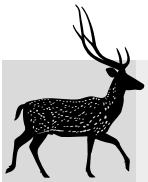

Axis axis
chital, ciervo axis

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Resumen. El ciervo axis o chital es nativo del subcontinente indio. Es una especie generalista de hábitat que evita ambientes extremos. Su sistema digestivo es de un consumidor intermedio y se alimenta de gran variedad de plantas, principalmente pasturas. Puede formar grupos de más de 150 individuos y alcanzar altas densidades en áreas protegidas libres de ganado y depredadores. Fue introducido en Uruguay con fines cinegéticos y desde allí se translocaron individuos a la provincia de Buenos Aires, donde se expandió asociado a montes de tala (*Celtis ehrenbergiana*) próximos a la Bahía Samborombón. Desde Uruguay habrían cruzado a Entre Ríos (Argentina), y se expandieron por prácticamente toda de la provincia llegando a la provincia de Corrientes y al bajo delta bonaerense del Río Paraná. También se translocaron individuos a la provincia de Santa Fe y a los Esteros del Iberá en Corrientes, desde donde se han expandido y formado poblaciones silvestres. En Argentina se ha observado que producen daño sobre la flora nativa y plantaciones forestales. Puede competir con el ganado, tanto de forma comportamental como por el uso de recursos alimenticios. A su vez es vector de enfermedades bovinas como la Diarrea Viral Bovina. Posee además parásitos que podrían afectar a la fauna nativa y a la salud humana. Las medidas de control han sido escasas hasta el momento y focalizadas en áreas protegidas, principalmente en el Parque Nacional El Palmar.

General description of the species

Chital, axis deer or spotted deer is one of the most common and widely distributed native cervid in the Indian subcontinent. It originally inhabits India, Nepal, Bhutan, Bangladesh and Sri Lanka (Duckworth *et al.*, 2015). It is a medium-sized deer. Males are usually larger, reaching a weight of up to 113 kg; nevertheless, the average adult males weigh 75 kg and the females 45 kg (Long, 2003). Their coat is reddish brown, darker at the top, with well-defined white spots on the back and flanks; a black stripe runs down the spine from the nape to the tip of the tail (Fig. 1). The abdomen, chest, throat, insides of legs and ears, and

underside of tail are white. The head is brown and the muzzle blackish. Only males have antlers, which usually have three ends, with a brow tine (found just above the base) and a forked main beam. Chital is a habitat generalist species. In its natural environment it avoids extremes, such as dense moist (evergreen) forests and open semi-deserts or deserts. Moist and dry deciduous forest areas, especially adjoining dry thorn scrub or grasslands, appear to be optimal for it, and highest densities of chital are reported from these habitats (Duckworth *et al.*, 2015). It eats a wide variety of plants. Being an intermediate feeder, the gastrointestinal system is similar in morphological characteristics to both types of ruminants: browsers and grazers (Pérez *et al.*, 2015). It usually feeds on grasses, but it also consumes leaves, flowers and fruits, mainly in seasons where forage quality decreases (Johnsingh and Sankar, 1991). Groups may number up to 150 or more individuals, with a composition that changes frequently during feeding periods and in flight from potential predators (Dinerstein, 1980). In their natural distribution they can be found at densities ranging up to 200 animals per km² in protected areas practically free of predators and livestock (Raman *et al.*, 1996). In a day, the periods when they are most active are usually during dawn and dusk, which are characterized by peaks in feeding activity (Álvarez-Romero *et al.*, 2008). Reproductive patterns in India show a clear seasonality; however, deer with hardened antlers and in rutting condition may be found throughout the year. Only one fawn (rarely two) is produced per pregnancy after a gestation period of 210–238 days (Mishra, 1982).

Figure 1. *Axis axis* in Argentina. Photo: Horacio Patrone.

History of the invasion

The first specimens in South America were introduced for hunting purposes by Aarón de Anchorena, in his farm in Barra de San Juan in Colonia department, Uruguay (González and Lanfranco, 2010). As for Argentina, chital were introduced sometime between 1928 and 1930, sent by Anchorena from Uruguay to Punta Indio, Buenos Aires province (Navas, 1987). Specimens from this region were later introduced to the mountain range systems of Ventania and Tandilia, and to central provinces such as La Pampa, Córdoba and Santa Fe (Abba *et al.*, 2009). The Santa Fe introduction in particular is reported to have been at least 30 years ago, in the vicinity of San Javier (Pautasso, 2008). Chital specimens were also taken to the provinces of Neuquén and Río Negro (Navas, 1987). In 1973, they are thought to have been introduced in Tucumán, in the Yastay hunting club (Grau *et al.*, 1995). In the early 1980s, 12 specimens were released in the area of Sayuque Viejo, San Luis province (Jackson, 1986). From Uruguay, crossing the homonym river, the species would have entered to Entre Ríos province (Muzzachiodi, 2007). In Corrientes province, chital would have entered from the south, coming from Entre Ríos; and also, it would have been introduced in the Esteros del Iberá (Fabri *et al.*, 2003). It has been observed in the Buenos Aires portion of the lower delta of the Paraná River since 2008 (Fracassi *et al.*, 2010).

