

Special issue

Status and distribution of Paraguayan canids

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Abstract

Four species of canids have long been documented in Paraguay, but we have learnt little about their ecology in the country since the works of Azara and Rengger in the early 19th Century. This paper collates specimen and literature data about this group to act as a basis for the stimulation of future research, reviewing canid specimens in all the major Paraguayan collections and all significant specimens in international collections. Data are presented in a hierarchical manner, with examined specimens, non-examined specimens, literature records, photographic records, reliable sight records distinguished, and a distribution map provided for each species. The vast majority of canid specimens were collected at least 35 years ago and the majority are from the Chaco region, with the Oriental region (east of the Paraguay River) extremely poorly sampled. Data suggests that two species (*Cerdocyon thous* and *Chrysocyon brachyurus*) are widespread in both regions of the country, and one species (*Speothos venaticus*) has an extremely restricted distribution. The remaining species (*Lycalopex gymnocercus*) has long been claimed to be widespread in both regions of the country, but although the species is widespread throughout the Chaco region, I was unable to find any documented evidence of the species in the Oriental region of Paraguay beyond a single photographic record from Isla Yacyretá in the Paraná River. I suggest that further investigation is required to confirm the true extent of this species' distribution in Paraguay.

Introduction

The Paraguayan Canidae includes four species in four genera (de la Sancha et al. 2017, Saldívar et al. 2017). However, studies on the group in Paraguay have been virtually non-existent, and basic data on the ecology and distribution of the species in the country is lacking, confused, or inadequate (Smith and Ríos *in press*). With a view towards consolidating the available data on the distribution and status of Paraguayan Canidae, a review of the specimens, literature, and reliable field records was performed. The results are presented here.

The history of canid studies in Paraguay

The fauna of the Jesuit territory of “Paraguaria” (which encompassed a large area of northern Argentina, Paraguay, southern Brazil, and eastern Bolivia) were described by several early Jesuit missionaries, notably Dobrizhoffer (1784) who mentioned three species of “foxes”, the large one called Kaalk by the Abipones, the middle-sized one called Licheran, and the smallest Lichera. The author only provided a description of the third, revealing it to be a skunk (Mephitidae) and the identity of the other two can only be guessed. Writing around the same time, Sánchez Labrador (1910) also described a skunk (Nigoteyo) as a species of fox; as well as another fox-like animal which he called Cachoque that is “grey mixed with white” and a “nocturnal enemy of birds”; and a larger, longer-haired species that is the size of a deer and “howls at night with sounds that closely resemble human screams”. The

identity of the latter two species is moot, but *Cerdocyon thous* and *Chrysocyon brachyurus* are probable candidates.

The first systematic treatise dealing with the Paraguayan species was de Azara (1801, 1802) who described two species of “foxes”, l'Agouara-Gouazou and l'Agourachay, providing detailed descriptions of the behaviour of each species. This was later translated to English by Hunter (1838). Rengger (1830) employed the same common names as Azara and correctly attributed them to the species now known as *Chrysocyon brachyurus* and *Cerdocyon thous* respectively, providing considerable new ecological data on both species. For much of the 19th Century this arrangement went unquestioned as l'Agourachay was repeatedly associated with *C. thous* but, during the early 20th Century, authors abruptly began to associate it instead with *Lycalopex gymnocercus* (Thomas 1914, Osgood 1915). The description was eventually demonstrated to be a composite of both species by Smith and Ríos (*in press*), who also provided an extensive discussion on the nomenclatural confusion resulting from the sudden change in usage.

The first published mention of *L. gymnocercus* in Paraguay that applied unequivocally to that species is thus much later than usually assumed, and in reference to specimens collected in the Chaco region by Wetzel and Lovett (1974). An earlier, unpublished specimen (FMNH 63861) had however been collected in Paraguay by the Mennonite collector Jakob Unger at Orloff, Boquerón department on 25 February 1946. Two specimens (AMNH 95205 and 95204) collected by Francisco Schade on 20 and 24 August 1931 predate the Unger specimens, but the locality “Villarrica, Guairá, Paraguay”

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is suspect. Schade resided in Villarrica, but many of the specimens he collected that bear that locality were obviously collected elsewhere, and Villarrica lies outside of the currently known range of the species. I have been unable to examine these specimens to confirm that they are correctly identified, and consequently I consider that they are best discounted until the expressed doubts can be dispelled. The fourth species in the family, *Speothos venaticus*, was reported for the first time by Bertoni (1924). Oddly, Bertoni (1939) later reported *S. venaticus* in the family Mustelidae.

Nomenclatural confusion in the family at the turn of the 20th Century (Allen 1905, von Ihering 1910, Thomas 1914, Osgood 1915, 1934, Stiles and Baker 1930, Cabrera 1931) is reflected in the constantly changing nomenclature and confusing taxonomy employed by Bertoni (1914, 1924, 1925, 1939). This was probably at the root of much of the misunderstanding of the Paraguayan distribution of *L. gymnocercus* which has long persisted in the literature (Lucherini and Vidal 2008) and has only recently been resolved (Smith and Ríos *in press*). However, beyond this point, with few exceptions (Brooks 1992), investigation into Canidae in Paraguay has been virtually nil and it was not until more recent times that *S. venaticus*, traditionally one of the least known canids, became the subject of study at Reserva Natural Bosque Mbaracayú (Beccaceci 1994, Zuercher et al. 2001, 2003, 2004, 2005, Zuercher and Villalba 2002, DeMatteo et al. 2004) and a captive breeding programme was coordinated by Itaipú Binacional (von Humbek and Perez 1998). Ironically, this perhaps ignominiously qualifies it as the most well-studied canid species in Paraguay.

In modern usage, the name Aguara is commonly employed to refer to “foxes”. However, the word is not used exclusively for canids, and is also used in reference to the crab-eating raccoon (*Procyon cancrivorus*, Aguara pope) or more rarely for Molina’s hog-nosed skunk (*Conepatus chinga*, Aguara ne). Cartes (2014) argues that the word Aguara is composed of two parts Agua meaning “rounded or bulky” and Ra/Rague meaning “fur or pelage”, interpreting the word as literally translating to “fierce animals with long fur or bulky tail”. On the other hand, Jagua (meaning in modern usage “dog”) was initially used to refer to fierce animals with short fur (Cartes 2014).

The conservation status of Paraguayan Canidae was recently reviewed, with two species found to be worthy of conservation concern (*C. brachyurus* and *S. venaticus*; Saldívar et al. 2017, Giordano et al. 2017). All species are listed on CITES Appendix II, except *S. venaticus* which is on Appendix I (Morales 2007).

Methods

Specimens of Canidae from the major zoological collections in Paraguay were reviewed during 2017 – 2019, identifications were confirmed by inspection of the specimens, and locality data was collated from museum databases and specimen labels. The location of specimens in foreign museums was gleaned from the literature and from Vert Net (which returned 260 results for Paraguayan Canidae). Where possible, specimens considered to represent significant geographical range extensions were reviewed with the assistance of museum curators. Those that did not present noteworthy distributions were assumed to be correct and not examined. Collection codes for museums housing Paraguayan canid specimens are listed in Appendix 1.

Species accounts begin with the current common name (following Hunter and Barrett 2011), scientific name, and author presented in bold type. The original described name, author, and type locality follow. There then follows a referenced list of the synonyms used in the Paraguayan literature with a single word descriptor of the subject of the publication in square brackets: aberration, abundance, biogeography, checklist, conservation, distribution, ecology, etymology, first record, folklore, husbandry, guide, list, mention, mortality, nomenclature, parasitology, specimen/s, taxonomy, tracks, use. The synonymy deals only with Paraguayan literature or literature citing Paraguayan specimens and is not intended to be a complete list of synonymy for the species. Subsection *Local names* lists all local common names published in the Paraguayan literature. An attempt to reference the earliest published usage for each name is made. Subsection *Comments* addresses noteworthy or confusing themes in the Paraguayan literature. There then follows a “hierarchical reliability” approach to the Paraguayan distribution of each species under *Geographical distribution*. This approach is taken so as to not unduly bias understanding by depending solely on the limited specimen record. The hierarchies are, in order of documented reliability: 1) *Examined*

specimens, 2) *Specimens not examined*, 3) published literature record (*Literature references*), 4) published photographic record (*Photographic records*), 5) reliable field observation by one of the authors or a knowledgeable local observer (*Reliable observations*). Records are presented with the political department in italicised capitals, followed by the details of the record (in alphabetical order). For specimen records this involves the specimen number (museum codes in Appendix 1) followed by the locality. These records are also mapped distinguishing the hierarchical categories so that readers may interpret their reliability for themselves (Figures 3–6). Records corresponding to categories 4) *Photographic records* or 5) *Reliable observations* include only localities that are not covered by any one of the previous three categories.

