Revista Chilena de Historia Natural
64: 615-626, 1991

Conservation of temperate ecosystems in Chile: Coarse versus fine-filter approaches

Conservación de ecosistemas templados en Chile: aproximaciones de filtro fino versus filtro grueso

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ABSTRACT

We review the status of the terrestrial biota of the temperate zone of Chile as well as the approaches followed by Chilean authorities for their protection. Over 50% of the Chilean endangered or vulnerable species live in the temperate region. Habitat destruction and illegal harvesting are the prime factors diminishing their populations. While 12 million ha have been allocated to parks and other conservation units in the temperate region, setting aside lands by itself will not suffice to ensure the long-term survival of several species. Management will be required. The conservation of biological diversity in Chilean temperate ecosystems has relied on two major approaches, the coarse- and the fine-filter approach. The former focuses on the conservation of community-types (in Chile, mainly forest-types) while the latter focuses on the conservation of individual species. The scientific knowledge required to support decisions based on each approach is essentially lacking. The type of information needed to solve critical conservation issues is equivalent to the information required to foster ecological theory. Therefore, ecological research in Chile should focus on endangered or economically valuable species within protected areas, satisfying both the need for solid scientific information for the decision-making process in conservation and the development of ecology as a scientific discipline.

Key words: Biological conservation, Chile, temperate ecosystems, national parks.

RESUMEN

Nosotros revisamos el estado de conservación de la biota terrestre de la zona templada de Chile y los enfoques seguidos por las autoridades chilenas para su protección. Sobre un 50% de la biota amenazada de extinción habita la región templada de Chile. La destrucción del hábitat y la explotación ilegal son los factores primarios responsables de esta situación. Si bien 12 millones de hectáreas han sido asignadas a parques nacionales y otros tipos de unidades de protección en la zona templada de Chile, la mera protección no será suficiente para asegurar la sobrevivencia a largo plazo de muchas especies sin un manejo de las especies y áreas. La conservación de la diversidad biológica ha descansado en dos enfoques: el de filtro grueso y filtro fino. El primer enfoque se centra en la conservación de comunidades tipo (en Chile, tipos forestales); el segundo se basa en la conservación de especies individuales. El conocimiento científico necesario para apoyar las decisiones basadas en cada aproximación es muy escaso. La información necesaria para resolver cuestiones cruciales en conservación es equivalente a aquella necesaria para promover el desarrollo de la teoría ecológica. La investigación ecológica en Chile podría enfocarse en especies amenazadas o de interés económico dentro de parques nacionales, satisfaciendo al mismo tiempo las necesidades de información científica para el proceso de toma de decisiones en conservación y el desarrollo de la ecología como disciplina científica.

Palabras claves: Chile, conservación biológica, ecosistemas templados, parques nacionales.

INTRODUCTION

Conservation biology aims toward the development of "principles and tools for preserving biological diversity" (Soulé 1985: 727). The conservation of biological diversity has, by itself, three goals: a) to maintain essential ecological processes and life support systems, b) to preserve genetic diversity, and c) to ensure the sustainable utilization of species and ecosystems (IUCN *et al.* 1980: vi). Therefore, conservation biology is ultimately related to human welfare via the preservation of species and ecosystem processes. As such, the conservation of living resources is pursued through the cooperative efforts of different disciplines such as ecology, genetics, sociology, economy, law and philosophy (Soulé 1985).

(Received 27 June 1990.)

Undoubtedly, the development of effective principles and tools for preserving biological diversity depends upon the nature and extent of the scientific information available (Soulé 1986). However, managerial plans and conservation decisions often have to be taken based on incomplete information. Societal demands and the current biotic crisis impose a time constraint upon conservation biology and its concurrent disciplines (Diamond & May 1985, Wilson 1985, Simonetti 1988). If available, time ought to be devoted to research aimed toward understanding crucial processes and mechanisms that, hopefully, will be relevant to unravel the factors affecting biological diversity in a long term perspective, helping to preclude the eventual demise of a significant fraction of the extant biota (Diamond & May 1985, Soulé 1986).