An earlier introduction of chital in Argentina is proposed by Novillo and Ojeda (2008), following Lever (1985). It would have been introduced in 1906, in La Pampa province, at about the same time when red deer specimens (*Cervus elaphus*) were introduced in the farm San Huberto (future nature reserve Parque Luro). However, a close examination of the data from the reserve does not support this proposal: the introduction of chital on that date is not mentioned in the reserve's history, neither is its presence when the farm was bought in 1939 (Amieva, 1992), and no specimens have been recorded in that location up to the present.

Patterns of expansion and current distribution

In Argentine territory, chital specimens have undergone numerous translocations because of their hunting importance. Subsequently, this species has expanded from the hunting grounds and formed wild populations (Fig. 2). However, not all the sites where the species is reported to have been introduced correspond to areas where wild population can be found in the present: for some of them, the number of individuals has declined or even disappeared; for others, they remain restricted to farms or hunting grounds; lastly, there are some specific sites where they may have not been introduced.

In Buenos Aires province they have proliferated in association with natural tala (*Celtis ehrenbergiana*) forests close to Bahía Samborombón (Navas, 1987), extending in General Lavalle, Magdalena, Tordillo, Punta Indio, Chascomús, Berisso and Castelli departments. Wild populations have also been recorded in Gral. Madariaga and Gral. Pueyrredón. Individuals have been registered in Tornquist, Bahía Blanca, Balcarce, Guaminí, Gral. Belgrano and Coronel Suárez (Carpinetti and Merino, 2000); however, we cannot ensure that wild populations exist in those departments. In the Buenos Aires portion of the lower delta of

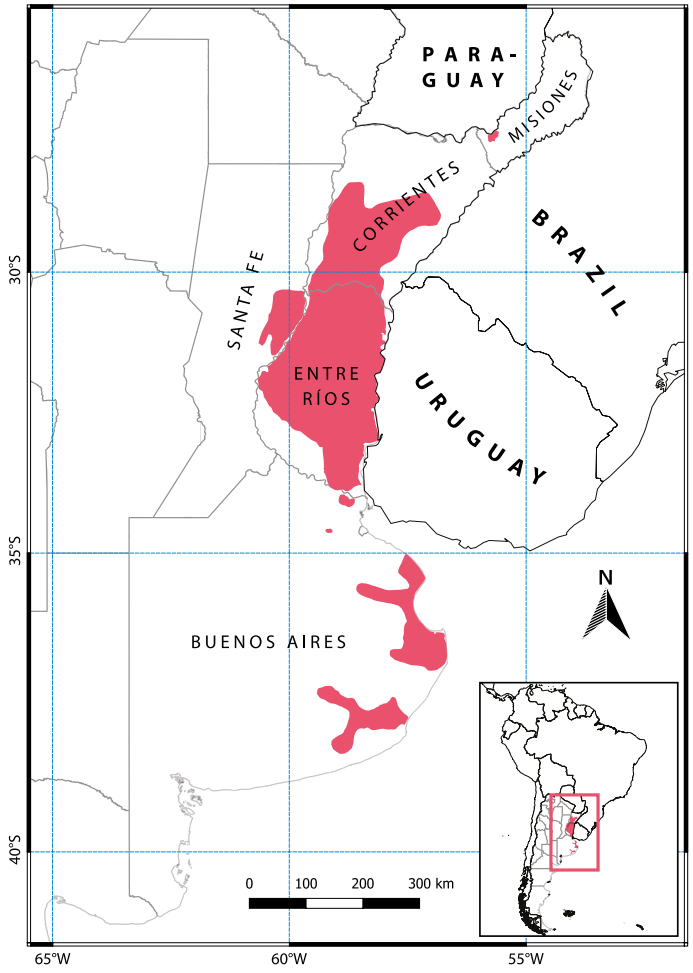

Figure 2. Distribution of *Axis axis* in Argentina. Modified from Tellarini *et al*. (2019). (Mapping: Ian Barbe and Alfredo Claverie).

the Paraná River, chital is found on a reduced area, due to the recent nature of the invasion, but records from the last few years suggest that it is expanding (Tellarini, pers. obs.).

