

PATAGONIA PARK: A DECADE OF HUEMUL CONSERVATION



TOMPKINS CONSERVATION WILDLIFE BULLETIN

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EDITORIAL

Patagonia National Park, an idea is born

In 2004, Conservacion Patagonica, a non-profit founded by Kristine Tompkins that is now under the umbrella of Tompkins Conservation, emerged on the Chilean conservation scene. Conservacion Patagonica's first undertaking was a landmark proposal to establish Patagonia National Park, through the purchase and eventual donation of the Estancia Valle Chacabuco (68,000 hectares), one of the largest cattle ranches in the Aysén Region of southern Chile. The park would be created by joining the privately assembled

conservation lands with two national reserves, Jeinimeni Lake National Reserve and Lake Cochran (or Tamango) National Reserve into a single protected area—the future Patagonia National Park.

The future Patagonia Park region—popularly known as Chacabuco Valley and Entrada Baker—is located in an ecologically significant area of Patagonia, in the transition zone between Andean forest and the Patagonian Steppe. For nearly thirty years, the Chilean government has recognized this

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area as a priority site for biodiversity conservation. This designation has been ratified by various committees of experts and scientists along with the Chilean Ministry of Environment as well as those responsible for protected areas (CONAF, the National Forestry Corporation) and the protection of natural resources (Environmental, Agriculture and Livestock Services).

With the creation of Patagonia National Park, Tompkins Conservation's goal of conserving these significant ecosystems and species in perpetuity will be greatly advanced. Equally significant is the impact the park will have on the local economy through the creation of high-quality, publicly accessible

ecotourism infrastructure. The park will become a major tourist destination in the Aysén region, and will in turn boost the local economy and contribute to the sustainable development of the region and surrounding local communities.

Among the conservation objectives in the future park, a key focus has been the recovery of the southern Patagonian huemul deer (*Hippocamelus bisulcus*), a native and endangered species with a world population today estimated at less than 1,500 individuals. The low population of the huemul, an iconic species that appears on Chile's national shield, is emblematic of the global loss of biodiversity due to habitat loss and the status of crisis faced by natural spaces.

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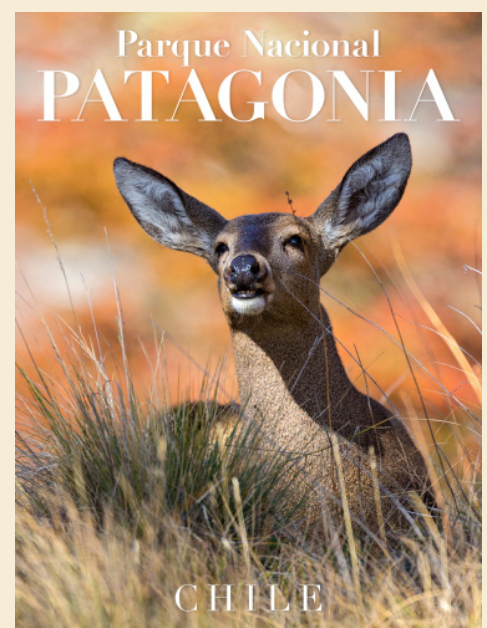
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The people behind the monitoring and protection of the huemul:

- Daniel Velásquez
- Delmiro Jara

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Acknowledgements



Fortunately, the area around Lake Cochrane, including the northern sector of the park, is home to approximately 10 percent of the estimated world population of the species today, thus presenting a crucial site for long-term huemul protection and recovery.

Twenty years before the Chacabuco Valley was privately acquired for conservation, the Cochrane (Tamango) Lake National Reserve was about to be degazetted as a protected area. Fortunately, in the early 1980s, the first huemuls were observed in the area, which changed the fate of the reserve, as well as the relationship between the community in the town of Cochrane and these iconic Andean deer. In the mid-1990s, CONAF began implementing habitat protections for the huemul of the north shore of Lake Cochrane and surrounding areas. Tamango, at that time was already a globally recognized site for the huemul population. Even so, these areas were still used by the neighboring ranches of the Chacabuco Valley, where more than 30,000 sheep and 3,000 cattle were being raised.

The possibility of realizing CONAF's vision of securing land and habitat conservation for the huemul in the Lake Cochrane region materialized in 2004, through the acquisition of Estancia Valle Chacabuco by Conservacion Patagonica. From that moment, Conservacion Patagonica complemented CONAF's efforts in the area, providing an increase in habitat and care for the area's huemul population. Efforts to increase the



Male huemul in the Lengua forest in the Chacabuco Valley.

huemul's habitat were in perfect harmony with scientific recommendations indicating that the priority sites for huemul conservation should include suitable habitat along slopes, near or between populations of the species, with the goal of ensuring the expansion and dispersal of the population.

Although there is still a ways to go, over the years we have seen a significant increase in interest in huemul protection. We are pleased that Conservacion Patagonica has enhanced the work undertaken by state institutions, other nongov-

ernmental organizations (NGOs), and civil society in general, including researchers and conservationists. Moreover, we are proud of the innovations we have pioneered in huemul conservation.

In these ten years of committed work by the Patagonia Park Wildlife Team—including rangers, veterinarians, technicians, volunteers, and other partners—Conservacion Patagonica has developed various methods for monitoring and preserving huemuls in the area. This has been made possible thanks to significant fi-

nancial support from donors and institutions who recognize the precarious status of the huemul population in the face of natural and human threats.

We see this as the ideal time to share the achievements and lessons of the work that our team has done, and is to doing to address these threats. Furthermore, we wish to use this moment to invite all interested parties to join us in this vital effort to prevent the huemul's slide toward extinction.

The leadership of Douglas and Kristine Tompkins, founders of the Patagonia Park project, who saw the urgent need to protect the huemul and its remaining habitat, has been key to our progress. The goal is ambitious but straightfor-

ward: to achieve widespread cooperation and societal will to protect this endangered deer. Fortunately, awareness and action have increased considerably, and every day people join us in this crusade.

It has been ten years since a few timid huemuls were spotted in areas hitherto intensively occupied by domestic livestock. We do not know of any similar experiences in other parts of Patagonia, where an extensive livestock operation has left space for natural restoration and the promotion of huemul recovery. We have achieved a sustained upward trend in deer population and habitat, in an area that, only a few years ago, was occupied by a large ranch. Along the way, we have gained a better understand-

ing of the relationship between Patagonian huemuls and their predators. We have been surprised by the discovery of livestock diseases in the huemul and the impact of red deer passing through the principal huemul habitat. These are some of the topics we will cover in this first bulletin in a series on Patagonia Park's wildlife.

We hope you find this publication of interest and will look forward to future issues that explore the protection and *rewilding* of Patagonia Park. ♦

Cristián Saucedo Gálvez

Director of Conservation,
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Conservacion Patagonica, Chile



Male huemul deer in a winter landscape at the Patagonia Park.

DATA SHEET

Souther Huemul (South Andean Deer)

Considering the marked reduction in the huemul's distribution and population numbers, with estimates of less than 1,500 individuals in the world, the species is classified by the IUCN as "Endangered." To provide greater guarantees of protection, both Chile and Argentina have declared the Huemul as a "Natural Monument."

Chile is home to three species of native deer: pudú, taruca, and huemul. The latter has a robust appearance, and it can be observed alone or in small family groups. Males are characterized by having a black spot in the shape of a Y on their faces and antlers, usually bifurcated, which can reach 30 centimeters long and are shed in the winter. Females do not have antlers and usually can be found in the company of that season's offspring and an adult male. Huemul have dense, thick fur, making them excellent swimmers.

Historically, in Chile, hue-

mul were found from Rancagua (34° S) to the Strait of Magellan (53° S). Today they are extinct in several regions of their former range and their populations are fragmented. There is a small core group in the Nevadas de Chillán area (36° S), which is very isolated. The species reappears in the southern part of Palena, with the regions of Aysén and Magallanes being the main refuges for the species.

In Argentina the huemul was formerly distributed from southern Mendoza (33° S) to the province of Santa Cruz (49° S). It is now extinct in the Mendoza Province and the northern portion of Neuquén, with the Lagoons of Epulafquen area (36° S) being the northernmost reach of the species and the provinces of Chubut and Santa Cruz representing the most promising areas for huemul persistence and recovery, ensuring the future of the species. ♦



Scientific Name:

Hippocamelus bisulcus

Size: Up to 1 meter (3,2 ft.) high at the withers; weight can reach 90 kilograms (198 lbs.).

Habitat: Lenga (beech) forests and ñirre scrubland. Also found in high steppe areas.

Geographical distribution: The huemul is an animal exclusive to Southern Chile and Argentina and Patagonia in general (see the distribution map). Its original distribution has been reduced dramatically. The species lives in isolated and fragmented areas of Andean Patagonian forest and periglacial areas, both in protected areas and on private and publicly owned properties.

Food: The huemul is a browser species, consuming varying herbs and leaves of shrubs and trees, depending on latitude and season.

Rut: Autumn

Gestation period: Females gestate for approximately seven to eight months.



Fawns: Only one fawn is born per parturition, with a uniformly colored coat (without spots). Fawns' spots remain dormant for the first two weeks to provide camouflage from predators. They suckle from their mothers for short periods at a time. Huemul young are very vulnerable to and defenseless against attacks by domestic dogs.

Threats: Reduction and habitat modification (replacement of native vegetation), livestock ranching and associated diseases, poaching, dog attacks, introduction of invasive species (red deer and wild boar), infrastructure projects (roads, power plants, and mining), and careless tourism development.

