

**OVERUSE AND ENDANGERMENT OF WILDLIFE:  
THE CASE OF CHILEAN MAMMALS**

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**RESUMEN**

El uso de mamíferos nativos por aborígenes en Chile tiene una larga historia. Ellos cazaban animales silvestres para obtener carne y pieles sólo a niveles de consumo bajos. Con la llegada de los europeos y con la ayuda de armas de fuego el uso de subsistencia de los mamíferos chilenos cambió a una explotación comercial descontrolada. La mayoría de las especies explotadas fueron incapaces de contrarrestar los altos niveles de captura, con lo que sus poblaciones disminuyeron tanto en número como en distribución. Evidencia anecdótica indica que modificaciones del hábitat por el hombre y la introducción de especies exóticas han contribuido a la disminución de los mamíferos silvestres, pero la causa más importante parece haber sido la sobreexplotación. Para lobos finos se documentan disminuciones poblacionales desde la primera mitad del siglo diecinueve. La chinchilla de cola corta fue extirpada de Chile después de un siglo de sobreexplotación. Actualmente, por la misma causa, sólo quedan poblaciones relictas de la chinchilla de cola larga y sus números continúan disminuyendo. Los esfuerzos de conservación para proteger a los mamíferos chilenos han sido en dos direcciones. Desde el siglo pasado se han dictado varias leyes, pero en general éstas no han sido aplicadas. El establecimiento de áreas protegidas a lo largo del país parece haber sido más efectivo. En éstas áreas, 15 especies de mamíferos silvestres con problemas de conservación han aumentado en número en las últimas décadas y actualmente algunas de ellas están consideradas fuera de peligro. Sin embargo, otras 9 especies aun están disminuyendo numéricamente y por lo tanto requieren de más atención. Es interesante notar que la academia no ha jugado un rol importante en la conservación de la vida silvestre en Chile. Actualmente un 48% de los mamíferos continentales chilenos presentan problemas de conservación. Diez especies son consideradas en peligro, 14 vulnerables, 8 raras, 4 insuficientemente conocidas y 5 fuera de peligro. Se recomiendan más estudios en estas especies y se proponen otros usos de manejo de la vida silvestre, tales como criaderos y ecoturismo, que realmente no han sido explotados en Chile.

**ABSTRACT**

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The use of native mammals by Indians in Chile has a long history. Natives hunted wild species for meat and fur at low consumption levels. The arrival of the Europeans, and the introduction of firearms changed the subsistence use to an uncontrolled commercial exploitation of Chilean mammals. Most of the harvested species were unable to withstand the heavy cropping and consequently their populations diminished in numbers and in distribution. Anecdotal evidence support the claim that different types of habitat modifications by humans and the introductions of exotic species have also contributed to the decimation of native mammals, but the most important cause seems to have been over-exploitation. For fur seals, the decrease in numbers was documented as early as in the first half of the nineteenth century. The short-tailed chinchilla was extirpated from Chile after one century of over-exploitation. The fate of the long tailed chinchilla was a slightly better. Today only a few relict populations remain in the wild and their numbers are still declining. The conservation efforts for protecting Chilean mammals has been mainly in two directions. Several laws have been passed since the past century, but they have been largely unenforced. The establishment of protected areas throughout the country seems to have been more effective.

Actually, within protected areas, there are 15 species of mammals of conservation concern that have increased in numbers during the last decades. Some of them are now considered «out of danger» by Chilean wildlife managers. However, nine other species are still declining and therefore they require more attention. Interestingly, the academia has not played a major role in the conservation of Chilean wildlife. Currently 48% of the Chilean continental mammals are of conservation concern. Ten species are considered endangered, 14 vulnerable, 8 rare, 4 insufficiently know, and 5 out of danger. More studies on those species are recommended. I propose other more managed uses of wildlife, such as ranching and ecotourism, which have been really exploited in Chile.

