Short Note

Antonella Argoitia* and Miranda Collett

Bats in wetlands: composition and structure of assemblage in Reserva Natural Don Luis, Esteros del Iberá, Argentina

https://doi.org/10.1515/mammalia-2021-0042
Received March 26, 2021; accepted September 27, 2021;
published online November 29, 2021

Abstract: We report diversity data and ecological aspects (richness, abundance and guilds) of bat assemblages in the Esteros del Iberá. We sampled four sites at Reserva Natural Don Luis, with an effort of 75 nights, 256 nets and 12 harp traps over six years. We made a species accumulation curve, Whittaker diagram, and calculated inventory completeness. A complete inventory for the area included 471 individuals belonging to 14 species of Phyllostomidae, Vespertilionidae, and Molossidae families. Insectivorous guilds present the greatest richness and abundance. Esteros del Iberá shelters a diversity of guilds, one threatened species, and a new bat record for the region.

Keywords: Chiroptera; diversity; inventory; trophic guilds.

The Esteros del Iberá include one of the most extensive and important wetlands of South America. Located in the north-central portion of Corrientes Province, Argentina, the Iberá macrosystem has an area of ~12,000 km^2, where complex ecological and human interrelations converge (Neiff 2004). These wetlands are characterized by high biological diversity, which includes several threatened species of vertebrates (Álvarez 2003; Giraudo et al. 2006). This biodiversity includes a chiropterofauna of 23 species, representing ~ca. 34% of the known bat species for Argentina (67 spp.) and 70% of those present in the province (34 spp.) (cf. Argoitia et al. 2021; Barquez et al. 2020; Collett and D'Occhio 2020). Four of these species are considered threatened (*Carollia perspicillata*, *Platyrrhinus lineatus*, *Myotis ruber*, and *Myotis simus*), with restricted distributions in Argentina and poorly studied populations in this country. Many aspects related to the natural history and the structure of the bat assemblages are unknown in the region, because the inventories are limited to a few (sometimes historical) records from scattered localities (Argoitia et al. 2019; Barquez et al. 1999; Fabri et al. 2003; Idoeta et al. 2011; Pardiñas et al. 2005; Pavé and Giraudo 2014).

Bats have suffered from multiple causes of mortality and disturbances from anthropogenic origin, and their populations have declined worldwide (O'Shea et al. 2016). Around 80% of the world's wetlands were lost in the last two centuries due to land transformations for human use (Van Asselen et al. 2013). In recent decades, the Esteros del Iberá have faced several threats, such as the substitution of native environments by monocultures (e.g., pine, eucalyptus and rice fields), a constant increase in livestock production with uncontrolled burning of the grassland, and inappropriate exploitation by tourists (Álvarez 2003; Giraudo et al. 2006; Neiff 2004; Neiff and Poi de Neiff 2006). Bats can be considered important bioindicators due to their quick responses to environmental change (Fenton et al. 1992; Jones et al. 2009; Medellín et al. 2000). In addition, studies providing information about bat assemblage patterns increase the knowledge of the state of natural ecosystems and have important implications for conservation (Meyer and Kalko 2008). The degradation of the Esteros del Iberá wetlands makes it increasingly urgent and important to characterize the community structure of bats to assess the ecological impact of these changes.

The objective of this study was to inventory and characterize the bat assemblage structure of the Esteros del Iberá, one of the least known ecosystems in southern South America (Neiff 2004). We provide information about species diversity and abundances, and trophic guilds for

***Corresponding author: Antonella Argoitia**, Departamento de Biología, Laboratorio de Biología de los Cordados, Facultad de Ciencias Exactas y Naturales y Agrimensura, Universidad Nacional del Nordeste (UNNE), Corrientes Capital C.P. 3400, Corrientes, Argentina; and Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Buenos Aires, Argentina, E-mail: anto.a_25@hotmail.com. https://orcid.org/0000-0002-2583-8411
Miranda Collett, Fundación Collett Trust for Endangered Species, Reserva Natural Privada Don Luis, Cambyretá, Ituzaingó C.P. 3302, Corrientes, Argentina; and Fundación Cambyretá para la Naturaleza (FUCANA), Reserva Natural Privada Don Luis, Cambyretá, Ituzaingó C.P. 3302, Corrientes, Argentina. https://orcid.org/0000-0002-8764-9405

Reserva Natural Don Luis (RNDL), discussing some ecological and conservational issues of this assemblage.

