
An Ecological Evaluation of Proposed New Conservation Areas in Idaho: Evaluating Proposed Idaho National Parks

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Abstract: *Four areas in the state of Idaho, U.S.A., have been proposed by various interest groups to be designated as national parks. The four areas average 220,000 ha and contain important biological, scenic, recreational, and geological resources. However, the biological resources that would be protected by these proposals have received relatively little consideration. We used the U.S. Fish and Wildlife Service's Gap Analysis Project databases to evaluate the vegetation types contained in each proposal. The scale of analysis was an ecoregion with the proposals falling within three of six ecoregions that encompass Idaho. Databases included vegetation type, land ownership, and land protection status, which were analyzed using a geographic information system. Vegetation types were used as surrogates for information on the distribution of other biological resources (i.e., biodiversity). A conservation strategy was evaluated that would preserve at least 10% of each vegetation type in an ecoregion. Only 15% of the vegetation types in the three ecoregions were protected under this criterion. The four pro-*

Una evaluación ecológica de nuevas áreas de conservación propuestas en Idaho: Evaluando parques nacionales propuestos en Idaho

Resumen: *Cuatro nuevas áreas en el estado de Idaho, U.S.A., han sido propuestas, por distintos grupos interesados en el tema, para ser designadas como Parques Nacionales. Las cuatro áreas promedian 220.000 ha y contienen recursos biológicos, escénicos, recreacionales y geológicos importantes. Sin embargo, los recursos biológicos que serían protegidos por esas propuestas han recibido poca atención. Nosotros usamos la base de datos del "Gap Analysis Project" del "U.S. Fish and Wildlife Services" para evaluar los tipos de vegetación contenidos en cada propuesta. La escala de análisis fue la de eco-región con las propuestas contenidas en tres de las seis eco-regiones que abarcan Idaho. La base de datos incluyó tipos de vegetación, tenencia de tierras y el estado de protección de las tierras, tales datos fueron analizados usando sistemas de información geográficos. Los tipos de vegetación fueron usados como substitutos de información sobre la distribución de otros recursos biológicos (i.e., biodiversidad). Se evaluó una estrategia de conservación que preservaría por lo menos el 10% de cada tipo de vegetación en cada ecoregión. Sólo el 15% de los tipos de vegetación en*

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posals added little to this figure because 67–78% of the vegetation types found in the proposals were already protected elsewhere in each ecoregion. Between 16–30% of the land areas in the proposals provided protection for vegetation types that were previously unprotected. We increased the size of each proposal by including vegetation types in a 15 km zone around each proposal in an attempt to enhance protection. None of the proposals could be feasibly modified to reach the 10% protection goal for all of the vegetation types. However, the protection provided by each proposal could be enhanced to varying degrees with the addition of relatively few hectares to their land area. Although national parks throughout the world play an important role in the conservation of biodiversity, this attribute is often accidental, and as our analysis showed, more attention needs to be devoted to biological data in the selection and design of new parks.

Introduction

The conservation of biological diversity will require a reserve system that is efficient in terms of maximizing resource representation within a framework of limited opportunities to devote lands to such a purpose. In most areas of the world, "national parks," or more specifically Protected Area categories I, II, and IV of the Commission on National Parks and Protected Areas of the International Union for the Conservation of Nature and Natural Resources (IUCN 1984), provide the greatest protection for biodiversity.

The concept that parks should represent the range of regional biophysical diversity has been advocated as a strategy for all parks (IUCN 1980), for biosphere reserves (Gregg & McGean 1985), and for units of the United States (U.S.), National Park Service (NPS) (National Park Service 1972, 1990). However, the attainment of that goal has been elusive. In the U.S., Crumacker et al. (1988) found that 24% of Kuchler's (1964) potential natural vegetation types were not adequately represented on federal and Indian lands. Furthermore, on NPS lands they found that representation of 33% of those vegetation types was lacking.