## INTRODUCTION

The use of natural resources by natives in Chile dates to ancient times. Chilean indians used several species of wild animals in different ways at a subsistence level (Miller 1980). However, with the arrival of Spaniards the use of wildlife changed to commercial exploitation (Albert 1913), mainly for fur (Iriarte & Jaksic 1986). Large-scale and intensive harvesting practices, with high short term returns, led to reductions in numbers and distribution of many Chilean species over the last 400 years (Elizalde 1970, Miller 1980). In addition, uncontrolled agricultural practices, livestock ranching, as well as large-scale mining and timber activities have modified the Chilean landscape markedly, adding indirectly to the reduction of wildlife (Fuentes & Prenafeta 1988). Finally, the introduction of exotic species contributed to the endangerment of Chilean fauna (Miller 1980).

Unlike the general trend in other countries, where habitat modifications play a primary role in the decrease in abundance of wildlife (Soulé & Wilcox 1980, Mares & Ojeda 1984, Redford *et al.* 1990), in Chile, over-exploitation of wild animals has been the more important cause (Miller 1980).

The first attempts for measures of wildlife conservation in Chile date to the end of the nineteenth century. However, as a general rule, the passing of laws to protect wildlife, has been too late and in many cases their enforcement has been frustrated by logistical constraints (Iriarte & Jaksic 1986). The establishment and efficient administration of a network of numerous protected wild areas throughout the country, successfully helped to revert processes of diminishing populations in several species of wild fauna (Glade 1988).

Here, as an example of wildlife use, I analyze the historical evidence of overuse of native Chilean mammals, other human-induced causes of endangerment, their consequences, and their current status. I show examples for endangerment of furbearers and present ideas for a sustained use of wild mammals. Nomenclature for autoctonous species follows Redford & Eisenberg (1992), and for exotics Tamayo *et al.* (1987).

## USE OF MAMMALS BY HUMANS BEFORE THE CONQUEST

Since the arrival of Spanish conquerors in Chile, early accounts have repeatedly described the use of wildlife by natives for many purposes at a subsistence level. During the last century, archaeologists have documented the harvesting of several species of mammals by indians for different uses throughout Chile (Miller 1980). The most important uses of wild animals were as a source of protein and for clothing.

The first record of a mammal hunted by Amerindians in Chile, the extinct *Mylodon*, dates to 11,000 years BP (Bird & Bird 1937). It may have been eaten by austral indians (Miller 1980). Chronicles describe the tuco-tucos (*Ctenomys* spp.) and guanacos (*Lama guanicoe*) as an important part of the diet of Fueguinean indians. Their skins were also used for clothing (Bird & Bird 1937). The hunting by natives for meat and hides of Chilean mammals (e.g. guanacos, chinchillas *Chinchilla* spp., fur seals *Arctocephalus* spp.) is extensively described by Gay (1848). In 1643, De Ovalle (1969) noted the widespread use of meat from degu (*Octodon degus*), mountain viscacha (*Lagidium viscacia*), and coypu (*Myocastor coypus*) by indians. At the time of the Spanish conquest, in the extreme north to the Chiloé Island, aborigines had already domesticated camelids, called «chillihueques» in central Chile (Miller 1980), and llama (*Lama glama*) and alpaca (*L. pacos*) in the altiplano.

Although natives had a subsistence level of gathering and utilized relatively inefficient hunting techniques, their population numbers were quite high, specially in central Chile (Larraín 1975). Therefore, the use of wild game in past times for food and hides by indians may have been intense. However, at the time of the Spaniard's arrival, there was no evidence of any species that were declining due to hunting by humans. On the other hand, the modifications of the environment by agricultural practices by natives seems to have been substantial (Miller 1980). This factor, more than the harvesting of wild populations of mammals *per se*, might have been important in shaping the distribution and abundances of some species in the past (Simonetti, pers. comm.).

