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A REVIEW OF INTRODUCED CERVIDS IN CHILE

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ABSTRACT

We review the extent of exotic deer distributions in Chile, which are encountered in all provinces, including Tierra del Fuego, except for possibly Region III: many deer are contained in >100 enclosures. Red deer (*Cervus elaphus*) by far have the largest feral population of exotic cervids in southern South America, providing source animals that can easily cross the Andes between Chile and Argentina. Red deer were introduced from Europe to the central valley of Chile in 1928. Since the 1940s, feral populations have expanded from Argentina into Chile, by way of easily accessible, low-elevation mountain passes of the Andes, accompanied by further direct shipments from Argentina. The area occupied by 1990 was about 3400 km², but this increased to 7700 km² by 2002. The overall area invaded by 2002 was between 37°42'S-54°55'S and 73°36'W-69°50'W (Argentina and Chile combined, though not contiguous). Negative ecological impact from red deer in Chile have been described since 1981, and red deer figure in the Chilean Pest Manual. A conservative rate for the red deer invasion is 1 km/year, but likely is more rapid where habitat modifications facilitate movement. The pre-Columbian northern limit of the native cervid huemul (*Hippocamelus bisulcus*) was 30°S, and as red deer have occupied all habitat types currently used by huemul, they could thus spread >750 km further north. To the south, all areas are suitable for red deer. Invasion patterns will depend on additional intentional introduction and enclosures on both side of the Andes due to the omnipresent risk of escapes. Fallow, axis and roe deer (*Dama dama*, *Axis axis*, *Capreolus capreolus*, respectively) also have been introduced to Chile and occur in many enclosures. Fallow deer recently escaped on Chiloé Island, became established and raise concerns due to the potential negative impacts on several endemic species on the island. The striking lack of information on feral deer may relate to the policy and laws about firearms and restricted access to hunting areas, resulting in the apparent absence of popular hunting, which could be a potential tool should the invasion continue and lead to future deer overabundance.

Additional keywords: exotic deer, Chile, distribution, *Cervus elaphus*, *Dama dama*, *Axis axis*, *Capreolus capreolus*.

INTRODUCTION

Phoenicians and Romans likely perceived only positive outcomes when translocating fallow deer (*Dama dama*), and for the same reasons Acclimatization Societies everywhere were going strong until the early 20th century. Releasing ungulates allowed alternative production including hunting and thus presented economic benefits. However, releases were also done without economic motives, sometimes to add to depauperate local fauna and improve sport hunting opportunities. Such motives resulted in releases of several ungulate species in southern Latin America, intensifying in the early 1900s (Flueck and Smith-Flueck 1993). Interest in impacts from such releases began already 7-8 decades ago in New Zealand, with government-supported control efforts since 1923 (Caughley 1983). Thereafter, as the economic liability became apparent, global research efforts and publications on invasive species increased exponentially (Kolar and Lodge 2001). Today awareness about impacts from invasive species is quite elevated, and exotic species have been recognized as a leading global threat to native biodiversity and ecosystem function (Pimentel *et al.* 2000; Sala *et al.* 2000; Olson 2006). Exotic deer may have undesirable impacts even at low density, but overt problems are certain when they become

overabundant. For a recent workshop on overabundant deer, held during the 7th International Deer Biology Congress in Chile, we reviewed information on exotic deer present in Chile.

RESULTS

We reviewed all sources of information available to us to provide an update on exotic cervids in Chile. Exotic cervids are encountered in all provinces, including Tierra del Fuego, except for possibly Region III (Fig. 1); from limited information, many of the deer in these provinces live in captive herds, which total over 100.

Red deer (*Cervus elaphus*) were introduced to central Argentina in 1906 and then taken to the Andean foothills in Argentina in the early 1920s (Flueck and Smith-Flueck 1993). In 1928, a shipment of red deer from Europe arrived to the central valley of Chile (Wollenhaupt 1983). Since the 1940s, red deer have expanded from Argentina into Chile, by way of easily accessible, low-elevation mountain passes of the Andean range, accompanied by further direct shipments from Argentina. The area occupied by 1990 in Chile was estimated at 3400 km², but this increased to 7700 km² by 2002 (Flueck *et al.* 2003). The overall area invaded by 2002 was between 37°42'S-54°55'S and 73°36'W-69°50'W (Fig. 2, Argentina and Chile combined, though not contiguous). Based on linear rates of expansion reported for Chile (Wollenhaupt 1983), a conservative rate of 1 km/year for the north-south and east-west dispersals can be assumed in Chile, but likely is frequently more rapid, particularly due to substantial presence of settlers with livestock, which have opened up forests through cattle use and intentional fires, thus allowing red deer to advance more efficiently. The pre-Columbian northern limit of the native cervid, the huemul (*Hippocamelus bisulcus*), was 30°S, and as the red deer has invaded all other known habitat types used by huemul, the potential northern limit for red deer could be >750 km further north of the present distribution. To the south, all areas are suitable for red deer. Overall invasion patterns in Chile will depend on additional local introduction on both side of the Andes and human population density. Already there are several major focal populations from which the invasion is radiating in various directions. Intentional introduction may still occur, but of more concern are new approved deer enclosures and the omnipresent risk of escapes. Captive enclosures represent high risks due to cases of escapees, which would provide source animals for feral populations. Enclosures in Argentina present the same risks for Chile as deer can easily cross the Andes. Red deer by far have the largest feral population of exotic cervids in southern South America and in Chile they are registered from the areas of Bullileo (Parral, region VII) about 35°S and then in all regions southward including Tierra del Fuego (Jaksic *et al.* 2002; Iriarte 2008; Urrutia and Ojeda 2008).

