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METAZOAN PARASITES OF RUFOUS-LEGGED OWLS (*STRIX RUFIPES*) FROM ÑUBLE AND BIOBÍO REGIONS, CHILE

Parásitos metazoos de concones (*Strix rufipes*) provenientes de las regiones del Ñuble y Biobío, Chile

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ABSTRACT. - Metazoan parasites of Chilean owls are scarcely known. We provide data about metazoan parasites of the Rufous-legged Owl (*Strix rufipes*), a forest-dependent species. Between 2012 and 2018, we examined for parasites eight Rufous-legged Owl carcasses from Ñuble and Biobío regions, south-central Chile. Seven out of eight owls hosted at least one parasite species. We found three ectoparasite species and six endoparasite species. Among ectoparasites were two lice species and one hippoboscid fly species. Among endoparasites were two nematode species, one tapeworm species, two trematode species, and one acanthocephalan species. We recorded the louse *Kurodaia magna* for the first time in Chile. This louse species and the helminths *Procyrnea spinosa*, *Centrorhynchus spinosus*, *Neodiplostomum travassosi*, *Capillaria* sp., Paruterinidae gen. sp., and Echinostomatidae gen. sp., represent new host-parasite associations. The record of hippoboscid flies is significant because they are vectors for hemoparasites. Additional studies are necessary to determine if the low richness of helminths in Rufous-legged Owls depends on the ecological traits of this owl species.
KEYWORDS: helminths, hippoboscid fly, lice, Neotropical owls.

RESUMEN. - Los parásitos metazoarios de las lechuzas chilenas son escasamente conocidos. Aportamos datos sobre los parásitos metazoarios del concón (*Strix rufipes*), una especie dependiente de bosques. Entre 2012 y 2018, examinamos en busca de parásitos ocho cadáveres de concones provenientes de las regiones del Ñuble y Biobío, centro-sur de Chile. Siete de los ocho búhos hospedaban al menos una especie de parásito. Encontramos tres especies de ectoparásitos y seis especies de endoparásitos. Entre los ectoparásitos encontramos dos especies de piojos y una especie de mosca hipobóscida. Entre los endoparásitos había dos especies de nemátodos, una especie de tenia, dos especies de trematodos y una especie de acantocéfalo. Registramos por primera vez en Chile el piojo *Kurodaia magna*. Esta especie de piojo y los helmintos *Procyrnea spinosa*, *Centrorhynchus spinosus*, *Neodiplostomum travassosi*, *Capillaria* sp., Paruterinidae gen. sp., y Echinostomatidae gen. sp., representan nuevas asociaciones hospedador-parásito. El registro de moscas hipobóscidas es significativo porque son vectores de hemoparásitos. Son necesarios estudios adicionales para determinar si la baja riqueza de helmintos en el concón depende de los rasgos ecológicos de esta especie de búho.

PALABRAS CLAVE: búhos Neotropicales, helmintos, mosca hipobóscida, piojos.

INTRODUCTION

The Rufous-legged Owl (*Strix rufipes*) inhabits mostly dense and mature native forest remnants in central and southern Chile and southern Argentina (Figueroa *et al*. 2017). Anthropic activities such as deforestation, agriculture, and poaching threaten its population viability (Raimilla *et al.* 2012, Figueroa *et al*. 2017, Pavez 2019).

Knowledge about Chilean owls is limited as there is little data about their biology, ecology, and, notably, parasitic fauna (Raimilla *et al.* 2012, Figueroa *et al*. 2017, Moreno & González-Acuña 2015, Oyarzún-Ruiz & González-Acuña 2021). The few publications about the parasites of Chilean owls describe mostly ectoparasites (Clayton 1990, González-Acuña *et al.* 2006). Yamaguti (1963) and Grandón-Ojeda *et al*. (2018) identified endo and ectoparasites in the Magellanic Horned Owl (*Bubo magellanicus*). Thus, the number of parasitological studies of Chilean owls is small if we compare them to Chilean hawks and falcons (Moreno & González-Acuña 2015, Oyarzún-Ruiz & González-Acuña 2021).

