SEA CAT PROJECT II
Assessment of the Population Density and Conservation Status of Sea Cat (Lontra felina) in the 10th Region of South Chile

--------- Final Activities Report ---------

Claudio Delgado-Rodríguez, Ricardo Álvarez & Ana María Pfeifer

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Conservación Marina

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I. INTRODUCTION

The marine otter, also known as Chungungo (*Lontra felina* Molina, 1782), belongs to the mustelid family and lives exclusively in marine habitats, particularly in exposed rocky shores (Castilla & Bahamondes, 1979). The population of *L. felina* is distributed along the Pacific coast, including parts of the Peruvian shoreline (6° S) and the entire Chilean coast reaching the 56°S parallel in Cabo de Hornos (Redford & Eisenberg, 1992; Larivière, 1998).

Before the past century, otters flourished all along the Chilean coast (Housse, 1953). However, beginning in the year 1900, the otter population was strongly diminished by illegal hunting, especially between 1910 and 1954 when nearly 38,000 otter skins were exported from Chile. Although at present illegal hunting is diminishing, the serious population decline produced during the first half of the past century adversely altered the otter’s geographic distribution and population density. Today the otter population in Chile is considered patched and fragmented.

Despite a Chilean law that gave marine otters legal protection in 1929, at present marine otters are still under threat, mainly due to habitat destruction, water pollution, poorly regulated conventional tourism, and illegal hunting, the last of which occurs primarily in the channels and fjords zone at the 43° 40’ S parallel. The other threats are related to the progressive use of the seashore, not only through conventional tourism, also by the building of infrastructure such as hotels and yachting marinas that are environmental inappropriate for the otters and their habitat. Each one of these problems contributes to the fragmentation of the population and increases the rate at which the marine otter nears extinction. In fact, the marine otter is currently considered in danger of extinction by the Red Data Book (Hilton-Taylor 2000), the Red Book of the Chilean Vertebrate (Glade 1993), and also in the Appendix I of CITES.

Although previous research on this species has been done, current knowledge of *L. felina* is still scarce and incomplete. Almost all past studies were conducted to assess diet and behavior (Castilla y Bahamondes 1979, Castilla 1982, Cabello 1985, Ostfeld *et al.* 1989, Sielfeld 1990a, Sielfeld, 1990a Rozzy y Torres-Mura 1990, Ebensperger y Castilla 1991, Medina 1995a y 1995b, Delgado 2001, Delgado 2005, Álvarez 2001, Medina *et al.* 2004), but no long-term research has been directed at assessing the population’s density and distribution along their habitat area. Therefore, to date nothing is known about the location of the fragmented population patches, the population density, or the actual conservation status. This is particularly true in southern Chile where significant otter populations are suspected to still exist and have not yet been well evaluated (Sielfeld & Castilla 1999, Sielfeld 1992). Population density and distribution information are important and basic variables to design a future marine otter conservation plan, which includes coastal protected areas.

This project is dedicated to contributing to the existing knowledge on the marine otter by means of a direct assessment of the population density, distribution, and conservation status.
of the marine otter along the Araucanian and Chiloense marine ecoregions in order to design and develop the first stage of a long term otter and habitat conservation program.

This report corresponds to the first phase of project activities and is focused on results obtained by observations conducted from June 2004 to November 2005, which covered approximately 70 percent of the total project area. This report includes insights into the standardized methodology which will be proposed for use in future marine otter monitoring initiatives, the main results of the first phase of the project, and the diffusion material produced for a public awareness campaign.
II. - PROJECT OBJECTIVES
Main objectives:
1. To assess the population density and conservation status of the marine otter (*Lontra felina*) along the central-south of Chile in order to design and develop the first phase of a long term otter and habitat conservation program.
2. To promote the importance of marine otter conservation and the protection of their habitat along the Chilean seashore.

Specific objectives:
1. To produce a population density map based on the geographic information system, which can easily be updated in the future.
2. To identify the main threats that effect otters in the 10th region of Chile.
3. To produce a map with the main threats along the study area.
4. To identify areas with a high population density to start the promotion of protected sites for otter conservation.
5. To standardize a survey method for the Sea Cat which can be used by other researchers, conservationists, governmental agencies involved in wildlife, and any other people interested in otter conservation.
6. To develop the first step of a public awareness campaign directly focused on fishing communities, promoting the importance of the marine otter conservation and their habitat.
7. To design the first Sea Cat conservation strategy at regional level based on conservation by design approach.

