Chapter 9

TARUKA *Hippocamelus antisensis* (d'Orbigny 1834)

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GENERIC SYNONYMY

Equus: Molina, 1782: 320. Not *Equus* Linnaeus, 1758.

Camelus: Treviranus, 1803: 179. Not *Camelus* Linnaeus, 1758.

Hippocamelus Leuckart, 1816: 23. Type species *Hippocamelus dubius* Leuckart [= *Equus bisulcus* Molina, 1782], by monotypy.

Auchenia: Hamilton Smith, in Griffith 1827: 762. Part, not *Auchenia* Illiger, 1811.

Cervus: d'Orbigny, in Geoffroy Saint-Hilaire and de Blainville, 1834: 91. Footnote. Not *Cervus* Linnaeus, 1758.

Cervequus Lesson, 1842: 173. Type species *Cervus* (*Cervequus*) *andicus* Lesson [= *Equus bisulcus* Molina, 1782] by monotypy. *Cervequus* was mentioned as a group of *Cervus* Linnaeus, 1758 (for the purposes of synonymy it is assumed as a subgenus as was treated by Cabrera, 1961).

Furcifer: Wagner, 1844: 384. Type species *Cervus* (*Furcifer*) *antisiensis* Wagner, 1844 [= *Cervus antisensis* d'Orbigny, 1834]. Described as a subgenus of *Cervus* Linnaeus, 1758 (treated as full genus by Gray, 1850). Not *Furcifer* Fitzinger, 1843.

Capreolus *Gray, 1849: 64. Part, not* Capreolus *Gray, 1821.*

Anomalocera: Gray, 1869a: 385. Type species *Anomalocera huamel* Gray, 1969. Not *Anomalocera* Templeton, 1837.

Xenelaphus Gray, 1869b: 498, figure. Replacement name for *Anomalocera* Gray, 1869a, preoccupied by *Anomalocera* Templeton, 1837 (a copepod crustacean).

Huamela Gray, 1872b: 445. Type species *Huamela leucotis* Gray, 1872, by monotypy (*Huamela* was more extensively described in Gray, 1873a: 217; the latter was depicted in Cabrera, 1961 as the description date).

Creagroceros Fitzinger, 1873: 358. Replacement name for Fu*rcifer* Wagner (1844), preoccupied by *Furcifer* Fitzinger, 1843 (a Chamaeleonidae).

Cariacus: Brooke, 1878: 923. Part, not *Cariacus* Lesson, 1842.

Mazama: Lydekker, 1898: 243. Part, not *Mazama* Rafinesque, 1817.

Odocoileus: Dabbene, 1911: 293. Part, not *Odocoileus* Rafinesque, 1832.

SPECIES SYNONYMY

Cervus Antisensis d'Orbigny, in Geoffroy Saint-Hilaire and de Blainville, 1834: 91. Footnote. Type locality: "versant oriental des Cordillières"; restricted to Andes near La Paz, Cochabamba and Chuquisaca, Bolivia, by d'Orbigny and Gervais 1847 (*Antisensis* is capitalized in the original).

Cervus (Furcifer) antisiensis Wagner, 1844: 384. An incorrect subsequent spelling of *C. antisensis* d'Orbigny, 1834, and inclusion of subgenus.

Anomalocera huamel Gray, 1869a: 384. Type locality: Tinta, South Peru.

Xenelaphus huamel Gray, 1869b: 498. Name combination on new genus.

Xenelaphus leucotis Gray, 1872a: 89. Part, not *Capreolus leucotis* Gray, 1849.

Xenelaphus anomalocera Gray, 1872b: 445. Replacement name for *Xenelaphus leucotis* Gray, 1872a: 89.

Xenelaphus chilensis Gray, 1873b: 61. Not *Cervus chilensis* Gay and Gervais, 1846.

Creagroceros antisiensis Fitzinger, 1873: 358. Name combination on new genus.

Furcifer chilensis Gray, 1874: 332. Name combination. Not *Cervus chilensis* Gay and Gervais, 1846.

Cariacus antisiensis: Brooke, 1878: 924. Name combination.

Furcifer antisensis: Nehring, 1895: 9. Name combination.

Mazama antisiensis: Lyddeker, 1898: 295, pl. 23. Name combination.

Hippocamelus antisiensis: Elliot, 1907: 52. First use of current name combination, but incorrect subsequent spelling of *Cervus antisensis* d'Orbigny, 1834.

Odocoileus antisensis: Dabbene, 1911: 293. Name combination

Hippocamelus antisensis: Lydekker, 1915: 196. First use of current name combination and spelling.

COMMON NAMES

Spanish names: ciervo andino, huemul del norte.

Native names: taruka, tarugo, taruca.

English names: Andean deer, northern Andean deer, northern huemul, Peruvian huemul, north Andean huemul.

German name: Andenhirsch.

French name: Cerf des Andes.

SUBSPECIES

The species is known only in the nominate form (*Hippocamelus antisensis*), and no subspecies have been described. No major differences in coloration or size have been observed among populations throughout its distribution.

MORPHOLOGICAL DESCRIPTION

The taruka is a medium size, heavy-built deer with weights ranging from 46 to over 60kg and shoulder heights from 69 to 80cm, with the smaller heights and weights corresponding to females (Pearson 1951; also data from captive individuals from Peru taken by the author). The pelage is coarse and the coloration is generally sandy-gray to grayish brown (Figure 1). The cover hairs throughout the body are hollow, appearing

Figure 1 - A female, a five-month old fawn and a male in southern Peru. The dark rump and the dark underside can be noticed in the female at left.

very thick, and banded on the terminal third of the length, with white curly wool hidden by the cover hairs.

