Preliminary data on movements and health condition of the first radio-collared huemul (*Hippocamelus bisulcus*) population study in Argentina

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Abstract

Even though less than 500 Patagonian huemul (*Hippocamelus bisulcus*) remain in Argentina, information on their population ecology and dynamics is severely lacking. For the first time in Argentine history, radio-telemetry collars were placed on a group of huemul to better understand the factors behind the population's failure to recover. Six adult huemul (3 of each gender) were captured in six days, the winter of 2017, inside Shoonem Protected Park, Chubut province. In this article, we present a description of the unique climatic conditions and characteristics of the environment that would be useful to consider in order improving the success of huemul captures, particularly in Argentina. Despite the outwardly healthy appearance of each radio-collared huemul on the last observation date (January 25, 2018), we identified clinical symptoms of disease in 5 of these 6 animals during their capture; these included lameness, affected hoof, exfoliation of 2-7 incisors, and muscular atrophy. Movement distances from the winter capture site to maximum summer distance recorded were 187% greater for females than males (n=6, p =0.05, Mann Whitney).

Resumen

Aun cuando solo quedan menos de 500 ejemplares de huemul patagonico (*Hippocamelus bisulcus*) en Argentina, existe escasa información sobre su ecología y dinámicas poblacionales. Por primera vez en la historia de Argentina, se instalaron equipos de radio telemetría en un grupo de huemules para

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entender de mejor forma los factores que no han permito la recuperación de las poblaciones. Durante el invierno del 2017, se procedió a la captura de seis ejemplares en seis días (tres de cada género), al interior del parque protegido Shoonem, provincia de Chubut. Se presenta en este artículo una descripción de las condiciones particulares del clima y las características del paisaje que serán útiles considerar para mejorar el éxito de capturas de huemules, particularmente en Argentina. Aun cuando los animales capturados presentaban un aspecto sano a primera vista, durante la última evaluación (25 enero 2018), identificamos signos clínicos de enfermedad en 5 de 6 animales capturados durante el procedimiento; incluyendo renguera, pezuñas deterioradas, perdida de 2-7 incisivos y atrofia muscular. Los desplazamientos registrados desde el sitio de captura en régimen de invernada a zonas de uso estival fueron 187% mayores en las hembras comparativamente a los machos.

Key words: capture techniques, disease, non-migratory

Introduction

An estimated 350 to 500 endangered huemul (*Hippocamelus bisulcus*) remain in Argentina. Despite these alarmingly low numbers, applying radio-tracking technology as a tool to study population ecology on the eastern side of the Andes has never been successful, mainly due to the remoteness of these approximately 50 fragmented populations, and the extremely low densities of animals inhabiting habitats of dense vegetation (0.5-1.6 huemul/km^2 in Argentina, Smith 2003, pg 106), which further hinder any opportunities for sightings, let alone captures. A first-ever population study of huemul in Argentina using radio-telemetry commenced in the winter of 2017 at Shoonem Protected Municipal Park in southern Chubut province. The capture operations successfully resulted in radio-marking 6 huemul (3 males and 3 females) over 6 days. This study also included the first male huemul to receive a radio collar in Argentine history. In this note, we describe a unique capture method, the average field time required to locate and capture the 6 individuals, the current health condition of the recently sampled population (n=7) considering a prevalent chronic bone disease affecting this population, preliminary information on seasonal home range use comparing gender, and initial observations on the influence of human activity on huemul.

Study area and methods

The study area covers the north, south and western sides of the La Plata Lake, an Andean lake at 930m elevation inside Shoonem Protected Park in southern Chubut province. The mountains surrounding the lake, on all but the eastern side, define the Chilean/Argentine border. The dominant mountains of the landscape include Dedo (2020 m) and Colorado Plata (1796 m) to the north and Condor (1996 m) and Catedral (2067 m) to the south; the mountains to the west are between 1300 and 1700 m, all with precipitous rock walls. The primary habitat is temperate woodland dominated by lenga, *Nothofagus pumilio*, situated between 930 and 1400 m.a.s.l. with a light understory predominating in shrubs: *Pernettya mucronata*, *Maytenus disticha* and *Berberis* spp. The climate is temperate and marked year round by persistent westerly winds with an average annual precipitation of 1000 mm. The warmest and driest months are December through February with an average monthly precipitation of 50 to 100 mm. Meanwhile, the average precipitation for the months of June through August is from 200 to 350 mm, principally as snow. The average temperature for the hottest month, January, is 8 to 10° C, while the coldest month, July, has average temperatures of -4 to -2° C.