III. - STUDY AREA
Surveys of marine otter habitat were carried out all along the coastline of the 10th region of Chile, which is located from 39°15'S / 71°45'W to 43°40'S / 74°15W. Physical boundaries are from the Andean Range (on the east) and the Pacific Ocean (on the west). The 10th region is 71.852 Km² in size, corresponding approximately to 10% of the total surface area of the country. In this administrative region, two marine ecoregions were identified and described by Sullivan and Bustamante (1999): the Araucana Marine Ecoregion, which is located from 33º 26' to 41º S, and the Chiloense Marine Ecoregion, located from 41º to 71º S. The coastal topography is mainly represented by rocky shores as well as varied sizes and types of sandy beaches. Rocky shores usually have a strong exposition to wind and waves and are characterized by the presence of cliffs, boulders, and funnels between large rocks. In the south part of the study area, located on the island of Chiloé, the western coast is similarly exposed and comparable to the north part of the region, however the eastern coast is shaped by numerous small island, fjords and channels, where the otters also reside. The coastal area in the upper tidal level is formed by terrestrial vegetation which is in almost all cases dominated by native shrubs where the main species are *Fascicularia bicolor*, *Chusquea quila*, *Greigia sphacelata* and *Gunnera chilensis*. In the intertidal zone the main species of vegetation are *Durvillea antartica*, *Lessonia nigrescens*, *Macrocystis pyrifera*, *ulva lactuca* and *Mazaella laminaroides*. 
In relation to human activities in this region, the most important in the coastal zone are artisan fisheries, the coastal harvesting of algae, crabs and mollusks, conventional tourism, and the farming of mollusks and salmon, particularly in the eastern zone of Chiloé Island.

The total length of the study area is approximately 1,100 km. Given the study area’s extreme length and size, it is possible to divide it into three distinct zones: the Continental zone, the Chiloé Island zone, and the Fjords-Channels zone. In general, it is possible to access almost at all the survey transects, pre-selected by photographic analysis, by a four-wheel drive vehicle, but in the south of Chiloé Island no roads suitable for any vehicles were found in the last expedition, therefore the unique way to access that zone must be by horseback and/or on foot. The access to the Fjords-Channels zone is possible through a combination of a four-wheel drive vehicle and a boat (small fishing boat or even inflatable). In this first phase of the project the assessment was focused on zones A (Continental zone) and B (Chiloé Island).

Figure 1. Study area. Zone A: Continental zone. Zone B: Chiloé Island and Zone C: Fjords-Channels zone.
IV. – METHODOLOGY

5.1 Study sites selection

The total extension of the shoreline in the study area is around 1,466 km. Considering the length, the coastline was divided into 35 grids of 20 km$^2$ each. This decision was adopted only in order to have a spatial scale for the population distribution and to have a better visual organization of the collected data. Surveys were carried out in two transects of 1 km for each grid, which were separated by at least 10 km. This way of surveying expected to diminish any bias of over-counting by not reporting information about home range or the daily movement of marine otters.

Each transect of 1 km into the 20 km$^2$ grid, was selected basically by potential for observer access and by the distance between transects. Preliminary transect selection was done using 2000 and 2002 satellite photography (Land Sat 7 Resolution; 1:6.5 and 1:16.2), aerial photography (1:20.000 cm), and different layers produced by the National Forestry Corporation of Chile (CONAF). Therefore, according with this methodology, at the completion of the study a total of 35 grids will be assessed and 70 km will be surveyed, representing 5% of the total study area. To date, a total of 15 grids were surveyed in the first stage of the project.

5.2 Census

Census information on the marine otter is based on direct observation made by three observers located in advantages points along the 1 km line transect. Observers record the presence of otters and their activities during four continuous hours. The observations are conducted simultaneously by the three observers, each visually scanning the ocean for eight minutes and the coast for two minutes. For each scan, the otter position is recorded in a map of the transect portion under observation. It is important to maintain the synchronicity of each visual scanner in order to avoid double-counting. This method is an adaptation of previous research developed in the rocky environments of southern Chile (Bartheld 2001, Delgado 2000, Medina et al. 2004, Medina et al. 2005, Delgado 2005). However, in the research for this project the observers used two-way radios to remain in permanent communication. This constant communication helped the observers correct multiple sightings of individual otters and to distinguish sighting locations, thereby diminishing a double-counting bias. All the observations were made with the aid of 10x50 power view binoculars and 15-60x60 zoom spotting scope.
5.3 Habitat assessment

In order to assess the existing otter habitats, both physical and biological attributes were recorded, as follows: the distribution and size of stones, the presence or absence of feeding sites, the presence or absence of sprainting sites, the distance between terrestrial vegetation and the tideline, the presence or absence of dens, the availability of freshwater, the structure and species dominance of coastal vegetation, the species dominance of intertidal vegetation, and the distance from human activity (human settlements or disturbance).

Figure 2. Form used to record physical and biological attributes for each line transect surveyed.