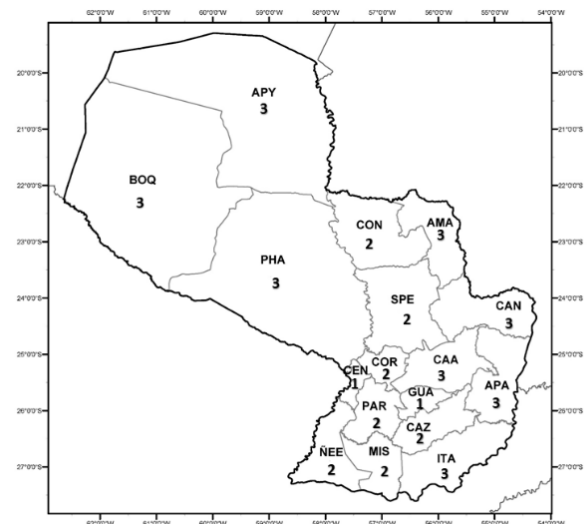


Figure 1: Map showing the political departments of Paraguay and the number of species of canids recorded in each. Departments as follows: Chaco region – Alto Paraguay (APY), Boquerón (BOQ), Presidente Hayes (PHA); Oriental region – Amambay (AMA), Alto Paraná (APA), Caaguazú (CAA), Canindeyú (CAN), Caazapá (CAZ), Central (CEN), Concepción (CON), Cordillera (COR), Guairá (GUA), Itaipúa (ITA), Misiones (MIS), Ñeembucú (ÑEE), Paraguari (PAR), San Pedro (SPE).

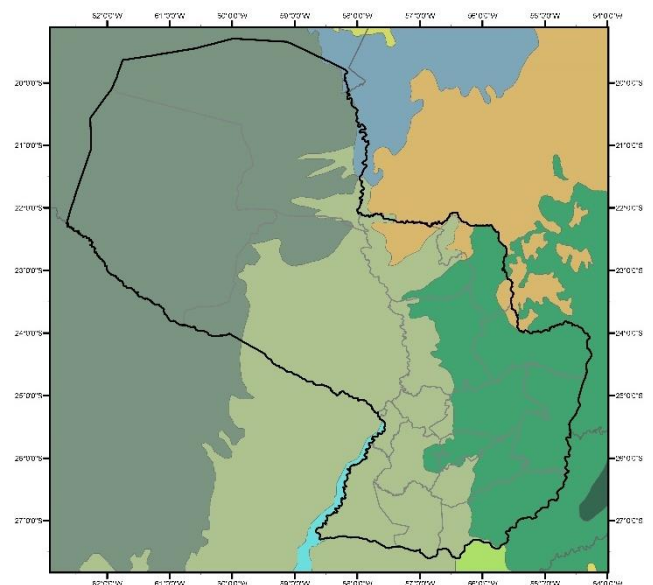


Figure 2: Map showing Paraguayan ecoregions. Dark green (Dry Chaco and Cerrados del Chaco); light green (Humid Chaco); orange (Cerrado); bright green (Atlantic Forest).

The criterion for inclusion of literature was that it was published in Paraguay or specifically deals with Paraguay, or in the case of international publications that it makes specific reference to Paraguayan specimens. The maps included in Neris et al. (2002) were omitted from this compilation. These maps were based on interviews with local people and contain numerous, obvious errors that I am keen not to perpetuate here. Also excluded are the results of Rapid Ecological Evaluations produced and published locally, due to the tendency amongst authors to extrapolate distributions without the necessary evidence in an effort to enhance the results produced after limited field time. On the advice of the author José Luis Cartes records of *C. brachyurus* in Cartes (2008) were also omitted and considered superseded by the data presented in Cartes et al. (2014). Every effort was made to be thorough with regard to critical inclusion of the literature, though undoubtedly some obscure references will have been missed and some mistakes will have been made.

A statement on the ecological affinities of each species in Paraguay is provided based on the ecoregions defined in del Castillo and Clay (2005) and Mereles (2013). These can be broadly defined as follows: Atlantic Forest (subtropical humid forests of eastern Paraguay), Cerrado (central South American bushy savanna of northern eastern Paraguay), Dry Chaco (low, arid thorn forest and scrub of the western Occidental region), Humid Chaco (palm savanna and marshlands of the Paraguay River Basin), Pantanal (gallery forests and swamps of the north-eastern Chaco), Cerrados del Chaco (an area of Cerrado in the northern Chaco contiguous with the Chiquitania of Bolivia), and Mesopotamian Grasslands (flooded grasslands of the southern Oriental region).

Species accounts

Pampas fox

Lycalopex gymnocercus (Fischer, 1814)

Procyon gymnocercus (Fischer 1814). Based solely on ‘l’Agourachay’ of de Azara (1801), therefore, type locality is Paraguay. Restricted by Cabrera (1958) to ‘vicinity of Asunción’, though this lies outside the known range of the species (Smith and Ríos *in press*).

Dusicyon gymnocercus gymnocercus (Wetzel and Lovett 1974 [specimens], Seese et al. 1981 [parasitology]).

Dusicyon gymnocercus (Schmidt and Martin 1978 [parasitology], Brooks 1992 [ecology], Villalba and Yanosky 2000 [ecology, tracks], Klassen 2007 [guide]).

Pseudalopex gymnocercus (Gamarra de Fox and Martin 1996 [specimens], Yahnke et al. 1998 [distribution], Areskoug 2001 [ecology], Esquivel 2001 [guide], Zuercher et al. 2001 [conservation, distribution], Lehr et al. 2002 [mention], Zuercher et al. 2003 [mention], Cartes et al. 2004 [distribution, ecology], Neris and Franco Rivarola 2005 [guide], Morales 2007 [conservation], Cartes et al. 2010 [mortality]).

Dusicyon gymnocercus (Lowen et al. 1996 [distribution], Hill and Padwe 2000 [mention]).

Pseudalopex gymnocercus (Neris and Colman 2001 [folklore, use]).

Pseudalopex (Dusicyon) gymnocercus (Fariña and Hostettler 2003 [list]).

Lycalopex gymnocercus (Gamarra de Fox et al. 1998 [conservation], Ramírez Pinto and Velázquez 2010 [checklist], Rumbo 2010 [biogeography], González et al. 2019 [distribution], Weiler et al. 2019 [guide], Smith and Ríos *in press* [nomenclature, taxonomy]).

Local names

Aguara cha’i (Villalba and Yanosky 2000); Aguará-pytá (Wetzel and Lovett 1974).

ACHE: Mberembó (Villalba and Yanosky 2000); Pepe jyká (Villalba and Yanosky 2000).

AVA: Guarachai (Villalba and Yanosky 2000).

AYOREO TOTOBIEGOSODE: Eapojaguê (Sánchez et al. 2020).

PÂI TAVYTERÁ: Guarachai (Villalba and Yanosky 2000).

SPANISH: Zorro de pampa (Areskoug 2001); Zorro de monte (Neris and Franco Rivarola 2005); Zorro Azara (Klassen 2007); Zorro gris (Klassen 2007). The indigenous name Aguará-pytá translates as ‘red fox’, whilst the Spanish name Zorro de pampa translates to ‘pampas fox’.