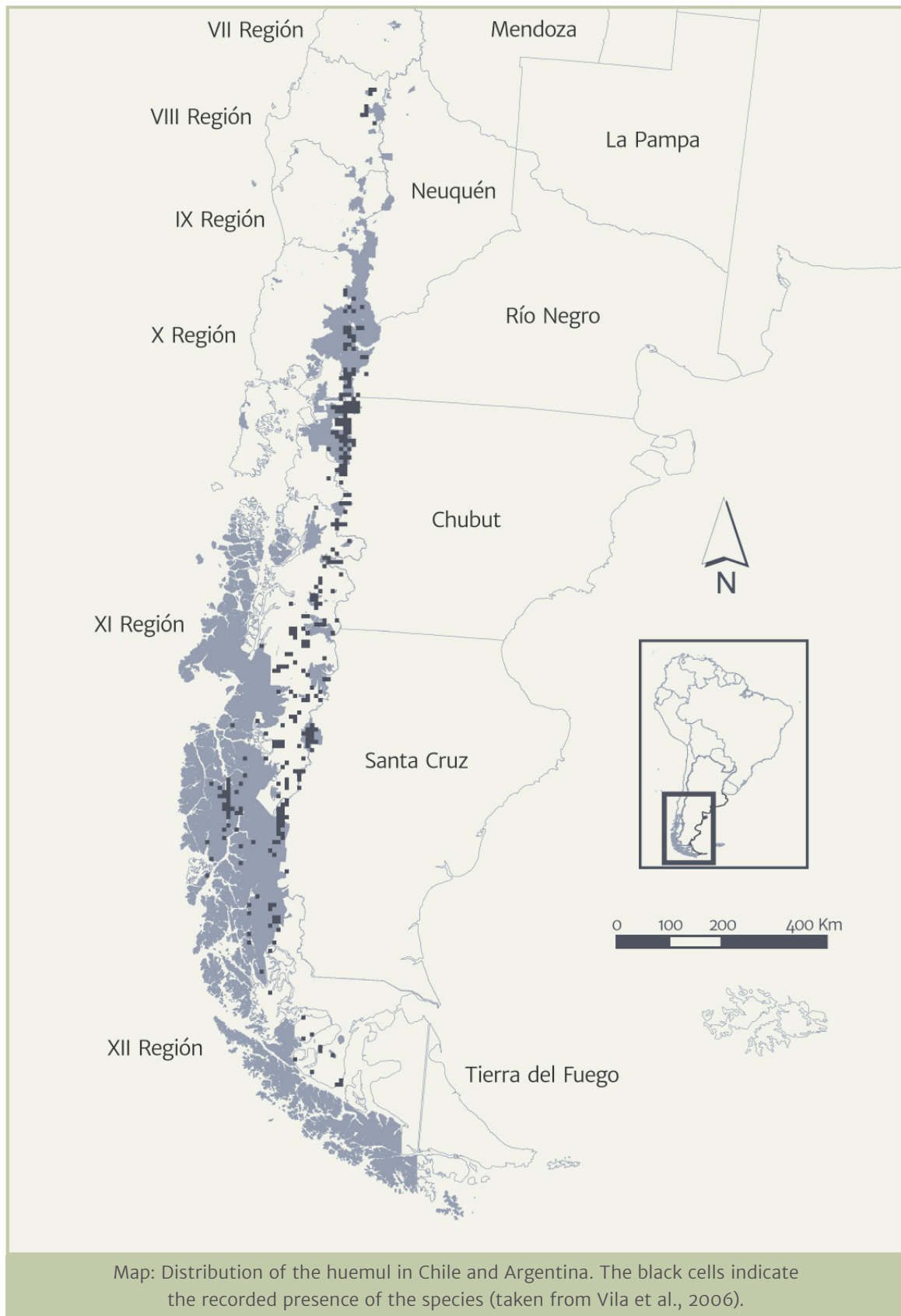
If you encounter a huemul

Remain calm, be patient, and stay still, giving the huemul (or group) a few minutes to get used to your presence, and always to leave it an escape path.

Record the experience with photographs while keeping your distance so that you can observe calmly and do not pressure the animal.

Share photos online specifying the location of the sighting and share the observation with ranger staff, professionals, and people who care about huemul conservation.





was vital in order for the huemuls to recover territories and portions of forest that have been lost due to more than 100 years of ranching in the area.

With the incremental transformation of the estancia into a park, a series of scientific questions related to the species highlighted (Figure 2) emerged:

- With livestock removal and the elimination of related fences, would the huemul population benefit and increase?

- If current law against puma and fox hunting was enforced under the new conservation-focused ownership (unlike during estancia years), what effects would these predators have on the huemul population? Would the lack of predator hunting increase deer predation? Would the puma and fox threaten huemul persistence and recovery?

We began removing cattle and fencing in zones containing suitable huemul habitat, especially those made up of lenga (beech) forest and brush around the northern portion of Lake Cochane. Through these measures, we sought to connect fragmented areas where we knew huemuls were present, such as Tamango and La Baguala (see Figure 3), areas of the ranch where livestock dominated, with only the rare huemul sighting.

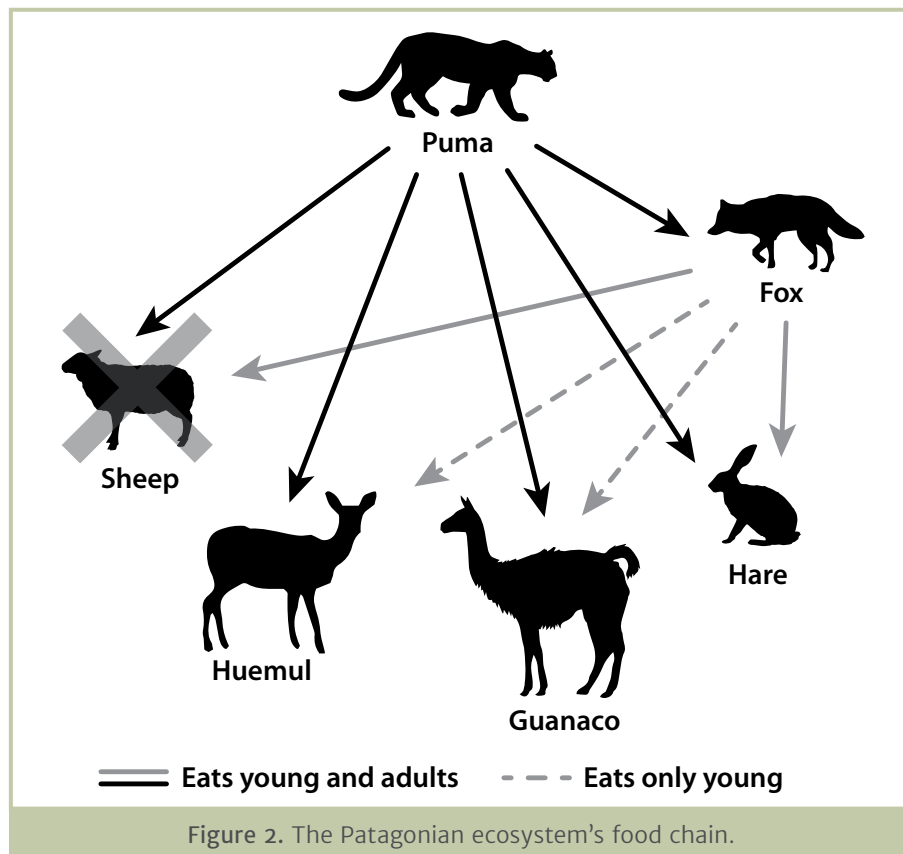
We expected that the wooded areas of the former estancia, located between the two sites, would be attractive to the huemul, presenting a quality refuge for them. We saw that these areas, given their ideal location, and with a little time and patience, had the potential to become important habitats; thus we focused our initial work there. From the outset, the objective of



The late René Millacura (1972– 2014), the first park guard hired to monitor huemul.

the huemul project was clear. Our priority was providing good conditions (secure, high quality habitat) for the huemul to recover as soon as possible in those territories that were previously degraded as a result of the livestock operation.

Because our information about huemul occupation of and movement around the area was very limited, coming from occasional observations of huemuls in some areas of the ranch, it was necessary to first form a ranger team to begin finding and monitoring the population in earnest. We contacted and invited René Millacura to undertake the challenge and responsibility of becoming the first ranger to monitor huemuls, and after a few months, Daniel Velasquez, who at that time was working on huemul research, joined the team in the Tamango area. Delmiro Jara, who for many years had served as



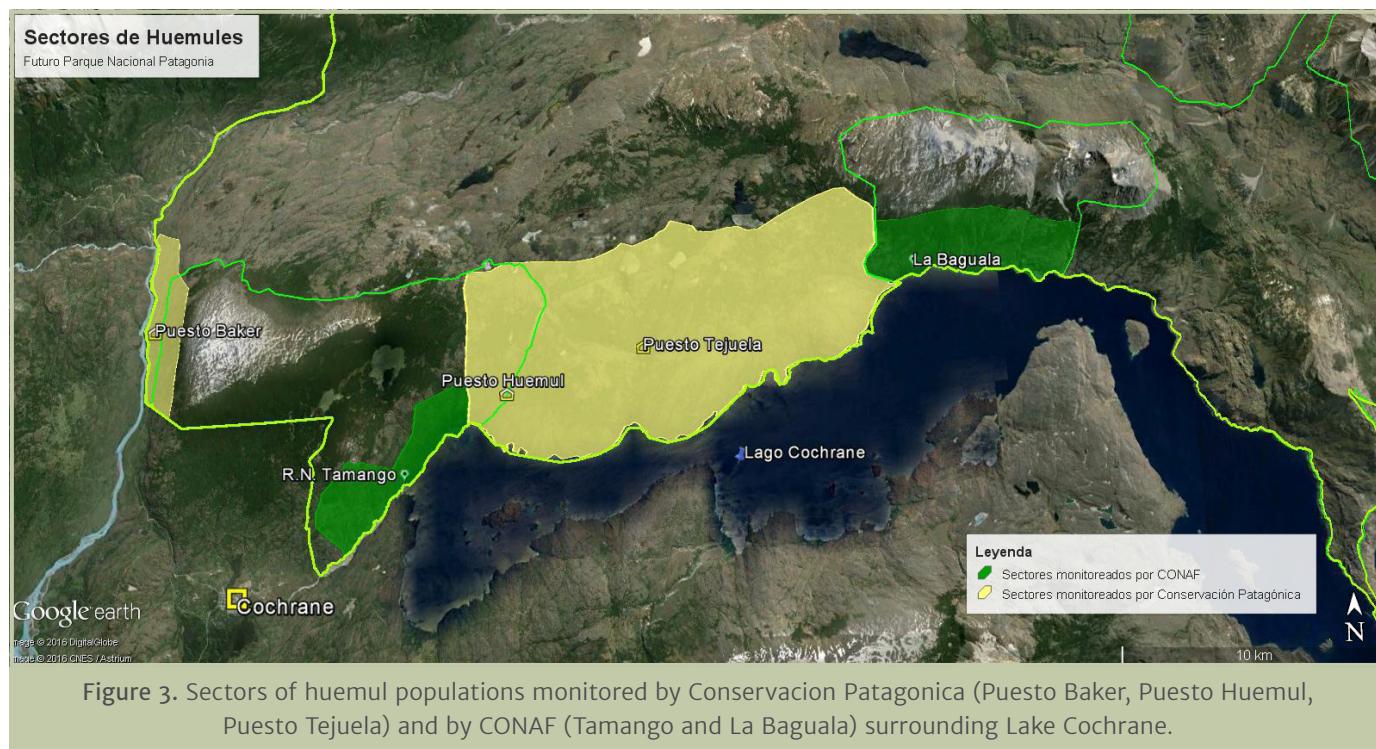


Figure 3. Sectors of huemul populations monitored by Conservación Patagónica (Puesto Baker, Puesto Huemul, Puesto Tejuela) and by CONAF (Tamango and La Baguala) surrounding Lake Cochrane.

a gaucho (or cowboy) at the estancia, became the third member of this team. These three individuals brought their combined years of field experience in the area, knowledge of huemul ecology, and most importantly, a commitment to care for and protect these endangered creatures.

The information regarding huemuls provided by the gauchos who had worked on the ranch for years was key in directing the initial fieldwork. We planned jobs based around different sections of the park and scheduled data-gathering trips in search of huemuls and evidence of their presence, including hoofprints, feces, bones, antlers, fur, or marks on trees. It was necessary to recognize the huemul's terrain, where they were, how many there were, their gender and estimated age, in order to determine the initial sta-

tus of that population and to detect changes that occurred over time. Thus began the wonderful and challenging fieldwork and the creation of an excellent team, fully committed to the work ahead.

Concurrently, we needed to determine locations for the rangers to live and find shelter from the elements. To do this, we decided to restore inherited puestos, or rustic "huts" from the estancia era; specifically, Puesto Tejuela, Puesto Huemul, and Puesto Baker, which were located in areas near the huemul habitat (Figure 3). These three sites became the base of operations from which rangers organized their routes and received volunteers who assisted in the work.

Building upon the experience we had gained earlier with CONAF, capturing and monitoring huemuls with radio collars in Ta-

mango, we decided, beginning in 2005, to extend this type of monitoring to certain zones around Lake Cochrane in the future Patagonia Park. This would allow us to combine the demanding job of searching for and observing huemuls in the field, with the individualized information generated from the monitoring of radio-collared huemuls. It thus became possible for rangers to create a single database of all huemuls, including those that were not marked, and assign a name to each animal based upon individual characteristics that distinguished them. Through this process we created a monitoring system in which local rangers played a major role. This system worked in conjunction with further efforts to improve habitat conditions, including the removal of fences, removal of domestic livestock (and thus prevent trans-



Male huemul with a radio collar in the Chacabuco Valley.

mission of potential diseases), as well as the removal of dogs associated with livestock husbandry.