Each line transect surveyed was characterized and recorded in the field table shown above (Fig.2). Criteria for each variable were as follows:

Exposition - corresponds to the location of the line transect in relation to the north;
Aperture - corresponds to the angle of the line transect (usually from 0 to 180º);
Otters observed - the number of the otters positively observed in the line transect (Note: When more than one otter was observed in the same transect at a different time, the assumption was that only one otter was observed because it is very difficult to differentiate one individual from another. For example, one transect only has 4 otters recorded if they were all observed at the same time.);
Station - each transect line was subdivided into four stations, separated from one another by 200 meters;
Rock size - divided into four categories based on rock diameter: Small (size between 1 to 50 cm), Medium (size between 50 to 150 cm), Large (size between 150 to 450 cm), and Very Large (more than 450 cm);
**Width** - corresponds to the distance from the tide-line to the coastal vegetation, which was divided into four categories: *class 1* (between 0 to 10 meters), *class 2* (between 10 to 20 meters), *class 3* (between 20 to 40 meters), and *class 4* (more than 40 meters); 

**Coastal vegetation** - corresponds to the vascular and non-vascular vegetation associated with the coastal shrubs (Note: Both the structure and the dominant species were recorded.); and 

**Inter-tidal vegetation** - corresponds to the macro algae placed in the inter-tidal zone, and both dominant and co-dominant species were recorded.

### 5.4 Threat assessment

Threat analysis is still in the development stage. The analysis is basically based on the review of existing scientific and non-scientific publications, in order to have an idea about the abundance and distribution of the otter population over the last centuries. To obtain more recent data, interviews were conducted within the local fishermen communities and in some cases with the instructors of coastal-based schools. Interviews were composed of eleven questions, from which five are related to knowledge about the otter and the other six are with regard to threats to the otter and the potential for conservation. The participants had four clear possible answers for each question. Data collected through this process can be analyzed using a Likert (1976) scale to assess the total proportion of the responses, which will give insight about the local population’s knowledge and propensity for otter conservation. Additionally, every response was georeferenced to the interviewee’s location, allowing for the identification of local threats. Thus, it will be possible to build a map including the major perceived threats occurring along the study area.

### 5.5 Public awareness

A major part of the project has been dedicated to public awareness through the design and production of brochures that inform the general public about the otter, their habitat, existing threats, the importance of conservation, and how we can do something to help otter conservation. Additionally, the brochures show the main objectives of this project and who is supporting the initiative.

Brochures and adhesives are being distributed to artisan fisheries organizations, coastal farmers, governmental and non-governmental agencies, and the general public. The public awareness campaign is expected to contribute to increasing community sensitivity to the importance of the marine species and their habitat conservation.
V. - RESULTS

At the present phase of the project a total of 15 sample square grids were assessed, which represent 30 line transects (or survey sites). This represents approximately 70 percent of the total sampled-squares designed for the project. However, from these 30 line transects, six were impossible to survey because they lack a way to access them directly. Therefore, this preliminary data analysis is based on records obtained from 24 line transects.

Square grids projected for the southern area of Chiloé Island were not possible to survey during the fieldwork on the Island, because it was not feasible to access the shoreline by vehicle. However we expect to access this area in 2006, as well as the fjords area, during the next phase of the project with additional financial support.

Funding provided by International Otter Survival Fund was absolutely essential to accomplish some important part of this project.

The following sections correspond to the results of the research and represent the fieldwork carried out during the first phase of the project from 2004 to December 2005.

5.1 Population distribution

The preliminary results, based on data from 56 continuous hours of direct observation and 24 line transects effectively surveyed, shows that the marine otter population could have a continuous distribution pattern along the entire shoreline from Queule (652431/5639983 UTM) to the Rio Bueno estuary (606820/5534266 UTM) and from the northern zone at Chiloé Island (595264/5368911 UTM) to Punta Pilot (569512/5256486 UTM) (Figure 3). However, some survey sites between the Rio Bueno estuary and Maullin River are not yet assessed, but it is expected that these sites will be surveyed during next phase of the project.

In the 24 transects effectively surveyed in this study, we found otters present in 17 survey sites. Therefore, with the current data, we hypothesize that the otter distribution along the study could be continuous. However, according to our observations, this continuity could be broken-up by the presence of large sandy beaches (possibly more than 2 kilometers) or by the occurrence of serious human impact, such as the destruction of habitat or the over-fishing of crab and fish that compose the otter’s main diet.
5.2 Population density

Preliminary results show that a total of 21 individual otters were observed during the surveys along the visited sites. Otter density varies from 1 to 5 individuals per lineal kilometre (ind/km). The average density for the 24 line transects surveyed was 2 ind/km \( \text{mean: } 2 \pm 1.48 \). The higher density (5 ind/km) was recorded in line transect 10, which corresponds to the coastline of the Valdivian Coastal Reserve, a private coastal reserve in the continental zone. The lower density (1 ind/km) was observed in transects 5, 17, and 32, where the first site corresponds to the northern zone of the study area (Queule), and the other two correspond to sites located in Chiloé Island (Table 1), respectively.