There are two fundamental reasons for this situation. The first is that many land use classifications including national parks can only be designated through national legislation. As a result, factors such as opportunity, aesthetics, administrative costs, local economic impacts, surrounding land uses, and political support are often more important in park establishment than resource considerations and system-wide plans (Wright 1984; Conservation Foundation 1985; Margules 1989; MacCracken & O'Laughlin 1992). As a result, the boundaries for parks rarely coincide with the landscape ele-

tres ecoregiones se encontraban protegidos actualmente bajo este criterio. Las cuatro propuestas contribuyeron poco a esta cifra debido a que entre un 67–78% de los tipos de vegetación encontrados en las propuestas se hallaban ya protegidos en otras áreas dentro de cada ecoregión. Entre un 16–30% de las áreas en las propuestas proveía protección a tipos de vegetación que no estaban protegidos en el pasado. Nosotros incrementamos el tamaño de cada propuesta incluyendo tipos de vegetación en una zona de 15 km alrededor de cada propuesta a los efectos de mejorar la protección. Ninguno de las propuestas pudo ser modificada feasiblemente para alcanzar la meta de un 10% de protección para todos los tipos de vegetación. Sin embargo, la protección provista por cada propuesta podría ser mejorada en grados diversos mediante la adición de unas (relativamente) pocas hectáreas a sus áreas territoriales. Si bien los parques nacionales alrededor del mundo juegan un rol importante en la conservación de la biodiversidad, este atributo generalmente es accidental y como muestra nuestro análisis se debe prestar más atención a los datos biológicos en la selección y diseño de nuevos parques.

ments necessary to maintain ecological processes (Noss 1987a; Wright 1992).

Second, the development of procedures to meet conservation goals has been limited. Most have been theoretical in nature and rarely applied in real world situations. For example, the NPS identified major physiographic and biologic zones and accompanying resources with the goal of having each represented within the NPS system (National Park Service 1972, 1990). However, this information has seldom been used to guide park establishment (Mackintosh 1991).

Klubnikin (1979) analyzed the distribution of vegetation types in California, U.S.A., relative to the location of parks and preserves and found that most areas tended to preserve only one or two vegetation types. Noss and Harris (1986) and Harris and Gallagher (1989) described a reserve system based on connecting landscape elements using coastal corridors and inland riparian habitats. Australian park planners and ecologists have used automated mapping systems and vegetation cover data to develop conservation strategies for large areas (Bolton & Specht 1983; Purdie et al. 1986; Pressey & Nicholls 1991). Dinerstein and Wikramanayake (1993) developed an untested strategy, based on conservation potential and potential threats, to prioritize the establishment of reserves in several countries in the Indo-Pacific region. Kirkpatrick (1983) used plant species distribution data to prioritize the selection of natural reserves in Tasmania.

The purpose of this paper is to illustrate a method used to address the contribution of specified areas in Idaho to the conservation of biodiversity. All of the areas analyzed have recently been proposed for national park designation and presumably, along with other areas, would form the basis for a biodiversity reserve system.

The data for each area were analyzed at a regional scale in relation to a specific conservation goal, land ownership—resource protection, and existing land areas that already contributed to meeting the conservation goal. The specific objectives of this study were to: (1) summarize the vegetation types contained in each proposal and the associated ecoregion; (2) contrast the level of resource protection provided by the proposals with that needed to achieve the conservation goal; and (3) modify the proposals if necessary to attempt to reach the conservation goal.

Background

The NPS administers four units in Idaho. All but one are relatively small, and all make little contribution to the preservation of the biodiversity in their associated ecoregions. MacCracken and O'Laughlin (1992) identified and described four other areas that have been proposed for national park status and have significant public support (Fig. 1). Each area is recognized for its important aesthetic, geologic, biological and cultural resources. The following is a brief description of each proposal.

Craters of the Moon National Park and Preserve would be created by expanding the existing 21,686 ha monument approximately six-fold. This area includes significant examples of plains volcanism (Greeley 1977) and supports sagebrush—wheatgrass (*Artemisia* spp.—*Agropyron* spp.) vegetation. This proposal and four alternatives were the subject of a NPS study (NPS 1989).

The Hells Canyon National Park—Chief Joseph National Preserve—Snake River Breaks National Recreation Area is a 123,200 ha proposal centered around the current Hells Canyon National Recreation Area and includes lands in Idaho, Oregon, and Washington (Hells Canyon Preservation Council 1992). Hells Canyon is the deepest river carved gorge in North America. Due to extensive elevation gradients and diverse topographic features the area supports many different ecosystems as well as significant archaeological resources. At the time of our analysis, the available data were limited to the Idaho portions of this proposal.

Since 1911 many attempts have been made to designate a national park centered around the Sawtooth Mountains in central Idaho. The 410,764 ha Sawtooth National Park and National Recreation Area proposal was the result of an NPS study in the early 1970s (NPS 1975). Resources include high elevation rugged mountains, spectacular scenery, and abundant wildlife.