During extensive tours on foot or horseback in search of huemuls or their transmitter signals, rangers carried—in addition to basic equipment such as a notebook, GPS unit, and binoculars—a receiver and antenna for radio-telemetry. This allowed the ranger team to closely monitor certain tagged animals and record the information obtained about huemul movement and habitat occupation.

Huemul live in small groups, usually fewer than five individuals, depending on the season. Additionally, they live in low densities, that is, a few individuals relative to the total area, preferring to occupy forest and mountain environments, making it gen-

erally difficult to find them in the grassy plains. Therefore, locating an unhabituated huemul could often take almost a full day and several hours of hiking.

Gradually, the job of following tagged huemuls began to involve a significant portion of time, effort, and dedication taking away from the routine work of the rangers. In turn, the huemuls became accustomed to the presence of their solitary yet permanent guardians. The classic tracking combined with radio-tracking provided a key strategy to monitor huemul group population numbers and their movements, and made it possible to more accurately estimate the reproductive success of some individuals and the survival of both adult and juvenile huemuls. ♦



Park guard Daniel Velásquez using radio telemetry by Lake Cochrane.

Huemul habitat and density in the Chacabuco Valley

Over the years, we have been able to verify the distinct preference that the huemuls have for the beech forest and brush environment, combined with rocky terrain and steep slopes. In these environments there is a greater diversity of plant species to feed upon and a lower risk of predation. Huemuls typically avoid expanses of grassland and Patagonian steppe, which are generally occupied by guanacos, the area's most abundant large herbivore. The huemul deer has a wide and varied diet yet it is also selective, focusing on buds and tender leaves of herbs, shrubs, bushes, and trees during each season. Because of this habit, the huemul is considered a browser species, unlike the guanaco which is a

grazer, feeding on a larger volume of grasses and other plants that grow close to the ground.

Both male and female huemuls are territorial, forming small family groups. Our monitoring data shows that the areas where the huemul live in Patagonia Park range between 400 and 1,200 hectares in size (Corti, 2008; Gill et al., 2008). Although there may be some degree of overlap, huemul tend to restrict their groupings to certain individuals. The territoriality of the huemul may mean that in a given area, resident dominant animals limit the arrival, permanence, and settlement of new huemul.

When we first started working on huemul habitat improvement in the Chacabuco Valley (at the Puesto

Huemul sector), sightings were rare, likely because of the livestock activity in the area. Over the years, it became possible to observe a gradual increase in the number of huemuls in the area, signifying a nearly fourfold increase in huemul density, from 0.35 huemuls per square kilometer in 2006 to 1.3 huemuls per square kilometer in 2015. These densities are some of the highest recorded, and are possibly typical of places that have reached their carrying capacity, less only than the numbers recorded in Bernardo O'Higgins National Park. This may be related to the fact that the huemul is not a species that forms herds or flocks but instead lives in small groups that rarely reach as many as six individuals.



Male and female in Lengua Forest, one of the huemul's preferred habitats in the Chacabuco Valley.

Possibly due to the high density of huemuls in Puesto Huemul-Tejuela, it has been possible to observe that some male youth and adults (and likely females) do not establish territories but instead disperse away from their birthplace. Those animals that disperse are key to maintaining connectivity between the huemul subpopulation of the Cochrane Lake basins in the south, with that of the Chacabuco Valley to the north. Identified dispersal has varied in length, with distances ranging from 2.5 to 5.5 kilometers, far exceeding typical huemul movements.

One of the most notable cases of such movements was seen with the individual we named “Silencio,” who was born at the mouth of Lake Cochrane and five years later



A female huemul taking care of her fawn.

was found with a group of huemuls 16 kilometers northwest of where he was born. The area that Silencio had chosen as his home happened to be the exact location on the Baker River where HidroAysen aimed to build a massive hydro-

electric dam. This huemul became yet another symbol of conservationists’ fight to protect the Baker River and the Patagonian region from river-killing hydroelectric development. ♦



The huemul known as “Silencio,” who, after moving outside of the park, became established in a private estate on the banks of the Baker River in the area of the proposed HidroAysen Project.

Population status of the huemul and limiting factors in the Chacabuco Valley

Conscious of the aforementioned methods of monitoring, which included rangers and radio tracking, we decided to concentrate our work in two specific areas of the Chacabuco Valley: Puesto Huemul-Tejuela and Puesto Baker, comprising a total area of approximately 75 square kilometers. Here, in 2005 and 2006, we first recorded the presence of small numbers of huemul, at the time not exceeding half a dozen widely dispersed animals in either the Puesto Huemul-Tejuela sector and in the Puesto Baker sector.

We did not have prior detailed historical information regarding population numbers and threats to huemuls in the area. Instead, we were basing our information on descriptive accounts. Season by season, as a result of the permanent and systematic work of rangers in these sectors, we recorded information regarding huemul behavior and population changes, as well as factors affecting mortality.

Between 2006 and 2014 in the Puesto Huemul-Tejuela sector we were able to observe a clear pattern in the huemul population. There has been a continuing upward trend in the number of individuals, from 6 to 26 adults (Figure 4), representing a more than four-fold increase. Additionally surprising was the fact that the males accounted for twice the number of females during this population rise.

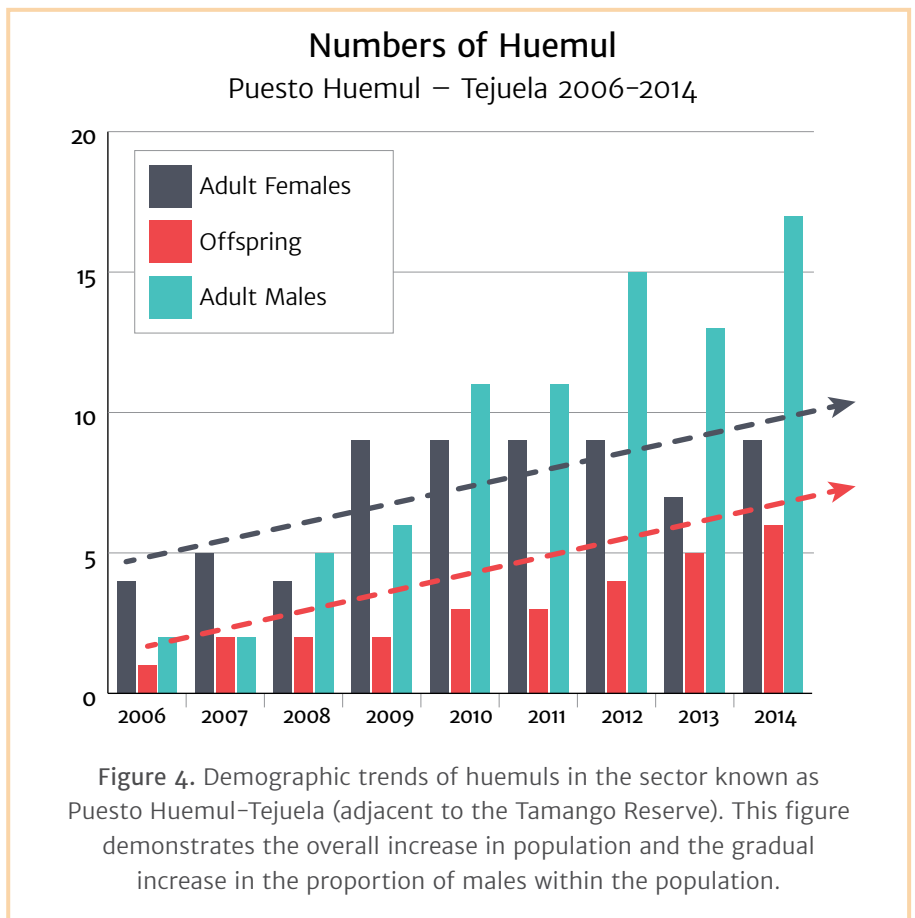


Figure 4. Demographic trends of huemuls in the sector known as Puesto Huemul-Tejuela (adjacent to the Tamango Reserve). This figure demonstrates the overall increase in population and the gradual increase in the proportion of males within the population.

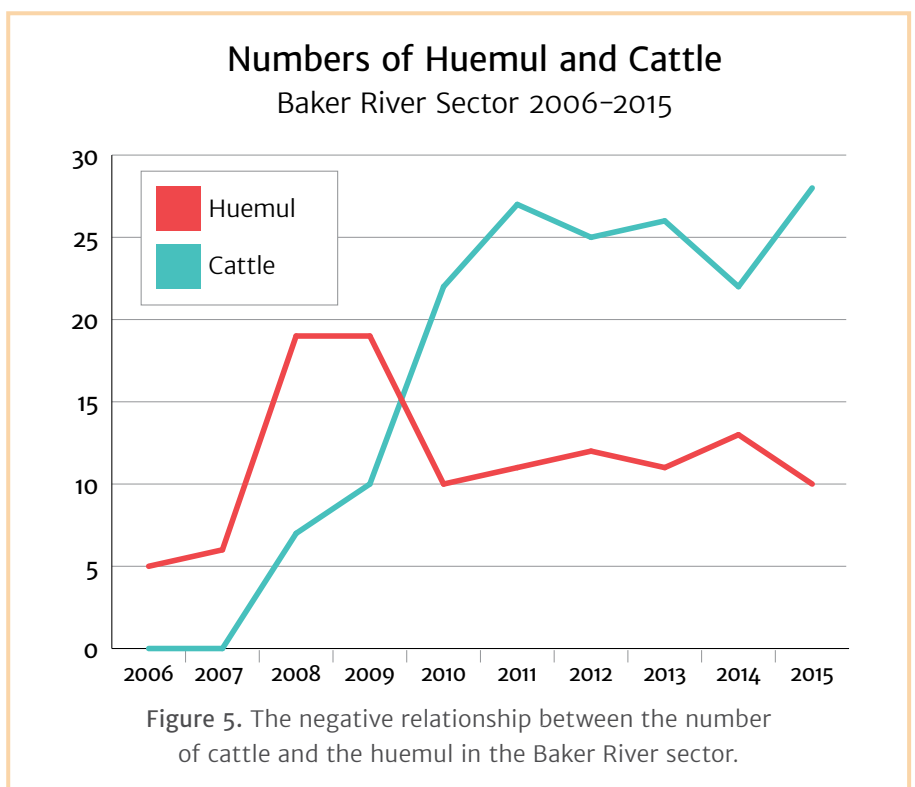
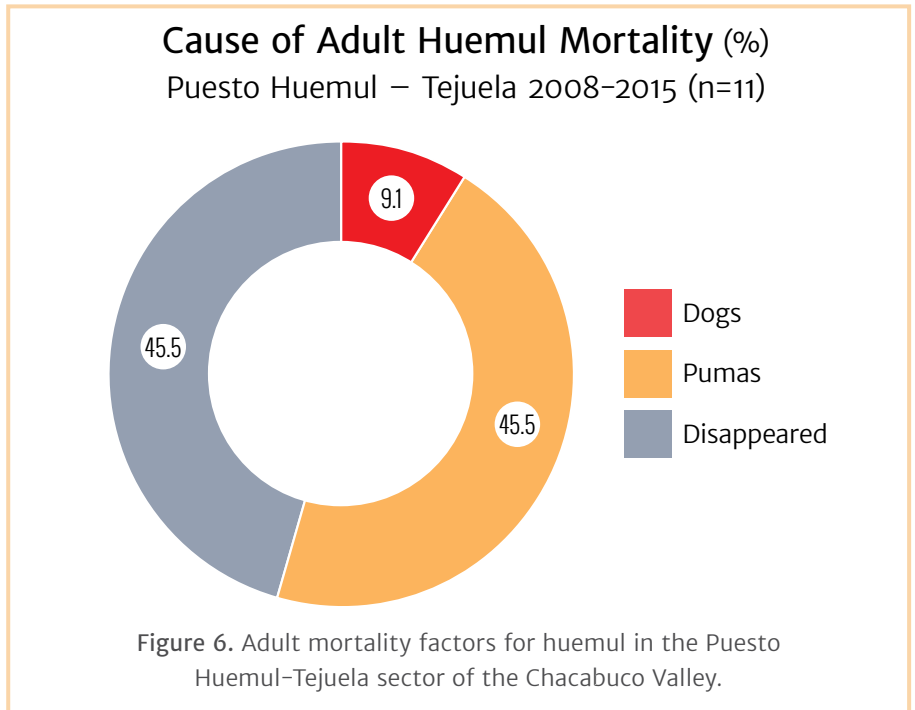


Figure 5. The negative relationship between the number of cattle and the huemul in the Baker River sector.