The density of the otter population was technically higher in the continental zone \( \text{mean: } 2,5 \pm 1,566; \ n: \ 12 \) than Chiloé Island \( \text{mean: } 1,4 \pm 1,17; \ n:10 \), however, further analysis shows no statistical difference in the distributions \( t: 1,49; \ p>0.01 \). (Figure 4)

Although this report is based on preliminary data analysis, it is good insight about the current otter population density. This study suggests that the density of the otter population on
Chiloe Island is not significantly higher than the continental zone and thus, that the abundance of otters on the island is perhaps much lower than expected by different authors. Reversely, the preliminary data suggests that the otter density in the continental zone is not significantly different from that of Chiloe Island, and this fact could be important when, in the near future, we start to design conservation strategies.

Table 1. Otter density observed by each line transect surveyed. Coordinates are given in Units Transversal of Mercator (UTM, zone: 19S, Datum Prov. SouthAmerican. 1956).

<table>
<thead>
<tr>
<th>transect code</th>
<th>Location</th>
<th>UTM coordinate</th>
<th>density (ind/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>northing</td>
<td>easting</td>
</tr>
<tr>
<td>1</td>
<td>continent</td>
<td>5621860.66</td>
<td>649641.34</td>
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<tr>
<td>2</td>
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<td>5631147.09</td>
<td>649355.89</td>
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<td>continent</td>
<td>5631171.09</td>
<td>649332.84</td>
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<td>continent</td>
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<td>5576071.08</td>
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<tr>
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<td>5580395.71</td>
<td>625706.36</td>
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<td>579503.52</td>
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<td>580177.73</td>
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</tr>
<tr>
<td>42</td>
<td>Chiloe Island</td>
<td>5271758.70</td>
<td>5280579.4</td>
</tr>
</tbody>
</table>
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Figure 4. Otter population density along the studied area. Based on information from 24 line transects surveyed. \(\text{Whole mean: } 2 \text{ ind/km} \pm 1.48\).
5.3 Habitat characteristics
5.3.1 Rock size

As was described earlier, rock size was divided into four categories based on the approximate diameter of the rock. The classification for this variable was as follows: small for rocks between 1 to 50 cm, medium (between 50 to 150 cm), large (150 to 450 cm), and very large (more than 450 cm). In this manner, in the 24 transects surveyed we observed a variety of rocks that fit all proposed categories, however a higher proportion of rocks were found to be large (38%) or very large (39.6%) (Kruskal-Wallis test, $H = 18.030 Df:3 P <0.001$).

We recorded a similar distribution across all rock size classifications for each surveyed transect between the continental zone and Chiloé Island. Although data shows that the frequency of small and medium rocks was higher in continental zone, there is no statistically significant difference (Small: $H=0.86 ; P=0.354$ and Medium: $H=0.135 ; P= 0.714$). Additionally, there is no significant difference in very large rocks between the Island and the continental zone ($H= 0.521; P = 0.470$) (Figure 6).

![Figure 5. Global frequency of rock size in transects surveyed at continental zone and Chiloé Island (n=24)](image)

![Figure 6. Frequency of rock size class observed in transects surveyed at Continental Zone (n=14) and Chiloé Island (n=10).](image)
5.3.2 Width of coast

To obtain an idea about the width of coast that the otter uses (ie, the distance from the high tide-line to the boundary of the coastal vegetation), we classified this variable into four classes: class 1 (between 0 to 10 meters), class 2 (between 10 to 20 meters), class 3 (between 20 to 40 meters) and class 4 (more than 40 meters).

Otters were recorded in 20 of the 24 surveyed sites and were primarily observed at three width classes; classes 1, 2, and 3. However, the most frequently observed width of coast were class 1 and 2. ($H= 34.732$ $Df: 3$ $P <0.001$). Class 4 was recorded only in one site at Chiloé Island and corresponded to a huge, sandy beach at the central zone of the Island (Cucao beach). Therefore, according to the obtained data, otters appear to be using rocky coasts between 0 and 20 meters (Figure 7).

Although class 1 and 2 were the most frequently observed classification of coast width, a comparison in class frequency between the continental zone and Chiloé Island demonstrates that class 1 was more recurrent at Chiloé Island, but no significant difference was observed ($H=2.629$ ; $P = 0.105$). Class 2 was observed with higher frequency in the continental zone ($P=0.011$). Similarly, class 3 was higher in Chiloé Island, but no significant difference was observed ($P = 0.296$) (Figure 8).

![Figure 7. Global frequency of width classifications observed in transects surveyed at continental zone and Chiloé Island (n=24)](image-url)
5.3.3 Structure and composition of terrestrial vegetation

Data recorded shows the occurrence of five different types of structure, terrestrial vegetation adjacent to the coastline in the surveyed sites: scrubs, renovation\(^1\), grassland, dune vegetation, and plantations. Additionally, we classified as no vegetation all sites where absolutely no type of vegetation was observed. Across all sites surveyed, the main vegetation structure was scrubs (90%), which were composed primarily of native species, especially at Chiloé Island. The second most frequently observed vegetation corresponded to grassland (5%), composed primarily of non-native species (Figure 9).

