Wilderness Attribute Mapping in the United Kingdom

BY STEVE CARVER, ANDY EVANS, and STEFFEN FRITZ

Abstract: A wilderness continuum concept can identify the wilder areas of Britain. Geographical Information Systems are used to present information on these areas and solicit public opinion as to which factors are perceived to be important wilderness quality indicators. Consensus maps are compiled from a composite of individual responses and the results compared to Britain's network of protected areas.

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Introduction

Although legal definitions of wilderness exist, the concept remains difficult to specify. Nash (1982, p. 1) was tempted to let wilderness define itself: "to accept as wilderness those places people call wilderness" with emphasis "not so much on what wilderness is but what men *think* it is." Nash describes wilderness as one extreme on a continuum from the "paved to the primeval." The position along the continuum at which wilderness occurs has more to do with perceptions than it does with ecological conditions.

Recent research in Britain has focused on identifying and mapping a wilderness continuum using Geographical Information Systems (GIS) methods that take perceptions of wilderness into account (Carver 1996; Carver and Fritz 1999). Despite the lack of extensive wilderness in Britain, it is argued that it is possible to identify a continuum from the most altered and accessible to the most natural and remote places. This article describes the techniques used to map the wilderness continuum for Britain using input from the general public on which geographi-

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cal factors are considered important wilderness quality indicators.

Britain and the Wilderness Continuum Concept

Most definitions of wilderness stress the natural state of the environment, the absence of human habitation, and the lack of other human-related influences and impacts. Clearly, few such areas exist in Britain today. Where they do, they take the form of small and isolated pockets. Go back a few hundred thousand years, however, and the whole of Britain was a wilderness with no human settlement. It was only with the arrival of early humans across a land bridge between Britain and the European continent that this wilderness began to be eroded by human incursion, settlement, and forest clearance. Just 2,000 years ago many areas were still home to wild animals commonly associated with North American wilderness: wolf, beaver, bear and lynx (Watson 1984). However, just a few hundred years ago the areas of Scottish Highlands we may be tempted to call wilderness today were the basis of a thriving rural economy. It was the "Clearances" of the early 19th century that erased these traditional hill-farming communities and reinstated the secondary wilderness that we see today (Ridley 1992).

True wilderness simply no longer exists in Britain. Yet, for any given area of the world it should be possible, in theory at least, to identify the wildest tract of land within its boundary, based on human perceptions of its wilderness qualities. The wilderness continuum concept states that true, pristine wilderness is one extreme on the environmental modification spectrum (Hendee et al., 1990). At the opposite end of this spectrum is the totally urbanized environment of the city center shopping mall or office.

Experiencing real wilderness firsthand may be the ultimate education, but it is one that not all of us are fortunate enough to have.

A GIS Approach to Mapping the Wilderness Continuum

GIS can be a valuable tool for wilderness management (Lesslie 1993; Carroll and Hinrichsen 1993; Ouren et al. 1994; Aplet et al. 2000; Davidson et al. 2000), particularly for mapping, monitoring, and analysis. The Australian Heritage Commission's National Wilderness Inventory, for example, identified wilderness on the basis of four factors: remoteness from settlement, remoteness from access, apparent naturalness, and biophysical naturalness (Lesslie 1994; Miller, 1995). These factors are mapped and combined by GIS overlay procedures to define a wilderness quality index. In the Australian example, minimum thresholds are established for these indicators to differentiate areas that do not meet minimum levels of remoteness and naturalness necessary to be considered for wilderness.

To meet a particular objective—in this case the mapping of wilderness quality—it is often necessary to evaluate several criteria and consider their different levels of importance. This multicriteria evaluation, or MCE, allows investigation of a large number of choice possibilities (geographical locations) in the light of multiple and often conflicting criteria (wilderness attributes). It is possible, however, to generate rankings of the alternative choice possibilities according to their attractiveness (in this case their overall wilderness quality). MCE techniques, originally developed in the planning and operations research fields (Voogd 1983), have been adapted for use with GIS and continuous datasets for site search and suitability mapping applications (Janssen and Rietveld 1990; Carver 1991; Eastman et al. 1993).