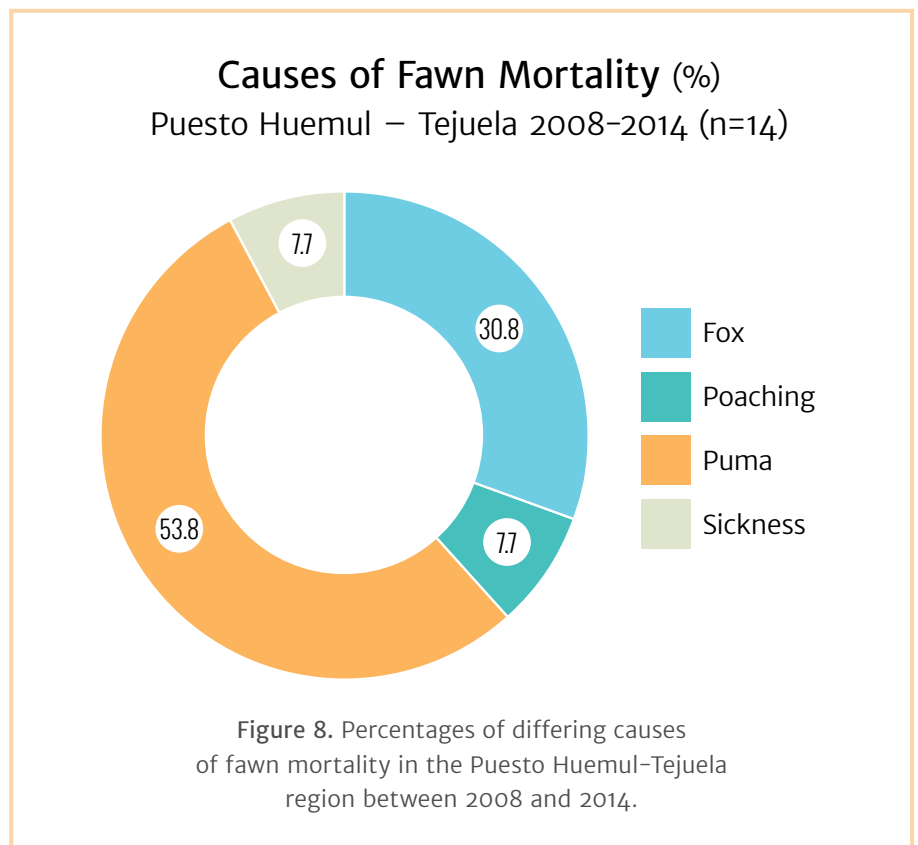
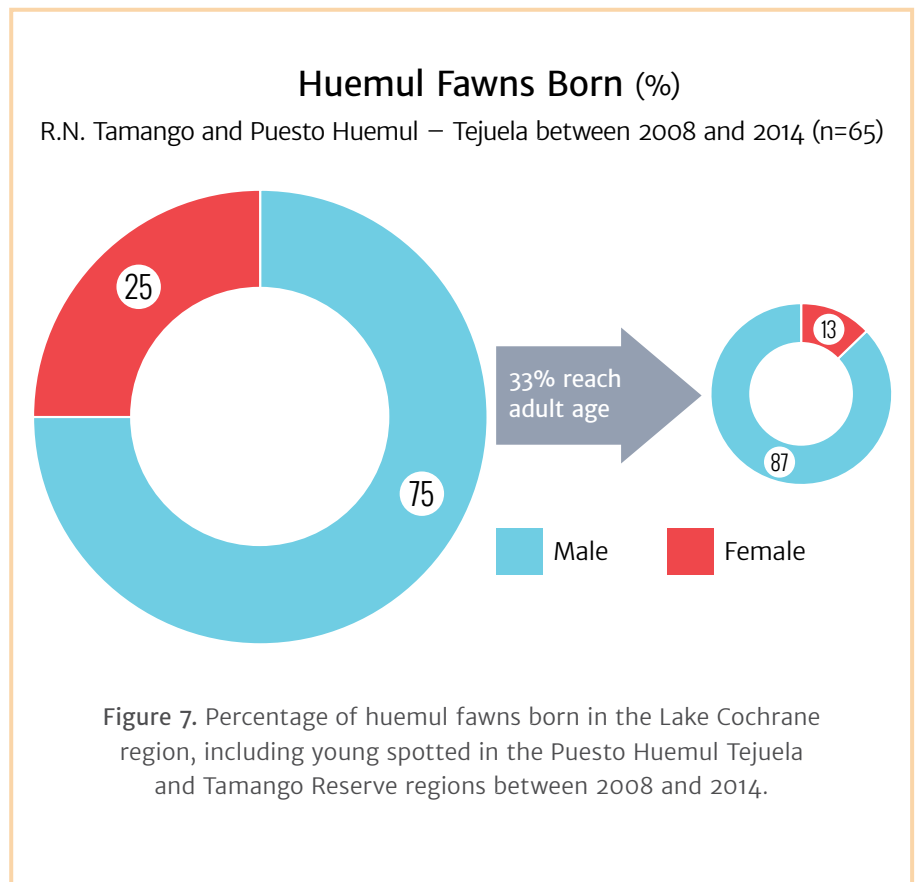
In the region surrounding the Baker River we detected an initial upward trend in the number of huemuls from 5 to 19 adults until 2009. From 2010, as a result of irregular livestock operations in the area, some of the groups dispersed to private land, away from monitored regions. This reduced the population in the local Baker River area to around 8–10 animals, a number that in recent years has remained relatively stable, although livestock continues to present a negative and limiting factor, as can be seen in Figure 5.



One important aspect of Conservacion Patagonica’s huemul monitoring program was to understand the factors contributing to huemul mortality. Between 2008 and 2015, for the Puesto Huemul-Tejuela sector, as seen in Figure 6, we found that a similar proportion of adults (45 percent) were killed by their natural predators (pumas) as disappeared or lost their tags, making them no longer observable. Of particular note was the impact of domestic dogs on almost 10 percent of the monitored huemuls. These dogs, introduced predators originating mainly from the town of Cochran, were responsible for a large proportion of huemul deaths.

In terms of the annual survival of adult huemuls living in the Puesto Huemul-Tejuela region, the values recorded reach close to 90 percent, similar to those previously measured in the Tamango Reserve by the Darwin Huemul Project (Saucedo & Gill, 2004) and Corti (2010). As such, it did not appear that the overall adult component of the population was under threat. Rather, the survival of adult females became highlighted as the most important component for the overall maintenance of and increased numbers in the huemul population.

Huemuls begin to reproduce after three years and females give birth to only one fawn per year. It is therefore very important to know if the fawns survive, since the like-



likelihood of the species' long-term survival depends upon overall population growth. Between 2008 and 2014 in the Puesto Huemul-Tejuela region of the Chacabuco Valley, we determined that the annual survival rate of fawns approached 50 percent, which is higher than the Corti (2010) estimate for the Tamango Reserve.

After analyzing the data regarding fawns born in the Lake Cochrane Reserve and Puesto Huemul regions between 2008 and 2014, it was determined that 75 percent of fawns born were male and 25 percent were female (Figure 7). Additionally, only one-third of the monitored offspring reached adulthood, 13 percent of which were female. Note that these results come from a sample of fawns born in the Lake Cochrane huemul population, and if this rate of mortality was widespread, it could impact the huemul's recovery in the entire area.

By examining the causes of huemul fawn mortality in the Puesto Huemul-Tejuela region between 2008 and 2014, we were able to determine that the majority of mortalities were associated with natural predator activity, with foxes responsible for about 31 percent of the predations and pumas responsible for 54 percent (Figure 8). The remaining 15 percent of the fawn deaths were not due to natural causes, and were instead associated with human activities such as hunting and livestock disease.

Pumas and foxes, native pred-



ators in the region, represent the main source of mortality to adult huemuls and their young, a natural and normal fact of life in this ecosystem's food web. This situation is similar to what has been observed in nearby regions such as the Tamango National Reserve by Gill et al. (2004) and Corti (2008), and, in the far northern huemul habitat of the Nevados de Chillán, VIII Region (Lopez et al., 2011).

The huemul population in the

monitored area has continued to rise, despite the permanent presence and impact of predators. This highlights the fact that, while predation has an effect on the population, it likely does not threaten its long-term survival. However, due to the present reality of dramatically decreased huemul numbers relative to pre-European settlement of the region, it is prudent to continue and increase huemul population monitoring. ♦

Puma and huemul interactions

Under natural conditions, the huemul has evolved behaviors that allow it to effectively evade their two main natural predators: the culpeo fox, which exclusively attacks huemul fawns, and the puma, which, in addition to attacking offspring, preys upon adult deer. Successful coexistence between the huemul and their predators has existed in the Patagonian ecosystem for more than 10,000 years.

The adaptation of the huemul to live in small groups, in low densities and remain camouflaged due to their coloration within the forest and scrub, coupled with their quiet movements (except for rutting season), has resulted in a reduced risk of predation. The fact that the offspring remain alone for long stretches between periods of suckling during the first weeks of life is a clear strategy against nat-

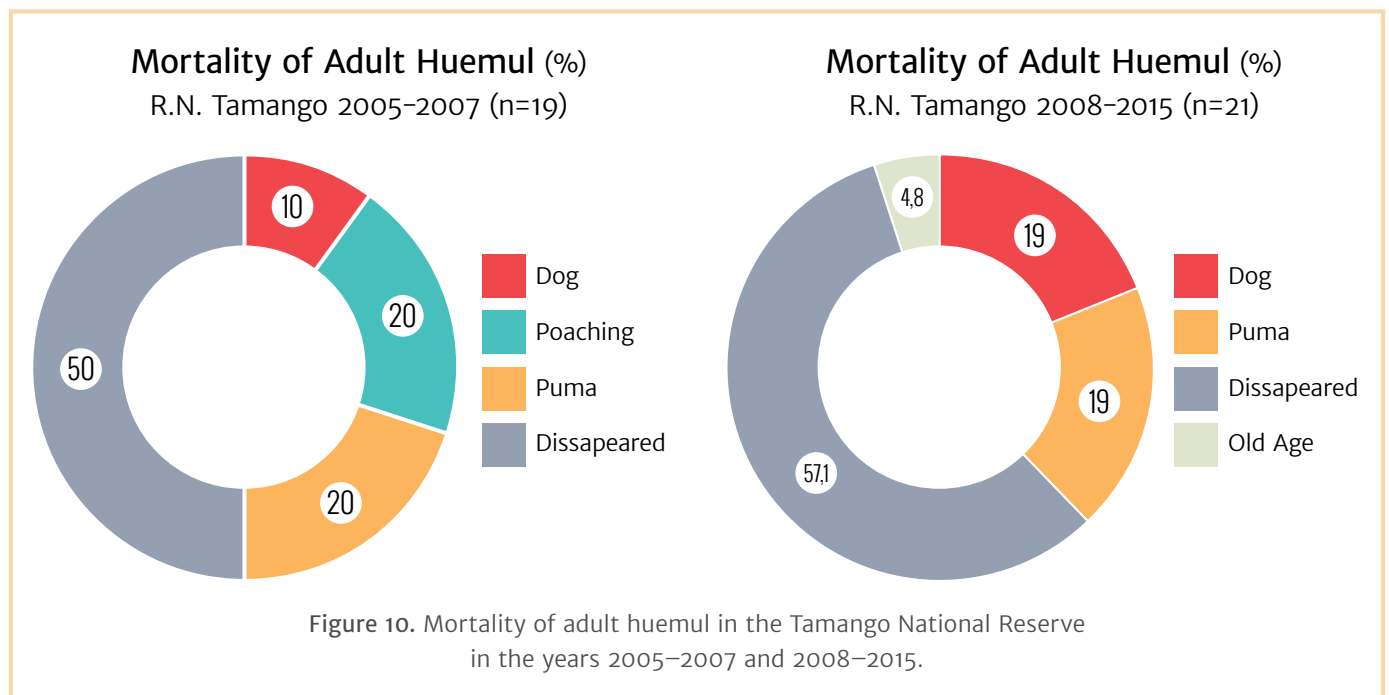
ural predation.