Species composition of the terrestrial vegetation was composed of ten species from which 8 are native species and the other 2 are exotic species (Table 2). The most frequent species for the whole study area were Poe (*Fascicularia bicolor*) (27%), Quila 19 (%), and Nalca (15, 91%), however Nalca was recorded only at Chiloé Island (Figure 10).

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\(^1\) **Renovation**, correspond to a vegetacional structure where young trees are dominant
Table 2. Species composition of the terrestrial vegetation adjacent to the coastline.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poe</td>
<td>Fascicularia bicolor</td>
<td>native</td>
</tr>
<tr>
<td>Chupon</td>
<td>Greigia sphacelata</td>
<td>native</td>
</tr>
<tr>
<td>Quila</td>
<td>Chusquea quila</td>
<td>native</td>
</tr>
<tr>
<td>Olivillo</td>
<td>Aetoxicon punctatum</td>
<td>native</td>
</tr>
<tr>
<td>Yelmo</td>
<td>Griselinia scandens</td>
<td>native</td>
</tr>
<tr>
<td>Nalca</td>
<td>Gunnera chilensis</td>
<td>native</td>
</tr>
<tr>
<td>Avellanillo</td>
<td>Lomatia dentata</td>
<td>native</td>
</tr>
<tr>
<td>Murta</td>
<td>Ugni molinae</td>
<td>native</td>
</tr>
<tr>
<td>Ulex</td>
<td>Ulex europaeus</td>
<td>Exotic</td>
</tr>
<tr>
<td>Pino</td>
<td>Pinus radiata</td>
<td>Exotic</td>
</tr>
</tbody>
</table>

Figure 9. Structural classification of terrestrial vegetation observed adjacent to the coastline in Continental Zone and Chiloé Island.

Figure 10. Global composition and relative frequency (%) of the terrestrial vegetation species observed adjacent to the coastline in the study area.
5.3.4 Intertidal vegetation composition

Intertidal vegetation is defined as macro-algae observed between the lower and higher tide lines. Results are based on direct observation of the presence and the dominance (and co-dominance) of each recorded species, but no quantitative assessment was done. However, we believe that this approach was appropriate to obtain a general characterization of the habitat attributes. From the 24 sites surveyed, we recorded six dominant species: *Ulva lactuca*, *Gigartina sp.*, *Mazaella laminaroides*, *Durvilleaea antarctica*, *Lessonia nigrecens*, and *Macrocystis pyrifera*. Considering global frequencies, *D. antarctica* was the most frequently recorded species (48.3%) along the whole study area (Figure 11).

The data demonstrates a similar pattern of observed species frequencies distribution between the continental zone and Chiloé island. Although *D. antarctica*, *U. lactuca*, *M. laminaroides* and *L. nigrecens* were observed with higher frequency on the continental zone, no significant differences were observed ($F=0.111$ $p=0.746$) (Figure 12).

![Figure 11. Frequency of dominant macro-algae species composition observed in the whole study area.](image-url)
5.4 Threat Analysis

Information on threats to otters and their habitat was obtained through review of published data, personal communication with governmental services related to wildlife issues, and a survey letter to fishermen and other local citizens in coastal communities, especially harvesters of shellfish, mussels and algae. We collected a total of 50 survey responses. Although this is a low sample size, this preliminary analysis provides good insight about current threats, and local coastal community perceptions and attitudes about otter conservation.

According to the obtained information, the primary threats identified are illegal hunting, habitat alteration or destruction (by road construction, urban development, and unregulated tourism), and accidental capture (Figure 13).

In general, the survey responses demonstrate that local coastal communities have a basic knowledge about otters and habitat conservation (77% of surveyed individuals). In other words, they are not familiar with general issues such as morphology, reproduction, feeding, and behaviour (Figure 14).

Results obtained from the surveys demonstrate that the majority of individuals surveyed have basic knowledge about otter issues, but there is still a need for increased education. For example, the question about otter morphology was well answered by 40% of responses, however a 36.6% responded that they did not know about the subject and the other 23% responded that they have doubts about it. In relation to questions on attitude assessment, responses reveal that most individuals surveyed have a positive attitude toward otter...
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conservation (83%). However, the other 17% of responses revealed indifference to the protection of otters (Figure 15). This was attitude-split is far better than we expected before the start of this study, because we still have the potential to better involve the 17% of indifferent individuals by redirecting the public awareness campaign. The question about the creation of coastal reserves to protect the otters was positively responded to as well, showing that 63.3% of individuals surveyed were in agreement with this idea. The threat analysis survey revealed much information for the project, because it will help us have a better focus about continuing or redirecting the public awareness campaign. Additionally, the survey responses will assist in the design of an appropriate strategy for the future conservation action plan that will involve coastal communities.