A variation of the Australian approach to wilderness mapping has been adopted, using similar factors within a GIS/MCE framework to identify the wilderness continuum in Britain (Carver 1996). Several existing digital datasets are used to create six factor maps describing remoteness from local population, remoteness from national population centrers, remoteness from mechanized access, apparent naturalness, biophysical naturalness, and altitude. All these datasets were created and analysed using the GRID module in the Arc/Info GIS software, working at a nominal resolution of 1 km^2 (0.39 square miles). Details of data sources and interpretation are shown in table 1. The factor maps were all standardized onto a 0 to 255 scale and combined using user-specified factor weights and a simple weighted linear summation MCE model as follows:

$$W_{sum} = \sum_{j=n}^{1} w_j(e_{ij})$$

where:

- W_{sum} = position on wilderness continuum
- w_j = j^{th} user-specified factor weight
- e_{ij} = standardized score
- n = number of factors

Table 1. Digital Map Data for UK Wild Area Mapping		
Factor	**Source**	**Interpretation**
Remoteness from local population	UK 1991 Census	Population-linear distance weighted surface using 25 km radius from target cell. Provides a measure of accessibility to local population.
Remoteness from national population centers	UK 1991 Census and CEH Countryside Information System	Population-road distance weighted surface for whole of Britain. Provides a measure of accessibility to the whole of the British population based on real travel distance weighted by population.
Remoteness from mechanized access	CEH Countryside Information System	Distance from nearest road weighted by road class. Larger roads with an implied greater traffic volume are weighted higher than smaller roads.
Apparent naturalness	CEH Countryside Information System	Distance from nearest human artifact weighted by number of features.
Biophysical naturalness	CEH Countryside Information System	Reclassification of the CEH Land Classification map showing degree of naturalness of land cover based on intensity of human use.
Altitude	CEH Countryside Information System	Height above sea level based on digital elevation model.

Other, more complex, MCE routines exist, but the weighted linear summation model is used here for simplicity and transparency (Carver 1991).

By applying user-specified factor weights, continuum maps can be generated. Figure 1 shows an example comparison between two wilderness continuum maps: one based on user weights that stress remoteness from population and access, and one based on user weights that stress apparent and biophysical naturalness. The differences between individual maps created in this manner serves to illustrate how different perceptions of importance affect the resultant continuum.

