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# Conservation of huemul in the future Patagonia National Park: a call for immediate management intervention

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**Abstract:**
Huemul on the privately owned Estancia Vallé Chacabuco in Chilean Patagonia have been negatively affected by management associated with the conversion of the property into the future Patagonia National Park. Specifically, the removal of abundant livestock together with abrupt cessation of predator control has resulted in increased predation rates of both fawns and adult huemul. High predation rates now threaten the viability of this population of huemul. We outline a framework for implementing necessary management to reduce predation and simultaneously call for future research to further our understanding of the causes underlying the decline of huemul. Our management recommendations include the targeted removal of pumas known to selectively prey upon huemul and also the reduction of culpeo foxes. Given the reluctance of the landowners to implement such management, we call for CONAF to take over huemul management in the future Patagonia National Park to avoid further population declines and subsequent local extinction.

**Resumen:**
En la Estancia Vallé Chacabuco en la Patagonia chilena, de dueños privados, huemules han sido impactados negativamente por el manejo asociado con la conversión de la propiedad al futuro Parque Nacional de Patagonia. Específicamente, la remoción de numeroso ganado, en conjunto con la cesación de control de predadores, han resultado en un aumento en las tasas de depredación tanto de adultos como crías de huemules. Altas tasas de depredación ahora amenazan la viabilidad de esta población de huemules. Esbozamos un marco para implementar el manejo necesario para reducir la depredación y simultáneamente pedimos que haya investigación en el futuro para avanzar nuestro entendimiento de las causas subrayando el declive de las poblaciones de huemules. Nuestras recomendaciones de manejo incluyen la remoción selectiva de pumas que depredan selectivamente a los huemules y también a zorros colorados. Dado las pocas ganas que tienen los estancieros de implementar tal manejo, exigimos que CONAF se encarguen del manejo de huemules en el Parque Nacional de Patagonia del futuro para evitar más disminuciones en la población y una subsecuente extinción local.

**Keywords:** Conservación Patagonica, culpeo fox, huemul, predator control, puma

## Introduction

Huemul (*Hippocamelus bisulcus*) (Figure 1) are among the most threatened deer species in the world. The estimated 1,500 remaining individuals are currently fragmented into >100 small and disjunct populations and are found only

in Chile (totalling ca. 1000 individuals) and Argentina (totalling ca. 500 individuals) (Jimenez *et al*. 2008). One of the largest remaining huemul populations in Chile can be found in Patagonia both on private property owned by Conservación Patagonica, an NGO registered in California, USA, and neighbouring public lands. Conservación Patagonica began acquiring land in 2004, when it purchased the *Estancia Valle Chacabuco*, one of Chilean Patagonia's largest sheep farms. The primary goals of Conservación Patagonica are to restore degraded agricultural lands on the Estancia into productive wildlife habitat and then integrate these lands into the future Patagonia National Park (hereafter referred to as PNP) (Conservación Patagonica 2013). The roughly 2,650 $km^2$ PNP (Figure 2) is scheduled to open in 2014, and will encompass and protect approximately 120 huemul (roughly 10% of the remaining huemul in Chile) (Wittmer *et al*. 2013a).

From late 2007 until 2010, we conducted research aimed at understanding the consequences of policy changes associated with the establishment of the PNP for the viability of huemul. Management changes were implemented immediately following the acquisition of the Estancia by Conservación Patagonica and were meant to prepare the ranch for conversion to a National Park. Management changes included the cessation of predator control and the commencement of a 4-year program to remove approximately 30,000 domestic sheep and 3,800 cattle (Conservación Patagonica 2013). As previous research (e.g., Courchamp *et al*. 2003) has indicated that there may be unanticipated risks associated with abrupt changes in predator or prey abundances, we were concerned about the potential negative effects of the above -described changes in local management on the viability of huemul. More specifically, given that previous research had identified predation from pumas (*Puma concolor*) and culpeo foxes (*Lycalopex culpaeus*) as a significant concern for huemul in the future PNP (Corti *et al*. 2010), we anticipated that the recovery of predator populations associated with cessation of predator control simultaneous with the reduction of available prey (i.e., domestic sheep) would result in increased and potentially unsustainable predation of huemul (both fawns and adults).

**Figure 1**: Male and female huemul (*Hippocamelus bisulcus*) in the future Patagonia National Park, Chile (photograph by L.M. Elbroch).