Figure 13. Threats identified along the study area.
Figure 14. General knowledge about marine otter species. Frequency of survey responses by rank classification according to Likert scaling.

Figure 15. Attitude about marine otter species. Frequency of survey responses by rank classification according to Likert scaling.
5.5 Public awareness activities

The main results of the public awareness activities were the production of 2,500 brochures and 1,500 adhesive stickers for the project, that have already been distributed to the local community, local governmental organizations related to wildlife management, and also to national and international conservationist organizations active in Chile. The brochures are focused on sharing information regarding the basic biological issues of the marine otter, but also include details about the historic population decline. In addition, the brochure includes guidelines about what can be done to conserve the otters and their habitat. Diffusion materials were designed to be easily comprehensible in order to appeal to a wide target audience and include some of the best photography of otters available in Chile, taken during fieldwork in this research. (See appendix)

Other important results linked with public awareness activities were the development of several presentations given at local universities and coastal schools. One of the most important was the conference carried out at Universidad de Los Lagos, where we were invited to discuss the importance of otter conservation and the possibility of using the species as a focal point or umbrella species for coastal ecosystem conservation.

Future cooperation is expected between the project and the Biological Research & Environmental Education Program of the Universidad de los Lagos, due to the interest showed by a professor in the program. The project is supported one student from the Universidad de los Lagos, helping her with sample collection and sharing our experience with field work and data analysis to help her accomplish her research thesis related to otter feeding behaviour. Therefore, the project has achieved good results on both public awareness and involving new people in the field of otter conservation.
VI. - Discussion

6.1 Population distribution and density of marine otter population

Although in the preliminary stages it is still difficult to compare our results with previous studies, we have good insight about the distribution of the otter population and we can confirm the presence of the otter in the northern area of Chiloé National Park, where Cabello (1983) recorded the higher population density of otters along the entire Chilean coast. Another important finding is the evidence of the marine otter using very quiet zones, with lower wave energy, such as in Ancud Bay on Chiloé Island. This observation is in contrast with the majority of publications that suggest that otters only use very exposed zones with higher wave energy, heavy sea activity, and strong winds (Castilla 1982, Ostfeld et al 1989, Sielfeld y Castilla 1999). Therefore, we suggest that, at least for Chiloé Island, otters use very calm waters, implying that their population distribution is not restricted to only very exposed zones, as was described by the aforementioned authors.

Several existing publications suggest that marine otters do not use sandy beaches for feeding (Castilla y Bahamondes, 1979, Castilla 1982, Cabello, 1985, Ostfeld et al. 1989, Sielfeld 1990a, Sielfeld, 1990a Torres-Mura, 1990, Ebensperger y Castilla, 1991, Medina, 1995a y 1995b, Delgado 2001, Delgado 2005, Álvarez 2001, Medina et al. 2004). Rozzy and Torres Mura (1990) described the potential use of sandy beach environments, on remote islands located in the south of Chiloé Island, based on the presence of Emerita analoga found in the stomach of a single dead otter. In our study, no observation of otters continuously using sandy beaches was done. However, we recorded feeding activities on the edges between rocky and sandy environments. The presence of the otters along the sandy coast could be simply related to the otters’ movement between two rocky sites rather than for specific feeding activities, although we have observed otters engaged in hunting activities along the border of rocky environments. Yet, more than 90% of the observed otters were recorded in rocky environments and the other 10% were observed in so-called edge environments. Additionally, all results where no otter was recorded correspond to environments dominated by sandy beaches. This information allows us to restrict the sandy beaches area (larger than 2 km) in our estimation of the overall population in the whole study area. By negating sandy beach areas, we will diminish the potential to overestimate the otter population.

Information obtained in this study regarding the density of the otter population is very important because it was the first attempt to assess the marine otter population density in such a large area and allows us to have a wide perspective about the current status of the otter. Values for population densities obtained in this study from Chiloé Island show significant differences to those published by Cabello (1977, 1983). Cabello reported a density of 10 ind/km in the northern zone of the island, which represented the highest value observed along the entire Chilean coast, and consequently this suggested that the greater otter population along the
Chilean coast exists on the island. However, in this study surveying the same sites studied by Cabello (1977, 1983), we recorded a density of only 1.5 ind/km. The different results between both studies could be explained by the use of different methodological approaches, by the different seasons, or by adverse human impacts during the last two decades. However, we are more inclined toward the first explanation, because, at least during our surveys in the area, we observed no interruption by humans and access to the site was not easily available to the general public. Moreover, we suspect that previous studies have overestimated the population density in this area due to the significant double-counting of individuals because the applied methodology.