Informal proposals have been made for a national park of 128,324 ha in the Owyhee canyonlands of southwestern Idaho (Crosby 1991). These lands have been recommended for wilderness designation (Bureau of Land

Management 1989, 1991). The Owyhee river and its tributaries dissect a high elevation desert plateau resulting in steep, isolated, and very scenic canyons. The area supports sagebrush—wheatgrass vegetation as well as riparian plant communities and an isolated population of mountain sheep (*Ovis canadensis californicus*).

Methods

Four different databases, discussed below, defined ecoregions, vegetation types, land ownerships, and land status. The data were stored, organized, and analyzed using a geographic information system (GIS).

Natural ecoregions as defined by Omernik (1986) were our primary scale of analysis. Ecoregions are considered to be objectively defined geographic units whose ecosystem properties are relatively homogeneous in terms of climate, topography, and vegetation (Bailey 1976). Idaho contains six ecoregions and the park proposals fell into three of those (Fig. 1). Craters of the Moon and the Owyhee canyonlands are in the Snake River Basin/High Desert Ecoregion, the Hells Canyon area is in the Blue Mountains Ecoregion, and the Sawtooth Mountains are in the Northern Rockies Ecoregion.

The existing vegetation of Idaho was mapped at a scale of 1:500,000. This effort used data from several sources to describe the 26 vegetation types that occurred in the three ecoregions that encompassed the four proposals (Appendix 1) (Scott et al. 1993).

Discrete vegetation types are often used as surrogates for information on the distribution of plant and animal species because they are more easily derived and more widely available (Pressey 1990). We assumed that by preserving a sufficient land area of a representative set of vegetation types the protection of a majority of all species would be assured. Some authors have indeed suggested that preserving representative plant communities could protect up to 85% of all species. However, this figure is probably overly optimistic and our strategy essentially represents a "coarse filter" that must be complemented by a species-specific strategy to conserve uncommon species (Noss 1987a).

A land ownership database was developed by the Idaho Department of Water Resources (IDWR) at a scale of 1:100,000. Ownerships by all federal and state agencies were combined into one class resulting in two broad categories of land ownership, private and public. We assumed that policy changes in land use designed to enhance biodiversity protection would involve similar actions on all public lands.

Land status maps for Idaho were produced at a 1:100,000 scale by IDWR and three classes were identified: protected public lands, unprotected public lands, and unprotected private lands (Scott et al. 1993). Pro-