The huemul has not evolved to have efficient defense mechanisms to address some human-associated activities such as predation by dogs, hunting, and the transmis-

sion of domestic livestock diseases. Consequently, the impact that these factors have on the huemul populations is extremely important, for it is in addition to natural causes of death. It is essential to

Prey	Amount	Percentage
Guanaco	980	79.5
Sheep	45	3.7
Hare	187	15.2
Huemul	9	0.7
Fox	1	0.1
Caiquén	3	0.2
Armadillo	7	0.6

Figure 9. Prey detected in GPS and radio-telemetry monitoring of 29 collared pumas in Patagonia Park between 2008 and 2015 (n = 1.232)



implement effective control measures to address these anthropogenic causes of mortality.

The impact of the puma on the huemul is one of the main reasons for the initiation of the 2008 puma-monitoring program in the Chacabuco Valley and future Patagonia National Park. After monitoring 29 pumas, we identified certain patterns with respect to their diet, predation patterns and movements within the park. A key finding: The guanaco is the preferred prey of the puma with an 80 per-

cent preference; huemuls represent a mere 0.7 percent of puma kills (Figure 9).

We had been concerned about the extent to which the puma, as the region's top predator, could play a limiting role in the persistence of huemuls in the Cochran Lake (Tamango) National Reserve Area. However, when we compare adult huemul killed and preyed upon by puma for the years 2005–2007 and 2008–2015, we can see there were no significant variations (Figure 10).

Thanks to the monitoring of pumas, both in Chacabuco Valley and Tamango, we have been able to verify that there are no examples of puma showing a marked selection for predation on huemuls. The huemuls that were preyed upon had differing physical conditions, ages, and sexes. It is therefore hypothesized that these are opportunistic and normal interactions, given the role that the puma plays as top and principal predator of large herbivores in this ecosystem. ◊

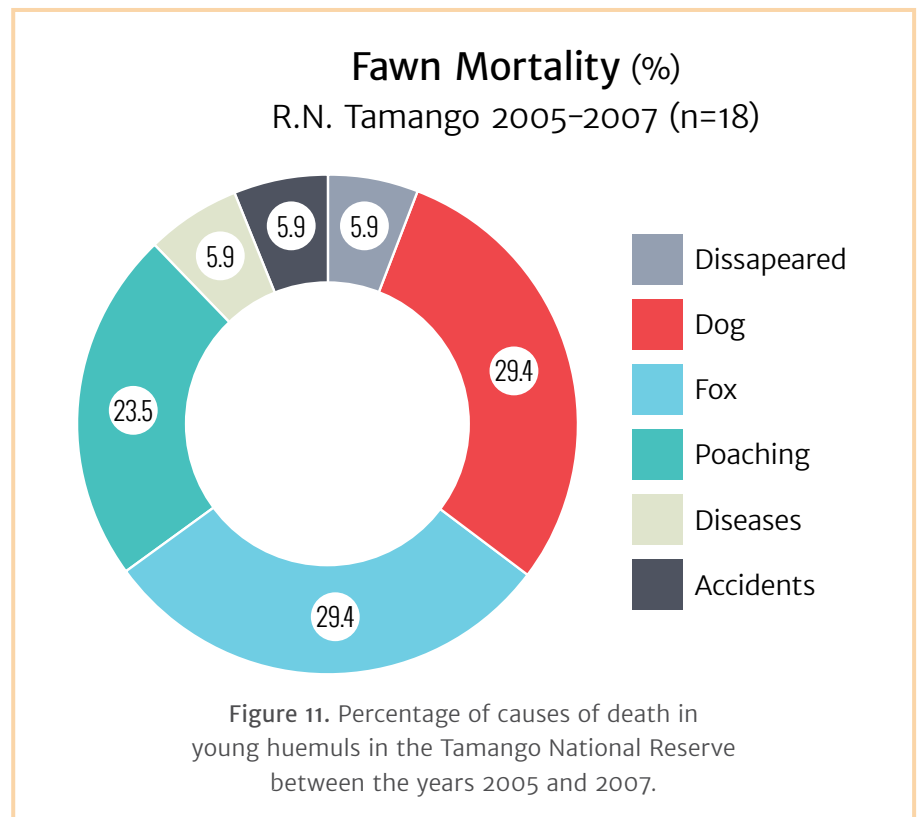


Interactions between dogs and huemuls

Dogs are one of the major threats to huemul populations. The huemul deer generally has limited evasion and defense strategies when faced with attack and persecution by canids such as domestic dogs. Through the process of evolution, the huemul today presents behaviors and habits—such as attempting to remain unnoticed, escaping predators in a short-distance, or seeking refuge in steep terrain—to address the threat posed by pumas and foxes. However, these and other behaviors, including attempts to seek refuge in waterways such as streams or lakes, are not very effective against dogs.

Unfortunately, throughout our ten years of work, dog–huemul interactions have risen in various areas around the Cochrane River and Lake Cochrane. This is the product of the growth and urban expansion of the town of Cochrane, in conjunction with the lack of control over domestic dogs, in both urban and rural areas.

To get an idea of the key threat that dogs pose to the huemul's survival, see the measure of adult huemul mortality rate as a result of dog attacks in the Tamango National Reserve between the years 2005 and 2015, which ranged up to 20 percent (Figure 10). The location of the reserve, near the city of Cochrane, certainly contributes to this situation.



During the years 2005–2007, the impact of dogs on adult huemuls and fawns in the Tamango National Reserve was systematically measured. Our research determined that approximately 30 percent of young huemuls were killed by dogs (Figure 11), equal to the percentage killed by foxes.

Dogs have had a significant impact on not only huemul mortality but also on the areas now occupied by the species. Thus, over the years, it has been possible to record the displacement and subsequent abandonment, on the part of the huemul, of areas that they had previously frequented, such as areas close to the Cochrane River

(Tamango National Reserve) and Puesto Baker, where recently they have only occasionally been observed. This is directly related to evidence confirming that dogs enter huemul areas and attack adult huemuls and fawns, usually with fatal consequences (Lara et al, 2012; Lara, 2013; Saucedo and Gill, 2004; Corti, 2008).

Additionally, some dogs associated with suburban and rural areas pass through zones where groups of huemuls reside and subsequently pursue them, as has been observed in the Puesto Baker area. We observe an increase in this threat with growing concern; data gathered by ranger Daniel

Velásquez has confirmed the encroachment of dogs and subsequent deaths of huemul in the Puesto to Huemul area in the winter and spring of 2015.

Although dogs only occasionally and briefly enter the area presently comprising Patagonia Park, these encroachments have important consequences due to the high vulnerability of the huemul. Moreover, the impact could be that much greater if these encroachments occurred during the deer's birthing season, seriously affecting the huemul's survival and the future of the population.

The threat that domestic dogs pose to the huemul is a complex problem. Dogs may also threaten human health (as a result of, for example, hidatidosis caused by parasitic infection, animal waste, or direct attacks on people) and the rural economy (from dog predation on livestock). Therefore, approaching the problem posed by unsupervised and unmanaged dogs requires ongoing work and must involve the active participation and collaboration of the community together with local authorities, institutions, and various organizations. ♦



Domestic cattle and livestock as threats and limiting factors for the huemul

Since the founding of Conservación Patagónica's huemul conservation program in the Chacabuco Valley, our goal has been to remove the fences and domestic livestock (sheep and cattle) in huemul habitat zones. Historical precedents have shown these measures as an effective means of assisting huemul population recovery.

As the program was implemented and as we captured certain huemuls in order to equip them with radio collars for monitoring, we took the opportunity to assess the health status of the huemul and to subsequently generate data. To do this, we performed physical examinations and obtained biological samples (blood and tissue) from

each animal. Through laboratory analysis we found evidence of huemul exposure to domestic livestock diseases, specifically bovine viral diarrhea (Corti et al., 2013), which causes miscarriages and births of weak calves, an economic burden to livestock operations.

Our data shows that in areas where there previously were livestock in the Chacabuco Valley, almost 8 percent of huemul fawns were born weak and/or died within days of birth. This fawn mortality could be related to this specific bovine diarrhea infection or to other infectious agents originating from domestic livestock.

With the support of laboratory work, we've observed and diagnosed cases of huemuls contracting sheep scab and sometimes presenting very severe cases with crusting and scaling (González-Acuña, 2009). When the animals contract the ear mites associated with sheep scab, their bodies react with secretions and a thickening of their skin, which in turn affects the huemul's hearing, leaving them more vulnerable to predation by pumas. Therefore, it has become necessary to perform deworming treatments on some of the affected huemuls.

To date we have found direct evidence of huemul exposure to these two infectious agents, but it is quite likely that a number of



Photographic evidence in 2007 in the Cerro Tamango of direct contact between huemul and livestock, highlighting the consequent risk of disease transmission that, in addition to predation, dogs bring.

other pathogens are being transmitted from livestock to the huemul, through either direct or indirect contact. The evidence for this is limited as the information is difficult to obtain and the effects on the huemul are generally unknown. In some cases, it could be that these infections do not cause immediate death to the huemul, but reduce their strength and aggregate contribution to ecosystem health, either through a drop in the huemul survival rate or a reduction in the survival of their offspring.

Considering that huemuls evolved separately and have simple immune systems, some experts speculate that huemuls could be particularly susceptible to infection and disease caused by live-

stock pathogens. This remains a focus for further study.

One clear example of another disease that affects the huemul has been indicated by more than 10 cases in which abscesses and “bumps” have been observed on huemuls since 2014 in the Cerro Castillo National Reserve. The bacteria causing caseous lymphadenitis, which likely originates in the sheep and goats adjacent to the Reserve, was isolated in a couple of the animals. Additionally, this disease plays a key role in spreading skin lesions caused by blood-sucking insects like horseflies. At present, the impact on and mortality of huemuls as a result of this disease is unknown. The situation is beginning to be monitored by pertinent government agencies.

Concern is growing within civil society, creating a demand for tangible actions to protect the species.