The 1600 ha RNDL is located in Cambyretá, Ituzaingó Department, Corrientes Province, inside the Provincial Park of Iberá, Argentina (27° 51′ 27.2″ S, 56° 54′ 22.4″ W) (Figure 1A). We selected four forest patches identified as: Monte Grande (MG), Monte Mono (MM), Monte Casa (MC), and Monte Sur (MS) for the sampling (Figure 1B). The landscape is dominated by wetlands and grasslands, including sandy hills covered mainly by grasses, such as *Andropogon lateralis* and *Elionurus muticus*, interconnected with shallow lagoons and alternated with hydrophilic forest patches (Carnevali 2003). The climate in the region is subtropical, with mean annual precipitations and temperatures of 1200–1800 mm and 21–22 °C, respectively (Neiff 2004).

The area was sampled through 32 sessions in different months and sites during six consecutive years: December 2015 (1 in MC); February to April, June, August, November and December 2016 (7 in MC); February to April, August and October to December 2017 (5 in MC and MS, 3 in MG); February to May and September to December 2018 (7 in MC and MS, 2 in MG); February to April and September to November 2019 (3 in MC and MS, 3 in MG); and February 2020 (1 in MC). The samplings had a duration of one to four nights each time, we used three or four mist nets (12 × 2.4 m, 12 × 4.8 m, 6 × 2.4 m, 9 × 2.4 m and 12 × 7.2; with a size mesh of 14 × 14 mm) and one harp trap. These were opened at sunset, kept active for 4 h, and checked at intervals of 20 min. Their locations were selected along potential flight paths (e.g., edges and clearings of forest patches, near to human constructions close to water or to potential roosts) (Kunz et al. 2009).

Each captured bat was identified using the keys of Barquez and Díaz (2009) and Díaz et al. (2016). To avoid overestimation in captures, each released individual was marked with a furclip on its dorsal side. Some individuals were photographed (see Appendix I). All bats were handled in accordance with the protocols of The Bat Workers Manual 3 (Mitchell-Jones and McLeish 2004). Species richness (S) and abundance were calculated for the entire area and relative abundance was expressed as the percentages of individuals of each species with respect to the total number of individuals present per site. To evaluate the representativeness of the inventory, a species accumulation curve was made based on the richness of the entire area. The sampling effort was considered to be the total number of nights with occurrence data in the traps (75 nights with 256 nets and 12 harp trap for the entire area [45 in MC, 22 in MS 1 in MM and 8 in MG]). We built a matrix of presence/absence, calculating the completeness of the