Ecosystems in the temperate region of Chile are a case in point. Most forests and their associated fauna are facing increasing human pressure, due to logging, burning, grazing, agriculture, the introduction of alien plants and animals, and potential global impacts, such as acid precipitation and greenhouse effects. In fact, several plant and animal species inhabiting the temperate rainforests of Chile are of conservation concern, but the structure and function of the ecosystems to which they belong are poorly understood (Veblen *et al.* 1983). As in other ecosystems, the lack of detailed or complete information regarding the structure and function of the Chilean temperate forests forces us to establish research priorities in order to satisfy both basic research, ranging from pure, modern natural history to testing of theoretical issues, and managerial needs, ranging from restoration procedures to exploitation strategies (Soulé 1986). Within this framework, our aim is to review the conservation status of the temperate biota of Chile and, to analyze how two basic approaches have been applied to the conservation of this biota: the fine- and coarse-filter approaches (Noss 1987).

First we provide a summary of the conservation status of woody plants and terrestrial vertebrates of the temperate ecosystems as well as the protection given to them in national parks and other conservation units. Second, we ask whether basic information regarding conservation issues is available, even if studies were not originally intended to contribute to conservation. We do not attempt to review all literature available on the flora, fauna, ecology and anthropology of the Chilean temperate ecosystems (see other articles of this volume for references). Rather, we will emphasize the assumptions, advantages and limitations of the fine- and coarse-filter approaches for biological conservation and indicate where critical information needed to support conservation decisions is currently lacking.

CURRENT STATUS OF THE TEMPERATE FLORA AND FAUNA IN CHILE

Conservation efforts in Chile have been concentrated in the National System of Protected Wildlands (SNASPE) (Weber & Gutiérrez 1985). Regarding biological diversity, SNASPE is oriented toward: a) maintaining areas of unique features or representatives of the natural ecological diversity of the country or places with animal and plant communities, landscapes or natural geological formations, in order to enhance education and research and to ensure the continuation of evolutionary processes, animal migrations, patterns of genetic flux, and environmental regulation, and b) to maintain and improve wild plant and animal resources and to rationalize their use (Chilean Law Nº 18362, 1984).

Several species inhabiting temperate ecosystems are currently of conservation concern. Among native trees and shrubs, a total of six species are considered endandgered, while seven are regarded as vulnerable, according to IUCN standards (Table 1). Among them, the tree pitao, *Pitavia punctata* and the shrub valdivia, *Valdivia gayana* are endangered, while the araucaria, *Araucaria araucana* and alerce, *Fitzroya cupressoides* are regarded as vulnerable (Benoit 1989; see also Muñoz 1971). Compared to the total number of native trees and shrubs of conservation concern in Chile, 35% are within the

TABLE 1

Conservation status of terrestrial plants and vertebrates in the temperate region of Chile. Status indicates the conservation status according to IUCN standards: E = endangered and V = vulnerable. Figures are number of species in each category in Chile and within the temperate region. Sources: Glade (1988) and Benoit (1989)

Estado de conservación de plantas y vertebrados terrestres en la región templada de Chile. Estado indica su estado de conservación acorde los estándares de UICN: E = en peligro de extinción, y V = vulnerable. Los valores indican el número de especies por categoría en Chile y dentro de la región templada. Fuentes: Glade (1988) y Benoit (1989)

Taxon	Status	Chile	Temperate region of Chile	
			n	%
Trees &	E	11	6	55
shrubs	V	26	7	27
Mammals	E	15	7	47
	V	15	9	60
Reptiles	E	1	–	–
	V	13	7	54
Birds	E	10	5	50
	V	32	13	41
Amphibians	E	6	3	50
	V	9	7	78
Fishes	E	18	11	61
	V	23	19	83
Subtotal	E	50	26	52
Vertebrates	V	92	55	60
Total plants	E	61	32	52
& animals	V	118	62	53

temperate region, particularly endangered species.

Among vertebrates, 26 species are endangered and 55 are vulnerable, accounting for 57% of the endangered and vulnerable species of Chile (Table 1). Among the mammals, seven species are endangered and nine are vulnerable, which accounts for 53% of the mammal species in these two categories in Chile (Table 1). Of the nation's endangered tree, shrub and vertebrate species, 55% are within the temperate region (Table 1). No information is available on the conservation status of terrestrial invertebrates, and other organisms which may be important in maintaining basic ecosystem processes (e.g., decomposers).