Fallow deer first came to Chile in 1887 and were released to several sites (Lever 1985), currently occur in regions IX, X, XI and more recently appeared in region V by the coast where they are numbering 6-800. Recently, fallow deer had also been taken to an enclosure on Chiloé island, from where they escaped and have established themselves in the surrounding area. Total numbers in Chile were estimated at more than 8000 deer (Iriarte 2008). Axis deer (*Axis axis*) are found in semi-captive enclosures in Region VII and XI where hunting opportunities are provided (Iriarte 2008); we are not aware of any feral populations. Roe deer (*Capreolus capreolus*) were brought to a semi-captive hunting ranch in 1990 in the region X (Jaksic *et al.* 2002; Iriarte 2008) and also appear to be confined.

DISCUSSION

Fallow deer escaping and establishing populations recently on Chiloé Island might be of more immediate concern, considering that this island has several endemic species including medium sized mammals. Otherwise, fallow, axis and roe deer have apparently not been reported as problems, in part because most may be under confined conditions.

Red deer placed recently in enclosures on Tierra del Fuego present environmental risks in case of escapees from the current enclosures. Due to the lack of physical barriers between Chile and Argentina, Jaksic *et al.* (2002) suggested the two countries should coordinate such policy moves in order to

prevent the entry of unwelcome invaders. The list of worrisome species provided by Jaksic *et al.* (2002) now also includes Himalayan tahr (*Hemitragus jemlahicus*), which was introduced to Argentina in 2000 and to Andean foothills a few years later (Flueck 2010).

The feral state of red deer on the other hand is much further advanced both geographically and numerically. Although there is likely substantial local information, there is a striking absence of well-founded published information in Chile. Even presence/absence data are very rudimentary, especially for more remote areas, and we are not aware of any population or individual based studies on free-ranging red deer, although ecological impacts from these deer in Chile have been described since 1981 and red deer figure in the Chilean Pest Manual (Urrutia and Ojeda 2008). The lack of information about feral deer population may also relate to the strict policy and laws about firearms and limited access to hunting areas. One result is the apparent absence of a popular large game hunting segment which, if active, would generate various lines of information, including presence/absence, age structure, diseases, and progress of the invasion. Thus, large game like exotic deer and boar (*Sus scrofa*) can only be hunted on ones own land or with the permission of another private landowner, and hunting on public lands is non-existing (SAG 2004). Consequently, deer hunting in Chile is currently aimed mainly at clients using hunting ranches. When private land suffers from overabundant deer, frequently the owners will find a way to correct the situation. In contrast, overabundance problems on public land depend on government intervention, and a popular hunting segment often is a primary tool to implement management. The continuation of the invasion by exotic deer will likely be a future challenge for Chile.

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FIGURES

Figure 1. Geographical location of Chile. Left: the internal division into Regions. Center: bulk of red deer distribution and habitats. Right: the Southern Cone.