The face has distinctive black markings, different among individuals (Barrio 1999; Merkt 1985; Nowak 1991; Roe and Rees 1976). Variation in head color pattern in a single population can be seen in Figure 2. Tarukas have a very large pre-orbital gland. The underside of the

Figure 2 - Variability of facial patterns among tarukas in southern Peru. All tarukas shown belong to the same population. Note: The observed differences of the skin color tones among individuals are mostly due to differences in color tones of the photographs.

head, from the mental patch to the buccal patch areas, is white. The extension of white and black in the muzzle is variable among individuals, but always includes a white narial patch. The white area may extend up to well above the nose or just the narial patch. The ears are long and pointed, color grayish brown, darker around the edges on the outside. On the inside the ears are brown, with whitish long hair along the inner edge. The base of the ears closer to the forehead is dark brown.

The fore neck is white from the gular patch area to the beginning of the chest. The sides and back of the neck, and the mantle are grayish brown. The back is darker near the rump, and the base of the tail varies from brown to dark brown. The underside of the body is dark brown from the lower chest to the abdomen, a tone markedly darker than the mantle, and very contrasting with the white inner side of the legs. The legs are white throughout the inner side, but on both sides at the distal area around the feet (Figure 3). The legs are short, which can be regarded as an adaptation to a rocky landscape and steep slopes. The rump has extensive white, which is exposed when fleeing. The tail is two-toned on its upper side, with a thin dark brown line as a median line towards the base and white at the sides and the long hair at the tip. On the underside, the tail is totally white.

Figure 3 – A side view of a male taruka showing the white inner side of the legs.

Males are noticeably larger than females and portray thicker necks (Merkt 1987; Pearson 1951; Roe and Rees 1976). The black area in the face of males usually—but not always, includes a black lateral band behind the narial patch and a distinctive dark Y or V from the sides of the

forehead to the rostral band. However, some individuals only show traces of dark areas. The antlers, only present in males, are bifurcated only once near the base, and measure up to 27cm (Geist 1998; Nowak 1991; Roe and Rees 1976). Females tend to show a dark brown area in the forehead, conspicuous when compared to the rest of the head, but this dark area has no definite shape. Frequently, females have a black line at each side of the dark area, above the eyes. Fawns are unspotted.

DISTRIBUTION

Historical

The historical distribution of the taruka was the same as the current one, as there is no certain evidence that the species ranged farther to the north or south of the current distribution. However, considering the status of taruka populations at the northern and southern edges of the distribution, where taruka populations are isolated from each other and heavily fragmented (Barrio 2006; Cajal 1983), the species might have reached farther to the north and south in the past, as accounts from local people indicate (Ferreyra, *in litt*, for the southern population). In any case, the distribution of the taruka included the same countries and regions as today, from north Peru to northwestern Argentina. Nevertheless, taruka populations were for sure less fragmented in the past, as habitat fragmentation is a continuous process.

Contrary to several publications (e.g. Cabrera 1961; Geist 1998; Grubb 1993; Pine et al. 1979; Weber and Gonzalez 2003; Wemmer 1998), the taruka might have never occurred in Ecuador. It is unlikely that the taruka has ever crossed north of the Huancabamba depression in Peru, as the habitat it uses does not occur in the area. Habitat types were lower during the last dry glacial period of the Pleistocene (21 – 14,000 years before present), and dry Paramo - similar to the habitat taruka currently uses, was continuous at 2000m along the Huancabamba depression (van der Hammen and Cleef 1986). However, the high Andes were then populated by two other deer genera, and not by *Hippocamelus* (Hoffstetter 1986; Wheeler et al. 1976). The asseveration of the former presence of taruka in Ecuador was based on doubtful records. One specimen in Buenos Aires museum and another in the Field Museum, Chicago, were marked as coming from Ecuador (Voss 2003), but both have disappeared and could have come from anywhere else, for example Peru or Chile, if they were correctly identified. Another two specimens were deposited in the Museo Nacional de Ciencias Naturales in Madrid (Voss 2003). These were authentic records from Ecuador, as the collector, the collection site and the year were identified (Voss 2003), but both specimens were also lost and there is no way to verify the species. Another record was an antler fragment tentatively identified as *Hippocamelus* from the third interglacial period from Punin, Ecuador (Hoffstetter 1986). However, these records have already been considered questionable or marked as doubtful by Hoffstetter (1986) and Tirira (2001). An explanation given by Tirira (2001) for the possible mistaken origin on the Buenos Aires specimen was that the single skull bought in Ecuador along with a group of skins from other species came from somewhere else, as the origin was not verified nor the collector identified.

Current

As mentioned on the previous section, current taruka distribution - from the departments of La Libertad and San Martin in north Peru south to La Rioja Province in northwestern Argentina - is most probably similar to the historical one (Figure 4). Nevertheless, the populations are nowadays fragmented throughout the distribution, especially in the southern part and the extreme northeast of the range. Despite the current levels of fragmentation in parts of the range - very high indeed in some areas, the estimation of an overall 60% range-reduction mentioned by Weber and Gonzalez (2003) is an overstatement without a solid reference base.

The taruka occurs as dispersed populations with thin contact areas among them, a distribution explained by the specialized habitat it uses. Its distribution can be regarded as almost continuous along the highlands of the Andes from the north of Peru to the northeastern tip of Chile and the highlands of the north eastern Andes of Bolivia, but we should be aware that the habitat type that tarukas use is isolated in several areas, and human density is high between some taruka populations. The range extension of the taruka population in Chile is small (Sielfeld et al. 1999), and its distribution seems to be isolated from the Bolivian population, forming an extension from the southern Peruvian population. Farther to the south, the taruka occurs as heavily fragmented populations throughout the high Andes of Bolivia - with no records in the west (Núñez 2005) - and northwest Argentina.