Regarding the proximate causes of population decline, the case of mammals is illustrative. Direct exploitation and habitat destruction are the prime factors diminishing the population for the 16 mammal species either endangered or threatened (Miller 1980, Miller *et al.* 1983). Mammals have been exploited by rural workers for meat and pelts in order to supplement their diets or income through commercial hunting. Sport hunting, mostly illegal, is of secondary importance as a cause for reducing mammalian populations. Habitat destruction is mainly due to logging, fire and livestock trampling (Miller *et al.* 1983: 347). Therefore, the protection of species within national parks and other conservation units seems a reasonable alternative to reduce the impact of these factors. However, the regulation of land use practices and commercial hunting outside parks is a necessary complement to protective measures within the SNASPE.

TABLE 2

Representation of the temperate region in the Chilean conservation system. Figures are a) the number of units in Chile and the temperate region, b) the area covered by them in the temperate region, c) the percentage of the continental surface of Chile protected by each type of conservation unit and, d) the percentage of each category in the temperate region regarding the total area protected by each category in Chile

Representación de la región templada en el sistema de conservación chileno. Valores son a) el número de unidades en Chile y la región templada, b) el área cubierta por ellas en la región templada, c) el porcentaje de la superficie continental de Chile protegido por cada categoría de unidad de conservación y d) el porcentaje de cada categoría en la región templada respecto al área total protegida por cada categoría de unidad en Chile

Units	Number in Chile	Temperate region	Protected land (ha) in temperate region	Percent of continental Chile	Percent of protected Chile
Parks	30	21	7,999,898	10.6	95.3
Reserves	36	28	4,888,275	6.5	92.7
Monuments	10	7	3,010	< 0.1	20.8
Total	76	56	12,883,183	17.1	94.3

Next, we examine the coverage and other characteristics of SNASPE in the temperate region of Chile.

Almost 14 million ha are currently part of SNASPE, representing 18% of the continental surface of Chile (see Valencia *et al.* 1987, for an analysis up to 1986). National parks alone account for 11% of the Chilean surface, amounting to 62% of the total land protected under SNASPE. Although Biosphere Reserves do exist in Chile, they overlap almost completely with national parks in areal extent, without adding extra protected or managed land to the SNASPE (Valencia *et al.* 1987, Weber 1983).

Temperate ecosystems, defined as natural areas south of 37°S (Vuilleumier 1985) are well-represented in the Chilean system of protected areas. Within the temperate region, protected areas amount up to 8 million ha, which represents over 95% of the total protected areas of Chile. Parks and other units in the temperate region amounts up to 17% of the surface of the country (Table 1; Valencia *et al.* 1987). According to di Castri (1968), the temperate zone of Chile includes five biogeographic regions, namely a) the oceanic region with mediterranean influence, b) the cool temperate oceanic region, c) the transandean region, d) the subantarctic oceanic region and, partially e) the andean continental region. These regions are included in only two biogeographic provinces defined by Udvardy (1984), the Valdivian forests, and the Chilean *Nothofagus* forests. Of the areas distinguished by di Castri (1968), the oceanic cool temperate region is particularly well represented in the SNASPE. Over 2 million ha are under protection either as parks, reserves or monuments, accounting for over 51% of the land surface of this biogeographic region. Similarly, the subantarctic oceanic region is well represented, with over 7 million ha in the SNASPE, which represents 71% of the total area of this biogeographic region in Chile (Valencia *et al.* 1987)[1].

Some parks and reserves have been created to protect a) particular species, such as *F. cupressoides* in Alerce Andino

[1] Some minor quantitative discrepancies exist between total ha included in conservation units and the number of units as estimated in 1986 and 1989. CONAF has recently modified the number of parks, monuments and reserves and their coverage in order to rationalize the SNASPE. Currently, there are fewer conservation units but more land protected than a decade ago (Weber & Gutiérrez 1985).