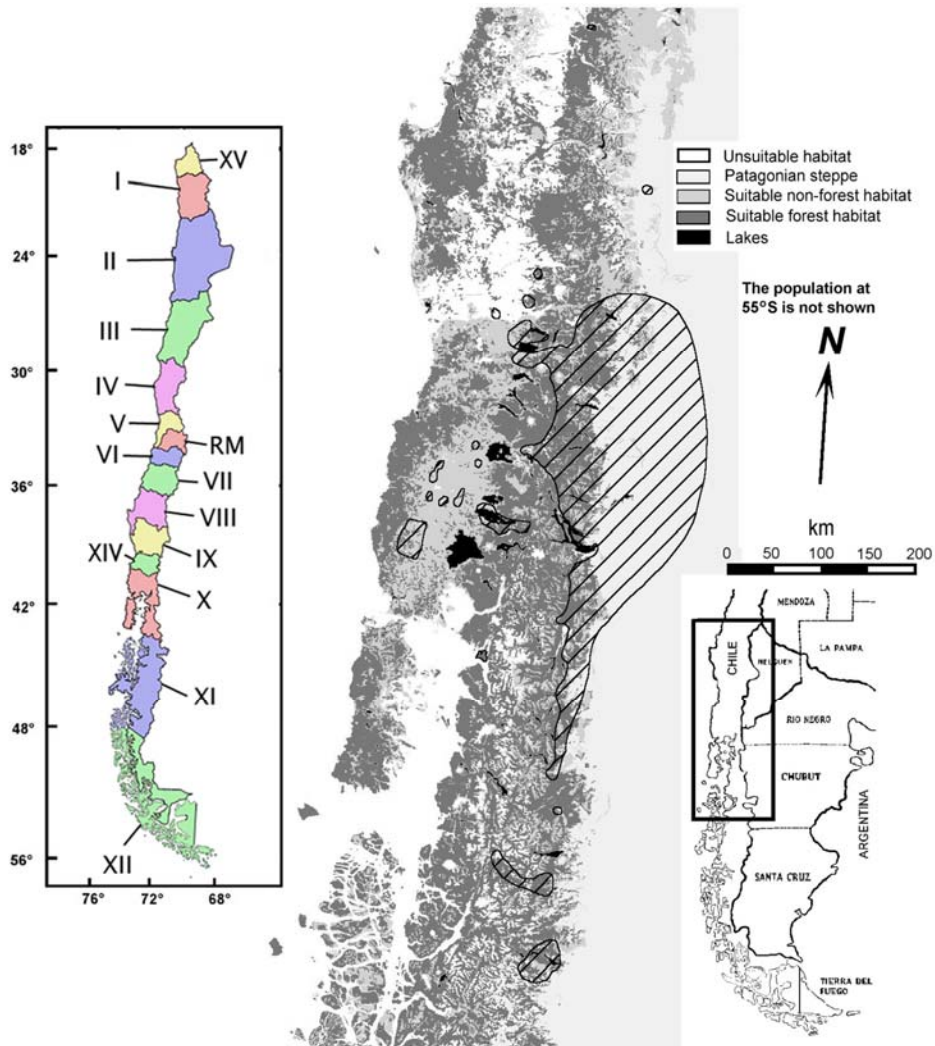
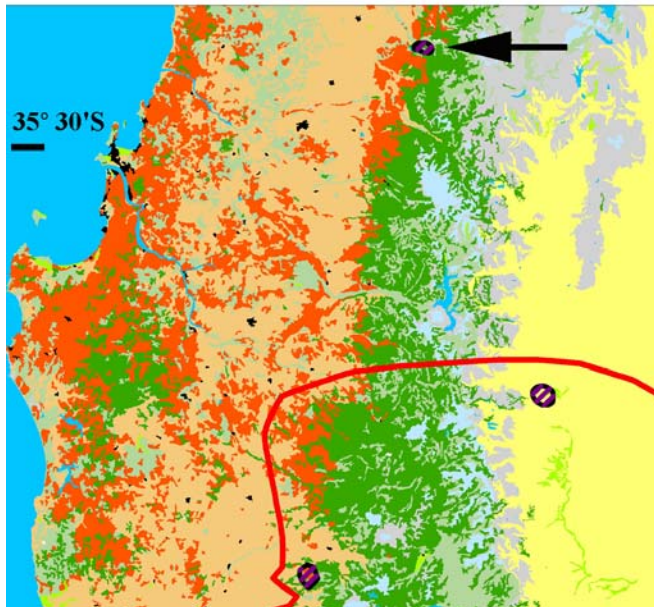
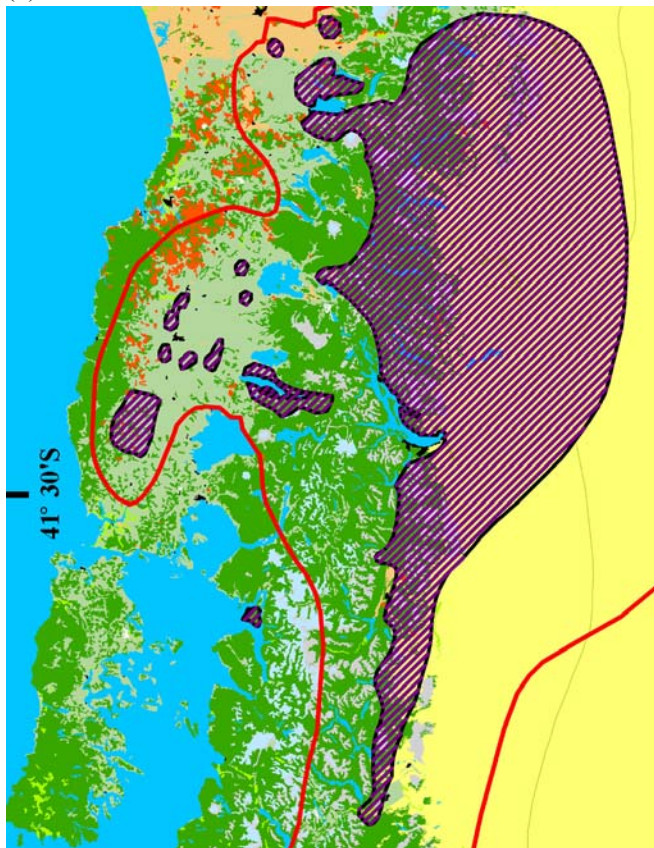


Figure 2. Distribution of feral red deer in Chile and Argentina, approximately year 2000: (a) northern section, (b) central section, and (c) southern section (without showing populations on Staten Island, nor recent enclosures in region XI and in Tierra del Fuego).

(a)



(b)



(c)