## AFTER THE SPANIARDS' ARRIVAL

At the time of the European arrival in Chile, in the first half of the sixteenth century, the use of natural resources by humans changed. Although the use of wildlife for subsistence still remained important, commercial exploitation started. Also, the physiognomy of the landscape started to change at a higher rate as a consequence of massive deforestation and burning, agricultural practices, introduction of domestic animals, mining activities, etc. (Elizalde 1970, Fuentes & Prenafeta 1988). Although habitat modification has been widespread, there is no study to date that shows its effect on Chilean wild animals (Mares & Ojeda 1984, but see Simonetti 1983). The settlers, intentionally or by accident, introduced new species of animals, mostly mammals, which in many cases became feral or wild, with devastating consequences for the environment and consequently for the native fauna (Miller 1980; see next heading). However, the introduction of firearms by the European and their use by the settlers was decisive for the fate of wildlife (Albert 1913). Since then, the rate of wild animals harvesting skyrocketed, compared with pre-conquest times, when indigenous people used more primitive techniques. This was especially evident after the hunters and consumers realized the high quality of the fur and meat of the wild species. Once the international trade started, the new wild products arrived at the European and North American markets and the demand became even higher (Iriarte & Jaksic 1986). Furthermore, as the demand for those wild products increased, the incentives for harvesting increased, generating a never ending spiral. The uncontrolled exploitation of natural resources began, and the consequences for the wild populations were soon evident. The most affected group in the country was the mammals (Miller 1980, Glade 1988). Most harvested species showed the same trend over time: a steady decline in distribution and abundance.

## THE INTRODUCED SPECIES

In addition to the habitat disturbance produced by people and the high rate of cropping of species, the introduction and establishment of 16 species of mammals (Tamayo *et al.* 1987) also affected Chilean wild mammals in different ways. Their impact is obvious even at the broad landscape level. Most of the invaders found optimal conditions in the new environment: mild climate with plenty of food and weak competitors (Péfaur 1969).

Furthermore, the native predators were ineffective in controlling these new species (Fuentes & Jaksic

1981, Jaksic & Soriguer 1981, Jaksic & Yáñez 1983). As a result, population numbers of introduced mammals increased rapidly (Péfaur *et al.* 1968), with the consequent impact on different ecological processes and on the landscape. By overgrazing the native vegetation, introduced herbivores changed the physiognomy of the landscape (*i.e.* rabbit *Oryctolagus cuniculus*, hare *Lepus capensis*, goat *Capra hircus*, and feral ass *Equus asinus*; Fuentes & Prenafeta 1988), drove species to extinction (*i.e.* feral goat in Juan Fernández islands; Miller & Rottmann 1976) and probably competed for food with native herbivores (*i.e.* ass, red deer *Cervus elaphus*, fallow deer *Dama dama*, rabbit, here; Péfaur 1969, Miller & Rottmann 1976, Pine *et al.* 1979, Fuentes *et al.* 1983, Simonetti 1983, Grigera & Rapoport 1983). Other species modified the soil structure (*i.e.* digging and rooting: rabbit, wild boar *Sus scrofa*, and trampling: ungulates) or changed hydrological systems (*i.e.* beaver *Castor canadensis*, muskrat *Ondatra zibethicus*; Sielfeld & Venegas 1980). The introduced carnivores (*i.e.* feral dog *Canis familiaris*, feral cat *Felis catus*, coatimundi *Nasua nasua*, and mink *Mustela vison*) prey on native prey, altering the species composition, distribution, and the native predator-prey relationships. Also introduced carnivores probably compete with native carnivores (*i.e.* small wild cats *Felis* spp., foxes *Pseudalopex* spp., river otter *Lutra provocax*). Some introduced ungulates are likely responsible for the transmission of diseases which strongly affect native deer populations (*i.e.* pudu *Pudu pudu*, southern guemal *Hippocamelus bisulcus*; Péfaur *et al.* 1968, Miller & Rottmann 1976). Introduced rats (*i.e.* Norway rat *Rattus norvegicus*, Black rat *R. rattus*, and house mouse *Mus musculus*) act as reservoirs of several diseases and parasites that affect both wild fauna and humans (Péfaur *et al.* 1968).