KNOWN POPULATIONS

in situ populations

The most important populations along its entire distribution are located throughout large, almost continuous, areas of high altitude mountains with extensive rocky areas in southwest Peru in the departments of Puno, Arequipa and Cuzco. The mentioned areas are situated approximately at intermediate latitudes when considering the overall north-south length of the distribution range of the taruka. Other important populations are located farther to the north of that area in the highlands of Lima, Junín, Huancavelica and Ayacucho, Peru, and immediately to the south of Peru in Parinacota, Chile, despite its small range. Most populations are scattered throughout mountain ranges, and do not form a cohesive population block. It is possible that large populations still roam in unexplored areas of its range.

In Chile, a recent satellite survey searching for known taruka satellite spectral signatures determined that the population was smaller than previously estimated (Silva 2005). The last two previous estimates, based on censuses carried up from 1987 to 1990, averaged around 750 individuals (Núñez et al. 1990; Sielfeld et al. 1999), while the new one estimated 587 individuals (Silva 2005). The smaller estimate may indicate either a 22% decrease in the last 15 years or a large miscalculation by the satellite

survey. A lot of individuals could have been missed by the satellite when considering the effect mountain shadows have over spectral signatures, and taking into account different coat tones depending on light conditions and individual variation. These constraints were not considered in the study. The whole taruka Chilean population is concentrated in a relatively small area in Parinacota, northern Chile.

Populations in the southern portion of the range are small and separated among them. The taruka population in Argentina is estimated to be under few hundred individuals despite the large distribution in the country. The taruka population in Argentina and south Bolivia is divided in several sectors and subpopulations that seem to be isolated among them (Cajal 1983; Dellafiore and Maceira 2001). However, the taruka population in some areas of La Rioja, Argentina, has been increasing since the late 1990s responding to a reduced hunting pressure (Ferreyra, *in litt*). The distribution range and population status of the taruka in Bolivia is mostly unknown.

Based on known densities and censuses for Argentina, Chile and Peru, and estimations for Bolivia, the total population is estimated to be around 15,000 - 20,000 individuals. Taruka population in Chile might be around 1,000 individuals, following census data from Sielfeld et al. (1988; 1999). Taking into account calculated densities, including all potential areas, and on extent of distributional range, total taruka population in Peru may be around 9,000 - 13,000 individuals, of which - based on known age structure - at least 75% are mature individuals (7-10,000 individuals).

ex situ population

The main captive population is a small herd currently kept in the city of Puno, south Peru. The first tarukas of the group (male and female) arrived as fawns and were brought in 1989. By late 1997, there were six individuals in the group, four born in captivity. All fawns lived, and without exceptions, were born during early February. Along the Peruvian Andes, the author has seen two local families keeping fawn tarukas. Those tarukas probably later ended up as food or were sold to private collections.

Few zoological gardens outside the taruka distribution have ever kept tarukas in captivity. However, captive breeding is not difficult as was shown by the West Berlin Zoo, where up to 12 tarukas were born in 10 years (Frädrich 1987). The West Berlin Zoo kept tarukas from 1889 to 1902 and from 1931 to 1941 (Frädrich 1987). The tarukas in the West Berlin Zoo have been the main taruka population ever kept captive outside its range, but they did not survive World War II (Frädrich 1987). The main zoological garden in Lima, Parque de Las Leyendas, has had few tarukas in the past, and it currently keeps a couple. Also, it is known of tarukas captured alive as fawns in Argentina that might end up in zoological gardens and enlarge the captive population (Ferreyra, *in litt*).

HABITAT

The taruka distributes along the high Andes, from northern Peru to northern Argentina (Barrio 1999; Grimwood 1969; Merkt 1985; Thornback and Jenkins 1982). The altitude used by tarukas varies with latitude, using higher ground in the northern portions of the range

