygons.
  &sv lincov = c%n%lin%c%

  frequency %lincov%.aat %lincov%.dat    /* The frequency command writes the length
  visible-code                           /* of each type of LCS88 linear feature to a
  lcs88                                  /* file.
  end
  length
  end

  &watch lcslinle.wat &append                  /* This section writes the data to a
  &type [format '%1% %2%' %n% %c%]             /* watch file, readable by Excel.
  list %lincov%.dat
  &watch &off

 &end        /* Ends the '&do c &list a b c' loop.

&end         /* Ends the '&do n = 1 &to 26 &by 1' loop.

&return
```