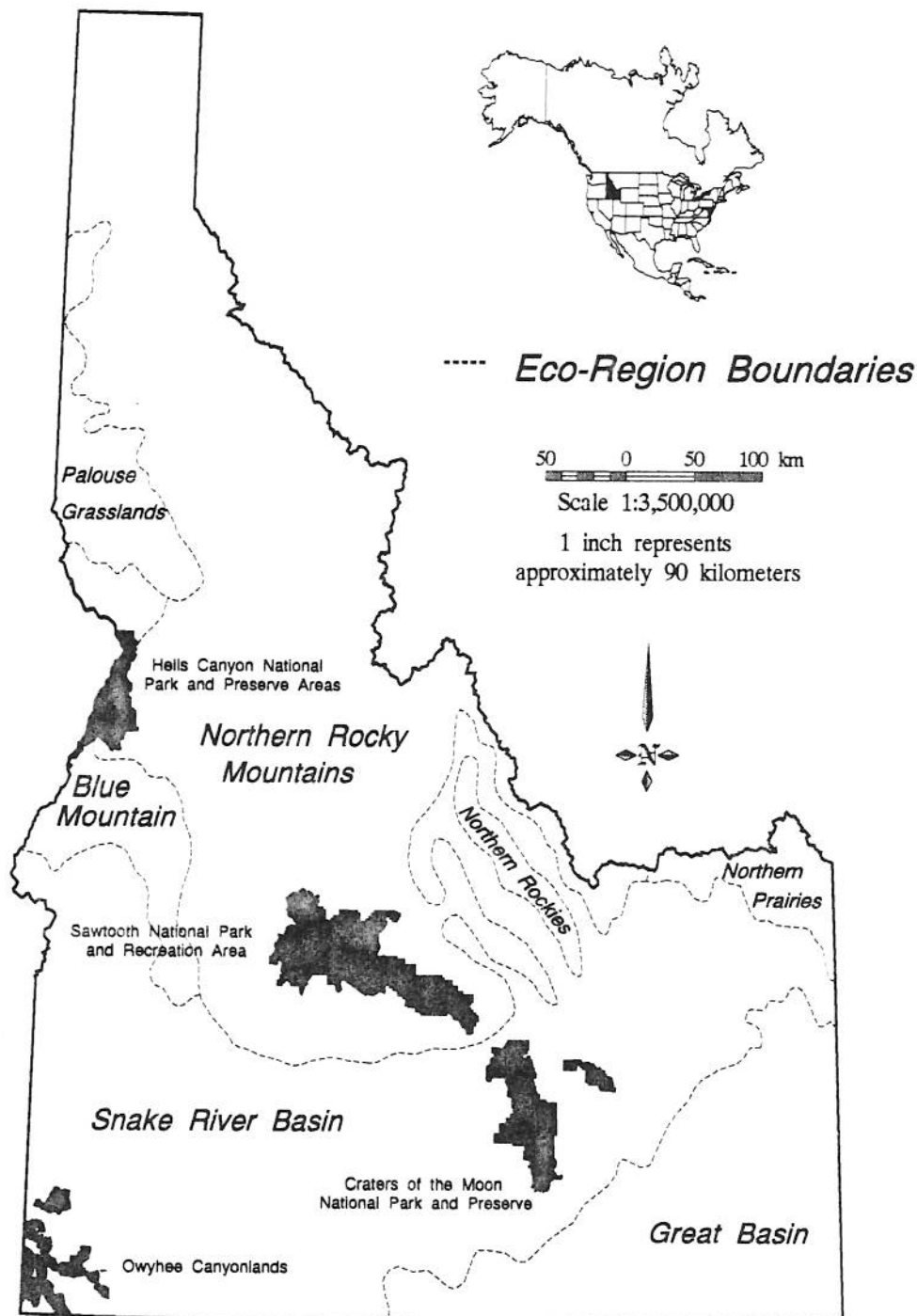


Figure 1. Map of the four national park proposals in Idaho and the boundaries of the ecoregions in which they are located.

tected public lands included those in which most resource extraction (e.g., mining and timber harvest), development (e.g., extensive road systems and facilities), and habitat manipulation (e.g., artificial alteration of native plant communities) is prohibited by law or agency policy. Unprotected public lands were those where consumptive resource use and development are permitted according to various laws and regulations.

All privately owned lands were assumed to have few legal mandates to protect them and were generally unavailable as part of a biodiversity reserve system. This assumption did not take into account the fact that a small percentage of private lands in Idaho are owned and protected by private conservation foundations.

Within each ecoregion, we evaluated a conservation strategy designed to preserve each vegetation type in

proportion to its occurrence. Criteria for determining the size of individual reserves include the maintenance of self-sustaining populations of particular species and how many species the area can support (Diamond 1986). Guidelines for the amount of land that should be devoted to a reserve system have been less conclusive, although the International Union for the Conservation of Nature and Natural Resources recommended that 10% of a nation's land area be protected (Miller 1984). Our goal in this analysis was to protect a minimum of 10% of the land area occupied by each vegetation type in each ecoregion. We assumed that all vegetation types had equal importance.

Analyses followed the steps described below.

- (1) Land ownership, vegetation, and land status data layers were organized and defined based on the extent of the three ecoregions encompassing the four national park proposals. Only data for the Idaho portion of those ecoregions were available.
- (2) The percentage of land area occupied by each vegetation type, land ownership, and land status was calculated for each ecoregion.
- (3) Maps of the four proposals were georeferenced and digitized.
- (4) The percentage of land area occupied by each vegetation type within the proposals was calculated.
- (5) The land area needed by each vegetation type in each ecoregion to meet the 10% goal was calculated. This figure was compared with the area occupied by each vegetation type in a proposal and with areas occupied by each vegetation type already in protected land status. This comparison allowed an assessment of the level of protection afforded a vegetation type and the extent to which a proposal added to that protection.
- (6) To evaluate potential modifications to the proposals, a 15 km zone was established around each proposal. Within the zone we plotted the spatial extent of all vegetation types requiring additional protection in an ecoregion.
- (7) The areas occupied by vegetation types occurring closest to the proposals that were large enough to meet the conservation strategy were identified as potential additions to the proposals.