Comments

There has been considerable disagreement over the correct generic name for South American ‘grey foxes’ (Thomas 1914, Cabrera 1931, Osgood 1934, Languth 1975, Clutton-Brock et al. 1976, van Gelder 1978, Berta 1987, 1988, Tedford et al. 1995). The genera *Pseudalopex* (Burmeister 1854) and *Dusicyon* (Hamilton-Smith 1839) have both been employed in the recent past, but according to the genetic results of Tchaicka et al. (2016) *Lycalopex* (Burmeister 1854) correctly applies to the genus as currently understood, with *Pseudalopex* applicable only if the basal species *L. vetulus* is excluded.

The taxonomic history of the group has long been the subject of debate and species limits are far from resolved (Zunino et al. 1995, Prevosti et al. 2013, Tchaicka et al. 2016, Chemisquy et al. 2019). Cranial morphometrics have suggested that this species is indistinguishable from the Patagonian grey fox *L. griseus* (Zunino et al. 1995, Prevosti et al. 2013) and, indeed, some specimens from within the proposed range of this species show mtDNA sequences identical to *L. griseus*, despite the two species apparently not even being sisters (Tchika et al. 2016). To further complicate matters, the sub-specific identity of the small, dark, short-haired Chaco population is undetermined, while those of the large, pale, long-haired ‘eastern’ population (to date known only from Isla Yacyretá) have been referred to the nominate (Lucherini and Vidal 2008) and these may in fact represent distinct species (Chemisquy et al. 2019).

Geographical distribution

Largely confined to the Chaco region, where it is widely sympatric with *C. thous*. Though the two overlap throughout the region, this species is most numerous in more xeric habitats, whilst *C. thous* is the dominant species in more humid habitats. Consequently, this species seems to increase in abundance from east to west, whilst the opposite is true of *C. thous*, and the two are of approximate equal abundance in the central Chaco ecoregion. This species is thus most common in the Dry Chaco and Cerrados del Chaco ecoregions, and less common in the Humid Chaco and Pantanal ecoregions where it is largely rare or absent from marshy areas.

Presence in the Oriental region of Paraguay has long been a subject of discussion, and the appearance of this species in faunal lists and popular literature across that region (e.g. in EERs, Gamarra de Fox and Martin 1996, Lowen et al. 1996, Hill and Padwe 2000, Esquivel 2001, Neris and Colman 2001, Neris et al. 2002, Fariña and Hostettler 2003, Rumbo 2010, Weiler et al. 2019) refer invariably to undocumented sight records and seem to be an artifact of duplicated misidentification, assumption, and/or repeated error. Indeed, the presence of the species in the Mbaracayú Reserve, Canindeyú department has been repeatedly claimed (Lowen et al. 1996, Hill and Padwe 2000, Esquivel 2001, Neris et al. 2002, Fariña and Hostettler 2003), despite the doubt expressed (Zuercher et al. 2001) and molecular testing of carnivore faeces identified in the field from this locality all proving to be *C. thous* (Zuercher et al. 2003). Yahnke et al. (1998) listed this species for Cerro Corá National Park, Amambay department, but omit it from Defensores del Chaco National Park, Alto Paraguay department. I am unaware of any physical evidence that the species occurs in Amambay. This may be a transcription error, or it may be on the basis of the misidentified specimen MNHNP 774 from ‘2.5 km N of administration, Cerro Corá National Park’ (Leg. Jody Stallings 7 February 1981) which is actually *C. thous* (Gamarra de Fox and Martin 1996; specimen examined). I elect to not map it, pending verifiable data. Lowen et al. (1996) report this species from Estancia Sombrero, Cordillera department, but they do not report *C. thous* and there is no documentation of the report. I again consider it doubtful pending verifiable proof and omit it from the distribution of the species. See the exploration of the synonymy in the Paraguayan literature by Smith and Ríos (*in press*) for further information.

The species is present in low numbers in natural grasslands on Isla Yacyretá, Itapúa department but Smith and Ríos (*in press*) were unable to find a single verifiable record from anywhere else in the Orient and thus I treat these reports as potentially erroneous pending confirmation. Whilst its presence in the Mesopotamian grasslands ecoregion of southern Paraguay would seem possible, potential occurrence in the Cerrado or Atlantic Forest of the extreme northeast of the Oriental region of Paraguay is also possible based on the known distribution in neighbouring Brazil (Brocardo et al. 2020). However, there is currently no evidence to support its existence on the mainland of Oriental Paraguay. The species is of Least Concern in Paraguay (Saldívar et al. 2017).

Examined specimens

Specimen lacking locality (MJUF). **BOQUERÓN**: 0.5 km S of admin PN Teniente Enciso (MNHNPY 775); 2 km N of admin PN Teniente Enciso (MNHNPY 773); Estancia San Ramón, 48 km SW of Colonia Neuland (MNHNPY 1045); Picada Saracura, PN Teniente Enciso (MNHNPY 1041).

Specimens not examined

“Gran Chaco” (CONN 17052); “Paraguay” (CONN 20407, MVZ 145333). **ALTO PARAGUAY**: 20 km E of Agua Dulce (CONN 19299); 139 km W of Puerto Sastre (CONN 19308); 144 km NE of Filadelfia (CONN 19302); Agua Dulce (CONN 19300); PN Defensores del Chaco, 10.5 km SW (MSB 54081); Fortín Madrejón (CONN 19312).

BOQUERÓN: 3 km S of Garrapatal’i, 7 km SW of km620 Ruta Transchaco (CONN 17546, 17547); 8 km W of Teniente Ochoa (CONN 17003); 11 km NW Fortín Teniente Pratt Gill (CONN 19301); 32 km W road Mariscal Estigarribia to Teniente Montaña (CONN 16873); 40 km W of Mariscal Estigarribia (CONN 17001); 42 km W road Mariscal Estigarribia to Teniente Montaña (CONN 16865); 49.6 km N by road from Filadelfia (UMMZ 124458); 144 km NE of Filadelfia (CONN 19305, 19306); 990 m NNE of Teniente Ochoa, km557 Ruta Transchaco (CONN 15973); Copagro, km589 Ruta Transchaco (CONN 18528, 18529, 18535, 18536, 18817, 18956, 18961, 19080, 19360, 19361, 19362, 20409, 20410); Estancia Iparoma, 19 km N Filadelfia (CONN 19347, 19348, 19349, 19350, 19351, 19352, 19355, 19356, 19359); Estancia Mbutureta, 90 km W of Mariscal Estigarribia (CONN 19318); Garrapatal’i, 7 km SW of km620 Ruta Transchaco (CONN 18085); km545 Ruta Transchaco (CONN 16225, 16226); km600 Ruta Transchaco (CONN 18527); km607 Ruta Transchaco (CONN 17534); km618 Ruta Transchaco (CONN 17545); km652 Ruta Transchaco (CONN 18013); Loma Plata (KU 142757); Orloff (FMNH 63861); PN Teniente Enciso (CONN 16869, 17002, 17011, 17012, 17535, 17536, 17537, 18144, 18160, 18161); PN Teniente Enciso, 1.5 km NW (CONN 17544); PN Teniente Enciso, 2 km SE of km654.5 Ruta Transchaco (CONN 18063); PN Teniente Enciso km654 Ruta Transchaco (CONN 18158); PN Teniente Enciso km655 Ruta Transchaco (CONN 18082, 18096, 18097); PN Teniente Enciso, field behind buildings km654.5 Ruta Transchaco (CONN 17548, 17551, 17552, 17553, 17554, 18080); Teniente Ochoa (CONN 16224, 16549, Brooks 1992); Sargento Rodríguez, km764 Ruta Transchaco (CONN 17538, 17541, 17543, 17798, 17984, 18083); Sargento Rodríguez, 1 km W (CONN 18017).

GUAIRÁ: Villarrica (AMNH 95204, 95205), in error?