As previously noted, the presence of livestock operations in areas near the Chacabuco Valley is a limiting factor in the numerical recovery of the huemul and the maintenance of connectivity between deer populations. This is a result of cattle displacing huemuls and these areas becoming hotbeds of infectious pathogens and disease along with other threats associated with livestock, including dogs, which are frequently used to herd livestock. Dogs negatively affect the huemul by barking, chasing, biting, and directly hunting the deer—adding to the negative factors impacting populations of huemul in the area. ♦

Summering domestic livestock in huemul habitat.



Mineral salts and the huemul

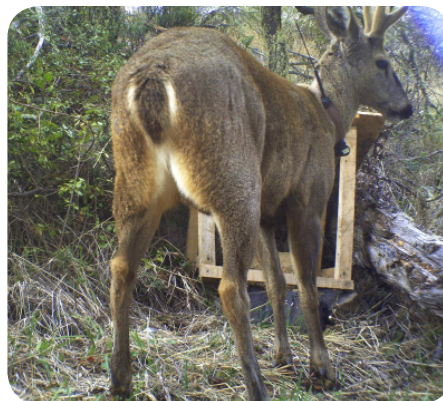
As a means of testing the acceptance level and effect of offering mineral salts to the huemuls in their natural environment, our team placed mineral blocks in certain areas frequented by huemuls in the Chacabuco Valley. In order to reduce the risk of predation, the blocks were frequently moved, especially if pumas were detected in the area.

We were able to observe that several huemuls accepted and used the blocks on a regular basis. Some

of the females even taught their offspring how to use the mineral salts, as shown in Figure 18. This is the first time that anyone has documented the huemul's acceptance of mineral salt blocks even though it has been attempted numerous times.

Although it was not possible to quantitatively measure the effect of salts blocks, we did observe that the huemuls that accepted the blocks had healthier coats and antlers. Additionally, we observed

and recorded evidence that young females who used the blocks gave birth to heavier young. We also observed that some individuals expressed no interest in the blocks. It's likely that there are certain mineral deficiencies in the natural diet of the huemul and that the contribution that these blocks make can be beneficial in some cases, as has been observed in other species of deer, but there is not enough solid evidence one way or the other. ♦



Camera trap evidence of a family of huemuls using the mineral block in the Puesto Huemul area of the Chacabuco Valley.

The red deer and the huemul

There is ample history to suggest that the arrival of exotic species such as red deer and wild boar into huemul habitat may displace, decrease, or cause the elimination of huemuls. It is not entirely clear how this occurred, yet it has been suggested that these negative effects are a result of the competition for resources, territoriality, and extreme aggressiveness attributed to the red deer as well as the possible predation of huemul fawns by wild boars.

Before 2010, the known distribution of red deer in the southern portion of the Aysén region was around the Mañihuales River and close to Puerto Chacabuco. However, in 2010 red deer, specifically fallow red deer, were introduced from the Los Rios region to Macías Island within the General Carrera Lake to establish a breeding center for hunting purposes. This introduction ignored the fact that the deer are excellent swimmers and were likely to escape to the mainland. Additionally, there was no regard for the health risk posed by these deer to huemuls and domestic livestock through the possible spread of pathogens, as the red deer came from a different region of the country (Flueck 2012).

In July of 2012, a male red deer was recorded in Patagonia Park in one of the huemul's preferred habitats. It is possible that

this deer arrived from Macías Island. The presence of the red deer had an enormous impact on the huemuls—affecting their routine, habitual behavior, and on occasion the territories they occupied. It was observed that the huemuls grew nervous and frightened and permanently abandoned areas they had formerly and routinely occupied. Fortunately, the invading red deer remained only a few days in the area before moving south of Lake Cochrane. The red deer was recorded days later at a private estate with domestic livestock. In recent years, however, there have been recorded

sightings of red deer in the zones of Bahía Murta, Puerto Tranquilo, Puerto Sanchez, Leones Valley, and Tortel.

The red deer, a new and growing threat that has come to stay in southern Aysén, has gradually increased in distribution into huemul habitats. This growing incursion requires the implementation of action that works within the framework of the regional hunting laws, which can be promoted by the authorities, as well as active collaboration with the community to control the spread of this species, which is potentially very invasive. ♦



A photographic record of a red deer interacting with domestic livestock on private land on the south shore of Lake Cochrane, 2012.

It should be noted that days before, the same deer was photographed in areas inhabited by huemuls.

Numerical changes in the huemul population in the future Patagonia National Park

In the ten years of monitoring huemul populations by our team of park rangers, we have observed numerical changes as well as changes in the geographical dispersion of huemuls. Monitoring work has gradually elevated our general knowledge about the current and historical presence of huemuls in the area of the future Patagonia National Park, in the Chacabuco Valley, the Tamango National Reserve, and the Jeinimeni National Reserve.

Until 2005, only scant information existed on the population numbers along the northern basin of Lake Cochrane, from the Baker River to the border with Argentina. There was an estimated population of 65 huemuls divided across four main areas: the Baker River

zone, the Tamango reserve, Puesto Huemul and La Baguala (Figure 12). This population was very fragmented and was distributed in a dispersed manner mainly due to the extensive livestock ranching in the area.

In 2015, south of the Chacabuco River, the population of huemuls was estimated to be approximately 120. This increase (Figure 13) is a product of conservation strategies developed over multiple years such as the removal of livestock, the establishment of park wardens, fence removal, and efforts to control dogs. These groups of huemuls are now better connected to one another through regenerating beech forest and brush, species of flora native to the area around Lake Cochrane. This signifies a

possible 100 percent population increase, accompanied by an increase in geographic distribution.

In most areas for which data is currently available, groups of huemuls have increased, as shown in Figure 18. However, in the zones around the town of Cochrané, which is located outside the future Patagonia National Park, huemul populations have decreased. This is indicated by the results of the annual field surveys conducted in Tamango National Reserve by CONAF (2015), and in the area near the Baker River conducted by Conservación Patagónica (2015). This decrease may be attributed to the effects of human activities such as livestock ranching, the introduction of dogs, and hunting.

However, it is notable that in

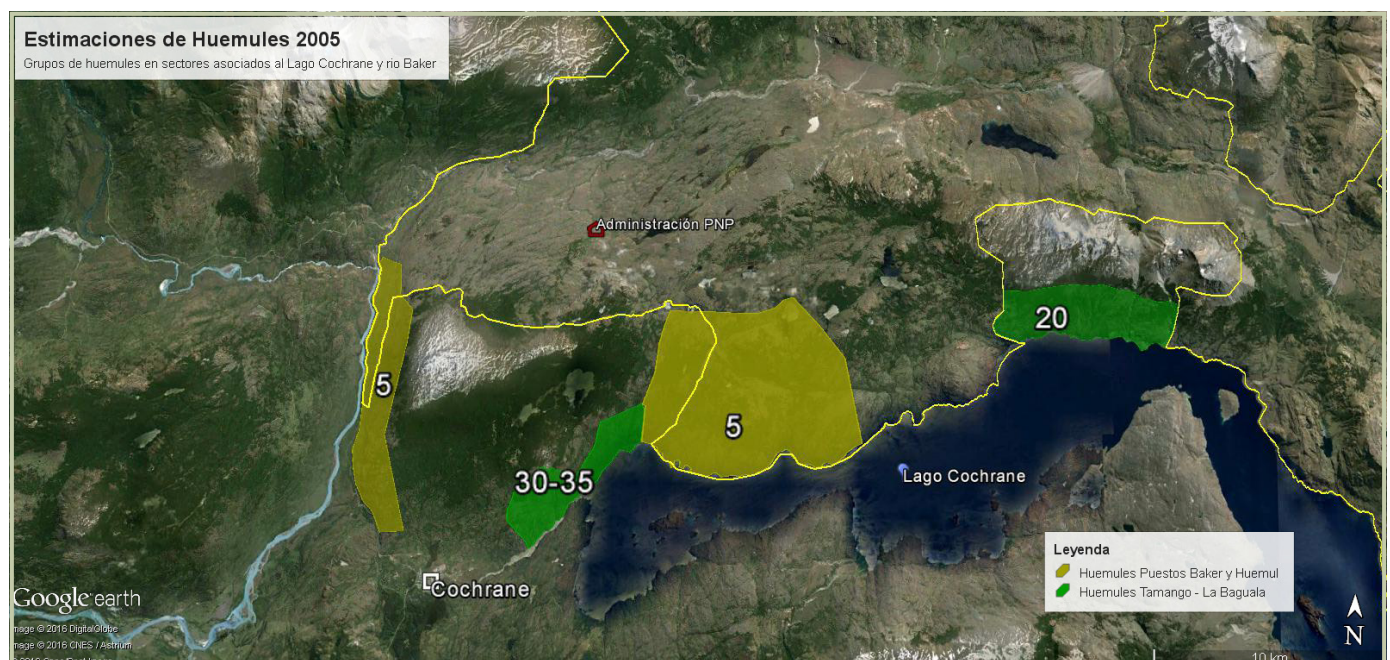
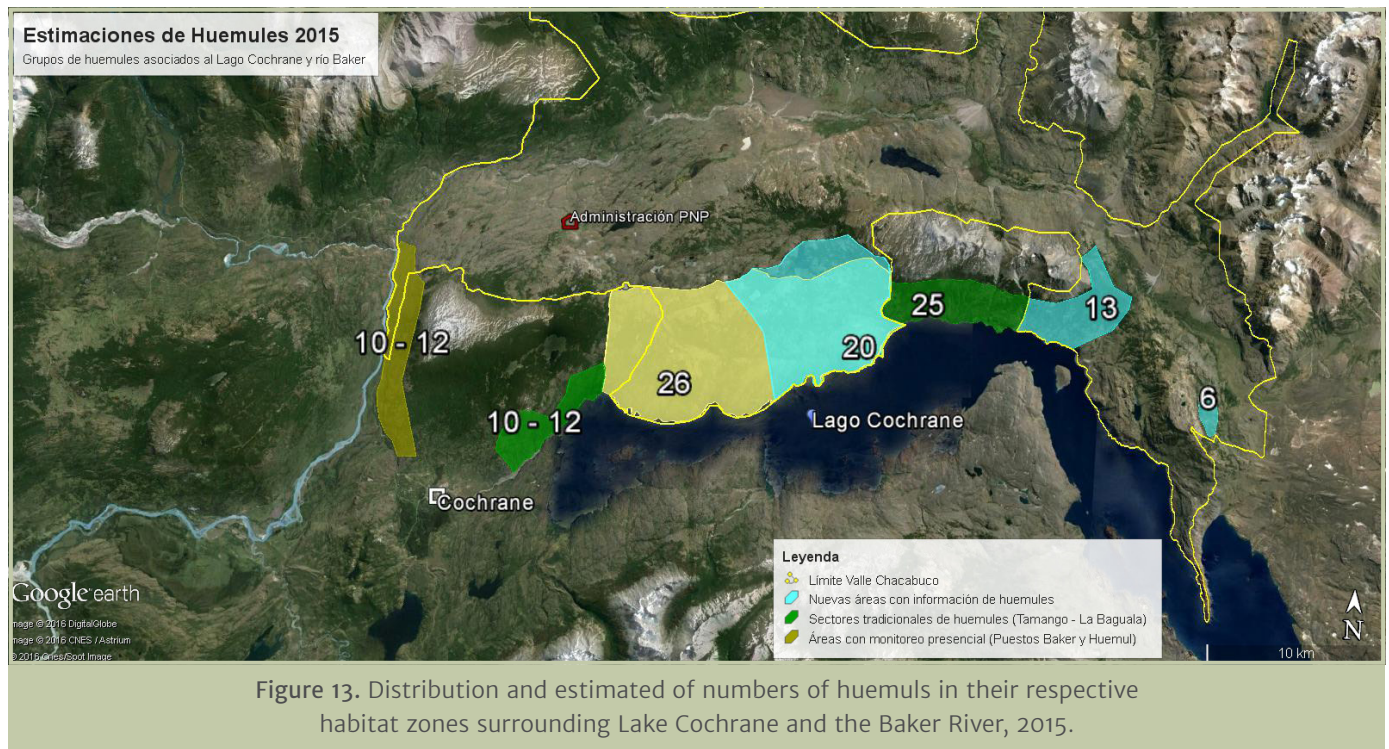


Figure 12. Distribution and estimated population numbers of huemul in the sectors of Lake Cochrane and the Baker River zone, 2005.



a few select places the population size and connectivity of the huemul groups in areas in the southern portion (including Tamango National Reserve and Chacabuco Valley) have increased and improved significantly. This signifies a real hope for the huemul in the future Patagonia National Park.