The assessment of the consequences of these introductions on the native fauna is a difficult task, and almost no work has been done so far (but see Simonetti 1983). However, common sense suggests that the effect on the native species is not negligible. Introduced species, by direct or indirect interactions might have greatly shaped the distribution and abundances of some native mammals. Further work on this area is needed.

However, some benefits from the introduced mammals can be obtained by people. Sport hunting has been an important activity (rabbit, hare, red deer, wild boar) practiced by elites in Chile. Meat and fur from rabbits and hares are used both for internal consumption and for export (Péfaur *et al.* 1968), generating significant incomes, especially for rural peasants in central and southern Chile (Miller 1980, Iriarte & Jaksic 1986).

## SOME OF THE NATIVE SPECIES AFFECTED BY HARVESTING

The Juan Fernández fur seal (*Arctocephalus philippii*) was the first species to be commercially exploited in Chile (Miller 1980). It inhabited the Juan Fernández Archipelago, and San Félix and San Ambrosio Islands. Between 1791 and 1809 about 3.5 million pelts, worth about 12 million dollars, were taken (Pereira 1971). By the early 1900s the species was thought extinct. Although now, the species is recovering from a few survivors left in the wild, poaching still occurs (Aguayo *et al.* 1970). The South American fur seal (*Arctocephalus australis*) population were virtually eliminated by 1890 for the same reasons. The southern elephant seal (*Mirounga leonina*) has an even worse story. It was hunted for oil as early as 1580. Once common in Juan Fernández, the southern elephant seal has been extirpated from the Chilean territory for at least 85 years (Albert 1901). Although the South American sea-lion (*Otaria byronia*) was also persecuted for its fur and oil, their populations were not as severely affected.

Foxes were hunted primarily for their fur. Between 1926 and 1946 fox skins were the principal item of trade in native wildlife products exported from Chile. Chilla (*Dusicyon griseus*), more valuable than culpeo (*D. culpaeus*), made up 86% of the total exports (Miller 1980). Chilla skins came even from central Chile and from Magallanes, and the majority of culpeo skins (97%) from central Chile. Miller (1980) concluded that «hunting for commercial gain in grey fox has resulted in a more marked decline than «predator control» hunting on culpeos. Although protected by law, foxes are still hunted throughout Chile (pers. obs.), mostly based on the common wisdom that they prey on poultry and livestock (Ginsberg & MacDonald 1990). By 1970, four other furbearers have been essentially eliminated from central and southern Chile due to over-exploitation for their pelts: river otter, marine otter (*Lutra felina*), coypu, and guanaco (Miller 1980).

### ONE OF THE MOST DRAMATIC CASE OF OVER-EXPLOITATION

The most striking example of over-exploitation of a furbearer is found in the chinchillas. Formerly common from the Choapa river throughout northern Chile, it is currently almost extinct in the wild (Jiménez 1990). Of the two chinchilla species, the last published record of a short-tailed or Andean chinchilla (*Chinchilla brevicaudata*) in the wild is from Rudolph (1955). After a century of over-hunting, the species is already extinct in Perú and Bolivia (Miller 1980). The

long-tailed or Chilean chinchilla (*C. lanigera*), remains a relict and probably as a marginal population near Illapel (Mohlis 1983). The quotation of Gay (1848) clearly explains the cause of the chinchilla's endangerment: «The beauty of their pelts and the fineness of their soft hairs has resulted in the searching out of these animals since the most remote epochs» Chinchilla pelts were used by the Inca noblemen and by the Atacameños indians long before the Spaniard's arrival (Grau 1986).

The commercial use of chinchillas began after 1810. Between 1900 and 1910, almost 200,000 pelts were exported annually from Chile, peaking to almost 700,000 in 1900 (Echegoyen 1917). The number of animals killed during 1900 were probably around 2.1 millions, since less than one third of the chinchillas actually killed were exported (Albert 1900). Considering a high ecological density of 0.31 chinchillas/ha, as in the Chinchilla National Reserve (Jiménez 1990), chinchilla hunters during 1900 (one year!) must have wiped out all the chinchillas from an area of the size of 260 x 260 km. Since the estimation is highly conservative, perhaps the surface was twice as much -an area bigger than half of the area in which chinchillas might have lived. Around 1912 the chinchilla was commercially extinct (Sage 1913).