PRESIDENTE HAYES: 8 km NE of km275 Ruta Transchaco (CONN 17010); 275 km NW by road of Villa Hayes (MVZ 145335); 290 km NW by road of Villa Hayes (MVZ 145334); between Estancia Juan de Zalazar and Teniente Ochoa (CONN 16750); Estancia Juan de Zalazar (CONN 20406); Estancia Juan de Zalazar, 1.5 km W of line camp (CONN 16770); Estancia Juan de Zalazar, 2 km SE of line camp (CONN 16756); Estancia Juan de Zalazar, 11 km W of Transchaco Bridge (CONN 16223); Estancia Juan de Zalazar, near line camp (CONN 16771); Estancia Laguna Pora, Colonia Fernheim, 85 km E of Loma Plata (CONN 19317, 19328, 19337, 19340, 19343, 19345); 13 km 100 Ruta Transchaco (CONN 16751); km113 Ruta Transchaco (CONN 18089); km361 Ruta Transchaco (CONN 17799); Retiro km305 Ruta Transchaco (CONN 17009, 17391); Río Verde, 137 m E of Ruta Transchaco (CONN 16241).

Literature references

ALTO PARAGUAY: Estación Los Tres Gigantes (González et al. 2019).

BOQUERÓN: between Filadelfia junction and Mariscal Estigarribia on Ruta Transchaco (Cartes and Morales 2010); Fortín Toledo (Brooks 1992); Gran Siete (Areskoug 2001); Parque Nacional Teniente Enciso (Yahnke et al. 1998).

BOQUERÓN / PRESIDENTE HAYES: between km174 and Filadelfia junction on Ruta Transchaco (Cartes and Morales 2010).

PRESIDENTE HAYES: between km71 and km173 on Ruta Transchaco (Cartes and Morales 2010); Estancia Amalia (Brooks 1992); Laguna Ganzo (Cartes 2008); Tinfunqué “National Park” (Cartes et al. 2004); Reserva Natural Privada Golondrina (Lowen et al. 1996).

Photographic records

ITAPÚA: Isla Yacyretá (Paul Smith).

Reliable observations

BOQUERÓN: Parque Nacional Médanos del Chaco (Paul Smith).

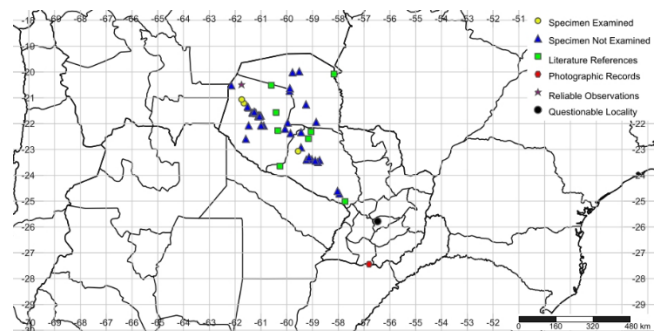


Figure 3: Distribution of *Lycalopex gymnocercus* in Paraguay.

Crab-eating fox***Cerdocyon thous* (Linnaeus, 1766)**

Canis thous (Linnaeus 1766). Type locality “Surinam”.

Canis azarae s. brasiliensis (Rengger 1830 [ecology, use]).

Canis azarae (Hunter 1838 [translation of Azara]).

Canis brasiliensis (Bertoni 1914 [checklist, distribution], Bertoni 1925 [aberration]).

Canis thous (Bertoni 1914 [checklist, hypothetical]).

Cerdocion thous entrerianus forma melampus (Bertoni 1939 [checklist, distribution]).

Pseudalopex g. gymnocercus (Bertoni 1939 [checklist, distribution]).

Cerdocyon thous entrerianus (Wetzel and Lovett 1974 [specimens], Seese et al. 1981 [parasitology]).

Cerdocyon thous (Schmidt and Martin 1978 [parasitology], Whitaker Jr and Abrell 1987 [parasitology], Brooks et al. 1993 [distribution], von Humbeck and Silveira Avalos 1995 [distribution], Gamarra de Fox and Martin 1996 [specimens], Lowen et al. 1996 [distribution], Gamarra de Fox et al. 1998 [conservation], Yahnke et al. 1998 [distribution], Hill and Padwe 2000 [mention], Villalba and Yanosky 2000 [ecology, tracks], Areskoug 2001 [ecology], Esquivel 2001 [guide], Neris and Colman 2001 [folklore, use], Zuercher et al. 2001 [conservation, distribution], Lehr et al. 2002 [distribution, specimens], Fariña and Hostetler 2003 [list], Hill et al. 2003 [use], Cartes et al. 2004 [distribution, ecology], Neris and Franco Rivarola 2005 [guide], Smith et al. 2006 [mention], Klassen 2007 [guide], Morales 2007 [conservation], Nava et al. 2007 [parasitology], Cartes 2008 [distribution], Cartes and Morales 2010 [mortality], Itaipú Binacional 2010 [guide], Ramírez Pinto and Velázquez 2010 [checklist], Rumbo 2010 [biogeography], Masi Pallarés 2011 [guide], Velázquez and Ramírez Pinto 2014 [guide], Gengler 2018 [distribution], González et al. 2019 [abundance, distribution], Owen and Smith 2019 [specimen], Weiler et al. 2019 [guide], Caballero-Gini et al. 2020 [distribution], Smith and Ríos *in press* [nomenclature, taxonomy], Entidad Binacional Yacyretá undated [guide]).

Cerdocyon (Dusicyon) thous (Zuercher et al. 2003 [distribution, identification]).

Cerdocyon thous (Smith et al. 2005a [mention], Smith et al. 2005b [mention]).

Local names

Aguara’i (Villalba and Yanosky 2000); Aguarachaî (Bertoni 1914); Aguarachay (Rengger 1830).

AVA: Peka (Villalba and Yanosky 2000).

ACHE: Krachoá (Villalba and Yanosky 2000); Krachoua (Esquivel 2001); Krachova (Fariña and Hostetler 2003).

AYOREO **TOTOBIEGOSODE**: Eapojaguë (Sánchez et al. 2020).

SPANISH: Zorro (Neris and Franco Rivarola 2005); Zorro cangrejero (Areskoug 2001); Zorro de monte (Areskoug 2001).

Comments

The indigenous Guaraní name *Aguara'i* means “little fox”, whilst the Spanish names translate as *Zorro de monte*, “forest fox”, and *Zorro cangrejero*, “crab-eating fox”. de Azara (1801, 1802) stated that the addition of “...chay” to *Aguara* had no real meaning, but was added in order to distinguish the fox from *C. brachyurus* (the maned wolf).

The correct name for the taxon in Paraguay was the subject of much debate. Rengger (1830) used the junior synonym *Canis brasiliensis* (Wied 1826); though the name was actually authored earlier by Schinz 1821) and from his description it is very clear that he refers to this species alone, and that he clearly believed his *Aguarachay* to be the same as Azara's. Nomenclatural confusion reflected in the various synonyms used in the works of Bertoni (1914, 1925, 1939) was clarified by Smith and Ríos (*in press*).

Five subspecies are traditionally recognised, with Paraguayan populations usually assigned to *Cerdocyon thous entrerianus* (Burmeister 1861) (Cabrera 1931, Tchaicka et al. 2007, Machado and Hingst-Zaher 2009). However, subspecies were defined largely on pelage colour which is distinctly variable in this species. More recent analyses have proposed a reduced number of distinct populations, with the defined “southern group” of Tchaicka et al. (2007) and Machado and Hingst-Zaher (2009) corresponding essentially to the proposed range of *C. t. entrerianus* and supporting its continued recognition.

As part of an extensive and charming description of the ecology of this species in Paraguay, Rengger (1830) noted that it was formerly regularly domesticated and that, when accompanying a hunt, the species showed greater tracking aptitude than trained hunting dogs, but that it tired more rapidly.

Geographical distribution

This is a common and widespread fox occurring across the country in all ecoregions. Occurrence in the most xeric areas of the western Dry Chaco is perhaps sporadic and probably partly dependent on climatic conditions, as the species appears to prefer areas where standing water is freely available. They likely extend the range into xeric areas along water courses during wet years, retracting again in drier years.