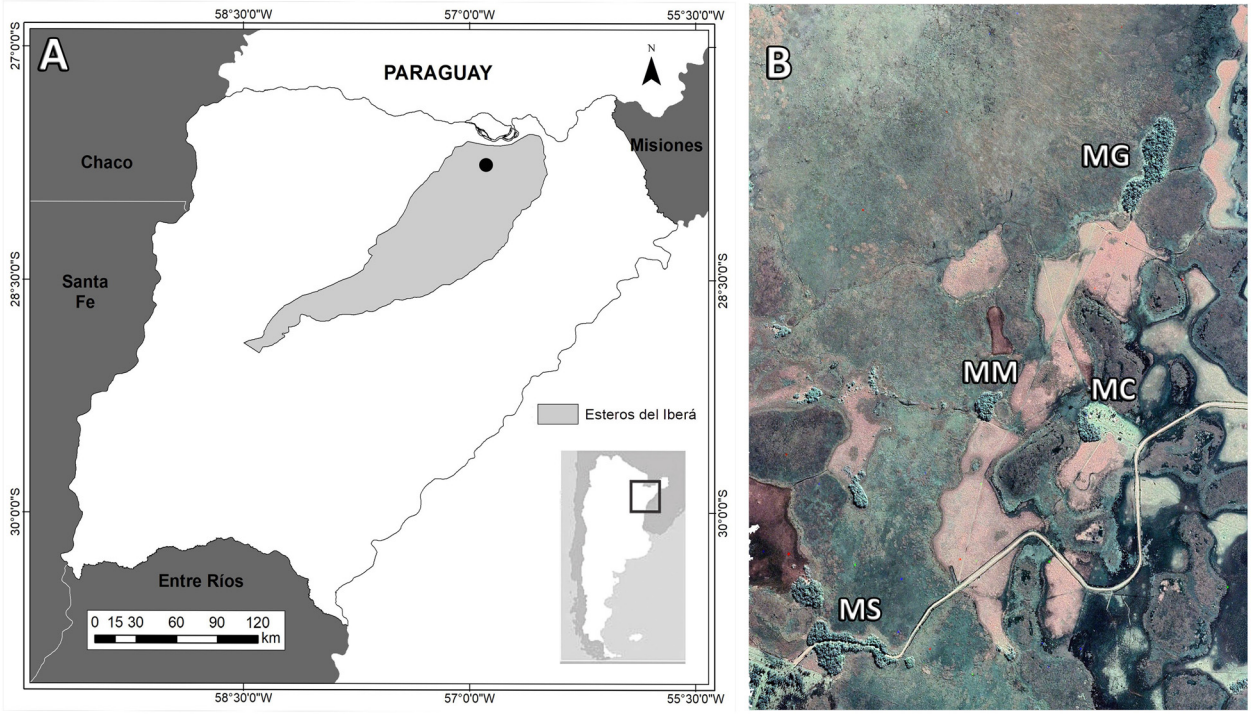

Figure 1: Map of Reserva Natural Don Luis, Corrientes, Argentina. (A) Location point. (B) General satellite image of the sampled area. MC, Monte Casa; MS, Monte Sur; MG, Monte Grande; and MM, Monte Mono.

Table 1: Bat species for the Reserva Natural Don Luis, Corrientes, Argentina.

Family/species	MC	MS	MG	MM	Tg
Phyllostomidae					
Desmodus rotundus	3 (1.2)	25 (21.3)	13 (12.1)	–	H
Sturnira lilium	–	17 (14.4)	15 (14.0)	–	F
Platyrrhinus lineatus	–	1 (0.8)	–	–	F
Vespertilionidae					
Myotis nigricans	34 (14.0)	11 (9.3)	9 (8.5)	–	IHCA
Myotis riparius	15 (6.2)	11 (9.3)	6 (5.6)	–	IHCA
Dasypterus ega	–	3 (2.5)	1 (0.9)	–	IBUnA
Lasiurus blossevillii	1 (0.4)	4 (3.4)	3 (2.9)	–	IBUnA
Eptesicus cf. *brasiliensis*	1 (0.4)	1 (0.8)	–	–	IHCA
Eptesicus furinalis	34 (14.0)	29 (24.6)	29 (27.1)	3 (50)	IHCA
Molossidae					
Eumops bonariensis	16 (6.6)	2 (1.7)	2 (1.8)	–	IBUnA
Eumops patagonicus	94 (38.5)	3 (2.5)	8 (7.5)	3 (50)	IBUnA
Molossops temminckii	43 (17.9)	3 (2.5)	8 (7.5)	–	IBCA
Molossus rufus	1 (0.4)	8 (6.9)	13 (12.1)	–	IBUnA
Tadarida brasiliensis	1 (0.4)	–	–	–	IBUnA
Total	242	118	107	4	
Richness (S)	11	13	11	2	

Number of individuals, relative abundance (in %) per site, and trophic guilds are indicated. MC, Monte Casa; MS, Monte Sur; MG, Monte Grande; and MM, Monte Mono. Tg, trophic guilds: insectivorous: IBUnA, uncluttered space/aerial; IIHCA, highly cluttered space/aerial; IBCA, background-cluttered space/aerial; frugivorous: F, highly cluttered space/gleaning/understory and hematophagous: H, highly cluttered space/gleaning.

inventory through a non-parametric estimator (Bootstrap) for incidence data. This estimator is based in the proportion of sampling units containing each species (Moreno 2001). The samples were randomized 1000 times to eliminate the influence of the order in which the data was taken (Colwell and Coddington 1994). The degree of completeness of the inventory was considered to be the percentage of species observed in relation to the number of species predicted by the richness estimator. A Whittaker diagram (dominance) was made, listing the species in decreasing order of abundance for the total area (Smith and Wilson 1996). All analyses were made in R Version 3.6.2, using the following function and packages: accumresult in BiodiversityR (Kindt and Coe 2005) for the species accumulation curve, specpool in vegan (Oksanen et al. 2019) for diversity estimator, and ggplot in ggplot2 (Wickham 2016) for graphic visualization.