Results

Approximately 83% of the lands in the Snake River Basin-High Desert Ecoregion were publicly owned. Protected lands comprised 6.6% of the total land area. Twenty-two vegetation types were present in the ecoregion but only three had at least 10% of their land area in protected status. There were 11 vegetation types that had less than 1% of their land area protected.

Most of the lands (78%) that occurred in the Craters

of the Moon proposal were occupied by the sagebrush-lava fields mosaic vegetation type (Big sagebrush) which was already adequately protected in the ecoregion (Table 1). The proposal provided no additional protection for 16 types that were inadequately protected, and made a relatively minor contribution to two others. The proposal substantially increased the protection given to the juniper/sagebrush/bitterbrush woodlands and annual grasslands.

The Owyhee Canyonlands proposal contained six vegetation types (Table 1). It made important contributions to the protection of three vegetation types: montane shrubfields, juniper/sagebrush/bitterbrush woodlands, and sagebrush mosaics. Two of the dominant vegetation types in the proposal, the sagebrush lava-fields mosaic and canyon grasslands were adequately protected elsewhere in the ecoregion.

Publicly owned lands comprised 60% of the Idaho portion of the Blue Mountains Ecoregion. Almost 7% of the total land area is protected. Twelve vegetation types were present in this area and three of these were unprotected. The Hells Canyon proposal did not substantially increase protection for many vegetation types, since 76% of the area was occupied by three types (Subalpine, ponderosa/grass, and canyon grasslands), which were already adequately protected (Table 2). Conversely, the proposal provided no additional protection to five vegetation types that were not adequately protected, and only a relatively minor contribution to two others. The proposal did substantially increase the protection given to the grand fir forest and montane shrub-field types.

Publicly owned lands comprise 88% of the Northern Rocky Mountains Ecoregion with most managed by the U.S. Forest Service. Twenty-four potential vegetation types were found in the Idaho portion of this ecoregion. Because of the large amount of designated wilderness in this ecoregion, a significant proportion of the lands were protected (22.4%). Twelve of the vegetation types had at least 10% of their lands in protected status while four types received no protection.

The majority of lands in the Sawtooth Mountains proposal (77%) supported vegetation types that were already adequately protected in the ecoregion. The proposal provided no additional protection to eight vegetation types that were not adequately protected (Table 3). It substantially increased the protection given to the mixed grand fir, mountain sagebrush, and shrub-steppe types.

It was not possible to modify any of the proposals to protect fully all of the unprotected vegetation types that occurred in the ecoregions using the 15 km limit. In most cases, only a few vegetation types in the zone met the conservation goal. These included shrub-steppe and perennial grasslands in the modified Craters proposal, grand fir, ponderosa pine, and montane shrubfields, in

Table 1. Vegetation protection in the Snake River Basin Ecoregion (Craters Expansion [CEP] and Owyhee Canyonlands proposal [OCP]).

Vegetation type*	Total area (ha)	Vegetation Protection (%)			Total
		Current	Additional with CEP	Additional with OCP	
Alpine	3026	0	0	0	0
Subalpine	1995	0	0	0	0
Lodgepole pine	869	0	0	0	0
Grand fir	2748	0	0	0	0
Douglas fir	70,338	0.9	0	0	0.9
Mixed lodgepole	3198	0	0	0	0
Ponderosa pine	12,706	0	0	0	0
Mixed grand fir	13,981	0.3	0	0	0.3
Lodgepole/aspen	1155	0	0	0	0
Ponderosa/grass	41,664	1.6	0	0	1.6
Mountain sagebrush	99,215	1.9	0.4	0	2.3
Montane shrubs	91,404	0	0	5.3	5.3
Woodlands	179,639	6.7	7.8	17.0	31.5
Shrub-steppe	801,178	1.7	0.6	0	2.3
Sagebrush	762,387	6.1	0	7.3	13.4
Big sagebrush	2,138,069	11.6	8.2	0.9	20.7
Salt desert	406,688	4.6	0	0.001	4.6
Canyon grassland	132,143	22.9	0	13.0	35.9
Riparian	23,668	8.2	0	0	8.2
Marshlands	11,629	49.9	0	0	49.9
Annual grassland	681,321	0.8	3.7	0	4.5
Perennial grassland	443,755	1.7	1.3	0	3.0
Total	5,949,033	6.6	3.8	2.2	12.6

*For a detailed description of vegetation types see Appendix 1.

the Hells Canyon proposal, montane shrubfields in the Owyhees, and mixed grand fir and shrub-steppe in the Sawtooths.