C. thous shows a preference for forested habitats (both humid and dry), and is able to survive in quite heavily degraded areas provided patches of trees are available. They are able to tolerate moderate human disturbance, and can persist in suburban areas where unmolested. In rural areas they commonly approach human dwellings. The species is of Least Concern in Paraguay (Saldívar et al. 2017).

Examined specimens

Specimen lacking locality (MJUF).

ALTO PARAGUAY: 2.5 km E of Agua Dulce on Línea 1 (MNHNPY 776); 8 km E of Agua Dulce on Línea 1 (MNHNPY 779); 10 km E of Agua Dulce on Línea 1 (MNHNPY 777); 17 km W of Colonia Neuland (MNHNPY 1049, 1050); Agua Dulce (MNHNPY 802, 803); Gabino Mendoza (MNHNPY 2217); PN Defensores del Chaco (MNHNPY 3259).

AMAMBAY: PN Cerro Corá (MNHNPY 774, 778, 781).

BOQUERÓN: Estancia San Ramón, 48 km SW of Colonia Neuland (MNHNPY 1042, 1043).

CORDILLERA: km50 Ruta II (MNHNPY 1180).

ITAPÚA: -26.649547, -55.66497, Libertad del Sur (CZPLT-M 512); Estancia Bogado, Isla Yacyretá (MNHNPY 1190).

MISIONES: Ruta IV 86 km E of Pilar (CZPLT-M 526).

ÑEMBUCÚ: 19.5 km N of Pilar (CZPLT-M 510); Ruta IV at -26.51187 - 58.11465 (CZPLT-M 540).

PRESIDENTE HAYES: km61 Ruta Transchaco (MNHNPY 780); km139 Ruta Transchaco (MNHNPY 836); Montelindo (MNHNPY 2221); Ruta Transchaco (MNHNPY 1046).

Specimens not examined

“Paraguay” (CONN 20408, MCZ 27904, 28639, MHNG 1968.075, NRM 586001, RBINS 381448, 502034); “Paraguay Chaco” (NRM 595089, 595094, 595095, 595097).

ALTO PARAGUAY: 36.1 km W by road of Fortín Madrejón (UMMZ 124459); 48 km NW of Fortín Madrejón (CONN 19311); 50 km WNW of Madrejón, Misión Nuevo Tribu (UMMZ 124460, 125566, 125567); 78 km N of Fortín Madrejón (CONN 19298); 139 km W of Puerto Sastre (CONN 19307); 144 km NE of Filadelfia (CONN 19303, 19304); Estancia Laguna General Díaz (MHNG 1706.013); Fortín Madrejón (UMMZ 124461); Pablo La Gerenza, 29 km N of Fortín Madrejón (AMNH 248466); surroundings of 20°46'57S, 59°48'53W, c.15-33 km S of Fortín Madrejón (MTD-B 24883; Ziegler et al. 2002).

BOQUERÓN: (AMNH 234214, 234215, 234216, 234217, 234218); 2 km S of Filadelfia (CONN 17004); 3.5 km S of Garrapatal'i, 7 km SW of km620 Ruta Transchaco (CONN 17533); 4 km S of Garrapatal'i, 7 km SW of km620 Ruta Transchaco (CONN 17532); 15 km SW of km589 Ruta Transchaco (CONN 20403); 39.5 km W road Mariscal Estigarribia to Teniente Montaña (CONN 16871); Copagro, km589 Ruta Transchaco (CONN 18530, 18531, 18532, 18533, 18534, 20404, 20405); Filadelfia (MTD-B 24882; Lehr et al. 2002); Guachalla Río Pilcomayo (FMNH 54327); km545 Ruta Transchaco (CONN 16063, 16238); Loma Plata (KU 92665); Pilcomayo (MHNG 1968.077); Teniente Ochoa (CONN 15971, 16059, 16255, 16548).

CAAGUAZÚ: Junction of the Iguazú and Yuquerí Rivers (MCZ 28638, 29061); Yuquerí River (MCZ 28647).

CANINDEYÚ: 13.3 km by road N of Curuguaty (UMMZ 126121, 126122, 146501).

CONCEPCIÓN: Parque Nacional Serranía San Luís (TTU 80239).

ITAPÚA: Trinidad (AMNH 36501, 36502, 36503, 36504, 36505, FMNH 146294).

PARAGUARÍ: Carapeguá Mt Bogarín (AMNH 234219).

PRESIDENTE HAYES: 22 km SW Fortín Gloria Meyer (CONN 19310); 30 km W of Puerto Pinasco (USNM 236635); 34 km east by road of Pozo Colorado (TTU 80347, 80348); 275 km west of Villa Hayes by road (MVZ 145327, 145328, 145329, 145330); Chaco Experimental Station, 295 km NW by road of Villa Hayes (MVZ 145331, 145332, 145336); Estancia Apéndice km293 Ruta Transchaco (MHNG 1689.065); Estancia Iparoma, 0.5 km SW (CONN 19358); Estancia Iparoma, 19 km N of Filadelfia (CONN 19353, 19354, 19357, 19363); Estancia Juan de Zalazar (CONN 15765, 15767, 15768, 16243, 16274, 16643, 16843); Estancia Juan de Zalazar, 1 km N Rio Verde station (CONN 15972); Estancia Juan de Zalazar, 2 km from Rio Verde station (CONN 16062); Estancia Juan de Zalazar, 4 km SW line camp (CONN 17390); Estancia Juan de Zalazar, 500 m N line camp (CONN 16773); Estancia Juan de Zalazar, 500 m W of Transchaco bridge (CONN 16239); Estancia Juan de Zalazar, between Transchaco bridge and Rio Verde station (CONN 16550); Estancia Juan de Zalazar, left bank of Río Verde near Transchaco bridge (CONN 16240); Estancia Laguna Pora, Colonia Fernheim, 85 km E of Loma Plata (CONN 19313, 19314, 19315, 19316, 19319, 19320, 19321, 19322, 19323, 19324, 19325, 19326, 19327, 19329, 19330, 19331, 19332, 19333, 19334, 19335, 19336, 19338, 19339, 19341, 19342, 19344, 19346); km55.5 Ruta Transchaco (CONN 17797); km75 Ruta Transchaco (CONN 17531); km250 Ruta Transchaco (AMNH 234220, 234221, CONN 16832); Retiro km305 Ruta Transchaco (CONN 16744, 16748, 16783, 16842, 16995, 17005, 17006, 17007, 17008, 17330, 17371); Retiro km310 Ruta Transchaco (CONN 17380); Río Verde, 300 km NW by road of Villa Hayes (MVZ 145337, 145338); surroundings of 22°32'S, 59°40'W, near Laguna Capitán (MTD-B 24883; Lehr et al. 2002); surroundings of 22°34'S, 59°20'W, Estancia Campo María (MTD-B 24886; Lehr et al. 2002).

Literature references

ALTO PARAGUAY: Estación Los Tres Gigantes (González et al. 2019); Parque Nacional Defensores del Chaco (Yahnkee et al. 1998); Río Negro National Park (Cartes et al. 2004).

ALTO PARANÁ: Área de Itaipú (von Humbeck and Silveira Avalos 1995); Estancia Don Oscar (Cartes 2008); Estancia San Antonio (Lowen et al. 1996); Itabó Itaipú (Cartes 2008); Limoy (Cartes 2008); Mondañ (Bertoni 1939); Puerto Bertoni (Bertoni 1925, 1939).

AMAMBAY: Parque Nacional Cerro Cora (Yahnkee et al. 1998).

BOQUERÓN: 22°35'S, 59°04'W (Lehr et al. 2002); between Filadelfia junction and Mariscal Estigarribia on Ruta Transchaco (Cartes and Morales 2010); Gran Siete (Areskoung 2001); Fortín Toledo (Lehr et al. 2002); Neuwestland (Lehr et al. 2002); Parque Nacional Teniente Enciso (Yahnkee et al. 1998).