Our results are more similar to studies carried out on the small islands in the south of Chiloé, where a mean density of 3.6 ind/km was recorded (Rozzy and Torres-Mura 1990). Additionally, our results align with the observed densities along the coastline of northern Chile, where densities of 2.5 ind/km were recorded in Los Molles between 1976 and 1977, a density of 1.25 indv/km recorded in the same place in 1980, and densities of 1.5 ind/km in Punta Lobos and 1.25 ind/km in Chañaral in 1981 (Castilla 1982).

Therefore results obtained in this study allow us to suggest that the otter population in the assessed area could be less than what was generally believed, especially for Chiloé Island. These results will assist us to develop a better approach for a future conservation action plan for the otters and their environment.

6.2 Habitat characteristics

According to the obtained results, otters are more frequently found in habitats with a high proportion of large (150 to 450 cm) and very large rocks (more than 450 cm). Although small and medium rocks are also present in otter habitats, these were observed in lower proportion. This trend was observed both in the continental zone and on Chiloé Island. Therefore, this suggests that the marine otter could have a preference for environments with heterogeneous rock sizes, but with a higher proportion of large rocks, which produce the better availability of funnels, channels, and caves that otters need for daily terrestrial activities (such as hunt prey, rest, sleep, and mate). This is in agreement with existing publications that describe otters using rocky environments with the presence of natural galleries commonly used as ways to access water and to establish dens (Castilla y Bahamondes 1979, Rozzi and Torres-Mura 1990, Ebensperger y Castilla 1992, Sielfield and Castilla 1999, Alvarez 2001, Medina et al. 2005).

In general, otters were found more frequently in sites with a width of rocky coasts that vary from 0 to 20 meters. Most likely otters are more secure from attack from humans, dogs or other wildlife species in narrow coasts with difficult access. Earlier studies reveal that otters use no more than 30 meters in-land (Castilla 1982), thus this study is in agreement with previous investigations.
Regarding the structure and composition of the terrestrial vegetation, in this study we observed a high frequency of shrubs composed primarily of native species, which is similar with reports by Sielfeld and Castilla (1999). Although we are unable to establish a relation between otter presence or density and the occurrence of native species, we observed more otters in locations with native vegetation. However, we do not know if this is because native shrubs offer a more suitable terrestrial habitat or because a non-native matrix (pines or eucalyptus plantations) could be affecting the otter population by inadvertently changing the ecology of the landscape (i.e., by water pollution or the increase of terrestrial sediments from non-native plant use that could affect the ecology of prey species).

The species composition of inter-tidal vegetation was very similar with that recorded by different authors (Castilla y Bahamondes 1979, Rozzi and Torres-Mura 1990, Ebensperger y Castilla 1992, Sielfield and Castilla 1999, Alvarez 2001, Medina et al. 2005). Similarly to the terrestrial vegetation, we can not demonstrate if the algae association, described previously, has any relation to otter density values. However, we observed a high frequency of Durvillea antarctica both on Chiloé Island and in the continental zone. This species of algae could offer good hiding opportunities for otter prey because important fish and crab species are commonly nested to a type of brown algae very similar to D. antarctica. Yet, more efforts are evidently needed to fully assess these probable relations.

6.3 Threats and the human dimension of marine otter conservation

Based on obtained information, illegal hunting is rare at the northern part of the study area, but the potential for illegal hunting apparently increases to the south. Although otter hunting is prohibited by Chilean law, some people in coastal communities still consider the ancestral tradition of having an otter pelt in the home a symbol of increased social status. Hunting appears to be more frequent on Chiloé Island, and according to Medina (2001) otter pelts are already commercialized by fishermen on the Island (see photographs in appendix). Rozzy and Torres-Mura (1990) described that in Chiloé, people living in a place called Inio kill otters using dogs. The dogs drive the otters from their dens and then hunters capture the otters using nets. The pelts are sold for approximately $20 USD.

During our surveys on Chiloé Island, we met only one person that informed us about illegal hunting occurring in a place called Faro Corona, and during surveys carried out in the continental zone we obtained no information about otter hunting. It appears that illegal hunting, although it exists, is not the greatest threat to the otter. Our observations confirmed only one place where illegal hunting could be taking place, however the project still needs to assess other places and new information could be uncovered.
Probably one of the most significant threats to otters is habitat alteration, which in many cases could be so significant that their habitats may be completely destroyed. Sources of otter habitat alteration are related with the building of structures to carry out tourist activities, but also recent housing development has been constructing houses and lodges very near to the coastline, removing rocks and coastal vegetation that are important components of otter habitat. Additionally, the arrival of new people to the coast may cause indirect negative effects, including greater predation of otters by dogs and the probability of increased foreign pathogens transmission, although this last hypothesis is still not proven.