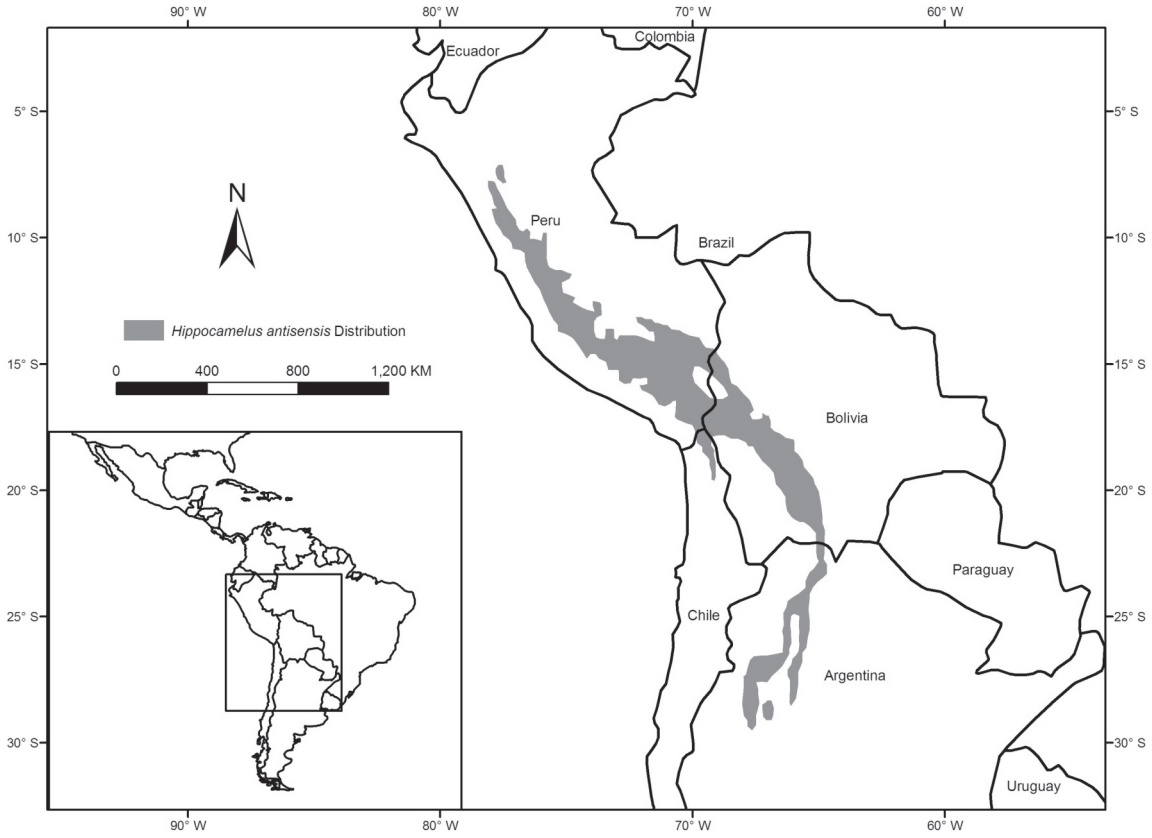

Figure 4 - Taruka (*Hippocamelus antisensis*) current distribution. Historical distribution did not differ much from the one shown in the map, only extending a little more to the north and south, with no isolated subpopulations.

and lower altitudes as the habitat used is located lower with increasing latitude. The tarukas have been found at 2000 - 3000m in the southern portion of their distribution in Argentina (Cajal 1983), at 2900 - 3900m in northern Chile (Sielfeld et al. 1999), and at 3800 - 5000m in the highlands of Peru and Bolivia (APECO 1996; Barrio 1999, 2004; Grimwood 1969; Jungius 1974; Merkt 1985; Pearson 1951; Roe and Rees 1976; Yensen et al. 1994).

Weather conditions vary along the distribution of the species, especially when considering the humidity of the environment. Tarukas live in areas with wet weather on the eastern side of the Andes (Barrio 2004; Jungius 1974; Núñez 2005) as well as areas with dry weather on the western Andes (Barrio 1999; Sielfeld et al. 1988) and on the southern portions of the range (Cajal 1983).

The main habitat type used in the northern half of the distribution is characterized by rock and cliff-like outcrops amid grassland and short-shrub vegetation, usually found above the treeline on mountain slopes (Barrio 1999, 2004; Jungius 1974; Merkt 1985; Roe and Rees 1976) (Figure 5). In a survey in Argentina, tarukas were cited as using altitudes where bunch-grasses flourish, but the report barely mentioned the presence of rocks in the area (Cajal 1983). The main habitat type described for the Chilean population of tarukas is rocky slopes covered by thorn scrub (Muñoz 2003; Sielfeld et al. 1999). Data from Barrio (1999) showed that taruka did not use the entire available habitat. Several vegetation plots outside the areas used by taruka were similar to plots located inside the areas used by taruka (Barrio 1999). Thus, the habitat used by taruka and the surrounding areas were frequently similar. Taruka seemed to favor a habitat type dominated by rocky outcrops and with more soft and leafy vegetation than other habitat types (Barrio 1999). The similarity of the habitat used by taruka and its surrounding areas suggested that distribution of taruka in southern Peru might be linked to displacement by human activities such as cattle ranching and hunting. In another study in southern Peru, human activities only included alpaca grazing (Merkt 1987), probably influencing taruka distribution in a smaller scale than in Barrio (1999) study. Taruka distribution in most of its range is probably more related to displacement by humans in times of the Andean civilization and only slightly to conditions in the near past and in current times.

Generally, the taruka prefers rocky areas of sparse vegetation with nearby water sources - usually a small ravine, lagoon or marsh (Barrio 2004; Jungius 1974; Merkt 1985; Roe and Rees 1976; Sielfeld et al. 1999). However, in some areas of the distribution they prefer shrubbery on slopes (Muñoz 2003). They have additionally been observed by the author in dense shrubbery near rivers and inside high altitude *Polylepis* sp. forests; however, tarukas do not visit regularly nor are dependent on these forests as stated by Grimwood (1969). In several sections along its distribution, taruka populations live in fragmented portions of the range (Barrio 1999; Cajal 1983). Also, tarukas that frequently consumed crops stayed close to them all day, resting in slopes in nearby mountains (Muñoz 2003; Sielfeld et al. 1988). The taruka shares its habitat with domestic stock, which might compete with them and decrease the area available to the deer (Barrio 1999, 2004).