BOQUERÓN / PRESIDENTE HAYES: between km174 and Filadelfia junction on Ruta Transchaco (Cartes and Morales 2010).

CAAGUAZÚ: Reserva Morombí (=Estancia Golondrina II, Brooks et al. 1993, Lowen et al. 1996, Cartes 2008).

CAAZAPÁ: Arrozal Codas (Cartes 2008); Parque Nacional Caazapá (Lowen et al. 1996, Cartes 2008); Reserva Natural Privada Ypetí (=Estancia Golondrina I, Brooks et al. 1993, Lowen et al. 1996); Reserva Tapytá (Cartes 2008, Velázquez and Ramírez Pinto 2014).

CANINDEYÚ: Estancia Felicidad (Cartes 2008); Estancia Jiménez (Lowen et al. 1996); Refugio Carapá (Cartes 2008); Reserva Bosque Mbaracayú (Brooks et al. 1993, Lowen et al. 1996, Hill and Padwe 2000, Esquivel 2001, Zuercher et al. 2001, 2003, Hill et al. 2003, Cartes 2008, Owen and Smith 2019); Reserva Privada Itabó (Lowen et al. 1996).

CENTRAL: Asunción (Bertoni 1914); Bahía de Asunción (Bertoni 1925, Cartes 2008).

CENTRAL / PARAGUARÍ: Lago Ypoá (Cartes et al. 2004).

CORDILLERA: Estancia Sombrero (Cartes 2008).

GUAIRÁ: Yvyturuazú (Cartes 2008).

ITAPÚA: Estancia Nueva Gambach (Smith et al. 2006).

MISIONES: Campo Llano (Cartes 2008); Estancia La Graciela (Cartes 2008); Yabebyry (Cartes 2008).

ÑEEMBUCÚ: Estancia Redondo (Cartes 2008).

PARAGUARÍ: Isla Alta (Gengler 2018).

PRESIDENTE HAYES: between km71 and km713 Ruta Transchaco (Cartes and Morales 2010); Estancia Millón (Cartes et al. 2004); Estancia Playada (Caballero-Gini et al. 2020); Laguna Ganzo (Cartes 2008); Tinfunqué “National Park” (Cartes et al. 2004); Río Negro (Cartes 2008); surroundings of 22°13S, 59°04W (MTD-B 24883; Lehr et al. 2002).

SAN PEDRO: Rancho Laguna Blanca (Smith et al. 2005b).

Photographic records

None.

Reliable observations

ALTO PARAGUAY: Cerro León (Paul Smith).

ITAPÚA: Carmen del Paraná (Paul Smith); Kanguery – Guyra Retá (Paul Smith); San Juan del Paraná (Paul Smith).

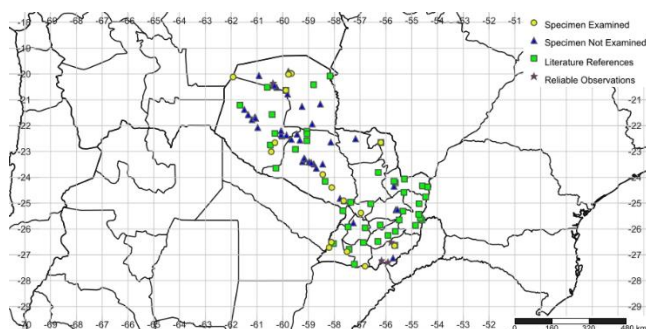


Figure 4: Distribution of *Cerdocyon thous* in Paraguay.

Maned wolf

Chrysocyon brachyurus (Illiger, 1815)

Canis brachyurus (Illiger 1815). Name based on “Agouara-Gouazou” of de Azara (1801). Type locality not given, but restricted to “los esteros del Paraguay” (Cabrera 1958).

Canis jubatus (Rengger 1830 [ecology], Hunter 1838 [translation of Azara], Bertoni 1914 [checklist, distribution]).

Chrysocyon brachyurus (Bertoni 1939 [checklist, distribution], Meritt 1973 [use], Wetzel and Lovett 1974 [specimens], Seese et al. 1981 [parasitology], von Humbeck and Silveira Avalos 1995 [distribution], Gamarra de Fox and Martin 1996 [specimens], Lowen et al. 1996 [distribution], Gamarra de Fox et al. 1998 [conservation], Hill and Padwe 2000 [mention],

Villalba and Yanosky 2000 [ecology, tracks], Areskoug 2001 [ecology], Esquivel 2001 [guide], Zuercher et al. 2001 [conservation, distribution], Fariña and Hostettler 2003 [list], Zuercher et al. 2003 [distribution, identification], Cartes et al. 2004 [distribution, ecology], Neris and Franco Rivarola 2005 [guide], Klassen 2007 [guide], Morales 2007 [conservation], Itaipú Binacional 2010 [guide], Ramírez Pinto and Velázquez 2010 [checklist], Rumbo 2010 [biogeography], Velázquez et al. 2010 [conservation, guide], Cartes 2014 [etymology], Cartes et al. 2014 [distribution, ecology], Velázquez and Ramírez Pinto 2014 [guide], González et al. 2019 [distribution], Weiler et al. 2019 [guide]).

Chrysocyon brachturus (Brooks et al. 1993 [distribution]).

Chrysocyon brevicaudatus (Smith et al. 2005b [mention]).

Chrydocyon brachyurus (Masi Pallarés 2011 [guide]).

Local names

Aguara (Villalba and Yanosky 2000); Aguara-guazu (Rengger 1830); Aguará-guasú (Bertoni 1914); Aguara guasu (Neris and Franco Rivarola 2005); Aguará pitá (Battilana 1985); Yagua pyta (Rengger 1830).

ACHE: Mbuaravachú (Villalba and Yanosky 2000); Mbua (Esquivel 2001).

SPANISH: Lobo de crin (Esquivel 2001); Zorro de crin (Areskoug 2001).

Comments

The indigenous name Aguará-guasú means “big fox”, whilst the Spanish name Zorro or Lobo de crin translates to “maned fox or wolf”. Rengger (1830) suggested that the name Aguará was derived from the *A-gua-a* call of the species. The priority of *C. brachyurus* over *C. jubatus* (Desmarest 1820), in use at the turn of the 20th Century, was demonstrated by Osgood (1919). The species is monotypic (Dietz 1985).

The first report referring unequivocally to this species was by de Azara (1801; history of canid studies section) who made notable claims about the ecology of the species, including an intolerance of raw beef and the presence of parasitic worms in the kidneys. Rengger (1830) confirmed the former observations, recounting the experience of Dr Parlet who had kept a domestic individual for over a year. Both authors provided natural history data that has not been improved upon by any Paraguay-based researcher to date.

There are no studies of the ecology of this species specific to Paraguay that have yet been published, and just two modern publications (last 50 years) dealing specifically with the species in Paraguay: Cartes et al. (2014) provided a brief summary of what is known about this species and how it applies to Paraguay; Meritt (1973) a short note on its inclusion in the wildlife trade. A recent conservation assessment concluded that the species is Vulnerable in Paraguay (Giordano et al. 2017).

Geographical distribution

Fairly widespread at low density in grassland and forest edge habitats across the Oriental region of Paraguay and more humid areas of the Paraguayan Chaco (including the Cerrado, Atlantic Forest, Mesopotamian Grassland, Pantanal, Cerrados del Chaco and Humid Chaco ecoregions, with marginal occurrence in the Dry Chaco. The species prospers where unmolested, and is able to tolerate habitat destruction where patches of natural habitat and sufficient food resources persist. They are even present in agricultural areas in the southern Oriental region, especially rice fields. A general regional distribution of the species was provided by Queirolo et al. (2011).

Examined specimens

Specimen lacking locality (MJUF).

ALTO PARAGUAY: Estancia Toro Pampa (MNHNPY 3251).

AMAMBAY: Bella Vista Norte (MNHNPY 1047, Cartes et al. 2014).