Trophic guilds were assigned following the criterion proposed by Idoeta (2018) and Sánchez (2016), based on diet, foraging habitat, and type of flight of each species. The conservation status of each species was taken from Categorization of Mammals in Argentina, according to their risk of extinction (Ministerio de Ambiente y Desarrollo Sustentable de la Nación and Sociedad Argentina para el Estudio de los Mamíferos 2019; digital version at: http://cma.sarem.org.ar).

We captured 471 individuals, belonging to 14 species (S) and nine genera included in three families: Phyllostomidae (3), Vespertilionidae (6), and Molossidae (5). Most of the species co-occurred at two or all sites. A total of 242 individuals were captured at MC ($S = 11$), 118 at MS ($S = 13$), 4 at MM ($S = 2$) and 107 at MG ($S = 11$) (Table 1). *Eumops patagonicus* and *Eptesicus furinalis* accounted for about half (42%) of the total captures (Figure 2A).

The species accumulation curve shows an asymptote for the data set (i.e., all grouped sites), indicating the high degree of representativeness of the sampled assemblage in our study area (Figure 2B). According to the Bootstrap estimator, inventory completeness reached high levels of 90% (Obs = 14/Exp = 15, with a 0.7 of standard deviation).

Trophic guilds were represented by five categories with different richness (S) and abundance (%): aerial insectivorous: of uncluttered space ($S = 6$, 34.1%), of background-cluttered space ($S = 1$, 11.7%), and of highly cluttered space ($S = 4$, 38.5%); frugivorous: of highly cluttered space/gleaning/understory ($S = 2$, 7.0%) and hematophagous: of highly cluttered space/gleaning ($S = 1$, 8.7%) (Figure 3). Guild structure was different among the sites. Five were present in MS and MG, four in MC, and two in MM, but none of the guilds could be considered exclusive to one site.

The 14 bat species recorded in RNDL, represent 61% of the region's diversity. This species richness almost doubles

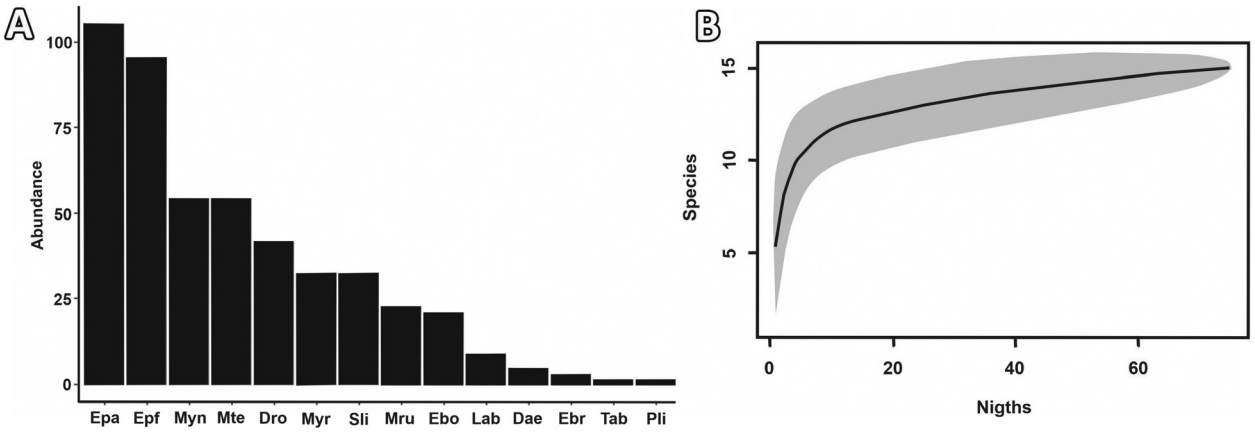

Figure 2: Structure of bat assemblage for Reserva Natural Don Luis, Corrientes, Argentina. (A) Bat species accumulation curve. The grey area corresponds to the standard deviation. (B) Abundance of each species. Epa, *Eumops patagonicus*; Epf, *Eptesicus furinalis*; Myn, *Myotis nigricans*; Mte, *Molossops temminckii*; Dro, *Desmodus rotundus*; Myr, *Myotis riparius*; Sli, *Sturnira lilium*; Mru, *Molossus rufus*; Ebo, *Eumops bonariensis*; Lab, *Lasiurus blossevillii*; Dae, *Dasypterus ega*; Ebr, *Eptesicus* cf. *brasiliensis*; Tab, *Tadarida brasiliensis;* and Pli, *Platyrrhinus lineatus*.