Figure 1. A) Huemul at La Plata Lake were often found walking through the water at the shoreline when deep snow was present; B) Darting a huemul from a boat on La Plata Lake.

Six huemul received radio-telemetry collars at the La Plata Lake study area during 6 working days in the winter of 2017: August 3-4, August 27-28 and September 19-20. The coastline was first scanned for huemul from a boat approximately 100 meters from the shore (with 2-5 people scanning at a time using either the naked eye or 8 to 10-powered binoculars), while taking advantage of winter storms that had brought approximately one meter levels of snow at the 930m elevation on the northeastern side of La Plata Lake. Such snow levels substantially reduced mobility and forced individuals to remain near the shore in search of food, and to use the water as a potential escape route from pumas, given their known ability as excellent swimmers. Snow pack was greatly reduced on the beaches, affected by the adjacent water temperatures, as compared to snow levels at distances of 5 meters and more from the shoreline (Figure 1). This fringe allowed easier access to vegetation, both browse and forage. In addition, animals were observed on two occasions to be foraging on submerged vegetation along the shoreline. It was not unusual to see animals walking through the water instead of walking on the snow (Figure 1a), thereby possibly reducing energetic costs and risk of injury; the darting team, for instance, found the snow extremely difficult to walk over, often breaking through the crusty surface and sinking more than 20 cm into the snow depth. This commonly observed behavioral adaptation of the huemul at the study site to concentrate at the shoreline during such climatic conditions was taken into consideration in the organization of the capture operation. The team was set in motion only after adequate snow deposition had forced huemul individuals to the coastline.

Once an animal was spotted, a decision was made whether to dart this animal using the methods described in Flueck and Smith-Flueck (2017). A Daninject gun was used and the dart was shot either directly from the boat when conditions were optimal (n=2) or from land (n=4) (Figure 1b). The latter choice involved a team of three leaving the boat to follow the selected animal on land until the situation allowed for darting it. Each animal was fitted with radio-telemetry collars that included VHF radios and mortality-motion sensors. Although several collars also included GPS radios, this preliminary analysis only includes data using the VHF capabilities of the collars. Additionally, body measurements were taken, teeth were examined to estimate age, and general health condition was evaluated (i.e., general body fat, condition of teeth, presence of any bodily defects or anomalies and ectoparasites).

During the following months, animals were regularly monitored to determine if their mortality sensor had been activated, with plans to immediately set a team in action to obtain the carcass in time to do a thorough necropsy. Locations were determined either by triangulation from the boats (2 directional readings taken within a 15-minute period) or by direct visual observation, after using the VHF radio signal to locate the animal. Huemul tolerated approaching them from between 5 to 100 m, enabling visual observations to be made with minimal disturbance, sometimes with as many as 7 people in the group. During the most recent field campaign in January, we were able to obtain accurate locations for all 6 study animals, either visually (n=4), or within 50 m of the animals (i.e., having a signal strong enough that the animal's radio-collar was heard "in cable", and thus audible with the cable detached from the antennae). Locations were then recorded using a Garmin GPS unit.

Results of capture operation

During a total of 9.32 hr of scans, we spotted 17 groups of deer, for a total of 37 individuals, taking an average of 93 min to sight an individual (SE ± 21, range 20-300 min). The time between spotting and successfully darting the animal averaged 46 min (n=6, SE 3.4, range 32-73 min), influenced by the type of terrain, the snow level of up to a meter, and the forest density. The average distance of shooting the tranquilizing dart to the animal was 15.7 m (n=6; SE ± 2.1, range 10-23 m). The average time between immobilization until full recovery was 45.5 min (n=6, SE ± 1.97, range 29-56 min). Comparing this with the only other huemul radio-marked so far in Argentina (2016) in Los Glacieres National Park, Santa Cruz province, by the National Park Administration, our operation in Shoonem Protected Park required 96.5% less man-days per animal.