Although the species is well protected in the Chinchilla National Reserve, their numbers are still declining (Jiménez 1990). Paradoxically, this species is represented by millions of captive chinchillas throughout the world.

## LEGISLATION AND CONSERVATION OF CHILEAN MAMMALS

As a result of over-exploitation, marine mammals were the first to be protected by Chilean law (Albert 1901). In 1892 a law was passed restricting hunting of seals, sea lions, and otters on the coasts, but was largely unenforced. Regulations restricting chinchilla hunting dated from 1898, but again, enforcement of the law failed (Albert 1900). This situation resulted in an international treaty in 1910 between Chile, Perú, Argentina, and Bolivia to ban the chinchilla hunting and commercialization (Grau 1986). In 1929, a general law was passed, which is still in effect today. It protected most of the Chilean furbearers, banning the hunting of 21 mammal species. The five Chilean felids were first protected in 1972 and the culpeo in 1980 (Iriarte & Jaksić 1986).

Although laws are reputedly stronger in Chile than in other South American countries, poaching still occurs on most of the protected species. The greatest failure of the Chilean conservation effort has not been a lack of interest, able personnel, knowledge, or legal

protection, but enforcement (Miller 1980). The hunting activities within the country are regulated by the Division of Protection of Natural Renewable Resources (División de Protección de los Recursos Naturales, DIPROREN), a branch from the Bureau of Livestock and Agriculture (Servicio Agrícola y Ganadero, SAG), dependent from the Agriculture Ministry. Enforcement of law is mainly in charge of Chile's uniformed police (Iriarte & Jaksic 1986).

The creation of National Parks and Reserves in Chile (currently under the National State's Protected Wildlands System, SNASPE) played an important role in the conservation of wildlife (Iriarte & Jaksic 1986). Inside the protected areas, laws have been successfully enforced by personnel of the Chilean Forest Service (Corporación Nacional Forestal, CONAF), organization that administers those areas. Non-governmental organizations, such as the «Comité pro Defensa de la Flora y Fauna», have also supported conservation efforts in Chile and have been generally effective in getting protective laws passed (Miller *et al.* 1983). Besides protecting wildlife, CONAF is also doing research. It has been working on Chile's fauna since 1972. For example, in 1986 CONAF carried out 16 specific projects on nine mammalian species with conservation problems (Table 1; Glade 1988). The actions taken by CONAF resulted in reversing the reduction in numbers of several species of mammals of conservation concern in a short time span (see heading The Trends). CONAF also organized the first symposium on the «Conservation Status of Chilean Terrestrial Vertebrate Fauna» in Chile (Glade 1988), which set the basis for the priorities of conservation of Chilean vertebrates.

Another important factor that helped conservation

of mammals in Chile was the change in attitude of the Chilean people in the last years towards the environment. The public is much more aware and conscious of their natural resources and of the role they play. Important in the diffusion of information has been several magazines, field guides, and TV programs produced within the country. Higher education programs in Chilean universities also contributed to promote this well-developed conservation ethic. Paradoxically, the direct involvement of academia in conservation issues has been minimal.

## THE CURRENT SITUATION

Out of the 86 species of continental native mammals recognized by Tamayo *et al.* (1987), 41 (48%; 51 considering subspecies) are of conservation concern (Glade 1988). They are included in the following categories: Endangered (10; 15 considering subspecies); Vulnerable (14; 15 considering subspecies); Rare (8); Insufficiently known (4) and Out of danger (5) (Table 1).