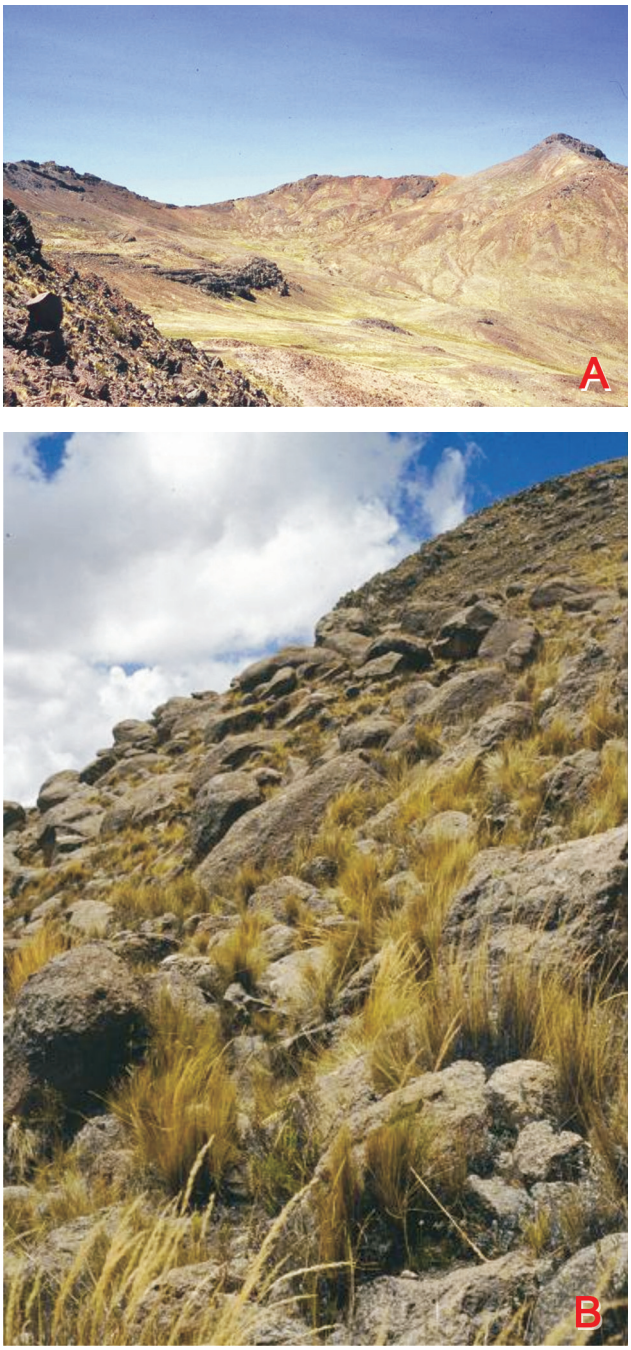

Figure 5 - A: Usual landscape where tarukas roam in the central section of its overall distribution. Tarukas are more likely to be found in the slopes. B: A closer view of the slopes. Slopes are dominated by large rocks and bunch-grasses, but contain larger amounts of non-grassy vegetation.

SPATIAL USE AND HOME RANGE

Taruka individuals use a determined space or home range, yet, they associate in groups with individuals overlapping their home ranges among them (Merkt 1987). The groups are more or less stable during daily activities; nevertheless, groups usually change composition over periods of few days (Barrio 1999; Merkt 1987). However, as individuals maintain a stable home range, at

least seasonally, the associations always occur with specific individuals so that in a larger scale they form cohesive population units (Barrio 1999; Merkt 1987). The groups move widely around their home ranges, disappearing from small areas for several days and even weeks (Sielfeld et al. 1988). Groups make altitudinal movements during the day, ascending in the morning towards noon, and descending late afternoon and night (Sielfeld et al. 1999). Observed group sizes vary widely among and within areas, with the largest published group size being 31 individuals (Merkt 1987). Older local people in two separate areas in Peru mentioned up to forty individuals in a single group around 40-50 years ago (Barrio *in litt*), a credible statement given the observed group size by Merkt (1987).

In a study on 90,000 ha in southern Peru, the areas used by taruka were identified as separated units (Barrio 1999). The size of those units ranged from 5.0 km^2 to 23.1 km^2 (Barrio 1999). The altitude range used by tarukas in the study was from 4000 to 4850m (Barrio 1999). However, actual sightings of taruka groups occurred in mountains from 4100 to 4850m, and the greatest number of tracks and most of the sightings (94.5%) were located over 4200m (Barrio 1999). Of the total area covered by the five units, 72% was located between 4200 and 4800m (Barrio 1999).

FEEDING ECOLOGY

The taruka mainly feed on small dicotyledon plants that grow near the ground instead of the abundant Andean bunch-grasses (Barrio 1999). This observation is consistent with data collected by Roe and Rees (1976) and APECO (1996). Roe and Rees (1976) mentioned that taruka seemed to feed on plants that grow inside rock fissures. Several plant genera have been identified as eaten by tarukas by direct observation (APECO 1996; Barrio 1999; Sielfeld et al. 1999) and by microhistological analysis (Gazzolo 2006; Sielfeld et al. 1999). Most identified genera were Dicotyledon plants with few grasses and a Gymnosperm. However, the grasses comprise several species and the bulk of food items during the rainy season, at least at the northern distribution area (Gazzolo 2006).

Among species eaten by taruka in Rio Abiseo National Park, Peru, at the northern extreme of the distribution, there were seven identified by APECO (1996), all Dycotiledon: *Werneria nubigena* (Asteraceae), *Gentianella* sp. (Gentianaceae), *Puya* sp. (Bromeliaceae), *Ranunculus weberbaueri* and *R.* aff. *kraptia* (Ranunculaceae), *Valeriana pilosa* (Valerianaceae), and *Lycopodium* sp. (Lycopodiaceae). On the other hand, the author observed tarukas eating in Rio Abiseo National Park, in June 2001, and collected eleven species bitten off by the tarukas. Four of the collected species were Monocotyledon: two Poaceae (*Agrostis foliata* and *Calamagrostis* sp.), a Juncaceae (*Luzula racemosa*) and a Cyperaceae (*Carex* sp.). Among Dycotiledon species, only one repeated from APECO (1996): *Werneria nubigena*. Other species were *Azorella biloba* and *Lilaeopsis macloviana* (Apiaceae), *Werneria pumila* and *Hypochoeris* sp. (Asteraceae), *Lupinus* sp. (Fabaceae) and *Isoetes* sp. (Isoetaceae, a Pteridophyta). Data from microhistological analysis on samples from Huascaran National Park, central Andes of Peru, show that the grass species eaten by taruka during the rainy season comprise around 60% of the consumed fragments (Gazzolo 2006). Gazzolo (2006) has identified more than 20 plant species eaten by tarukas. Among the species that are represented with more than 4% of the fragments each, Gazzolo (2006) has found *Poa gymnatha*, *Bromus villosissimus*, *Calamagrostis* sp., *Trisetum spicatum* and *Poa spicigera* (Poaceae), *Luzula racemosa* and *Distichia muscoides* (Juncaceae), *Werneria nubigena* and *Senecio comosus* (Asteraceae), and *Ephedra americana* (Ephedraceae, a Gymnospermae). In the Aymara-Lupaca Reserved Zone, southern Peru, the only wild genus observed as being eaten by tarukas was *Ephedra* (Barrio 1999). However, most genera and species identified as eaten by tarukas in Rio Abiseo and Huascaran National Parks in Peru are also present in Aymara-Lupaca Reserved Zone. Data from the dry season at the Nor Yauyos – Cochas Landscape Reserve, central Peru, include around 50 plant species consumed by the taruka, with close to 30% of them belonging to grass species (Gazzolo, *in litt*). Of the species found in the pellet group samples, none was dominant in the diet. The most abundant in the diet, *Alchemilla pinnata* (Rosaceae) had a total frequency of less than 8%; however, at the genus level, at least eight species of *Senecio* were consumed and comprised more than 20% of the diet. Eight species of *Calamagrostis* comprised around 10% of the diet (Gazzolo, *in litt*).