Metazoan parasites are among the least-known parasitic fauna of the Rufous-legged Owl. A few authors mention helminths such as *Centrorhynchus nahuelhuapensis* (Acanthocephala) and *Thelazia longicaudata* (Nematoda) from Argentina (Schuurmans-Stekhoven 1951, Steinauer *et al.* 2020), and *Centrorhynchus conspectus* from Chile (Yamaguti 1963). Other authors have found two ectoparasite species in Rufous-legged Owls from Chile: the louse *Strigiphilus syrnii* (Ischnocera, Philopteridae) and a hippoboscid fly (Hippoboscidae) (Bequaert 1954, Clayton 1990, González-Acuña *et al.* 2006). Dubois (1988) described the trematode *Australapatemon magnacetabulum* (Digenea: Strigeidae) parasitizing the Rufous-legged Owl from Paraguay. Nevertheless, the "Paraguayan Rufous-legged Owls" population is now a separate species: the Chaco Owl (*Strix chacoesis*; König & Weick 2008). Therefore, only three helminth species, one louse species, and one hippoboscid fly species are recognizably parasites of the Rufous-legged owls.

Parasite infection is potentially detrimental to wild animal fitness. However, to anticipate the potentially damaging effects of parasites in wild animals, it is essential to establish parasite diversity and prevalence (Krone & Cooper 2002, Atkinson *et al*. 2008, Santoro *et al.* 2010). Here, we report a recent survey of metazoan parasites in the Rufous-legged Owl in central and southern Chile. We aim to contribute to filling information gaps about host-parasite associations for this owl species.

MATERIAL AND METHODS

Between 2012 and 2018, we examined eight Rufous-legged Owl carcasses from unspecified localities in Ñuble and Biobío regions, central and southern Chile. The causes of death were diverse, including collisions with vehicles, poaching, and euthanasia at the Wildlife Rehabilitation Center at Universidad de Concepción, Chillán, Chile. All specimens were frozen at -20°C until we performed the parasitological examination.

We collected ectoparasites by directly inspecting the feathers and skin of the head, wings, rectrices, and body. Additionally, we applied the "dust-ruffling" technique to collect additional ectoparasites (Walther & Clayton 1997). The nasal cavity was washed by nasal flushing with a tap water-soap solution following the modified Yunker's technique by Wilson (1964). After washing, we dissected the nasal turbinates, orbital cavities, and nares to retrieve additional nasal parasites (Fain 1957). We made a nasal flushing inspection and nasal cavity dissection under a stereomicroscope NexiusZoom (Euromex, Netherlands). All collected ectoparasites were fixed and preserved in ethanol 70%.

For lice processing, we executed the following protocol: (i) clearing with 20% KOH, (ii) dehydrating in a series of ethanol concentrations (40%, 80% and 100%), (iii) clearing in clove oil, and (iv) mounting with Canada balsam (Palma 1978, Price *et al.* 2003, Oyarzún-Ruiz & González-Acuña 2020). For the specific lice identification, we followed the keys by Price & Beer (1963), Clayton & Price (1984), and Price *et al*. (2003). We identified the hippoboscid flies by directly observing them under the stereomicroscope. Additionally, we obtained images using a scanning electron microscope (SEM; Hitachi-SU 3500 equipment) at the Universidad de Concepción. For the specific fly identification, we followed Bequaert (1950, 1954), Maa (1966), and Santos *et al*. (2014).

Helminths were collected following the procedures by Lutz *et al.* (2017), including the prospection of eyes, subcutaneous tissue, respiratory system, aerial sacs, esophagus, gastrointestinal tract, liver, gallbladder, and kidneys. All retrieved helminths were washed in saline, fixed and preserved in ethanol 80%. We mounted nematodes and acanthocephalans in temporary preparations and cleared them with glycerin-ethanol 80% for one week at least. In the case of tapeworms and trematodes, we stained them with Alum carmine stain, then dehydrated them in a series of ethanol concentrations (70-100% ethanol), cleared them with clove oil, and finally mounted them in permanent preparations with Canada balsam

(Lutz *et al.* 2017, Oyarzún-Ruiz & González-Acuña 2020). We deposited all parasite specimens in the collection of Laboratorio de Parásitos y Enfermedades de Fauna Silvestre, Universidad de Concepción in Chillán.