BOQUERÓN: Loma Plata (MNHNPY 1048).

ITAPÚA: Isla Yacyretá (MNHNPY 1904, Cartes et al. 2014).

MISIONES: Estancia Santa Ana (MNHNPY 1104, Cartes et al. 2014), Reserva Yabebyry (MNHNPY 1161).

PRESIDENTE HAYES: 24° 0' S, 58° 30' W (MNHNPY 1172); km105 Ruta Transchaco (MNHNPY 1175, Cartes et al. 2014); km233 Ruta Transchaco (MNHNPY 2216); Ruta Transchaco (MNHNPY 1171, 1883).

Specimens not examined

“Paraguay” (AMNH 61144; FMNH 46003, 54406; MCZ 28628, 28629, 28630; NMR 999000001004).

CAAGUAZÚ: Junction of the Iguazú and Yuquerí Rivers (MCZ 28615); Río Yuquerí (MCZ 30267).

PRESIDENTE HAYES: 15 km SW Fortín Gloria Meyer (CONN 19309); Estancia Juan de Zalazar (CONN 17989, Cartes et al. 2014); Estancia Juan de Zalazar, 2 km W of Transchaco bridge (CONN 17394).

Literature references

ALTO PARAGUAY: Estación Los Tres Gigantes (Cartes et al. 2014, González et al. 2019); Río Negro National Park (Cartes et al. 2004).

ALTO PARANÁ: Itaipú Dam “zone of influence” (von Humbeck and Silveira Avalos 1995, Cartes et al. 2014); Mondañ (Bertoni 1914).

AMAMBAY: Cerro Corá National Park (Cartes et al. 2014); Reserva Natural Kai Rague (Cartes et al. 2014).

BOQUERÓN: Gran Siete (Areskoug 2001).

AAGUAZÚ: Reserva Morombí (=Estancia La Golondrina II, Brooks et al. 1993, Cartes et al. 2014).

CAAZAPÁ: Reserva Tapytá (Velázquez et al. 2010, Velázquez and Ramírez Pinto 2014, Cartes et al. 2014).

CANINDEYÚ: Reserva Bosque Mbaracayú (Lowen et al. 1996, Hill and Padwe 2000, Zuercher et al. 2001, 2003, Esquivel 2001, Cartes et al. 2014).

CENTRAL/PARAGUARÍ: Lago Ypoá (Cartes et al. 2004).

CONCEPCIÓN: Arroyo Tagatiya Mi (Cartes et al. 2014); Estancia Estrella (Cartes et al. 2014); Paso Bravo National Park (Cartes et al. 2014); Serranía San Luís National Park (Cartes et al. 2014).

CORDILLERA: Arroyos y Esteros, Ruta III km79 (Cartes et al. 2014); Reserva Natural Sombrero (Cartes et al. 2014).

MISIONES: Estancia La Graciela (Cartes et al. 2014).

ÑEEMBUCÚ: Estancia Redondo (Cartes et al. 2014).

PRESIDENTE HAYES: Estancia El Trébol, entrance (Cartes et al. 2014); Estancia El Trébol at km23 of Ruta XII (Cartes et al. 2014); Estancia Golondrina (Cartes et al. 2014); Estancia Karanda (Cartes et al. 2014); Estancia La Petrona (Cartes et al. 2014); Estancia Maroma (Cartes et al. 2014); Estancia Pozo Azul (Cartes et al. 2014); Estancia Santa Asunción (Cartes et al. 2014); Estancia Santa María del Doce (La Piedad, Cartes et al. 2014); km40 Ruta Ñ (Cartes et al. 2014); km60 Ruta Transchaco (Cartes et al. 2014); km70 Ruta Transchaco, close to Estancia Buena Vista (Cartes et al. 2014); km175 Ruta Transchaco (Cartes et al. 2014); km240 Ruta Transchaco, Estancia La Victoria (Cartes et al. 2014); km250 Ruta Transchaco, close to Pirahú (Cartes et al. 2014); km286.7 Ruta Transchaco (Cartes et al. 2014); Reserva Toro Mocho (Cartes et al. 2014); Tinfunqué “National Park” (Cartes et al. 2004, Cartes et al. 2014).

SAN PEDRO: Estancia Don Luís (Cartes et al. 2014); Rancho Laguna Blanca (Smith et al. 2005b, Cartes et al. 2014); Estancia Señorita (Cartes et al. 2014).

Photographic records

SAN PEDRO: Agroforestal Río Verde (Para La Tierra).

Reliable observations

CANINDEYÚ: Aguara Ñu, Reserva Bosque Mbaracayú (Paul Smith).

ITAPÚA: Cruce San Cosmé, Ruta I (Paul Smith).

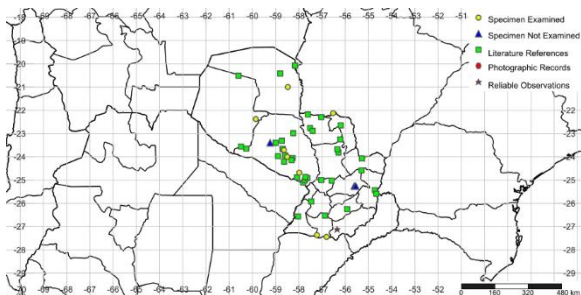


Figure 5: Distribution of *Chrysocyon brachyurus* in Paraguay.

Bush dog***Speothos venaticus* (Lund, 1842)**

[*Cynogale*] *venatica* (Lund 1842). Type locality “Lagoa Santa, Minas Gerais, Brazil”.

Speothos venaticus (Bertoni 1924 [first record], Beccaceci 1994 [diet, distribution], Brooks et al. 1993 [distribution], von Humbeck and Silveira Avalos 1995 [distribution], Gamarra de Fox and Martin 1996 [specimens], Lowen et al. 1996 [distribution], Gamarra de Fox et al. 1998 [conservation], von Humbeck and Pérez 1998 [husbandry], Hill and Padwe 2000 [use], Villalba and Yanosky 2000 [ecology, tracks], Esquivel 2001 [guide], Zuercher et al. 2001 [conservation, distribution], Zuercher and Villalba 2002 [distribution, use], Fariña and Hostteler 2003 [list], Zuercher et al. 2003 [distribution, identification], Cartes et al. 2004 [distribution, ecology], DeMatteo et al. 2004 [ecology], Zuercher et al. 2004 [conservation, distribution, ecology], Neris and Franco Rivarola 2005 [guide], Zuercher et al. 2005 [ecology], Morales 2007 [conservation], Itaipú Binacional 2010 [guide], Rumbo 2010 [biogeography], Owen and Smith 2019 [distribution], Saldívar Bellasai et al. 2020 [distribution]).

Speothos (Icticyon) venaticus (Bertoni 1939 [checklist, distribution]).

Icticyon venaticus (Masi Pallarés 2011 [guide]).

Local names

Jagua pytāngy (Villalba and Yanosky 2000); Jagua yvyguy (Villalba and Yanosky 2000).

ACHE: Betapa (Fariña and Hostteler 2003); Mbetapá (Villalba and Yanosky 2000).

AVA: Jagua turuñe’ e (Villalba and Yanosky 2000).

MBYÁ: Jagua saite (Villalba and Yanosky 2000); Jagua turuñe’ e (Villalba and Yanosky 2000).

PÁITAVYTERÁ: Jagua rova pe (Villalba and Yanosky 2000); Tãi vava (Villalba and Yanosky 2000).

SPANISH: Perro de agua (Esquivel 2001); Zorro vinagre (Esquivel 2001).

Comments

Translations of some of the indigenous names are as follows: Jagua pytāngy “pink dog”; Jagua yvyguy “burrowing dog”. The Spanish names translate as Perro de agua, “water dog”, and Zorro vinagre, “vinegar fox”. There are three subspecies, with Paraguay within the range of the nominate subspecies (de Mello Beisiegel and Zuercher 2005).