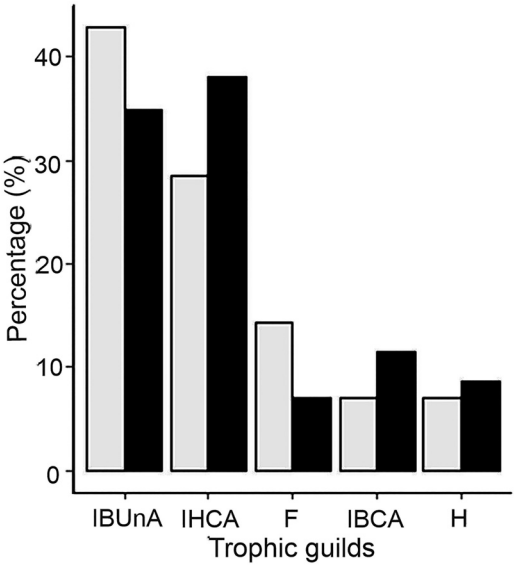

Figure 3: Representation of the five trophic guilds present in the Reserva Natural Don Luis, Corrientes, Argentina. Insectivorous: IBUnA, uncluttered space/aerial; IHCA, highly cluttered space/aerial; IBCA, background-cluttered space/aerial; frugivorous: F, highly cluttered space/gleaning/understory and hematophagous: H, highly cluttered space/gleaning. The grey bar is the percentage of species represented by each trophic guild and black bar is the percentage of individuals.

previous findings for the ecoregion, in which the most sampled localities (n = 15) had less than 6–8 species each (see Fabri et al. 2003). The occurrence of one individual of *Tadarida brasiliensis* represents the first record in Corrientes, increasing the regional number of bats to 35 species. We added a previously unknown region for this widely distributed species, which had been poorly recorded in the northeast of Argentina. In addition, this area represents a refuge for *P. lineatus* recently considered Near Threatened (NT) for Argentina (Sánchez and Sandoval 2019). This species has a restricted distribution in the country (Barquez et al. 2020; Idoeta et al. 2010). *E. patagonicus* and *E. furinalis* were placed at the highest position in the abundance diagram, standing out as dominant in most of the studied forest patches (22.5 and 19.5%). The remaining species presented lower abundances, which is a characteristic pattern of tropical bat assemblages, where a few species are dominant and several others appear with lower abundance values (Chávez and Ceballos 2001; Medellín 1993; Rex et al. 2008; Sáenz et al. 2017; Sánchez 2016). Most of these rare species are those that are the most susceptible to habitat disturbance and local extinction (Turner 1996). The dominance of molossids and vespertilionids, shows how Neotropical bat assemblages shift in the southern end of their distribution range, since further north, in the tropical areas, most assemblages are dominated by phyllostomid bats. Further studies, including the use of acoustic monitoring could increase the number of recorded species, especially for those taxa that can avoid traditional mist nets used for samplings (MacSwiney et al. 2008).

The structure of RNDL trophic categories showed that insectivorous bats dominated the assemblages in terms of species and individuals. The overlap of more than one species in the same guild can be understood as a greater availability of resources or an increase in the specialization of foraging strategies (e.g. altitude of flights, size of the prey and time of activity) (Patterson et al. 2003). This situation could be related to the abundance and diversity of the arthropods in the region (Bar

et al. 2005). The guild with the highest species richness and abundance was the uncluttered spaces guild (IBUnA) (i.e., *Dasypterus ega*, *Lasiurus blossevillii*, *Eumops bonariensis*, *E. patagonicus*, *Molossus rufus*, and *T. brasiliensis*), corresponding to the dominant landscape of open grassland across this region. However, some of these species have low abundances (i.e. <2%), and consequently their competition for resources may be ecologically negligible. An analysis of bat's diets and morphological adaptations to environmental variables would confirm whether these differences translate into a real food resource partitioning.

The high abundance of all insectivorous guilds in MC could be related to the greater sampling effort at this site, and to the fact that near constructions provide refuge for large colonies of *Molossops temminckii* and *E. patagonicus*. The absence of frugivorous species in this site could be related to a limited availability of food resources or other aspects that should be better evaluated. The abundance of *Desmodus rotundus* in MS and MG (33.4%), is related to the presence of roosts. The limited presence of different guilds in MM could be related to the reduced sampling effort carried out on this site.