Observed osteopathology and explanation

Physical examinations of the 6 study animals during the capture, plus a necropsy of a fresh female carcass found under a fallen tree in late-August on the southwest side of Lago La Plata showed 86% of these individuals to be diseased and all under 5 years of age (Flueck & Smith-Flueck 2017). Clinical pathophysiognomy included lameness, affected hoof, exfoliation of from 2 to 7 incisors (Figure 2), other cranial osteopathologies, and muscular atrophy. These clinical cases, particularly when considering that all animals were classified to be young adults that will most likely never come close to reaching their

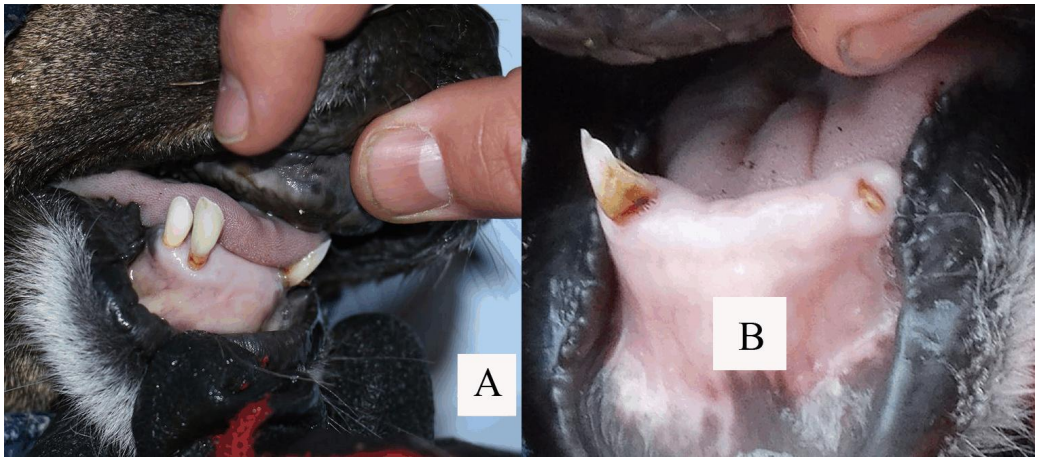

Figure 2. A) Female 3.5 years old with loss of 4 central incisors; gums, though healed over, are receded, exposing roots of remaining teeth; B) Male 4 to 5 years old: only 1 front tooth remains; the right canine is broken and only part of the root of the left canine remains at gum level**.**

potential lifespan--an estimated ≥14-year longevity for their species (Smith-Flueck 2000)-- provide an explanation for the absence of population recovery, and are congruous with the high prevalence of osteopathology evidenced in earlier carcasses collected from this same population (Flueck & Smith 2008). Skeletal remains collected between 1993 and 2007 provided data on bone disease, demonstrating its potential to contribute to morbidity: osteopathy among adults was at least 57%, with affected individuals having mandibular (63%), maxillary (100%), and appendicular lesions (78%). Furthermore, the estimated ≥14-year longevity (Smith-Flueck 2000), which was based on comparison of various deer species with known longevity, is low. Instead, when basing an estimate by the body weight (Speakman 2005), we can expect longevity of 26-years for huemul (assuming 100 kg), when using the formula:

log(e) age=0.851 + 0.209xlog(e) body weight in grams

Selenium (Se), a limiting trace mineral for all mammal species, could be responsible for the high prevalence of bone disease in this population. Although traditional wintering grounds are rich in Se, soil Se levels in areas currently used by huemul measured 0.19 ppm, which is at the low end of the deficiency range along this trace mineral's spectrum (Flueck & Smith-Flueck 2014a). This is

corroborated by overt selenium deficiency reported in local livestock and plants (Contreras et al. 2005) and in a Chilean huemul population (Flueck & Smith-Flueck 2014b). The Andean region is well recognized for its primary iodine deficiency, a mineral whose absorption is further aggravated by selenium deficiency. The nexus to nutritional ecology of huemul in such a population can be explained by the lack of presence of huemul today in fertile lowlands and traditional winter ranges due to elimination of migratory traditions and concomitant elimination of source populations. Essentially, most remaining huemul populations are restrained to marginal if not sink areas, or ecological traps.

One male at capture (September 19th) had only one full incisive tooth remaining out of the eight in the mandible (Figure 2b), and was in an emaciated condition. We did not expect him to survive the winter, which was one of the harshest over the past 20 years. Visual observations and photos of this male on January 20, 2018 suggest his health condition to be fine, as he exhibited a healthy looking summer coat and good-sized, well-formed antlers. However, we must be cautious with this interpretation as there are other cases where animals have appeared well but instead were in critical condition. One recent reported case was of an adult male huemul in Cerro Castillo National Reserve in southern Chile with serious abscesses. Although he was captured and treated on February 15, 2018 by park rangers and veterinarians of the Chilean government agency CONAF, and his coat and antlers gave the impression of a healthy animal, he was reported to be in serious physical condition; although not emaciated, he lacked a fat accumulation expected for this time of year, and exhibited a loss of incisors and abnormalities with the remaining teeth. Therefore, even though we observed all 6 radio-collared animals to be in good condition during the January monitoring period, including improvement in the gait of the male with a bad limp at capture (Figure 3A), we must not assume their overall health condition to be optimal, particularly when considering the poor state of their teeth. A mineral deficiency at the subclinical level can easily give us a false interpretation of the animal's situation. With this in mind, regular monitoring of their radios -each equipped with mortality sensors -is crucial.