Discussion

Three of the four proposals have very similar characteristics in terms of land area occupied by vegetation types currently in protected status and their contributions to the conservation goal. The exception to this was the

Owyhee Canyonlands where 67% of the lands in the proposal were occupied by two vegetation types not adequately protected in the ecoregion. The majority of the vegetation types contained in the other three proposals were already adequately protected elsewhere in their respective ecoregions. In the Snake River Basin this protection is provided by Craters of the Moon National Monument and the Idaho National Engineering Laboratory (253,186 ha combined). In the Blue Mountains and Northern Rockies Ecoregions protection is provided by 1.6 million ha of designated wilderness. The proposals did, however, make significant advances toward the goal for some vegetation types. For example, montane shrubfields in the Snake River Basin currently lack any protection, and the Owyhee proposal would bring 5.3% of this type into protected status (Table 1).

Combining data across ecoregions would result in a different view of conservation needs. For example, while no alpine communities are protected in the Snake River Basin, 25% of the lands in this vegetation type are protected in the Northern Rockies. However, efforts to protect representative samples of national environments must be scaled to a relatively homogeneous geographical unit. We feel the ecoregion is the most appropriate unit of spatial analysis and has been used in other studies and management programs to define gaps in the protection of biological and physiographic resources (NPS 1972; Austin & Margules 1986).

The use of buffer zones to expand the protection of

Table 2. Vegetation protection in the Blue Mountains Ecoregion (Hells Canyon Proposal [HCP]).

Vegetation type	Total area (ha)	Vegetation Protection (%)		
		Current	Additional with HCP	Total
Subalpine	14,552	19.2	18.7	39.9
Subalpine forests	3751	0	0	0
Grand fir	92,763	4.3	3.2	7.5
Douglas fir	8821	4.3	1.8	6.1
Ponderosa pine	268,111	1.5	1.5	3.0
Ponderosa/grass	113,411	11.9	11.6	23.5
Mountain sagebrush	12,344	0	0	0
Montane shrubs	85,817	0.5	7.4	7.9
Shrub-steppe	16,706	0.3	0	0.3
Big sagebrush	43,973	0.1	0	0.1
Canyon grassland	111,469	24.6	24.5	49.2
Riparian	4912	0	0	0
Total	776,630	6.8	7.3	14.1

Table 3. Vegetation protection in the Northern Rockies Ecoregion (Sawtooth Proposal [SP]).

Vegetation type	Total area (ha)	Vegetation Protection (%)		
		Current	Additional with SP	Total
Alpine	80,585	24.5	46.3	70.8
Subalpine	735,758	30.2	17.8	48.0
Subalpine forests	467,874	53.0	6.3	59.3
Mountain hemlock	136,732	28.2	0	28.2
Lodgepole pine	337,508	28.6	1.6	30.2
Montane forests	494,369	1.8	0	1.8
Western redcedar	1,242,104	6.9	0	6.9
Grand fir	340,040	13.5	0	13.5
Douglas fir	1,328,461	36.1	3.7	39.8
Mixed lodgepole	493,647	39.1	10.0	49.1
Ponderosa pine	929,872	26.4	0.001	26.4
Mixed grand fir	146,886	2.1	4.2	6.3
Ponderosa/grass	145,049	21.1	0	21.1
Mountain sagebrush	508,047	9.0	14.4	23.4
Montane shrubs	301,034	21.3	0	21.3
Woodlands	399	0	0	0
Shrub-steppe	328,687	2.3	3.5	5.8
Sagebrush	43,205	0	0	0
Big sagebrush	65,233	0.4	0.1	0.5
Salt desert	36,775	4.9	0	4.9
Canyon grassland	41,024	3.2	0	3.2
Riparian	34,027	19.5	33.8	53.3
Annual grassland	460	0	0	0
Perennial grassland	3617	0	0	0
Total	8,196,802	22.4	5.0	27.4

natural reserves has been widely advocated (Oldfield 1988; Mwalyosi 1991). In general, our analyses suggest that simply expanding the proposals did not contribute greatly to the preservation of biodiversity. This was because many of the lands surrounding the proposals were occupied by the same vegetation types that were found in the proposals. Inadequately protected vegetation types were relatively uncommon and widely dispersed in their respective ecoregions. For example, nearly half of the vegetation types in the Snake River Basin occupied only 1.3% of the land area. They also occurred in a small number of distinct areas and thus the probability of their occurring in the 15 km zone was low. This suggests that protecting 10% of some vegetation types in some regions may be not realistic without focusing on those rare types and expanding from those.