Bat richness and activity are strongly associated with water availability (Korine et al. 2016; McCain 2007), indicating the extreme importance of wetlands for maintenance of bat diversity (Salvarina 2016). Nonetheless, little is known about the importance of wetland systems and bat assemblages in South America (Alho et al. 2011; Fischer et al. 2018). We found that the importance of this type ecosystem in Argentina is evident, not only in the number of bat species, but also in the various habitats and trophic guilds that they occupy, including different degrees of specialization. We can say that this wetland provides roosts, and food resources, for many bat species. This scenario emphasizes the need to preserve wetlands for bat conservation in the region.

Acknowledgments: Alejandra Boloqui, Cepriano Oporto, Martin Oporto and Mario Rodriguez for their technical and logistical assistance. Pablo Teta for his comments and suggestions on a preliminary version. Special thanks are given to the reviewers and editor who gave important comments which helped to improve the manuscript.

Author contributions: All authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

Research funding: This work was supported by the Fundación Cambyretá para la Conservación de la Naturaleza (FuCANA) (Resol. N° 00142/19 - Expdte. 221-18-09-3287/19) and Fundación Collett Trust for Endangered Species (AJC523/395).

Conflict of interest statement: The authors declare no conflicts of interest regarding this article.

Ethical approval: For this study, we were granted permits from Dirección de Recursos Naturales, Dirección de Parques y Reservas, Ministerio de Producción, Trabajo y Turismo de la provincia de Corrientes (Disposición n° 845) and we followed the protocols proposed by The Bat Workers Manual 3 (Mitchell-Jones and McLeish 2004) for the ethical treatment and care of the taxa of study.

References

Alho, C.J.R., Fischer, E., Oliveira-Pissini, L.F., and Santos, C.F. (2011). Bat-species richness in the Pantanal floodplain and its surrounding uplands. Braz. J. Biol. 71: 311–320.

Álvarez, B.B. (Ed.) (2003). *Fauna del Iberá*. Editorial Universitaria de la Universidad Nacional del Nordeste (EUDENE), Corrientes.

Argoitia, A., Cajade, R., Piñeiro, J., and Teta, P. (2019). Nuevas localidades y notas sobre la historia natural de los murciélagos (Chiroptera: Phyllostomidae, Vespertilionidae y Molossidae) de la provincia de Corrientes, Argentina. Notas sobre mamíferos Sudamericanos 12: 1–11.

Argoitia, A., Cuaranta, P., and Barquez, R.M. (2021). First record of *Cynomops planirostris* (Peters, 1866) (Chiroptera, Molossidae) in Corrientes province, Argentina. Check List 17: 683–681.

Bar, M.E., Damborsky, M.P., Avalos, G., Monteresino, E., and Oscherov, E.B. (2005). Fauna de Arthropoda de la Reserva Iberá, Corrientes, Argentina. Miscelánea 14: 294.

Barquez, R.M. and Díaz, M.M. (2009). *Los murciélagos de Argentina: clave de identificación*. Publicación Especial N° 1. Programa de Conservación de los Murciélagos de Argentina (PCMA), Magna, Tucumán.

Barquez, R.M., Mares, M.A., and Braun, J.K. (1999). The bats of Argentina. Spec. Publ. Mus. Texas Tech Univ. 4: 1–275.

Barquez, R.M., Díaz, M.M., Montani, M.E., and Pérez, M.J. (2020). *Nueva guía de los Murciélagos de Argentina*. Publicación Especial N° 3. Programa de Conservación de los Murciélagos de Argentina (PCMA), Tucumán.

Carnevali, R. (2003). *El Iberá y su entorno fitogeográfico*. Editorial Universitaria de la Universidad Nacional del Nordeste (EUDENE), Corrientes.

Chávez, C. and Ceballos, G. (2001). Diversidad y abundancia de murciélagos en selvas secas de estacionalidad contrastante en el oeste de México. Rev. Mex. Mastozool. 5: 27–44.

Collett, M.J. and D'Occhio, M. (2020). First record of *Glossophaga soricina* (Pallas, 1766) (Chiroptera, Phyllostomidae) in the province of Corrientes, Argentina. Check List 16: 1115–1118.