Furthermore, we note that numerous sightings of huemuls have been recorded in sectors not covered by systematic monitoring. Many of these sightings occurred in the northern sector of the Chacabuco River, specifically on the slopes of Campo Díaz, the Furioso River, and Cerro Rey, all part of the Chacabuco Valley. There have also been recorded sightings of huemul hoofprints by hikers and visitors in some areas of the Jeinimeni National Reserve.

Considering this increase in recorded evidence of huemuls in the northern portion of our proj-

ect area, a more comprehensive understanding of huemuls in this region is crucial. This would help to more precisely determine trends in the huemul populations and activities in the northern zone of the Chacabuco Valley and some sectors of the Jeinimeni Lake National Reserve. Additional studies in the northern zone would also help to identify factors that threaten the huemul and would aid in creating strategies to mitigate those threats.

Observing the current geography of occupied huemul habitats in the future Patagonia National Park, it is clear that the species' distribution is divided into two subpopulations: the northern population and the southern population (Figure 14). Connectivity between populations has been limited by loss of habitat, including ñirre, a native brush plant, and lenga beech tree forests and zones with coirones,

grasses, and neneos thorn bushes. The forest in the buffer zone between the two populations has been degraded, and in many cases lost, as a result of 100 years of livestock ranching, overgrazing, human-caused fires, and logging for firewood.

Despite the factors isolating the two subpopulations, in the last ten years, as a result of our huemul recovery program, there has been a significant increase in recorded sightings of huemuls in transit and their dispersal in areas on the periphery of *Nothofagus* environments (lenga beech forests and ñirres, shrubs).

Recorded sightings of huemuls in "unusual" or infrequent areas are clear indicators of the historic connectivity between the two subpopulations, which now has gradually begun its restoration. If the goal is to contribute to and strengthen the rebuilding

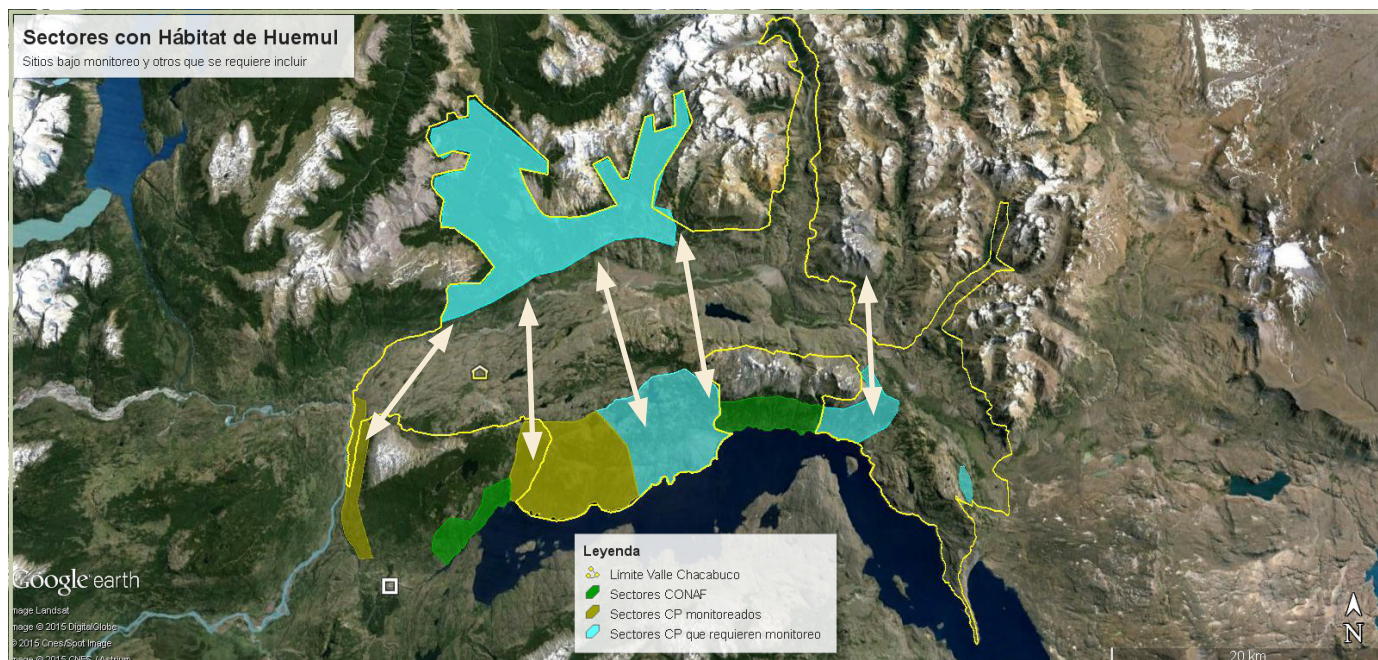


Figure 14. Subpopulations of huemul dispersed in the north and south of Chacabuco Valley. Arrows indicate areas for habitat restoration so the connectivity between the northern and southern populations can be reestablished, aiding in gene flow and genetic diversity.

of this lost connectivity between the northern and southern subpopulations, the key is to restore the *Nothofagus* environments. While this is an ambitious goal, we believe it can be achieved through a joint effort between public and

private organizations. This effort would strive to supporting long-term regeneration of native plant species—both trees and brush—through replanting, thereby recovering a network of environments lost due to human activity

in the area. The loss of these native ecosystems has had a great effect on the huemuls and their movement, as well as on a number of other species dependent on these environments for their habitats. ◊



Ranger monitoring and threat control: The case of huemul in the Chacabuco Valley

The achievements of the fieldwork conducted in the southern zone of the Chacabuco Valley, which monitors and protects the huemul population, provides a valuable learning model, referred to as “ranger monitoring and control of threats.”

This model was implemented in three stages, which correspond to key areas of work by our team: developing a conservation program, the permanent presence of rangers, tracking of huemuls with

radio telemetry, and controlling threats to the huemuls, as indicated in Figure 15.

We seek to replicate this successful model in the northern and eastern zones of the Chacabuco Valley in order to extend huemul recovery into new geographical and ecological areas. These zones are crucial to the huemul program because they include extensive areas with favorable habitat, but they have suffered from the ille-

gal intrusion of livestock especially during the summer pasture season.

This extension represents a challenge for the rewilding team at Patagonia Park, but also a great opportunity to continue restoring huemul habitat and accelerate the species’ recovery. Efforts to control the entry of domestic livestock in huemul habitat must become a priority, given the incompatibility of ranching and native species restoration. ◊

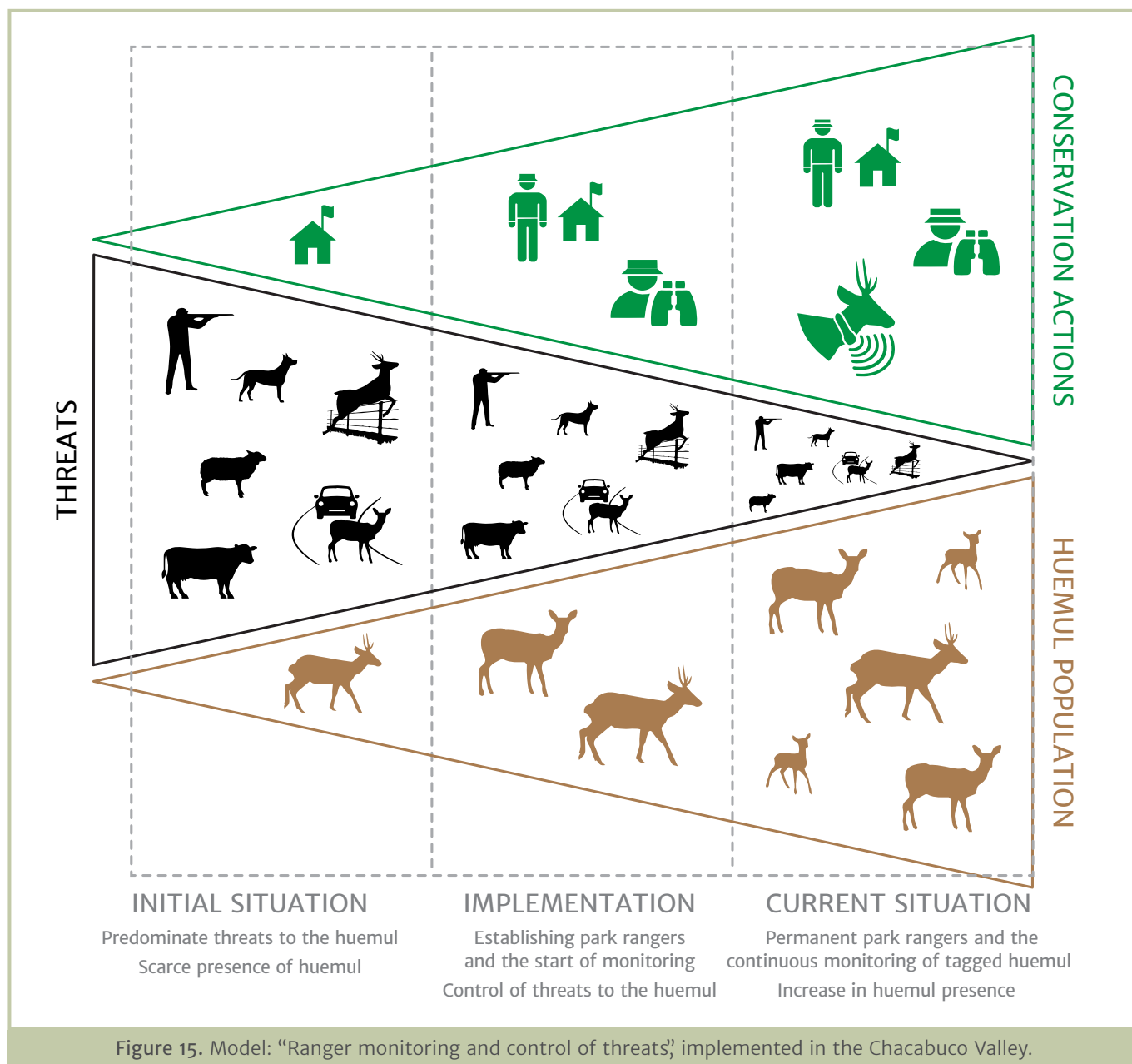


Figure 15. Model: “Ranger monitoring and control of threats”, implemented in the Chacabuco Valley.

Cochrane: The huemul refuge

Just as the huemul typically moves slowly in the forest, the species is slowly gaining popularity in the communities of the Aysén region. The city of Cochrane (3,500 inhabitants) has been privileged to live in close proximity with the “way of the huemul.”