For the specific identification of nematodes and acanthocephalans, we followed the keys by Yamaguti (1961, 1963), Anderson *et al.* (2009), Smales (2013), Oyarzún-Ruiz *et al.* (2016), and Bagnato *et al.* (2018). We identified tapeworms and trematodes following Yamaguti (1959), Khalil *et al*. (1994), Gibson *et al.* (2002), Jones *et al.* (2005), and Lunaschi & Drago (2005). During the owl necropsy, we also looked for macroscopic lesions caused by helminth parasites to establish pathological consequences of the infections.

The parasitological descriptors of prevalence (P), intensity (I), range (R), mean intensity ($_{M}$I), and mean abundance ($_{M}$A) were estimated and interpreted according to Bush *et al.* (1997). Prevalence is the proportion of infected hosts by a particular parasite among all the hosts studied for that parasite. Intensity of infection refers to the number of individuals of a specific parasite species among the infected hosts. Range considers the minimum and maximum number of individuals for a particular parasite. Mean intensity is the number of individuals of a given parasite species divided among all the hosts parasitized by that parasite species. Meanwhile, mean abundance is the same number of parasite individuals divided among all the examined hosts, infected or not with the parasite.

RESULTS

Seven of eight Rufous-legged Owls examined had at least one species of metazoan parasites. We retrieved 364 ectoparasites from the seven parasitized owls, among which we identified two lice species and one hippoboscid fly species (Table 1, Fig. 1). We detected no feather or nasal mite from the examined owls.

Three Rufous-legged Owls hosted 72 helminths in their gastrointestinal tract, among which we identified two nematode taxa and three platyhelminth taxa: one unidentified tapeworm and two trematode species (Table 1, Fig. 1). Some taxa were not assigned to a specific taxon because of the absence of male worms as occurred with *Capillaria* sp. (Capillariidae), or because the poor state of preservation of worms as consequence of freezing such as the tapeworm Paruterinidae gen. sp. and the trematode Echinostomatidae gen. sp.

The louse *S. syrnii* was the most common ectoparasite, although the mean intensity and abundance were higher in the louse *Kurodaia magna* (Menoponidae). The acanthocephalan *Centrorhynchus spinosus* (Centrorhynchidae), the nematode *Procyrnea spinosa* (Habronematidae),

Table 1. Metazoan parasites retrieved from Rufous-legged Owls (*Strix rufipes*) collected in several localities from Ñuble and Biobío regions, central and southern Chile. Abbreviatures: n = number of parasitized individuals; P = prevalence (proportion of infected hosts by a particular parasite among all the hosts examined for that parasite); I = intensity de infection (number of individuals of a specific parasite species among the infected hosts); $_{M}$I = mean intensity of infection (number of individuals of a given parasite species divided by all the hosts parasitized by that parasite species); $_{M}$A = mean infection abundance (number of parasite individuals divided among all the examined hosts, infected/infested or not); R = range (minimum and maximum number of individuals of an specific parasite species).

Parasite species	n	P	I	$_{M}$I	$_{M}$A	R	Site of isolation
Chewing lice							
Kurodaia magna	5	62.5	253	50.6	31.6	1-197	Body feathers
Strigiphilus syrnii	7	87.5	108	15.42	13.5	1-60	Body feathers
Hippoboscid fly							
Ornithoica vicina	1	12.5	3	3	0.4	3	Inside ears
Helminths							
Nematodes							
Capillaria sp.	1	12.5	1	1	0.1	1	Gizzard
Procyrnea spinosa	2	25	44	22	5.5	11-33	Gizzard
Platyhelminths							
Cestodes							
Paruterinidae gen. sp.	2	25	2	1	0.3	1	Duodenum
Trematodes							
Echinostomatidae gen. sp.	1	12.5	1	1	0.1	1	Duodenum
Neodiplostomum travassosi	1	12.5	21	21	2.6	21	Duodenum
Acanthocephalans							
Centrorhynchus spinosus	2	25	2	1	0.3	1	Jejunum-ileum[a]

[a]These two sections of the small intestine were dissected together.