Colwell, R.K. and Coddington, J.A. (1994). Estimating terrestrial biodiversity through extrapolation. Phil. Trans. R. Soc. Lond, B, Biol. Sci. 345: 101–118.

Díaz, M.M., Solari, S., Aguirre, L.F., Aguiar, L.M., and Barquez, R.M. (2016). *Clave de Identificación de los murciélagos de Sudamérica*. Publicación Especial N° 2. Programa de Conservación de los Murciélagos de Argentina (PCMA), Tucumán.

Fabri, S., Heinonen Fortabat, S.H., Soria, A., and Pardiñas, U.F.J. (2003). Los mamíferos de la Reserva Provincial Iberá, Provincia de Corrientes, Argentina. In: Álvarez, B.B. (Ed.). *Fauna del Iberá*.

Editorial Universitaria de la Universidad Nacional del Nordeste (EUDENE), Corrientes, pp. 305–316.

Fenton, M.B., Acharya, L., Audet, D., Hickey, M.B.C., Merriman, C., Obrist, M.K., Syme, D.M., and Adkins, B. (1992). Phyllostomid bats (Chiroptera: Phyllostomidae) as indicators of habitat disruption in the Neotropics. Biotropica 24: 440–446.

Fischer, E., Silveira, M., Munin, R.L., Camargo, G., Santos, C.F., Ramos Pereira, M.J., Fischer, W., and Eriksson, A. (2018). Bats in the dry and wet. Pantanal. Hystrix 29: 11–17.

Giraudo, R.A., Bortoluzzi, A., and Arzamendia, V. (2006). Vertebrados tetrápodos de la Reserva y Sitio Ramsar "Esteros del Iberá" (Corrientes, Argentina): Análisis de su composición y nuevos registros para especies amenazadas. Nat. Neotrop. 37: 1–20.

Idoeta, F.M. (2018). *Murciélagos de los Campos y Malezales de Argentina: aspectos taxonómicos, corológicos y Ecologicos*, Ph.D. thesis. Buenos Aires, Universidad Nacional de La Plata.

Idoeta, F.M., Milano, A.M., De Santis, L.J., and Barquez, R.M. (2010). Nuevos registros *de Platyrrhinus lineatus* (Geoffroy St.-Hilaire, 1810) (Phyllostomidae, Stenodermatinae) para Argentina. Chiropt. Neotrop. 16: 789–794.

Idoeta, F.M., De Santis, L.J.M., and Barquez, R.M. (2011). Leucismo en *Eptesicus furinalis* (d'Orbigny y Gervais, 1847) (Chiroptera: Vespertilionidae) en la provincia de Corrientes, Argentina. Chiropt. Neotrop. 17: 985–988.

Jones, G., Jacobs, D.S., Kunz, T.H., Willig, M.R., and Racey, P.A. (2009). Carpe noctem: the importance of bats as bioindicators. Endanger. Species Res. 8: 93–115.

Kindt, R. and Coe, R. (2005). *Tree diversity analysis. A manual and software for common statistical methods for ecological and biodiversity studies*. World Agroforestry Centre (ICRAF), Nairobi.

Korine, C., Adams, R., Russo, D., Fisher-Phelps, M., and Jacobs, D. (2016). Bats and water: anthropogenic alterations threaten global bat populations. In: Voigt, C.C. and Kingston, T. (Eds.). *Bats in the Anthropocene: conservation of bats in a changing world*. Springer Open, Cham, pp. 215–241.

Kunz, T.H., Hodgkison, R., and Weise, C.D. (2009). Methods of capturing and handling bats. In: Kunz, T.H. and Parsons, S. (Eds.), *Ecological and behavioral methods for the study of bats*, 2nd ed. Johns Hopkins, Baltimore, pp. 3–35.

MacSwiney, G.M.C., Clarke, F.M., and Racey, P.A. (2008). What you see is not what you get: the role of ultrasonic detectors in increasing inventory completeness in Neotropical bat assemblages. J. Appl. Ecol. 45: 1364–1371.

McCain, C.M. (2007). Could temperature and water availability drive elevational species richness patterns? A global case study for bats. Global Ecol. Biogeogr. 16: 1–13.

Medellín, R. (1993). Estructura y diversidad de una comunidad de murciélagos en el neotrópico húmedo mexicano. In: Medellín, R. and Ceballos, G. (Eds.). *Avances en el estudio de los mamíferos de México*. Asociación Mexicana de Mastozoología, México, pp. 333–354.