National Park, and b) certain forests and community types, such as the Puyehue National Park, where *Nothofagus* rainforests and other community types are protected. In general, conservation units include samples of almost all types of forests in the temperate region of Chile (Oltremari & Jackson 1985). However, despite the extensive coverage of the SNASPE, not all plant and animal species of conservation concern are included in a national park or reserve (Table 3). In fact, only 53% of the endangered and threatened tree and shrub species are found within a conservation unit. The case of endangered tree and shrub species seems dramatic as only two out of the six species in this condition are protected in a conservation unit (Table 3). For instance, no population of the endangered *V. gayana* has been recorded in any unit of the SNASPE. The same occurs with the rare *Lobelia bridgesii*. Other endangered trees, such as the pitao *P. punctata* and ruil *Nothofagus alessandrii* are represented only in the national reserve Los Ruiles, a protected area of 45 ha. This situation contrasts with that of species, such as *F. cupressoides*. Populations of *F. cupressoides* are found in the Alerce Andino, Vicente Pérez Rosales, and Chiloé National Park, as well as in the Valdivia and Llanquihue National reserves (Table 3; Benoit 1989, CNNPA 1982).

TABLE 3

Representation of plant species of conservation concern in the Chilean conservation system. The number of conservation units (either parks, reserves or monuments) and the total area protected in which they occur are given for endangered and vulnerable terrestrial plants. Source: Benoit (1989)

Representación de especies de plantas en peligro de extinción o vulnerables en el sistema de conservación chileno. Valores son el número de unidades (parques, reservas o monumentos) en que cada especie ha sido detectada y el área protegida en la cual existe actualmente. Fuente: Benoit (1989)

	Number of units	Area (ha)
Endangered species		
Gomortega keule	0	0
Nothofagus alessandri	1	45
Pitavia punctata	1	45
Valdivia gayana	0	0
Vulnerable species		
Araucaria araucana	14	277,333
Austrocedrus chilensis	5	174,147
Fitzroya cupressoides	6	425,245
Laretia acaulis	4	58,942
Legrandia concinna	0	0
Nothofagus glauca	1	45
Nothofagus leonii	0	0

The areal representation of most Chilean temperate ecosystems in the SNASPE seems adequate. However, setting aside national parks or reserves will not suffice to ensure the long-term conservation of the biological diversity and for maintaining the representation of ecosystems and community types currently recognized. Several species and ecosystems require active management for their long-term sustainability (e.g., Soulé *et al.* 1979), including management programs and use of surrounding unprotected areas (Garratt 1984, Janzen 1988), e.g., fire control programs in *Eucalyptus* forests.

The adequacy of management procedures and the final success of Conservation Biology will depend upon the nature and extent of the information available about the protected species, communities and ecosystems. In the next section, we critically examine some of the underlying assumptions for the development of the Chilean SNASPE, and analize what kind of information is available to validate them.

COARSE AND FINE-FILTER APPROACHES TO CONSERVATION

The Chilean conservation system has focused on two hierarchical levels, species (and their populations) and community types or, in practical terms vegetational units. In many cases these vegetation units are restricted to forest types, thus ignoring non-forest plant formations (Oltremari & Jackson 1985). These two levels of concern can be referred to as the fine- and coarse-filter approaches to maintain biological diversity (Noss 1987).

The coarse- and fine-filter approaches have basic assumptions and requirements regarding the available database that ought to be considered in order to become successful conservation strategies. Here, we briefly review some of the underlying assumptions of these two approaches, while highlighting the evidence available to support and/or needed to correct them.

The coarse-filter aims to protect the best representatives of the indigenous diversity of community-types in each biogeographic region. This view assumes that a proper array of vegetation or community-types will encompass the vast majority of the species. This assumption depends on the demonstration that the areas of each community-type contain the maximum number of species estimated from species-area relationships. These relationships, however, are unknown for most of the natural communities under protection. Those rare species which are not included by the coarse-filter as they occur in few of the major community-types, ought to receive particular attention (Noss 1987). For example, 15 forest-types (read community-types) are recognised in the temperate region of Chile (Veblen *et al.* 1983). A large portion of this diversity of forest-types is represented in several national parks, such as Puyehue, Pérez Rosales and Chiloé which also encompass several of the plant species of conservation concern along a vast array of other plant species (Muñoz 1980, Villagrán *et al.* 1974). However, rare species or those with highly localized populations will rarely be included. Such seems to be the case of the ruil *N. alessandrii.* As of 1983, *N. alessandrii* was known from eight discontinuous populations covering only 820 ha (Donoso & Landaeta 1983). Therefore, special efforts are allocated to this species, setting aside some small areas just to preserve it (see Benoit 1989).