In Entre Ríos, it has expanded practically all over the province, and presence has been documented for the protected areas of Parque Nacional El Palmar, Parque Nacional Predelta and the El Potrero private reserve (Muzzachiodi, 2007). In Santa Fe, the species seems to be scattered over a large area that includes the entire zone between Saladillo Dulce and Saladillo Amargo streams and the surroundings of the provincial route 39 (San Javier and San Justo departments), it has also been recorded a little north of Fortín Olmos in Vera department (Pautasso, 2008). In Corrientes, it is distributed mainly in the center and south of the province, and in the south-east area of the Iberá reserve, occupying mainly the Espinal environments; even though it seems to be beginning to expand into patches of hygrophilous forests surrounded by grasslands (Cirignoli, pers. comm.). In Neuquén there are no

wild populations; it is confined to private farms (Guichón *et al.*, 2016). The same may have occurred in Córdoba and Río Negro: in the latter, the wild population of Victoria Island could not prosper due to the cold weather and the competition with red deer and fallow deer (*Dama dama*) (Navas, 1987). In Tucumán, it may have never been introduced (Juliá, pers. comm.), and the notion of chital in that province could be attributed to a miscitation of red deer presence. In San Luis, the only available report is of an individual that was found dead on Route 27, 80 km south to Villa Mercedes. In Misiones, there are recent records in the south of the province as well as in the center-east, in El Soberbio locality. In La Pampa province, it is present in numerous hunting grounds, where it probably remains confined.

Impacts

No studies on the impacts of chital on native and implanted flora have been performed in Argentina. Nevertheless, damage to trees has already been observed in native trees in Parque Nacional El Palmar (Sobral Zotta, pers. comm.), as well as in forest production in Entre Ríos (Tellarini, pers. obs.) and ornamental trees in Uruguay (González and Seal, 1997). These effects are greatest during the reproductive season, when bucks rub their antlers on bark.

It has been shown that chital compete with other deer species such as white-tailed deer in Texas, USA (Faas and Weckerly, 2010). In Argentina, it shares territory and could compete with the pampas deer (*Ozotoceros bezoarticus*) in Bahía Samborombón and Corrientes, with marsh deer (*Blastocerus dichotomus*) in Paraná River delta and Corrientes, and with gray brocket (*Mazama gouazoubira*) in Corrientes, Santa Fe and Entre Ríos; agonistic behaviors towards the latter have been observed in Iberá (Cirignoli, pers. comm).

Chital presence can also be linked to an increase in parasites and illnesses affecting local mammals. Research from Iberá marshlands shows that chital and native fauna are both infected with the same tick species, resulting in a population increase of ticks and their associated parasites (Debárbora, 2012). Bovine Viral Diarrhea antibodies have been detected in blood tests performed on chital individuals hunted in Iberá (Sciocia *et al.*, 2011). In Parque Nacional El Palmar, 22 % of the analyzed individuals showed positive seroprevalence for leptospirosis (Tammone *et al.*, 2018). The presence of *Mycobacterium bovis*, the main agent of tuberculosis in cattle, was observed in deer from Buenos Aires, Entre Ríos and Corrientes (Barandiaran, pers. comm.).

A known effect of chital in its native distribution is the competition with livestock, both behavioral and through the use of food resources (Madhusudan, 2004). A survey of field enclosures with winter pastures for cattle performed in Gral. Lavalle (Buenos Aires) showed that chital consumed 60 % of the greenery (Mc Loughlin, pers. comm.).

Management

Chital is included in the exotic species management plan of Parque Nacional Campos del Tuyú. Although the species is not established within the park, isolated individuals are occasionally hunted in it (Beade, pers. comm.). In Parque Nacional Iberá, in Estancia

El Socorro, individuals have been hunted as part of a control program in order to reduce its quantity and mitigate its possible impacts (Cirignoli, pers. comm.). In Parque Nacional El Palmar, chital hunting began in 1996. Since 2006, a formal invasive exotic mammal control plan has been applied. Several methods of hunting are used, the most common being the elevated hunting platforms with firearms using salt baiting. From 2006 to 2015, the number of deer hunted per year has grown, reaching 513 deer hunted in 2015 (Gürtler *et al.*, 2018).

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