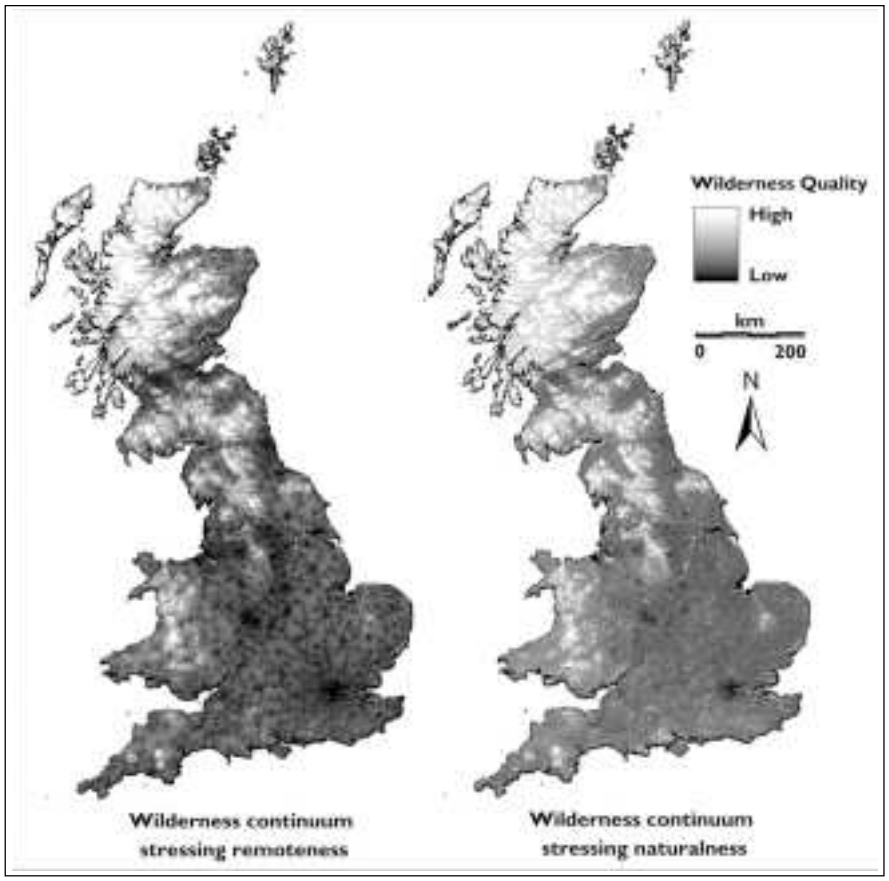

Figure 1— Comparison of two different example wilderness continuum maps.

Internet-based Surveys of Public Perceptions

Internet-based GIS have been used to solicit public opinion about a growing range of spatial decision problems (see, for example, Carver et al. 2000; Lenk 1999; Ghose 2001). The basic thrust of this research has been that the public can be empowered within traditional planning and policy-making structures if they have access to information and decision support tools such as GIS. At the same time, policy can, in turn, be far better informed (and so meet with greater public approval) from the insights gained into public opinion (Kingston et al. 2000). Research has shown that the public becomes better informed and improves understanding on a particular issue or decision problem through the use of interactive online decision support systems. A three-stage process of

exploration, experimentation, and formulation has been proposed as a model for public participation in spatial decision problems (Carver et al. 2000).

A simple, easy-to-use website has been developed to survey public perceptions of wilderness in Britain. The web mapping system allows users to *explore* their perceptions of wilderness in the British landscape through viewing a series of attribute maps and descriptions. The user can then *experiment* with weights applied to these attribute maps and draw their own wilderness continuum map on the screen. Weighting of attribute maps is done using simple slider bars and a Java mapping applet that recalculates and then redraws the continuum map. All processing of the maps is done using client-side applets and preloaded attribute maps, thereby greatly reducing redraw times and making the system highly interactive. Once users are satisfied with a wilderness continuum map, a further slider bar can be used to "top-slice" the continuum map and *formulate* a decision as to where they think wilderness begins on their wilderness continuum as shown on the map. By moving this slider bar those areas thought of as wilderness or wildland are highlighted on the continuum map. The main map interface to the system is shown in Figure 2. All final user responses submitted are retained in server-side log files such that is possible to redraw individual wilderness continuum maps for subsequent analysis. Consensus wilderness area maps are compiled from the log files.

To date, the system has remained as a prototype and is undergoing live testing with small sample groups of students. When launched as a full online survey the system will be specifically targeted at interested groups using e-mail lists, newsletter articles, advertisements, and direct mailing and will employ an online profile form to col-