The fine-filter approach requires to know the specific needs of threatened species. That is, it is assumed that the area set aside to protect a given species will contain all or most physical and biotic conditions which impinge upon its population dynamics, if the recovery and long-term viability of the population is to be assured. For a plant species for instance, it is useful to know whether soil types in areas not presently supporting the target species could be adequate for seedling establishment and adult survival. Similarly, present and, more important, future climatic conditions must be evaluated to determine whether they are and will be within the tolerance limits for adult reproduction, seed germination, seedling establishment and survival. This means that ecophysiological tolerances of the critical phases of the life cycle ought to be known. In addition, it is often ignored that interactions with other organisms may mediate crucial steps of a plant's life cycle, as is the case of animal-pollinated plants, or animal-dissemination of seeds. The area set aside for protecting and animal-pollinated plant should include the pollen-vector and consider its ecophysiological tolerances as well. If the animal is absent from the protected area, it should be reintroduced. In general terms, basic aspects of the natural history of the target population should be known.

Again, ruil (*N. alessandrii*) offers a good example. This species is considered the least known among species of the genus *Nothofagus,* despite its scientific and economic value (Donoso & Landaeta 1983). All stands of *N. alessandrii* are second-growth, where all stems are resprouts from old stumps (Donoso & Landaeta 1983). Natural reproduction is unknown, as well as population parameters such as age and age to maturity, which are crucial to evaluate extinction probabilities (Soulé 1987). Similarly, factors affecting the regeneration of threatened tree species, such as alerce (*F. cupressoides*) are poorly understood (Veblen & Ashton 1982, Veblen *et al.* 1976).

The protection of species in small, almost homogeneous patches, such as the areas allocated to *N. alessandrii,* albeit practical, involves a high risk of extinction. The probability of extinction is related to patch area, landscape homogeneity and connectivity between patches. The smallest, more homogeneous and isolated the patches are, the higher are the extinction rates (White & Bratton 1980, Fahring & Merriam 1985, Wilcox & Murphy 1985, Wilcove *et al.* 1986, Quinn & Hastings 1987). No study is available for *N. alessandrii* or other species regarding its risk of extinction within protected areas given their current population size, patch area and degree of connectivity. Therefore, although the Chilean conservation system protects species that "slip through" the coarse-filter, we lack basic information regarding their probabilities of long-term survival.

Similarly, little information is available regarding ecophysiological tolerances of different plant and animal species to physical conditions, except for some species of *Nothofagus* (e.g., Alberdi *et al.* 1985). Potential climatic changes due to the greenhouse effect (Peters & Darling 1985) may modify local conditions in parks and reserves, which in turn affect survival and persistence of different species. Plant and animal species respond individualistically to varying climates, tracking environmental conditions at different pace. Therefore, the surface response of critical stages of the life cycles of plant and animals to various probable conditions of temperature and moisture would be valuable as well as information on the potential migratory routes for susceptible species to potentially varying climatic conditions (Graham 1988, Hunter *et al.* 1988).

Regarding animal species, their survival in parks will depend upon the availability of food resources and habitat, while their population responses will also be affected by their social structure (e.g., Chepko-Sade & Halpin 1987). Basic information about food habits and preferences of some species is available (e.g., Ortiz 1974, Yáñez *et al.* 1986, Patterson *et al.* 1989), as well as information on the home range and habitat utilization (e.g., Johnson *et al.* 1988), Ortega & Franklin 1988, Raedeke 1979). However these data are largely based on organisms which are not of conservation concern within the temperate region of Chile, studies have been conducted outside Parks, and have not addressed problems such as the organism's response to habitat deterioration especially in human-modified landscapes (e.g., Courtin *et al.* 1980).

As mentioned, a major threat to wild populations within the temperate region is their past and present commercial exploitation (Miller *et al.* 1983). Conservation plans ought to consider the likelihood and consequences of sustainable resource use as a basis for social support for conservation efforts (McNeely 1988; see also Mares 1988). Here, both the social and cultural value of the species involved must be taken into account while planning for conservation (e.g., González & Valenzuela 1979, Gunkel 1980) as well as the potential use, either consumptive or not, of the species involved (e.g., Franklin & Fritz 1991).