In Parinacota, northern Chile, Sielfeld et al. (1988) observed tarukas feeding on *Balbisisa microphylla* (Ledocarpaceae), *Coreopsis suaveolens*, *Chersodoma jodopappa* and *Ambrosia artemisioides* (Asteraceae), *Chenopodium petiolare* (Chenopodiaceae), and *Nasella pubiflora* (Gramineae: Poaceae) during April, after the rainy season. Additionally, pellet groups were collected throughout the year to determine presence of plant species remains in the diet (e.g. seeds), and to perform microhistological analyses. Among the species identified, there were several besides the ones already mentioned, totaling 26 different Dycotiledon genera, including two identified only to family level (Sielfeld et al. 1988). Additionally, remains from Gramineae were only identified in pellets collected during the rainy season (Sielfeld et al. 1988), besides the observation in April. Presence based on seeds found in the pellets, indicated that *Tarasa* aff. *operculata* (Malvaceae), *Chenopodium petiolare*, and *Spergularia fasciculata* (Caryophyllaceae) occurred in more than 70% of the samples (Galaz 1998; Sielfeld et al. 1988). The study does not present selectivity or total food item percentages in the feces, however, it mentions *Senna birostris* (Caesalpinaceae) and *Balbisisa microphylla* as the most important wild species consumed by the tarukas (Sielfeld et al. 1988). The study in Chile included lower altitudes than studies from Peru, which explains the difference in plant species. A summary of the most important wild species known to be consumed by taruka is shown in Table 1.

Crops were widely consumed by tarukas throughout some of the study areas. Alfalfa (*Medicago sativa*) and corn (*Zea mays*) were the most important crops consumed

Table 1 - Most important wild species consumed by taruka.

Species	Family	Locality	Method	Season	Reference
Isoetes sp.	Isoetaceae, a Pteridophyta	1	2	2	2
NN	Briophyta	5	1	2	3
Ephedra sp.	Ephedraceae, a Gymnospermae	2, 3, 5	1, 2	1, 2	2, 3
Nasella pubiflora	Poaceae	4	2	4	4
Agrostis foliata	Poaceae	1	2	2	2
Bromus villosissimus	Poaceae	2	1	3	3
Calamagrostis sp.	Poaceae	1, 2, 5	1, 2	2, 3	2, 3
Calamagrostis nitidula	Poaceae	5	1	2	3
Calamagrostis vicunarum	Poaceae	5	1	2	3
Poa gymnatha	Poaceae	2, 5	1	2, 3	3
Poa spicigera	Poaceae	2	1	3	3
Trisetum spicatum	Poaceae	2	1	3	3
Distichia muscoides	Juncaceae	2, 5	1	2, 3	3
Luzula racemosa	Juncaceae	1, 2	1, 2	2, 3	2, 3
Carex sp.	Cyperaceae	1	2	2	2
Azorella biloba	Apiaceae	1	2	2	2
Lilaeopsis macloviana	Apiaceae	1	2	2	2
Ambrosia artemisioides	Asteraceae	4	2	4	4
Baccharis genistelloides	Asteraceae	5	1	2	3
Chersodoma jodopappa	Asteraceae	4	2	4	4
Coreopsis suaveolens	Asteraceae	4	1, 2	4	4
Hypochoeris sp.	Asteraceae	1	2	2	2
Senecio comosus	Asteraceae	2, 5	1	2, 3	3
Senecio hohenakeri	Asteraceae	5	1	2	3
Senecio sp.	Asteraceae	5	1	2	3
Werneria nubigena	Asteraceae	1, 2, 5	1, 2	2, 3	1, 2, 3
Werneria pumila	Asteraceae	1	2	2	2
Xenophyllum dactyllophyllum	Asteraceae	5	1	2	3
Puya sp.	Bromeliaceae	1	2	2	1
Senna birostris	Caesalpinaceae	4	1	1	4
Arenaria sp.	Caryophyllaceae	5	1	2	3
Spergularia fasciculata	Caryophyllaceae	4	1, 3	2	4
Chenopodium petiolare	Chenopodiaceae	4	2, 3	1	4
Lupinus sp.	Fabaceae	1, 5	1, 2	2	2, 3
Gentianella sp.	Gentianaceae	1	2	2	1
Balbisisa microphylla	Ledocarpaceae	4	1, 2	4	4
Lycopodium sp.	Lycopodiaceae	1	2	2	1
Tarasa aff. *operculata*	Malvaceae	4	1, 3	1	4
Plantago lamprophylla	Plantaginaceae	5	1	2	3
Ranunculus aff. *kraptia*	Ranunculaceae	1	2	2	1
Ranunculus weberbaueri	Ranunculaceae	1	2	2	1
Alchemilla pinnata	Rosaceae	5	1	2	3
Solanum fragile	Solanaceae	4	1, 3	1	4
Valeriana pilosa	Valerianaceae	1	2	2	1
Verbena gynobasis	Verbenaceae	4	3	1	4