Eight causes, that could operate individually or together on the same species, were identified by Miller *et al.* (1983) for the decline in the abundances of Chilean mammals. The most important are the exploitation for pelts and meat (22 + 5 non-exclusive cases, respectively; = 24 species), followed by habitat deterioration due to human activities (11 species; Table 1). All the furbearer species (22) are of conservation concern (Table 2). Most of them are considered endangered or vulnerable and are medium or large-sized species (Table 2). There is no furbearer or commercially exploited species of small size in Chile.

TABLE 1

Chilean mammal species of conservation concern (terrestrial and continental; after Glade 1988) and its probable causes (after Miller 1980, modified). Names are after Tamayo *et al.* 1987. An asterix indicates the species on which special projects were developed by the Chilean Forest Service during 1986.

STATUS/SPECIES	PROBABLE CAUSE
<b>ENDANGERED</b>	
<i>Rhyncholestes raphanurus</i> , Long-snout rat-opossum	H
<i>Euphractus nati</i> , Puna haired-armadillo	MD
<i>Chinchillula sahamae</i> , Highland chinchilla-mouse	OF
<i>Chinchilla brevicaudata</i> , Short-tailed chinchilla	OF
<i>Chinchilla lanigera</i> , Long-tailed chinchilla*	OF, H
<i>Lutra provocax</i> , Southern river-otter*	OF
<i>Felis colocola</i> , Pampas cat	H, OF, PR
<i>Felis geoffroyi</i> , Geoffroy's cat	OF
<i>Felis guigna</i> , Austral spotted cat	OF, H, PR
<i>Hippocamelus bisulcus</i> , Southern guemal*	OM, H, D

Table 1 continues in next page .....

STATUS/SPECIES	PROBABLE CAUSE
<b>VULNERABLE</b>	
<i>Euphractus pichiy</i> , Pichi	MD
<i>Lagidium viscacha</i> , Mountain viscacha	OF, OM
<i>Octodon bridgesi</i> , Bridges' degu	H
<i>Octodon lunatus</i> , Coastal degu	H
<i>Pseudalopex fulvipes</i> , Chiloe fox	H, PR
<i>Galictis cuja</i> , Lesser grison	PR, OF
<i>Lutra felina</i> , Southern sea-otter*	OF
<i>Felis concolor</i> , Puma*	PR
<i>Arctocephalus phillipii</i> , Juan Fernández fur seal	OF
<i>Mirounga leonina</i> , Southern elephant seal	OO
<i>Lama guanicoe</i> , Guanaco*	OF, OM, C
<i>Vicugna vicugna</i> , Vicuña*	OF
<i>Hippocamelus antisensis</i> , Northern guemal*	C
<i>Pudu pudu</i> , Southern pudu*	H, OM, D, C

#### RARE

<i>Desmodus rotundus</i> , Vampire bat	?
<i>Euphractus villosus</i> , Patagonian haired-armadillo	MD
<i>Geoxus valdivianus</i> , Valdivian mole-mouse	H
<i>Cavia tschudii</i> , Tschudi's cavy	?
<i>Galea musteloides</i> , Highland cavy	?
<i>Microcavia australis</i> , Lesser cavy	?
<i>Lyncodon patagonicus</i> , Patagonian weasel	MD
<i>Felis jacobita</i> , Andean cat	OF, H

#### INSUFFICIENTLY KNOWN

<i>Euneomys chinchilloides</i> , Chinchilloid silky-mouse	?
<i>Abrocoma cinerea</i> , Smoki chinchilla-rat	OF
<i>Pseudalopex culpaeus</i> , Culpeo fox	OF, PR
<i>Pseudalopex griseus</i> , Gray fox	OF, PR

#### OUT OF DANGER

<i>Myocastor coipus</i> , Coypu	OF, OM
<i>Conepatus chinga</i> , Hog-nosed skunk	OF
<i>Arctocephalus australis</i> , South American fur seal	OF
<i>Arctocephalus gazella</i> , Antarctic fur seal	OF
<i>Otaria byronia</i> , South American sea lion	OF, OO

- C = consider to damage crops and/or compete with livestock.  
D = diseases transmitted by domestic animals.  
H = habitat destruction.  
MD= marginal distribution.  
PR = considered predator of livestock or poultry.  
OM= over-exploitation for meat..  
OO= over-exploitation for oil.  
OF = over-exploitation for fur.  
? = unknown.