The coarse-filter on the other hand, aims to protect representative communities, especially forest-types. It is often assumed that vegetational units are recognizable and somehow permanent natural entities (Noss 1987). Here lies a fundamental problem with this approach. Communities can be regarded as epiphenomena of the individualistic response of each species to both the physical and biological environment (Gleason 1926, Whittaker 1967). In fact, modern species assemblages are recent ecological phenomena. During the Pleistocene and part of the Holocene many species that today occur together exhibited different geographic distributions, being allopatric during the recent past, and vice versa (Davies 1986, Graham 1986). Consequently, species assemblages must be conceived in a permanent dynamic flux, possibly far from an ecological equilibrium (Pickett 1980, Wiens 1984). Interestingly, few studies of the history and the dynamics of modern plant and animal assemblages are available within national parks. Especially useful would be retrospective and long-term studies of community dynamics on permanent plots (Likens 1989).

The temperate ecosystems of Chile are no exception to the recent origin of modern communities (Villagrán, this volume). Many current forest types are known only for the last 3,000 years. Interestingly, small mammal assemblages seem to have been more resilient to climatic changes than plants, at least regarding species composition. During the last 11,000 years the faunal composition of small mammals probably remained almost invariant, despite large climatic and vegetational fluctuations (Pearson 1987, Simonetti & Rau 1989). Recent changes could be attributed to modern human disturbance (e.g., Sielfeld 1979, see also Simonetti 1989).

In addition to climatic and soil conditions, species interactions also contribute to shaping community structure. Studies regarding the role of interactions upon biological diversity in habitat isolates seem necessary. So far, few studies of interactions, particularly of seed dispersal (Armesto *et al.* 1987), pollination (Arroyo *et al.* 1983), competition (Medel *et al.* 1988), herbivory (Veblen *et al.* 1989) and predation (Wilson 1984) have been conducted within national parks. Although none of these studies explicitly addressed managerial or conservation issues, their results are of prime concern for assessing the adequacy of the current protection strategies.

Rather than focusing on the protection of preconceived forest-types, an alternative conservation strategy suggests that a broad array of environments should be included in protected areas, exceeding the narrow focus on community types, to deal with a landscape scale (Hunter *et al.* 1988). Areas currently protected ought to encompass "a range of environments to allow organisms to adjust their local distribution in response to long-term environmental changes, and... should be connected as much as possible by large scale corridors that would allow species to change their geographic distributions in response to climate changes" (Hunter *et al.* 1988: 382), or to reinvade from nearby refuges in case of local extinctions.

Many national parks in the Chilean temperate region are indeed "large" by international standards, e.g., the Parque Nacional Bernardo O'Higgins which covers 3.5 million ha. However, it is unclear whether these territories encompass a broad variety of climatic and physical conditions as to offer a mosaic of environmental alternatives to their occupants. Particularly needed are studies focused on landscape-level which examine the interactions and fluxes between communities within and outside parks (Forman & Godron 1986; see also Garratt 1984, Ovington 1984). In fact, an important gap exists between the large Andean Parks and Coastal Range Parks which are small and isolated. There are not possible connections between those two natural systems through the Central Valley which is disturbed. However, migrations between the Andes and Coastal Ranges through the central depression have been important in the past (Villagrán, this volume).

Another aspect related to conservation units is whether they are large enough to encompass the "minimum dynamic area" (*sensu* Pickett & Thompson 1978), that is an area which includes all successional stages of the present communities in order to maintain the maximum number of species. Chilean *Nothofagus* forests are characterized by catastrophic disturbance, either related to vulcanism, earthquakes or fires (Veblen & Ashton 1978, Veblen 1979, 1985). These disturbances modify the mosaic of succesional stages represented by the *Nothofagus* forests. This mosaic associated with minor disturbances such as tree falls, provides an array of opportunities which are critical for the maintenance of many species in the region, e.g., shade intolerant tree species (Veblen 1985, Armesto & Fuentes 1988). Again, although some conservation units are large, it is unknown whether they encompass a mosaic of successional patches and how species diversity and patch distribution may be affected if parks become fragmented or reduced in area in the future (Soulé & Simberloff 1986).