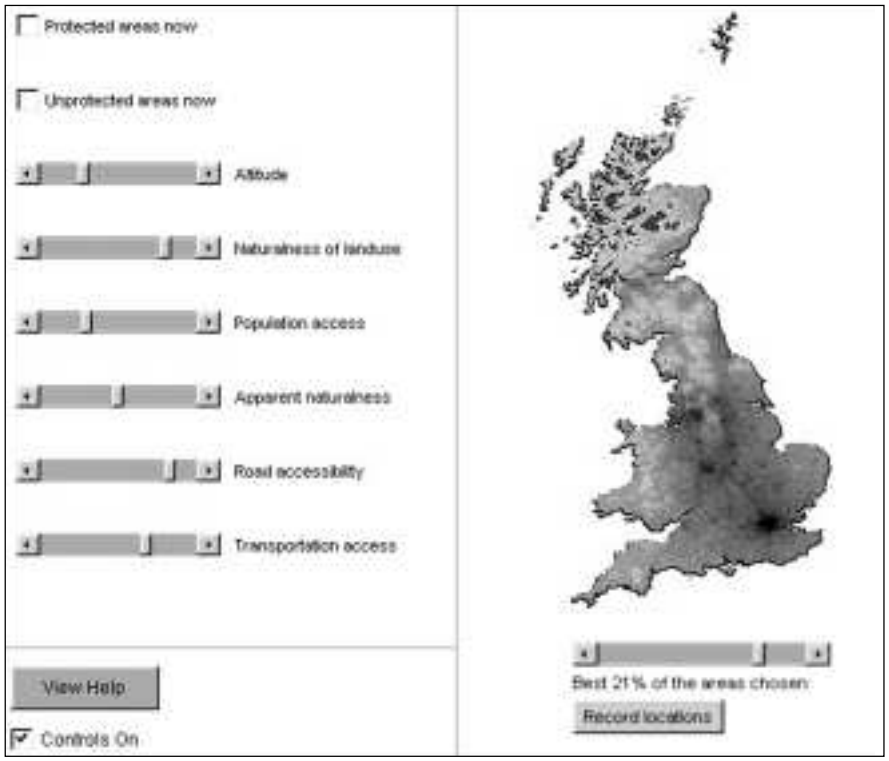

Figure 2— Wilderness mapping web interface.

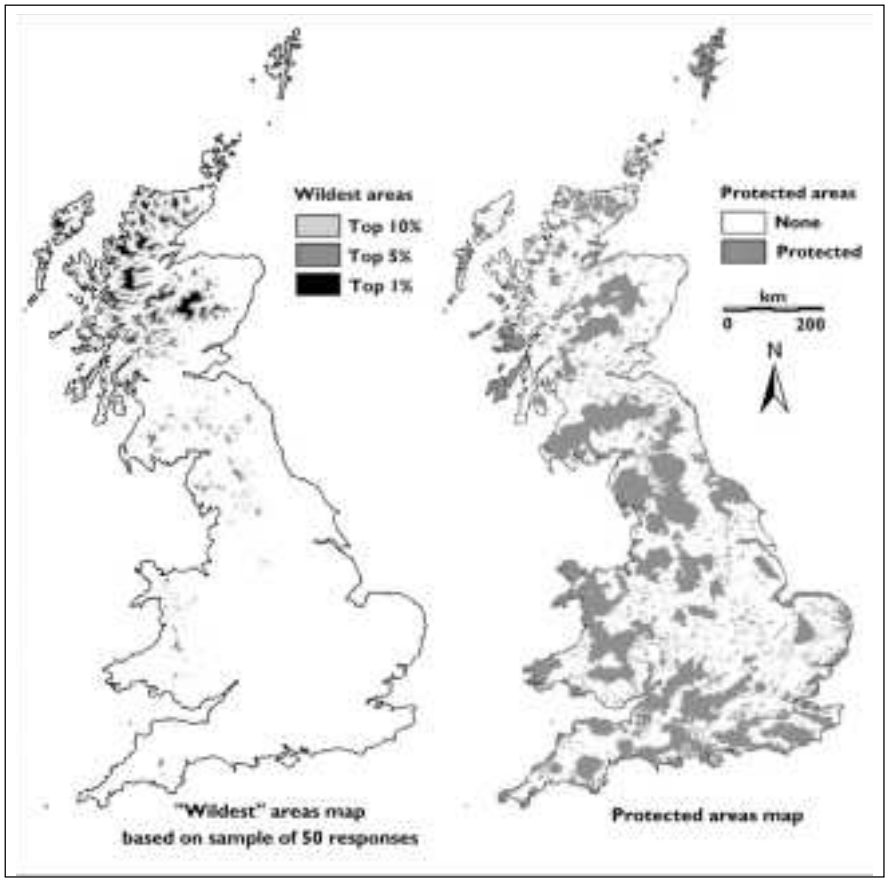

Figure 3— Comparison of "wildest" areas with existing protected areas in Britain.