Medellín, R., Equihua, M., and Amín, M. (2000). Bat diversity and abundance as indicators of disturbance in Neotropical rainforest. Conserv. Biol. 14: 1666–1675.

Meyer, C.F. and Kalko, E.K. (2008). Assemblage-level responses of phyllostomid bats to tropical forest fragmentation: land-bridge islands as a model system. J. Biogeogr. 35: 1711–1726.

Mitchell-Jones, A.J. and McLeish, A.P. (Eds.) (2004). *The bat workers' manual*, 3rd ed. Joint Nature Conservation Committee, Peterborough.

Moreno, C.E. (2001). *Métodos para medir la biodiversidad*, Vol. 1. M&T–Manuales y Tesis SEA, Zaragoza, pp. 19–33.

Neiff, J.J. (2004). *El Iberá… ¿En peligro?* Fundación Vida Silvestre de Argentina, Buenos Aires.

Neiff, J.J. and Poi de Neiff, A.S. (2006). Situación ambiental en la ecoregión Iberá. In: Brown, A., Martínez Ortiz, U., Acerbi, M., and Corchera, J. (Eds.). *La situación ambiental Argentina 2005*. Fundación Vida Silvestre Argentina, Buenos Aires, pp. 177–184.

Oksanen, F., Blanchet, F.G., Friendly, M., Kindt, R., Legendre, P., McGlinn, D., Minchin, P.R., O'Hara, R.B., Simpson, G.L., Solymos, P., et al. (2019). Vegan: Community Ecology Package. R package version 2.5-6, Available at: https://CRAN.R-project.org/package=vegan.

O'Shea, T.J., Cryan, P.M., Hayman, D.T., Plowright, R.K., and Streicker, D.G. (2016). Multiple mortality events in bats. Mamm. Rev. 46: 175–190.

Pardiñas, U.F.J., Teta, P., and Fortabat, S.H. (2005). Vertebrate prey of the barn owl (*Tyto alba*) in subtropical wetlands of northeastern Argentina and eastern Paraguay. J. Raptor Res. 39: 65–69.

Patterson, B.D., Willig, M.R., and Stevens, R.D. (2003). Trophic strategies, niche partitioning, and patterns of ecological organization. Bat Ecol. 9: 536–557.

Pavé, R. and Giraudo, A.R. (2014). Nuevos registros de quirópteros para la provincia de Corrientes, Argentina. Mastozool. Neotrop. 21: 349–354.

Rex, K., Kelm, D.H., Wiesner, K., Kunz, T.H., and Voigt, C.C. (2008). Species richness and structure of three Neotropical bat assemblages. Biol. J. Linn. Soc. 94: 617–629.

Sáenz, V.H.M., Horváth, A., Montoya, L.R., Segura, G.E., and Gutiérrez, D.A.N. (2017). Patrones de diversidad de murciélagos en la Reserva de la Biosfera Selva El Ocote, Chiapas, México. Mastozool. Neotrop. 24: 365–387.

Salvarina, I. (2016). Bats and aquatic habitats: a review of habitat use and anthropogenic impacts. Mamm. Rev. 46: 131–143.

Sánchez, M.S. (2016). Structure of three subtropical bat assemblages (Chiroptera) in the Andean rainforests of Argentina. Mammalia 80: 11–19.

Sánchez, M.S. and Sandoval, M.L. (2019). *Platyrrhinus lineatus*. In: Secreteria de Ambeinte y Desarrollo Sustentable (SAyDS) y Sociedad Argentina para el estudio de los Mamíferos (SAREM) (Eds.), *Categorización 2019 de los mamíferos de Argentina según su riesgo de extinción*. Lista Roja de los mamíferos de Argentina. Versión digital: http://cma.sarem.org.ar.

Smith, B. and Wilson, J.B. (1996). A consumer's guide to evenness indices. Oikos 76: 70–82.

Turner, I.M. (1996). Species loss in fragments of tropical rain forest: a review of the evidence. J. Appl. Ecol. 33: 200–209.

Van Asselen, S., Verburg, P.H., Vermaat, J.E., and Janse, J.H. (2013). Drivers of wetland conversion: a global meta-analysis. PLoS One 8: e81292.

Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis*. Springer-Verlag, New York.

Supplementary Material: The online version of this article offers supplementary material (https://doi.org/10.1515/mammalia-2021-0042).