Note - Locality: 1. Rio Abiseo National Park, Peru, extreme north of taruka distribution, 2. Huascaran National Park, central Peru, 3. Aymara Lupaca Reserved Zone, south Peru, 4. Parinacota, north Chile, 5. Nor Yauyos – Cochas Landscape Reserve, central Peru;
Method: 1. Microhistology, 2. Observed feeding and collected plant, and 3. Seeds found in pellets;
Season: 1. Year round, 2. Dry season, 3. Wet season, and 4. Passage from wet to dry season;
Reference: 1. APECO 1996, 2. This study, 3. Gazzolo 2006 and *in litt*, and 4. Sielfeld et al. 1988.

in Parinacota (Sielfeld et al. 1988). In southern Peru, at higher altitude, the cultivated species observed eaten by tarukas included sprouts of potato (*Solanum tuberosum*) and barley (*Hordeum vulgare*) (Barrio 1999). However, areas cultivated with potato in Parinacota were untouched by taruka (Sielfeld et al. 1988).

REPRODUCTIVE BIOLOGY

Taruka reproduction is markedly seasonal (Barrio 1999; Geist 1998; Merkt 1985, 1987). The seasonality of the reproduction is expected in environments where plant growth is seasonal; in such a way that parturition coincides with the height of food availability (Clutton-Brock and Albon 1989; Merkt 1987). In the high Andes, plant growth is at maximum at the end of the rainy season.

Based on interactions between males and females and on mountings, the peak of the rutting season occurs in June, during the dry season (Merkt 1985; Roe and Rees 1976; Sielfeld et al. 1988). Interactions between sexes were usually initiated by the male and ended with the female moving away or by the male mounting the female (Merkt 1987). The gestation period is around 240 days considering that during their first month fawns remain hidden (Merkt 1987). The length of the gestation period may seem long for a deer the size of the taruka (Geist 1998; Sadleir 1987), but the cold environment and reduced nutritional resources during the dry season could account for a prolonged gestation. However, if we follow the equation relating gestation period and adult weight for ungulates, developed by Kihlström (1972), the expected gestation time for tarukas would be around 230 days, not far from the gestation time estimated by Merkt (1987).

Births mostly occur at mid rainy season, generally during February (Barrio 1999; Merkt 1987), but the birth season extends from January to March (Merkt 1987). A single fawn is usually born, but twins have been observed in the humid puna of the highlands at the eastern Andes (Barrio 2006), an area where forage availability can be regarded as plentiful, given the abundance of rains. On few occasions out of season fawns have been spotted (Barrio 1999; Merkt 1987), which is not that uncommon in deer displaying marked seasonal reproduction (Sadleir 1987).

The antler cycle is highly synchronized and seasonal (Merkt 1987). Around September most males drop their antlers in south Peru, by November most males are still without antlers in Chile and by December all males are already in velvet (Merkt 1987; Sielfeld et al. 1988). By February, all adult males have shed the velvet and have clean antlers (Merkt 1987). An individual taruka in captivity badly injured in the leg while growing its antlers ended up with deformed antlers, however, the same individual developed normal antlers the next year.

BEHAVIOR

The taruka lives mostly in mixed groups for most of the year, with up to 31 individuals in a single group (Merkt 1987). Mixed groups are composed of adult males and females, including yearlings and fawns (Merkt 1987; Barrio 1999). Nevertheless, there are also small all-male and all-female groups (Merkt 1987). Females segregate themselves when it is time to give birth (Merkt 1987). This segregation causes a change in group size throughout the year, decreasing during the fawning months, from January to April (Merkt 1987). However, taruka grouping patterns are guided by a fission-fusion society, where groups break up in subgroups and merge again during the day (Barrio 1999). Therefore, a single individual could be found in groups of different size and composition each day (Barrio 1999; Merkt 1987). Average size for taruka groups determined in several studies can be seen in Table 2.

Among the main behavioral activities, groups have been observed eating while moving several kilometers (Sielfeld et al. 1988). Bedding areas and trails are well marked (Barrio 2004; Sielfeld et al. 1988) suggesting that groups use specific paths. However, tarukas move in a wide open pattern when feeding, and then the individuals walk along different paths, almost in parallel. Only when fleeing the group runs in a line.

In mixed-sex groups a female is the one guiding the group, moving always ahead of the other individuals (Roe and Rees 1976; Sielfeld et al. 1988; Barrio 1999). The last individual behind the group is usually a male, supposedly the older one (Sielfeld et al. 1988), probably defined by a larger size. Some males are clearly larger than others, a trait observed in mixed-sex groups that include several males, and it could be assumed that those males are older or are the ones that dominate reproduction (Barrio 1999). When fleeing, the group either divides in smaller units or run in line. Then, the last individual leaving the area is always a male, and, if fawns are included in the escaping group, they usually ran behind an adult male and in front of another adult male (Barrio 1999).

Mixed groups are the largest throughout the year, and usually are the most common group type, however, from just before fawning through fawn's first months (January to April), single sex groups of either males or females are more common (Merkt 1987). By the end of

Table 2 - Average group size at selected localities in Peru and Chile.