Neither a national park is an island, nor parks seem sufficient to ensure the long-term survival of wide ranging species (e.g., Soulé *et al.* 1979). Therefore, the conservation of species will have to rely on areas of mixed social uses, read exploitation and conservation, and areas where conservation has no explicit priority. A matrix of both managed and presumably pritine areas, named the "semi natural matrix"

(Brown 1988)[2], which is an expanded version of the concept of a biosphere reserve (Goodier & Jeffers 1981) is a reasonable alternative to protect wide ranging species. We know of no attempt to determine whether national parks in the Chilean temperate region by themselves are big enough to support wide ranging species, and if not, how their conservation could be extended into the matrix of habitats available under agricultural, silvicultural and other social uses. The conservation of large mammals such as *Felis concolor* and *Lama guanicoe*, may have to rely on this approach. This could also be the case of many plant species that depend on man-created disturbances for their survival in the landscape mosaic. These species will disappear from parks as human activities are banned.

The term "seminatural" matrix, used in the context of conservation and protection laws usually implies that human activities are alien to the structure and functioning of local communities and ecosystems. This view neglects the long-term history of occupation of the temperate ecosystems in South America (Núñez 1989). Modern communities ensambled almost simultaneously with the first human invasions, over 10,000 years ago (e.g., Moore 1978). Further, several aboriginal populations relied on wild plant and animal species for ritual and are part of their cultural heritage (González & Valenzuela 1979, Gunkel 1980). If these species are protected in national parks, managers are forced to accept human use of these areas for cultural purposes by the descendent of the original populations (Dasmann 1984).

At the same time, the local flora and fauna has been exploited prior to and following the Spanish conquest. The significance of this long-term human-resource interaction needs to be clarified before strict managerial plans which preclude all human uses of the land are enacted (Simonetti 1986). In fact, some forms of land-use may be responsible for the present mosaic of communities and excluding human users may eliminate some species and change the dynamics of communities (e.g., Simonetti & Cornejo 1990).

WHERE DO WE GO FROM HERE?

Both the fine-and coarse-filter approaches including the landscape level seem and adequate strategy to ensure the long-term maintenance of biological diversity (Noss 1987). However their success depends on the amount and quality of the information available to back up managerial decisions (Mares 1988, Soulé 1986). Interestingly, critical ecological questions regarding conservation issues are almost the same as those required to advance ecological theory, e.g., effects of connectivity at the population, community and landscape level upon population survival (see Simberloff 1988, Pimm & Gilpin 1989).

The biota of the temperate region of Chile is threatened by habitat disruption and explotation. Over 50% of the Chilean biota of conservation concern is within this region. Protection through national parks and other conservation units appears satisfactory in terms of amount of land allocated to the SNASPE. However, the suitability of these areas as effective refuges and the viability of the populations protected in them are yet uncertain.

Protected areas offer unique opportunities to carry out scientific research. Not only unique species are available but also long-term ecological monitoring can be carried out without major risks of equipment or habitat disruption (Yáñez 1974, Franklin 1976). Although some ecological research has been conducted in Chilean national parks, mostly is descriptive, and largely unrelated to issues dealing with the long-term sustainability of the species and the ecosystems. It is clear that several theoretical and applied problems need to be studied in relation to the conservation of the Chilean temperate ecosystems. Further, the Corporación Nacional Forestal (CONAF; the Chilean organism in charge of biological conservation) has recently

[2] BROWN JH (1988) Alternative conservation priorities and practices. Bulletin of the Ecological Society of America 69 (supplement): 84 (abstract).

launched a program for supporting biological research in areas of the SNASPE, open to all researchers. Therefore, the time seems ripe for ecologists to develop research programs in a socially responsible fashion. That is, we must be primarily concerned with those issues and species that currently are at risk of extinction, as well as those species whose conservation may enhance human welfare through their sustained use as resources.

ACKNOWLEDGMENTS

This manuscript was written under the sponsorship of grants DTI 2596-8934 to JAS and FONDECYT 860-88 and DTI 2210-8945 to JJA.

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