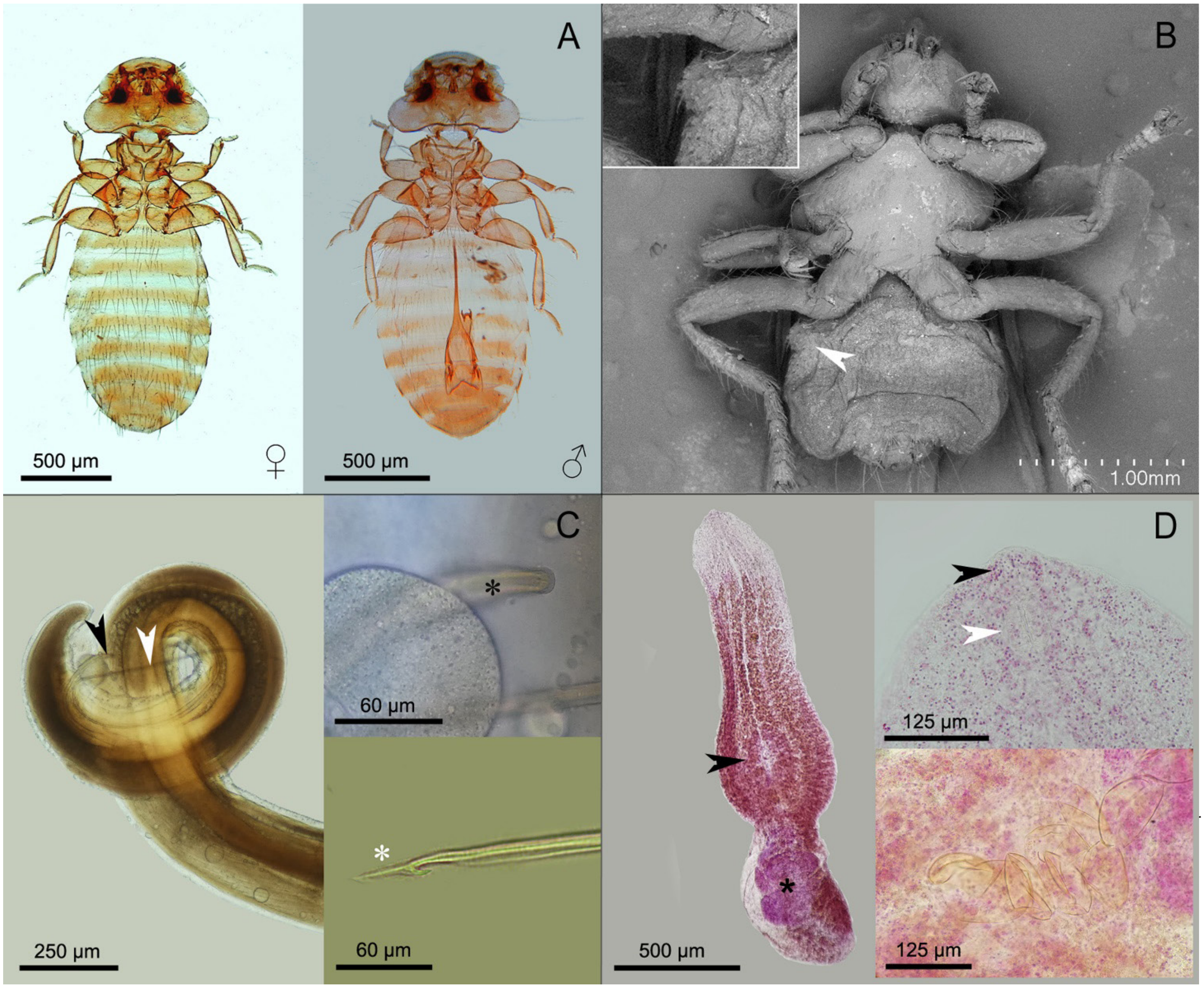

Figure 1. Metazoan parasites isolated in the Rufous-legged Owls from Ñuble and Biobío regions, central and southern Chile. **Ectoparasites**. **A.** Ventral view of the louse *Kurodaia magna* including female and male specimens. **B.** Ventral view of the hippoboscid fly *Ornithoica vicina*. Note the presence of a spinous tubercle next to the spiracle (white arrow). Inserted image: close-up to the tubercle. **Endoparasites: helminths**. **C.** The nematode *Procyrnea spinosa*; posterior end of male worm. Note the two spicules; the right spicule is short (black arrow) with a rounded tip (upper right side), and the left spicule is slender (white arrow) with an arrow-shaped tip (bottom left side). **D**. The trematode *Neodiplostomum travassosi*; *in toto* worm, where the tribocytic organ (black arrow) and gonads in the posterior third of body (*) are evident. Upper right side: note the small rounded oral sucker (black arrow) followed by the pharynx (white arrow). Bottom right side: Note the presence of a reduced number of eggs inside uterus.

and an unidentified tapeworm were most prevalent among helminths. However, *P. spinosa* and the trematode *Neodiplostomum travassosi* (Diplostomidae) showed the highest mean intensity and abundance (Table 1).

DISCUSSION

Our study represents up to date the most complete parasitological survey of the Rufous-legged Owl. Previous publications report findings of only a few parasite taxa (*e.g*., Schuurmans-Stekhoven 1951, González-Acuña *et al*. 2006, Steinauer *et al*. 2020). Thus, our results contribute to filling the information gaps about the parasitic fauna of an elusive Neotropical owl species.

Ectoparasite diversity in Rufous-legged Owls