TABLE 2

Conservation status of native Chilean mammals (according to Glade 1988), displayed by size classes (small <200 g; medium 200 - 4,000 g; large >4,000 g) and by furbearer status. The categories are endangered (E), vulnerable (V), rare (R), insufficiently known (I), out of danger (O), and of no conservation concern (N).

SIZE	E	V	R	I	O	N	TOTAL
SMALL	2	0	6	1	0	37	46
MEDIUM	6	8	2	2	2	8	28
LARGE	2	6	0	1	3	0	12
TOTAL	10	14	8	4	5	45	86

  

FURBEARER STATUS	E	V	R	I	O	N	TOTAL
FURBEARER	7	6	1	3	5	0	22
NON-FURBEARER	3	8	7	1	0	45	64
TOTAL	10	14	8	4	5	45	86

### THE TRENDS

The historical trend over the past two centuries has been a steady decline in population numbers of the wild mammals harvested in Chile. Péfaur *et al.* (1969) predicted the short-term extinction of huemul, pudu, river otter, small cats, fur seals, chinchilla, and vicuña. However, the actions taken in the past decades make the picture more favorable. Anecdotal evidence shows that at least within the Chilean protected areas the measures taken successfully reversed the general trend. This tendency is clearly reflected by all the «out of danger» species (5), whose populations were declining due to over-exploitation for fur (Table 1). Other species of wild mammals, most of them over-exploited for fur, such as vicuña, guanaco, northern huemul (*Hippocamelus antisensis*) and southern huemul, chilla and culpeo, southern sea otter, puma (*Felis concolor*), Juan Fernández fur seal, and mountain viscacha are also increasing in number (Miller 1980, Miller *et al.* 1983, Glade pers. comm.) However, there is another group of 9 mammals whose status is not as clear or they are still decreasing in number. Therefore, they deserve more attention, study, and protection. Among them are southern river otter, long-tailed chinchilla (short-tailed chinchilla is already extirpated from Chile; Miller 1980), the four small cats, lesser grison, pudu and hog-nosed skunk (Glade 1988, Jiménez 1990).

The general consensus of the symposium organized by CONAF in 1987 was to carry out research «very urgently», «urgently», and «necessarily» on 23, 13, 12 Chilean mammals, respectively (Glade 1988).

### ALTERNATIVE USES: LOOKING FORWARD

The overexploitation of mammalian species has resulted in «killing the layer of the golden eggs». Instead of understanding the biology of the species at the same time as they were being harvested, the exploitation has been blind. No attention has been paid to the rate of cropping and to the sustainability of the resources. The scientific knowledge needed for a sustained management could have been obtained with a relatively small amount of effort, and the management of the wild populations could have been possible with the help of the enforcement of the appropriate laws at the right time. Much progress could be made if Chilean people and decision-makers were convinced that the wildlife resources in and of themselves represent an economic resource worthy of proper management (Miller 1980, Robinson & Redford 1991).

Other uses could be given to our wildlife. The management of vicuñas by the Incas is a good example of sustainable use of wild fauna. Actually, the successful recovery of the vicuña in the Chilean altiplano, after its almost extinction by over-exploitation (Miller *et al.* 1983), and the first harvesting of 100 individuals for restocking in another country is a current real example (Glade pers. comm.). For guanaco in southern Chile, Franklin & Fritz (1991) proposed a sustained harvesting model. Many of the species discussed above could, with effective management, provide economic returns to poor rural residents and foreign exchange for the Chilean economy. Development of economic return is one promising possibility (Miller *et al.* 1983). Ranching of different

species under semi-natural or controlled conditions have been proved to be an alternative for some artiodactyles (*i.e.* pudu), rodents (*i.e.* coypu, chinchillas) and carnivores (*i.e.* foxes, otters). On the other hand, both introduced and native mammals are appreciated hunting trophies. Species such as guanaco, pudu, red deer, and wild-board could be raised in fenced areas for sport hunting. Many of those species are also appreciated for their meat, thus they could be used as a source of protein by local communities and for commercial use.