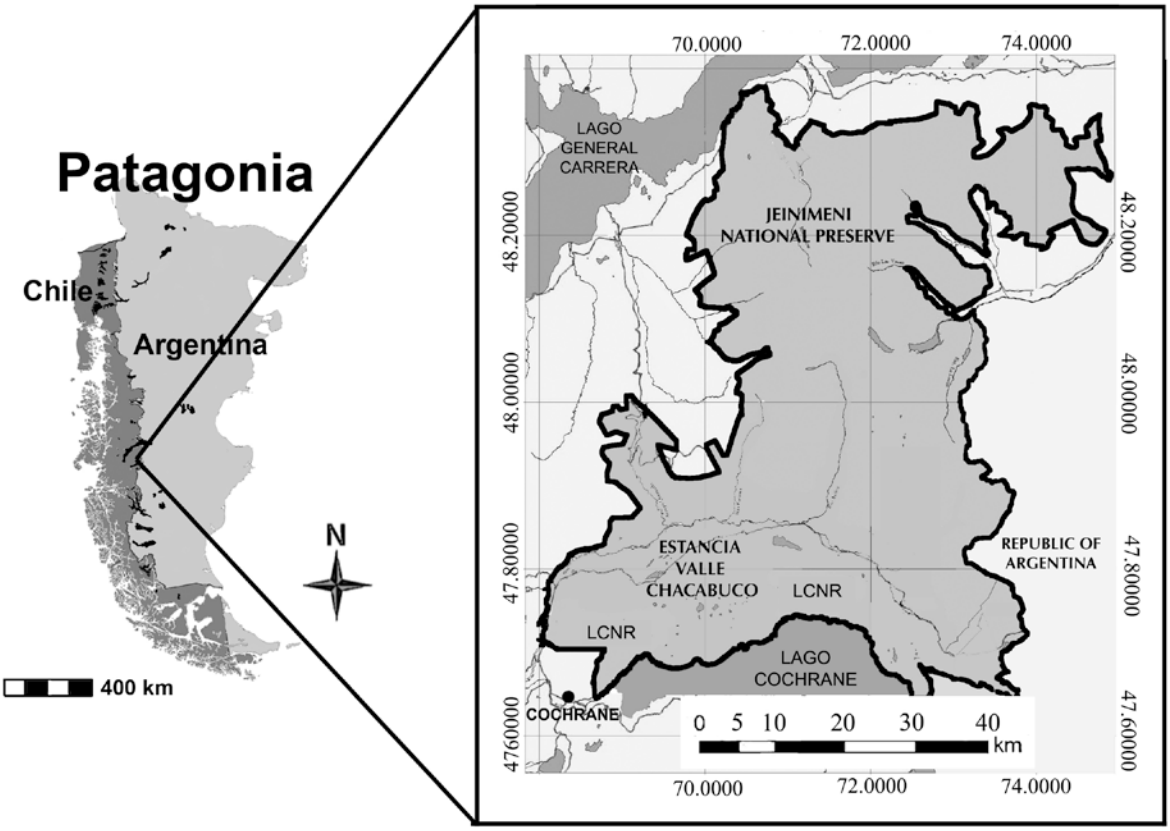


**Figure 2:** Location of the future Patagonia National Park (PNP) in Chile. The PNP will encompass ca. 2,650 km$^2$ and consist of both public (i.e., Jeinimeni National Preserve & Lago Chochrane National Reserve (LCNR) and private lands (i.e., *Estancia Valle Chacabuco*).

Four results from our research on the foraging ecology of pumas and their predation of huemul raised serious concerns about the future viability of the small huemul population in the PNP. First, pumas in the PNP currently occur at densities comparable to unhunted populations in other parts of their range (Elbroch & Wittmer 2012a) including Patagonia (Rinehart *et al*. *in press*) and are primarily preying on species other than huemul; >98% of puma diets were comprised of guanaco (*Lama guanicoe*), sheep, and European hares (*Lepus europeaus*) (Elbroch & Wittmer 2013a). Second, observed kill rates of pumas in the primarily open grasslands of Chilean Patagonia, where most of the available prey biomass can be found, appear almost 50% higher than kill rates observed in the more forested habitats of North America (Elbroch & Wittmer 2013a). These increased kill rates were at least partly due to

competition from scavengers, particularly Andean condors (*Vultur gryphus*) (Elbroch & Wittmer 2012b, 2013b), but also new research methods that have improved detection of puma kill sites (Elbroch & Wittmer 2013a). Third, during our study, pumas killed huemul almost twice as often as expected based on total prey availability in the PNP (Elbroch & Wittmer 2013a). When we used our results to adjust estimated survival probabilities of huemul based on identifiable individuals (Corti *et al*. 2010), we found that predation rates on both adults (from pumas) and fawns (from culpeo foxes) were unsustainable (Wittmer *et al*. 2013a). Finally, based on outcomes of a Population Viability Analysis (PVA), we predicted that huemul in the PNP are at risk of extinction (Wittmer *et al*. 2014). Ultimately, our results provided further support for the apparent competition hypothesis as the underlying cause responsible for current declines in the PNP first proposed by Corti *et al*. (2010).