Located a few kilometers from the town of Cochrane, the Tamango National Reserve, created in the late 1960s, was the first reserve to protect huemul habitat. Efforts to protect the species gained momentum in the 1980s, and in the early 1990s the huemul was declared a symbol of the community by municipal decree.

With the passing of the years, public consciousness regarding the status of the Patagonian huemul has increased considerably, and the number of initiatives and programs oriented toward huemul conservation has expanded. Conservacion Patagonica’s work in the Chacabuco Valley has significantly strengthened existing efforts to protect these animals.

Together with the Municipality of Cochrane, CONAF, and other organizations, Conservacion Pata-



The huemul has been the symbolic animal of the community of Cochrane since 1990. It appears on the flag and in the town logo.

gonica has actively fostered appreciation for the huemul through various projects focusing on education, awareness, as well as local, regional, and national participation.

Our outdoor education program, in which 80 percent of the school community of Cochrane participates, has included the theme of the huemul and the necessity for its conservation and monitoring. At the community level, we have provided information on the value of the species by exhibiting films and distributing educational materials. Conservacion Patagonica is an active participant and member of the Local Advisory Council of the Tamango National Reserve, further advocating the value of huemul conservation.

Conservacion Patagonica has contributed to the successful development of eleven Ruta del Huemul (the Route of the Huemul) events, consisting of a two-day trek covering over 20 kilometers that involves the participation of over 100 hikers walking from the Chacabuco Valley to the Tamango National Reserve. It is the oldest and largest outdoor education activity in the Aysén region, seeks to raise awareness and engage participants in the urgency and the importance of caring for the huemul, as a symbol of the community of Cochrane, and the landscape it calls home.

The local government has placed many references to the huemul in the main square of Cochrane and has made “The Refuge of the Huemul” its new community slogan. The community is now known as one of the best areas on Earth to observe the huemul in its natural setting. This elevated status is exceptional and carries with it a huge responsibility. For this status to remain, it requires a long-term commitment from the community and local authorities to protect and care for the region’s iconic, and beloved, huemul deer. ♦



Group of participants to the “Ruta del Huemul” in 2016.

THE PEOPLE BEHIND THE MONITORING AND PROTECTION OF THE HUEMUL

Daniel Velásquez

Daniel Velásquez grew up in the Colonia River Valley area neighboring the Northern Icefield of south Chile. His parents came from Chiloé to Aysén as pioneers to live in a very isolated area of Patagonia. From an early age he learned to ride horses and, as he grew, he began helping out with the family farm, working with cattle, cutting firewood, and building and repairing fences. When he got older, he took on jobs associated with caring for livestock, shearing sheep, and operated a seafood processing plant. At the beginning of the year 2000, and for several successive summers, he served as a temporary park ranger for CONAF in Cochrane Lake National Reserve.

Daniel is a very skilled gaucho and an outstanding leathersmith. The quality of his leatherwork is widely recognized in the community of Cochrane, where people order custom jobs, mainly horse tackle and tools. In addition, he is a lover of horses and knives.

In 2004, Daniel was part of the team that captured and moved the first couple of huemul deer from Aysén to the Huemul Breeding Center of Huilo-Huilo in the Rivers region. Soon after he was offered the possibility of joining a research project on the huemul of the Tamango National Reserve as an assistant field technician, an opportunity he took and which marked the beginning of his work with huemuls. He was later hired



Park guard Daniel Velásquez

permanently by Conservacion Patagonica to continue his research and, with time and experience to become an expert huemul ranger. Daniel has enthusiastically participated in mountain guide courses with the Patagonia Guide School, as well as in courses in botany, archeology, paleontology, and first aid.

Daniel today brings to the Patagonia Park team a high level of experience and knowledge of huemul ecology. He is an expert tracker of huemul and other native species. He has participated in numerous huemul captures and possesses unrivaled experience in the radio telemetry monitoring of tagged huemuls.

His passion and care for these animals is impressive and contagious. As he himself admits, he never thought that he would one day get to work so closely with the huemul. Every summer, Bella, his wife, and their two sons, Daniel and Tito, accompany Daniel at the Puesto Huemul. It is a beautiful example of a Cochrane family committed to the care and protection of the huemul. ♦



Park ranger Daniel Velásquez with his sons, Daniel and Cristian, while capturing and tagging a huemul in the Puesto Huemul zone.

THE PEOPLE BEHIND THE MONITORING AND PROTECTION OF THE HUEMUL

Delmiro Jara

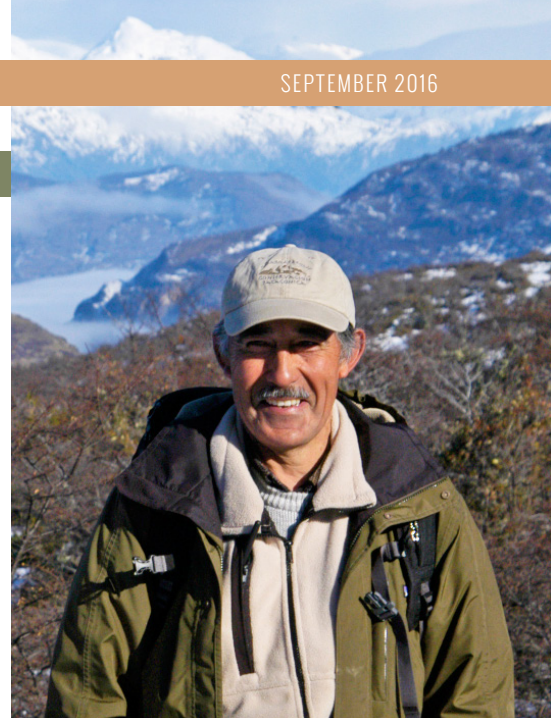
Delmiro Jara was born in Chile Chico and grew up in the Claro River and Lake Plomo area where, together with his family, he traveled from Lake Bertrand, either on horseback or by paddling in a boat and letting the horses swim in the river, a journey which took a little less than an hour. His parents came from Villarrica, from the region of Los Rios, settling first in the Zeballos area, then in Baker, and finally settling in the Lake Plomo area.

Until age 14, he lived next to the Northern Ice Field in Plomo, after which he began his journey through the southern Aysén region. He did many field jobs with livestock and fences, in farms on the Baker and Nef Rivers and near Chile Chico, Zeballos and

Puerto Guadal. From Puerto Guadal he began doing work for mining and road construction companies. In the late 1970s he worked for several years in the Chacabuco Valley and in the Municipality of Cochrane. He returned to the Estancia Valle Chacabuco in early 2000.

Delmiro is the only current Conservacion Patagonica employee who was working at the Estancia Valle Chacabuco in 2004 when Conservacion Patagonica acquired the property. He then worked as a gaucho in the Puesto Tejuela area, with a charge of over 400 cattle. Previously for the estancia he had cared for over 3,500 sheep in the Campo Nuevo and Campo Grande areas.

Delmiro, a man of few words,



Park guard Delmiro Jara

is a skilled horseman with great experience in the management and care of sheep and cattle. His quiet demeanor, thoughtfulness, and deep knowledge of the Chacabuco Valley's trails makes him a key member of the park ranger team tasked with capturing pumas (for research purposes) each winter. He has been a guide for multiple Ruta del Huemul events as well as to multiple groups of children, youth, and older adults visiting the Chacabuco Valley and the area of the future Patagonia National Park. Delmiro is always willing to share his experiences and knowledge from a lifetime in the field.

A consummate outdoorsman, Delmiro is an excellent tracker, likes to fish, and has contributed significantly as a ranger responsible for the care and monitoring of huemuls in the Puesto Baker area.

Delmiro and his wife Ana Pinnilla live in the city of Cochrane and have five children: Rody, Paula, Eda, Evaristo, and Mirna. ♦



Park ranger Delmiro Jara alongside a tagged huemul in the Puesto Baker area.

Acknowledgements

Conservacion Patagonica's achievements in huemul conservation have been possible due to the collaboration and commitment of many institutions and individuals. We would like to sincerely thank all for their support, although it is likely that our list is incomplete, and we regret inadvertent omissions.

We offer thanks to the Ministry of Agriculture, the National Forestry Corporation (CONAF), and the Agricultural and Livestock Service (SAG), the government agencies that have a direct connection to huemul protection and recovery. We would like to highlight the support of veterinarians Dennis Aldridge and Julio Cerda, as well as other officials such as Andrés Gómez, Hernaldo Saldivia, Jaime Gutiérrez, Jorge Pérez, Pe-

dro Isamitt, Omar Ojeda, the late Marcos Ramírez, José Urrutia, Piero Caviglia, Javier Subiabre, Jorge Abello, and Claudio Manzur.

Hernán Velásquez deserves a special mention as the administrator of the Tamango National Reserve for over ten years. Conservacion Patagonica was pleased to support Paulo Corti during his research for a doctoral thesis, which produced new scientific knowledge about the huemul in the Tamango and Chacabuco Valley areas. The insights, knowledge, and actions of both men have been invaluable and advanced huemul conservation.

The Municipality of Cochrane, through Mayor Patricio Ulloa and Javier Muñoz, has played a key role in promoting the Ruta del Huemul, as well as the vision and dis-

semination of the concept of "Cochrane, the refuge of the Huemul." The Municipality of Cochrane has successfully managed funds for and developed a series of activities associated with the huemul and the outdoors in general. It has been instrumental in ensuring the willingness of the teachers and directors of the Hernán Merino Correo School and the Lord Cochrane Austral High School to participate in environmental conservation and huemul-related activities. A special acknowledgement must go out to Don Juan Guillermo Opazo, director of the high school, for his active participation and support for the Outdoor Education program.

We also appreciate the continued support of friends and colleagues such as Rody Alvarez, Lu-



igi Solís, Fernando Vidal, Verónica Venegas, Ingrid Espinoza, Jorge Molina, Cristian Restrepo, Eduardo Pavez, Jürgen Rottmann, Jim Williams, Jimmy Valdés, Wolfram Heise, Felipe Henríquez, Ramón Henríquez and Rodrigo de los Reyes, who share an interest and concern for the status of the huemul and the conservation of its habitat. Additionally, we appreciate the recent appearance of the Cultural Association of Protection Huemul of Patagonia on the regional scene.

Huemul-oriented fieldwork was made possible thanks to the commitment and effort of the experienced team of Conservacion Patagonica park rangers comprised of Daniel Velásquez, the late René Millacura, Delmiro Jara, Cristián

Rivera, and Arcilio Sepúlveda. We also appreciate the enthusiasm of the management and finance teams located in Puerto Varas and Puerto Montt.

A very special thanks for the perpetual support provided by Paula Herrera and Benjamín and Martín Saucedo, who have been pillars in the development of this project, enthusiastically joining in the cause, even consenting to be separated or distant from family for more than one holiday.

Conservacion Patagonica's past and present activities to monitor, conserve, and promote huemul recovery has been made possible thanks to the commitment and financial support from exceptional partners including Ellen and Duncan McFarland, the Weed-

en Foundation, Manfred-Hermsen Stiftung (MHS), and other organizations and anonymous donors.

We greatly appreciate the unconditional support and enthusiasm of Ignacio Jimenez, who urged us to disseminate the results of this work, and whose cooperation was essential in the generation of this first bulletin.

Finally, we would like to thank all the officials, activists, technicians, conservationists, scientists, colleagues, family, volunteers, and citizens who, in different ways and in their own particular styles have collaborated with us over these years to stop the huemul's slide toward extinction and create a different future for this extraordinary creature who symbolizes the wild character of Patagonia. ◊



Daniel Velásquez family in the Lago Cochrane sector.

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