	RANP[a]	PGNR[b]	La Raya[c]	ALRZ[d]	P-T[e]
Average ± SE	3.2 ± 0.52	2.65 ± 0.55	6.4 ± 0.36	3.8 ± 0.57	2.45 ± 1.66
Group size range	1-7	1-11	1-31	1-11	1-7

Note - a. Rio Abiseo National Park (APECO 1996, September-October; and Barrio 2004, April-June); b. Pampa Galeras National Reserve (Merkt 1985, February-June); c. La Raya Station (Merkt 1985, year round); d. Aymara Lupaca Reserved Zone (Barrio 1999, June-November); e. Parinacotas, Tarapaca (Muñoz 2003, January and April-May).

the rainy season (April – May) lactating females and their fawns return to mixed groups (Merkt 1987). Solitary individuals are rarely found, but when they occur, they are usually males (Barrio 1999; Merkt 1987). Solitary individuals tend to be more common in areas with high human influence. During the rut from June to August, large mixed-sex groups get subdivided into smaller groups within the larger group (Merkt 1987; Sielfeld et al. 1988). These smaller groups are composed of a male and up to three females, and sometimes include juveniles (Sielfeld et al. 1988). Males in those groups defend and repel other males approaching in an attempt to steal females from the small group (Sielfeld et al. 1988). Adult males in a dominant behavior towards younger ones show the white area on the underside of the head by lifting the head upwards and backwards with the chin pointing to the sky while standing (Roe and Rees 1976). They also nod their head and raise the forelegs one at a time, and/or point their antlers towards the juveniles, while the neck stays in line with the back, sometimes slowly walking stiff (Roe and Rees 1976).

Courtship was observed as rutting activity from May to July (Merkt 1987; Sielfeld et al. 1988). The courtship previous to the mounting is initiated by the male (Merkt 1987; Roe and Rees 1976; Sielfeld et al. 1988). In the only detailed description of a sexual interaction, the male approached a resting female with his head low and penis semi erect, nosed and licked the vulva and heaved her hindquarters many times until the female stood up (Roe and Rees 1976). Subsequently, the female walked and urinated with her back arched and the male tasted the urine exhibiting flehmen. The male followed the female licking and nosing her vulva and lifting her hindquarters. There is no indication by Roe and Rees (1976) if the mounting occurred just after or during the courtship.

CONSERVATION STATUS

Already in 1969 the species was considered as threatened by hunting (Grimwood 1969). The International Union for the Conservation of Nature and Natural Resources (IUCN) currently defines the taruka in its endangered species list as Vulnerable (VU), based on IUCN criteria C2a(i) E (Barrio and Ferreyra 2008). In addition, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists taruka in Appendix I (Barrio and Ferreyra 2008).

The taruka is considered to be Vulnerable due to a small population size and ongoing decline (criterion C) estimated from hunting and inferred from reduction of habitat quality, and following a quantitative analysis (criterion E). The total census population estimation for the species is 12,000-17,000 individuals, of which less than 10,000 are estimated to be mature. The remaining 10,000 mature individuals are divided into subpopulations, each with less than 1,000 mature individuals. Habitat fragmentation is also a serious threat to the existing populations. Additionally, the cumulative population in a large portion of the existing range between Argentina and Bolivia may not reach 2,000 mature individuals. An analysis exclusively on those two countries would likely categorize the taruka as Endangered. A PVA on a healthy population in southern Peru showed a high probability of extinction in 100 years (Barrio 2007), further justifying a Vulnerable listing. The scenario from Peru is representative of the whole population. Also, vicuña (*Vicugna vicugna*) Peruvian census data from 1988 included taruka in some areas, and following local people accounts in those areas, the taruka population had decreased more than 50% in the previous 20 years (1960s to 1980s). A similar trend was obtained in recent years by the author in three separated areas from Peru. Habitat fragmentation is a serious threat to the existing populations. Threats include competition with domestic stock, habitat destruction, trophy hunting, and predation by domestic dogs (Barrio 2006; Barrio and Ferreyra 2008).

Peru currently classifies the taruka as Vulnerable following an assessment based on IUCN criteria (MIN AGR 2004). In Bolivia, the taruka is protected by a hunting ban decree (Decreto de Veda General Indefinida) and it is included in the Bolivian Red Book of threatened vertebrates (Núñez 2005). Chile classifies the taruka as Vulnerable (Galaz 1998; Glade 1993) and it is protected by the general Hunting Law (SAG 2001). In Argentina, the taruka is currently classified as Endangered (Dellafiore and Maceira 2001; Diaz and Ojeda 2000; Fernandez et al. 1997). Moreover, it was declared a Natural Monument in 1996 by the Argentinean Congress (Fernandez et al. 1997). Both Peru and Chile had the taruka classified as Endangered in previous lists of threatened fauna (Galaz 1998; MIN AGR 1999). However, a better assessment from the Peruvian side and a population recovery in Chile since the 1970s was the basis of the current lower threat category in both countries.

The taruka occurs in several protected areas throughout its range. However, taruka habitat in most of the protected areas is marginal, so that few of those areas actually include an important taruka population, and most tarukas range outside protected areas. The protected areas that may harbor the larger taruka populations are Nor Yauyos – Cochas Landscape Reserve, Huascaran National Park, Salinas y Aguada Blanca National Reserve and Aymara Lupaca Reserved Zone in Peru, and Lauca National Park in Chile. However, the only protected areas that may harbor populations large enough as to be viable by itself are Nor Yauyos – Cochas Landscape Reserve in the western central Andes of Peru, and Aymara Lupaca Reserved Zone in south Peru. Elsewhere in Peru, the taruka occurs in another eight protected areas. In Bolivia, the taruka has been reported from six protected areas, all along the eastern Bolivian Andes (Núñez 2005), but in some of them the taruka is present only marginally. Along the more endangered Argentinean population, the taruka occurs in only two provincial protected areas, Potrero de Yala Provincial Park in Jujuy, and Los Cabrera Provincial Park in La Rioja (Ferreyra, *in litt*). The taruka is the emblem of Calilegua National Park in Jujuy, however, no evidences have been found as to support its occurrence in that area. Nevertheless, education on taruka conservation has been carried out in the surroundings of Calilegua National Park (Ferreyra, *in*

litt). Two Argentinean national parks that may harbor the species are Los Cardones and Campo de Los Alisos, as it is usually stated, but its presence has not been verified by Argentinean biologists. It is urgent that other protected areas be created over what is left of the taruka population in Argentina.

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