True wilderness simply no longer exists in Britain. Yet, for any given area of the world it should be possible, in theory at least, to identify the wildest tract of land within its boundary, based on human perceptions of its wilderness qualities.

lect information about the user, including demographic details, profession, membership of relevant organizations, and recreational interests.

Implications for Protected Areas and Education

Using results from the GIS/MCE and Internet-based mapping methods it should be possible to identify what people believe to be the wildest parts of the country. While there may be some misgivings as to how representative these maps may actually be, it does form a useful benchmark against which Britain's existing network of protected areas can be evaluated. The "wildest" areas shown in Figure 3 are derived from the mean wilderness continuum map from a student sample (n=50) by selecting the wildest 1, 5, and 10% of the country. For the purpose of discussion these are shown next to a map showing existing protected areas within Britain. These include National Parks, Areas of Outstanding Natural Beauty, National Nature Reserves, Special Areas of Conservation, Special Protection Areas, and Environmentally Sensitive Areas. While existing protected areas may contain landscapes of high wilderness value, a significant proportion of the wildest areas of the country are not formally protected by conservation area status.

The majority of Britain's wildest areas are within private rather than public ownership. Notably, the majority of Britain's wildlands occur in the northwest Scottish Highlands. Many of these landscapes may be regarded as secondary wilderness, created during the "clearances'" and maintained subsequently by land management practices focused on deer stalking, grouse shooting, sport fishing, and sheep farming. As long as land management practices there are responsible and sympathetic to the environment, then these wild areas will be protected without need for formal policy. However, the landscape mosaic of Britain is constantly changing, so vigilance is required concerning land use pressures affecting the wilder parts of the country. Relevant organizations and conservation groups are currently formulating policies and action plans specific to the preservation and re-creation of wild landscapes within Britain. These include the National Trust and the National Trust for Scotland, Scottish Natural Heritage, and English Nature. The term "rewilding" is often used in Britain to describe the process of reinstating natural or near-natural ecosystems in formerly human-dominated landscapes through the promotion of natural processes with or without human assistance.

Much interest has been generated in rewilding projects such as those of Trees for Life (Featherstone-Watson 1996), the Carrifran Wildwood Project, Moor Trees, Coed Eryri, and the Council for National Parks (Council for National Parks 1998). Again, this kind of map could be profitably employed in identifying areas suitable for rewilding: those areas that are already the most wild stand the best chance of success in any rewilding program.

Certain ethical issues arise at this point. It may transpire that if these results were widely published, the remaining wild areas of the country would be brought to the attention of the country's burgeoning number of outdoor recreationists, who in turn may actively seek out these wild areas thereby destroying, by mere numbers, the wilderness character they value. The counterargument is that if these areas are not formerly identified and protected then we run the risk of losing them to the pressures of development. We believe that the arguments in favor of bringing these areas to the close attention of conservationists and policy makers, together with the educational benefits from wilderness recognition programs, far outweigh the risks from overuse.

In fact, Internet-based wilderness attribute mapping could prove very useful in drawing public attention to the status of wild places and, therefore, stimulate discussion about protection in the United Kingdom. This is particularly the case when spatial information on the status of wildland is available to a wider audience on the Internet. It can raise public awareness of wildland conditions and help to educate people about the value of land that is "not developed." Wilderness preservation is heavily dependent on good education. If people do not know about wilderness and its values then they are unlikely to support policy on its preservation. Wilderness information campaigns, whether based on

paper, TV, or the Internet, can only go so far in educating the public. It is essentially a one-way process, with the public receiving secondhand experiences through the medium of text, sound, and pictures, but being unable to give in return. Experiencing real wilderness firsthand may be the ultimate education, but it is one that not all of us are fortunate enough to have. The Internet GIS approach outlined here may go some way toward providing the public with the opportunity not only to learn about wilderness and its position within the landscape, but also to interact with the geographical context and actively contribute to the process of policymaking, planning, and conservation.

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