Bertoni (1939) included this species in his broad concept of the Mustelidae (which also included Mephitidae). Members of the Aché, Mbyá, and Avá indigenous groups at least previously captured the species for food, and individuals were kept as hunting dogs for hunting pacas *Agouti paca* and armadillos (Dasypodidae, Chlamyphoridae; Zuercher and Villalba 2002).

First reported for Paraguay by Bertoni (1924) who reported on a specimen captured by Sr. Fortunato Amarilla on the Río Apa in the foothills of the Cordillera del Amambay in 1921. The author also mentioned having never encountered the species in Alto Paraná in thirty years. von Humbeck and Pérez (1998) stated that “the species is known from the Concepción area in the Río Apa region”, but it seems that this may have been based on the abbreviated distribution of “Río Apá” given in Bertoni (1939), when in fact Bertoni (1924) makes it clear that the true locality was in Amambay department. Zuercher and Villalba (2002) provided physical evidence of the species at two localities in the Oriental region, and noted that local people at Reserva Natural Privada Ypetí (=Estancia Golondrina I, CAN/CAA), and Mbyá hunters at San Rafael National Park (CAZ/ITA) reported the presence of the species. These localities, plus others not included in Zuercher and Villalba (2002), were then listed as protected areas in which the species occurs in Paraguay in Zuercher et al. (2004), but it is unclear whether or not additional information became available in the interim. Beccaceci (1994) includes some information about the species provided to the author by the Aché of the Reserva Bosque Mbaracayú (CAN) and Saldívar Bellasai et al. (2020) the first camera trap photograph of the species from the Reserva Natural Carapá (CAN).

The live specimen in the zoo at the Botanic Garden in 1923 came from the “Paraguayan Chaco” according to C. Fiebrig (Bertoni 1924). Claimed presence in “Bahía Negra” and Alto Paraguay department may have its basis in

this report (von Humbeck and Pérez 1998, Neris et al. 2002, Cartes et al. 2004, Cartes 2008, Giordano et al. 2017), but I am not aware of any confirmation of existence in this area of the country. Indeed, the historical distribution illustrated by Neris et al. (2002) based on interviews with local people, includes almost the entire Oriental region, a good portion of the Humid Chaco and a wide distribution in Alto Paraguay department, but this perhaps owes more to the imagination of the respondents than to the presence of the species. I suggest that, given the rarity of this species, a more conservative approach to the reporting of its distribution will be of greater utility for effective management.

Details of the breeding programme for this species at the Centro de Investigación de Animales Silvestres de Itaipú (CIASI) were published in von Humbeck and Pérez (1998). The series of CBMI specimens with vague localities such as “Hernandarias, Alto Paraná” and “Refugio Fauna, Alto Paraná” presumably originated from captive specimens within this programme. A recent conservation assessment concluded that the species is Endangered in Paraguay (Giordano et al. 2017).

Geographical distribution

Very poorly known, indeed many of the localities proposed for the species in Paraguay are based on hearsay and local reports, and adequate documentation of distribution is thin on the ground. The species appears to historically have been restricted to a relatively small area of the eastern Atlantic Forest region with sandy and clay soils, west as far as 56° W (von Humbeck and Pérez 1998).

Examined specimens

None.

Specimens not examined

CBMI 0020, 0036, 0043, 0126, 0129, 0143, 0147, 0156, 0199, 0253, 0264.
CANINDEYÚ: Curuguaty (CBMI 0120).

Literature references

“Chaco” (Bertoni 1924, 1939).

ALTO PARANÁ: Itabó Itaipú (von Humbeck and Silveira Avalos 1995, Cartes 2008); Pozuelo (von Humbeck and Pérez 1998).

AMAMBAY: Río Apá at the foot of the Cordillera del Amambay (Bertoni 1924, 1939); Reserva Natural Privada Ka’i Rague (Zuercher et al. 2004).

CAAGUAZÚ: Parque Nacional San Rafael (Zuercher et al. 2004); Serranía de San Joaquín near the mouth of the Río Acaray (von Humbeck and Pérez 1998); Tacuaruzú settlement on the Ypetí River (Zuercher and Villalba 2002); Ypetí (Brooks et al. 1993, Zuercher et al. 2004, Cartes 2008).

CAAGUAZÚ / CANINDEYÚ: Reserva Natural Privada Morombi (=Reserva Privada Golondrina II, Zuercher et al. 2004).

CANINDEYÚ: Reserva Natural Carapá (Saldívar Bellasai et al. 2020); Reserva Bosque Mbaracayú (Brooks et al. 1993, Beccaceci 1994, Lowen et al. 1996, Hill and Padwe 2000, Zuercher et al. 2001, 2003, 2004, 2005, Zuercher and Villalba 2002, DeMatteo et al. 2004, Owen and Smith 2019).

Photographic records

None.

Reliable observations

CANINDEYÚ: Reserva Natural Itabó (Hugo del Castillo).

Discussion

Four species of Canidae in four genera are reaffirmed to occur in Paraguay. The family is fairly well-represented in the specimen record, though there is a taxonomic bias towards two species (*C. thous* and *L. gymnocercus*) and a strong geographical bias towards collection in the Chaco region.

A chronic lack of study of this family means that local knowledge has advanced little since the publications of de Azara (1801) and Rengger (1830) in the early 19th Century, and much of what we claim to know about these

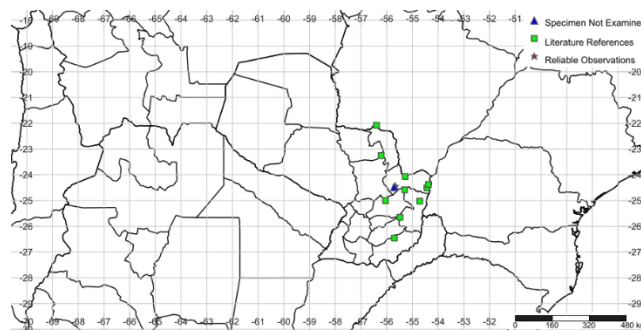


Figure 6: Distribution of *Speothos venaticus* in Paraguay.

species is extrapolated from field work carried out in neighbouring countries. Population estimates are not available for either of the globally and nationally threatened species (*C. brachyurus* and *S. venaticus*) that occur in Paraguay (Giordano et al. 2017), and presence and absence data is based almost entirely on chance encounters by a limited number of reporters. Indeed, the distribution of the rarely-recorded *S. venaticus* is almost exclusively based on inference and local knowledge, and the current distribution may in fact be greatly over-estimated as a result. Such a lack of basic data for these two species is undoubtedly seriously hampering our attempts to conserve them.

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Biographical sketch

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Appendix 1. Collection codes for museums housing Paraguayan Canid specimens

AMNH American Museum of Natural History, New York, USA
CBMI Colección Biológica Museo de Itaipú, Hernandarias, Paraguay.
CONN University of Connecticut Museum of Natural History, Storrs, USA
CZPLT Colección Zoológica Para La Tierra, Pilar, Paraguay.
FMNH Field Museum of Natural History, Chicago, USA.
KU Kansas University Natural History Museum, Lawrence, USA.
MJUF Museo Jakob Unger, Filadelfia, Paraguay
MCZ Museum of Comparative Zoology, Harvard University, Cambridge, USA.
MHNG Musée d'histoire naturelle de Geneve, Switzerland.
MNHPY Museo Nacional de Historia Natural del Paraguay, San Lorenzo, Paraguay
MSB University of Mexico Museum of Southwestern Biology, Albuquerque, USA
MTD Museum für Tierkunde, Dresden, Germany
MVZ Museum of Vertebrate Zoology, Berkeley, USA.
NMR Natural History Museum, Rotterdam, Netherlands
NRM Naturhistoriska Riksmuseet (Swedish Museum of Natural History), Stockholm
RBINS Royal Belgian Institute of Natural Sciences, Brussels, Belgium
UMMZ University of Michigan Museum of Zoology, Ann Arbor, USA
USNM Smithsonian National Museum of Natural History, Washington D.C., USA
TTU Texas Tech University Museum, Lubbock, Texas, USA.