Although our wildlife is depauperate in species compared with those from our neighboring countries, Chile possesses a unique set of species with high local endemisms (Mann 1978, Redford *et al.* 1990). The high variety of ecosystems that can be found throughout the country, together with the diverse landscape creates the ideal conditions for ecotourism. Who could resist the temptation of visiting the wonderful Chungara Lake at 4,800 m elevation, to contemplate hundreds of vicuñas feeding against the

8,000 m ever-snowed Payachata volcanoes?... to walk at Torres del Paine, almost touching guanaco herds, in front of the impressive Cuernos del Paine? Or of diving among or observing the breeding and courtship of thousands of sea lions in the fjords of Chiloé, one of the most isolated areas on the globe?.

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#### LITERATURE CITED

- AGUAYO A, R MATURANA & D D TORRES (1970) El lobo fino de Juan Fernández. *Revista de Biología Marina (Chile)* **14**: 135-149.
- ALBERT F (1900) La chinchilla. *Actas de la Société Scientifique du Chile* **10**: 379-407.
- ALBERT F (1901) Los pinipedos de Chile. *Actas de la Société Scientifique du Chile* **11**: 215-272.
- ALBERT F (1913) El agotamiento de los recursos naturales de bosques, pesca i caza. *Boletín de Bosques, Pesca i Caza (Chile)* **1**: 217-253.
- BIRD J & M BIRD (1937) Human artifacts in association with horse and sloth bones in southern South America. *Science* **86**: 36-37.
- DE OVALLE A (1969) *Histórica relación del reino de Chile*. Instituto de Literatura Chilena. Editorial Universitaria, S. A., Santiago. 503 pp.
- ECHEGOYEN H (1917) Necesidad de conservar algunas especies útiles de la fauna y de la flora de Atacama. *Actas de la Société Scientifique du Chile* **15**: 16-73.
- ELIZALDE R (1970) La sobrevivencia de Chile, la conservación de sus recursos naturales renovables. Second edition, Ministerio de Agricultura, Servicio Agrícola y Ganadero, Santiago. 492 pp.
- FRANKLIN WL & MA FRITZ (1991) Sustained harvesting of the Patagonia guanaco: is it possible or too late? In: Robinson JG & KH Redford (eds): *in Neotropical wildlife use and conservation*: 317-336. University of Chicago Press, Chicago.
- FUENTES E R & F M JAKSIC (1981) Consideraciones teóricas para el control biológico del conejo europeo en Chile central. *Medio Ambiente (Chile)* **5**: 45-49.
- FUENTES E & S PRENAFETA (eds) (1988) *Ecología del paisaje de Chile central: estudios sobre sus espacios montañosos*. Ediciones de la P. Universidad Católica de Chile, Santiago.
- FUENTES E R, F M JAKSIC & J A SIMONETTI (1983) European rabbits vs. native mammals: effects on shrubs seedlings. *Oecología* **58**: 411-414.
- GAY C (1848) *Historia de Chile*. Zoológica. Volume 1. Maulde & Renou, Paris.
- GINSBERG J R & D W MACDONALD (1990) Foxes, wolves, jackals, and dogs: an action plan for the conservation of canids. IUCN/SSC Canid Specialist Group and IUCN/SSC Wolf Specialist Group.
- GLADE A A (1988) Red list of Chilean terrestrial vertebrates. Proceedings of the symposium «Conservation status of Chilean terrestrial vertebrate fauna.» Chilean Forest Service (CONAF). Impresiones Comerciales, S.A., Santiago.
- GRAU J (1986) *La chinchilla, su crianza en todos los climas*. Third edition, El Ateneo, Buenos Aires, Argentina.