Another cause of habitat alteration is water pollution. The effect is not well-documented for marine otters, but it is probable that in zones where native forests have been changed into non-native plantations (where the use of pesticides and herbicides is intensive), such activity could negatively affect habitat quality or disturb the composition of prey species. This hypothesis must be further analyzed in future investigations at the ecological landscape level. However, at the northern zone of the study area plans exists to build a duct to evacuate water with waste from cellulose production at the coastline of Mehuín. Although the negative effect of pollution by cellulose production waste on otters is not documented, the company which plans to build this duct was recently found responsible for the massive mortality of a black-necked swan population in the Río Cruces Sanctuary near Valdivia city, due to their evacuation of waste water with high levels of iron into the river. This waste water seriously altered the primary productivity in the river and consequently impacted high levels within the ecological web, including the black-necked swan population. This unfortunate precedent represents a significant threat to the otter population if the waste water duct is now redirected to the coast.

One of the most recent threats to otters along the study area in the last five years is road construction. At this moment a huge coastal highway is under construction with direct and indirect negative effects on otter habitat, causing significant habitat alteration or even destruction because in many cases stones and gravel are taken directly from the coast where otters live. Moreover, in a variety of different sites this highway is directly impacting the once absolutely pristine coastal ecosystem in the area. Indirect and cumulative impacts that will affect the otters include the significant increase of conventional tourism and other anthropogenic activities that cause negative impacts (Davies et al. 1987, Green 1991, Clarke et al. 1998, Körbel 1995 Mason and Macdonald, 1996, Seiler 2001)

In reference to local knowledge and attitude, we observed that interviewed individuals from coastal communities (primarily fishermen) have a general knowledge about basic biological issues concerning the otter and demonstrate a positive attitude toward conservation efforts. This information is very relevant, because it will assist us in redirecting the public awareness campaign, especially about the design and distribution of materials. The interviews also revealed that coastal communities are interested in discussing and exploring ways to
conserve otters and their habitat. This is important for the design of the conservation action plan, which will involve the coastal communities' participation in order to generate future community-based management plans within Benthic Resource Management Areas, and hopefully focusing on the marine otter as an umbrella species for conservation. Thus, future plans should involve commercial marine resources, but also the whole web of biodiversity that are under the marine otter.
VII.- CURRENT STAGE OF THE PROJECT AND NEXT STEPS

First Phase of the project was done. The results and the experience obtained from this preliminary work in the study area will allow us to continue efforts with more conviction that will be necessary for the long-term initiative of otter and coastal environment conservation.

In this phase we obtained very relevant information offering good insight into the current situation of the otter species and their habitat. We also identified potential obstacles and difficulties for future work with this project. In this phase we identified and made contact with key actors that will be involved in the next phase. One important actor is a professor from the Biological Research & Environmental Education Program of the Universidad de los Lagos, which showed great interest in taking part in our initiative by incorporating students of biological sciences into the project. It’s expected that for 2006 a new student could be involved for field training. In addition, the approach with the Valdivian Coastal Reserve permits to us carry out a long term monitoring of otter population and design a conservation strategy at local level. As part of the project and based on our data, marine otter’s population were considered as a conservation target in the management and monitoring plan of the Reserve. Others outcomes during this phase was the inclusion in the River Otter Journal, two publications about marine otters. One about feeding ecology of marine otter (study supported by IOSF during 1999 – 2000), published in the volume 14 and the other one about the findings during this project, published in the volume 15.

At the current stage, two new projects will be carried out. First one will be focused on survey the fjords and channel zone, which was poorly assessed during first phase (mainly due to lack of sufficient funds). Therefore, during March-April 2006 an intensive survey at this zone will be done. Second project, is focused on the assessment of the efficiency of marine otter as umbrella species in rocky exposed shores, this new initiative will be carried out in the central south of Chile at three different sites identified during the first phase surveys, where one of these will be placed at the Valdivian Coastal Reserve.

It’s expected for the next step, the formal commence of the promotion of coastal conservation initiatives at different levels; government organizations and other non-governmental institutions involved in wildlife issues, in order to discuss better ways to design and propose coastal protected areas in the central-south of Chile, supported on obtained and the new information. Part of this process began with the inclusion and consideration of the marine otters as a key conservation target in the largest private coastal conservation area of Chile.

At the same time, the current phase will continue working in two lines; a more strong public awareness campaign, but this time focused more on stakeholders and students of coastal schools. And the scientific research about the movement range, the umbrella potential, subtidial habitat characteristics and interference with artisan fisheries. Only having good information
about this, the promotion of coastal protected areas and the conservation of marine otter populations will be efficient. Although, all the necessary funds for this component of the new phase are not already secured.

Even though the modest financial support of IOSF, for the whole project this was essential because permit to us a better accomplishment of the proposed objectives and specially because permit start with the public awareness campaign, producing stickers and brochures, but also complementing other items such us travel and alimentation.

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IX. REFERENCES