All of the modified proposals could be reduced in size without diminishing their ability to meet the conservation goal by excluding portions of vegetation types that are adequately protected by the original proposal or elsewhere in the ecoregion. Since the total area occupied by a proposal is likely to be a source of controversy, it would be advantageous to make those additional modifications. However, we did not consider this option in our analyses because these types of refinements are best conducted by agency planners and administrators.

Although the boundaries of the ecoregions used in this analysis extend beyond the borders of Idaho, we feel that, as in many areas of the world, political bound-

aries will continue to play an important role in conservation planning efforts (Van Riet & Cooks 1990). For example, Idaho is the only western state that does not have a national park headquartered within its borders. This situation is one of the driving forces behind the national park proposals analyzed in this study, and may be a significant factor leading to the establishment of a new park (MacCracken & O'Laughlin 1992).

It could be argued that by combining the proposals (e.g., Craters of the Moon and Owyhee Canyonlands) resource protection would be enhanced (Table 1, last column). While this is partially true, all of the proposals are highly controversial and the probability of more than one park being established in the near future is low.

The approach outlined in this paper provides an objective basis for setting priorities among various proposals based on their contribution to the protection of biological resources and has wide application to large-scale reserve design throughout the U.S.A. and in many other countries. The methodology would be of value to planners, decision makers, and interest groups as it appears unlikely that more than one proposal will be seriously considered in the near future. This analysis also illustrates that the planning process for new parks needs to be an interdisciplinary effort. The proposals were all based primarily on visual and recreational resources as well as dissatisfaction with current management programs affecting the resources. The proposals would probably do an adequate job of protecting scenic and recreational attributes of each area. However, the relatively small contribution these proposals made toward conserving the biological elements in their respective ecoregions reflects the need for more attention to ecological criteria in proposal selection and design. This point raises considerations similar to those used in arguments over the value of habitat corridors (e.g., Noss 1987b; Simberloff et al. 1993). That is, if limited funds and political capital are used to set aside lands for a national park that contributes little to biodiversity protection, the potential to add other biologically diverse lands may be compromised.

This exercise has illustrated the benefits of using resource data in conjunction with a GIS to help define the boundaries of proposed conservation areas (i.e., proposal modification). It has also shown some of the limitations of this technique. The approach we took was the converse of the gap analysis methodology (Scott et al. 1993) which uses overlays of resource data and land status to identify zones of unique habitat assemblages or high species richness that are currently unprotected. Gap Analysis then targets these areas as those where the greatest resource protection can be achieved. By using preselected areas, we were constrained to the data within and adjacent to each proposal. As a result we were less likely (i.e., only by coincidence) to encounter unique resources or regions of high species richness.

Appendix continued

<i>Vegetation code</i>	<i>Description</i>
Montane shrubs	Montane shrubfields with buffalo-berry <i>Shepherdia canadensis</i> , cinquefoil <i>Potentilla</i> sp., and vetch <i>Astragalus alpinus</i>
Woodlands	Foothills and plains woodlands with western juniper (<i>Juniperus occidentalis</i>), sagebrush sp., bitterbrush (<i>Persia tridentata</i>), and greasewood (<i>Atriplex</i> sp.)
Shrub-steppe	Shrub-steppe grasslands with several species of sagebrush, and bitterbrush
Sagebrush	Mosaics of various sagebrush species
Big Sagebrush	Big and low sagebrush mosaics

Appendix continued

<i>Vegetation code</i>	<i>Description</i>
Salt desert	Salt desert shrub
Canyon grassland	Canyon grassland and shrub communities
Riparian	Riparian and wetlands including cottonwood and willow floodplain types
Marshlands	Marshes with rushes <i>Juncus</i> sp., sedges <i>Carex</i> sp., and cattails <i>Typha latifolia</i>
Annual grassland	Annual grasses including cheatgrass (<i>Bromus tectorum</i>) and foxtail fescue (<i>Festuca megalura</i>)
Perennial grasslands	Perennial bunchgrasses including bluebunch wheatgrass <i>Agropyron spicatum</i> and Idaho fescue <i>Festuca idahoensis</i> grassland