Management strategies required to conserve species affected by apparent competition are complex but likely require some level of active predator control, at least temporally (Wittmer *et al*. 2013b). Consequently we proposed to cull individual pumas that have been confirmed to select huemul, defined as killing huemul disproportional to their availability, to reduce adult huemul mortality rates and reverse the current population decline (Elbroch & Wittmer 2013a). More recent analyses from our PVA (Wittmer *et al*.2014) indicate that both puma and culpeo foxes may have to be controlled to achieve population growth of huemul. Controlling predator species, even to protect endangered prey, is controversial (see references in Wittmer *et al*. 2013b). However, we believe that management aimed at addressing causes of decline of huemul in the future PNP ought to be based on best scientific understanding of limiting factors rather than policies based on personal values.

Therefore we propose the following actions to *Corporación Nacional Forestal* (CONAF), the agency responsible for managing protected areas in Chile:

1) Instead of waiting until the proposed opening date in 2014, CONAF should resume responsibility for management of huemul in the future PNP immediately.

2) Immediately hold a workshop, inclusive of all stakeholders as well as independent researchers, to develop a recovery strategy for huemul. Such a recovery strategy should be based on all available data, including those collected by staff of Conservación Patagonica.

3) Immediately administer wildlife monitoring and research programs within an adaptive management paradigm (Walters and Holling 1990). Conservation actions should involve the following individual components:

a. Reinstate an intensive monitoring study of individual pumas using GPS satellite technology to facilitate the identification of their kills and the proportion of huemul in their individual diets. Pumas shown to select huemul should be removed. Our previous results suggest that a limited number of individual pumas specialize on huemul (Elbroch & Wittmer 2013a), so such intervention would be highly targeted. Prior to deployment of GPS collars, capture protocols for pumas in the PNP need to be reviewed and addressed to reduce injuries (Elbroch *et al*. 2013).

b. Initiate a detailed study of fawn predation by culpeo foxes in order to further our understanding of fox predation on huemul fawn survivorship (Corti *et al*. 2010, Wittmer *et al*. 2013a). Remove resident culpeo foxes from known fawning locations as a precautionary measurement and to quantify possible increases in fawn survivorship associated with fox removal.

c. Implement an effective monitoring program for huemul across their distribution in the PNP using marked individuals as described by Wittmer *et al*. (2010). Such a monitoring project is essential to provide accurate yearly estimates of huemul abundance and thus population growth in the PNP needed to assess outcomes associated with predator control within the adaptive management framework outlined above. Ultimately data on changes in huemul abundances in the PNP are also needed to further test our hypothesis that apparent competition is currently the most significant threat to the viability of huemul in the PNP.

d. Further assess the role of domestic dogs in the decline of huemul, particularly around the township of Cochrane (Corti *et al*. 2010) and, if necessary, address this issue through education or dog control.

e. Initiate a comprehensive study to evaluate other potential effects associated with the establishment of the Park. For example, an extensive trail system is currently being established in the PNP (Conservación Patagonica 2013). While tourism is an important mandate of all National Parks, research in other systems has shown that trails may provide ease of travel for predators, subsequently resulting in increased mortality of endangered prey (e.g., wolf (*Canis lupus*) predation on caribou (*Rangifer tarandus*); Whittington *et al*. 2011).

During our study we observed significant positive changes associated with the restoration measures implemented by Conservación Patagonica. The removal of fences together with the increased access to low elevation grasslands appears to have benefited species such as guanacos (Wittmer *et al*. 2013a). In addition, charismatic species such as condors are benefitting from a healthy population of pumas providing access to carcasses (Elbroch & Wittmer 2012b). Unfortunately, our results also indicated that current management is threatening the viability of huemul in the PNP. Our proposed actions are controversial as they may require killing charismatic and protected carnivores, both pumas and culpeo foxes, and, due to the scale of the proposed monitoring projects, will also be expensive. Further, since Conservación Patagonica holds to a no-predator-kill policy, huemul management falls to CONAF to ensure that huemul will remain a vital part of the future PNP and an opportunity for all people, both Chilean and foreign, to enjoy and experience. Given that Conservación Patagonica unintentionally created new community dynamics, costs for implementing future restoration actions should be covered by the landowners. Because if we cannot maintain huemul inside protected areas such as the PNP, their future as a species in Chile indeed looks bleak.

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