Survival and seasonal habitat use (spatial distribution)

As of January 25, 2018 -"the southern summer"-all 6 radio-marked animals were still alive and with no observed clinical symptoms. Survival time since capture dates would thus be from 4 months, 6 days to 5 months, 23 days (= 151.83 days, SE ± 8.58). Summer locations identified showed that the movement distances from the winter capture site to maximum summer distance recorded were 187% greater for females than males with 1.82 to 3.85 km and 1.39 to 1.5 km distances moved, respectively (n=6, p =0.05, Mann Whitney). Thus, males and females behaved differently in terms of the distance moved between the winter capture site and the summer location of furthest distance. These initial observations of movement patterns suggest that all 6 individuals are resident − not migratory − deer, in that year round they use the same habitat sector that we would label as the "winter zone". Similarly, Gill et al. (2010) found that radio-collared huemul in the Aysen region of Chile undertook a modest seasonal migration or none at all. The mean distance between mean summer and winter positions was 552 m (range 44–1219 m), less than the median distance moved in 24 h (706 m). They reasoned that the study animals remained at summer range elevations year round given that lower elevations didn't provide suitable habitat due to grazing and other human activities' being commonplace. It is additionally important to consider, however, that given the seasonal climatic conditions of that region, which are similar to that of the Lago La Plata study area, it is possible that huemul in the Aysén region of Chilean Patagonia also migrated down to winter ranges in the historic past, up until some chain of events led to the extinction of that behavioral pattern.

Other biological observations

The first captured male huemul, judged to be approximately 2.5 years old based on antler size, had short nubs for antlers when captured on August 3 (Figure 3a). Twenty-six days later his antlers had grown 10 cm, but exhibited asymmetrical growth, which is a typical condition in the presence of injuries. Before his capture, we noted him to be limping with an antalgic gait favoring the right front leg.

The three marked adult males were identified to have hard antlers by 17 to 22 January 2018, as well as two other adult males observed in another group. In contrast, a yearling male spotted down on the

lake's coastline (930 m) on January 18th had short nubs still in velvet.

Figure 3. A) 2.5 years old male had short nubs in velvet when captured on August 3, 2017 in Shoonem Protected Park. Before capture, this male had a strong limp, and favored his right front leg; B) A female darted in Shoonem Protected Park with a young by her side.

The first female captured on August 4th had a fawn that remained close by her during the immobilization period. This female was found to be lactating and upon complete recovery after the reversal drug, she called to the fawn, which then ran to her and immediately began nursing. Considering data on other huemul fawns (Smith-Flueck 2003, pg 293), the date of birth was shown to be between late October and early January, with most births occurring between mid-November and mid-December. If we apply a fairly late birth date, that of early January, to the fawn of this radio-marked female, then this fawn would be estimated to be 7 months of age or more, and yet still nursing. According to observations at Torres del Paine National Park and Huilo Huilo Biological Reserve, fawns nurse up to 5 month of age (Guineo et al. 2008, pg 52, Vidal 2010, pg 25). In *Odocoileus virginianus*, a North American deer of similar stature, weaning occurs at approximately the 4th month (Brady et al. 1978).

Potential influence of recreational activity

Initial observations indicate human activity might influence huemul distribution. Accurate locations of all animals were obtained during a recent monitoring operation (15-26 January 2018). In one of the bays, where three of the animals had been captured, all three individuals were close to the coast and less than 1.5 km from their capture sites upon our arrival. At that time, this bay was quiet and void of

human activity. Then, on the evening of January 19th, we observed a large group of people arriving in two 4x4 vehicles to camp at the main beach. For three days these people remained, and were observed fishing from their boats or wading and fly fishing along the shoreline. A day after their arrival, one of the three marked animals in this bay had already moved out. Two days after their arrival, the other two marked individuals had also moved further into the forest to higher elevations; the male had gone a distance of 1400 m, while the two females had moved 3850 and 1550 m. These coinciding observations demonstrate the importance to evaluate further the potential impact of human activity on this population. Drouilly (1983) found some huemul individuals in Chile to move as much as 3 km in a 7-hr time period in response to human disturbance. Our management recommendations would be to heed the precautionary principal and avoid any potential negative affects by closing off road access to this particularly sensitive area.

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