We found that lice were the most frequent taxa among the metazoan parasites of Rufous-legged Owls. That agrees with patterns of parasite diversity elsewhere (*e.g*., Hunter *et al*. 1994, Price *et al*. 2003, González-Acuña *et al*. 2006, Atkinson *et al.* 2008). Lice of the genus *Kurodaia* typically parasitize American owls (Price *et al*. 2003). *Kurodaia magna* parasitize several North American owl species, including the Northern Barred Owl (*Strix varia*), Spotted Owl (*Strix occidentalis*), and Great Horned Owl

(*Bubo virginianus*) (Price & Beer 1963, Hunter *et al.* 1994, McAllister *et al.* 2019). Other *Kurodaia* species isolated from owls distributed in Chile are *Kurodaia* (*Conciella*) *subpachygaster* in Barn Owl (*Tyto alba*) and *Kurodaia* (*Conciella*) *caputonis* in Austral-pygmy Owl (*Glaucidium nana*) (González-Acuña *et al.* 2006, Moreno & González-Acuña 2015). Thus, the finding of *K. magna* in the Rufous-legged Owl constitutes an additional host-parasite association (see González-Acuña & Palma 2021).

The louse *S. syrnii* is a common ectoparasite of the Great Gray Owl (*Strix nebulosa*), Northern Barred Owl, Spotted Owl, and Great Horned Owl from North and Central America and Eurasia (Clayton & Price 1984, Hunter *et al.* 1994). However, Clayton (1990) and González-Acuña *et al.* (2006) found *S. syrnii* in the Rufous-legged Owl from southern Chile. Lice of the genus *Strigiphilus* are ubiquitous in Chilean owls, and each owl species hosts a *Strigiphilus* species (Moreno & González-Acuña 2015, Grandón-Ojeda *et al.* 2018, González-Acuña & Palma 2021).

The hippoboscid-fly *Ornithoica vicina* is restricted to the Americas, parasitizing bird species within ten orders (Maa 1966, Santos *et al.* 2014). Among its avian hosts are several owl species, including species of the genus *Strix*. In North America, *O. vicina* parasitizes Northern Barred Owls and Spotted Owls (Bequaert 1954, Hunter *et al.* 1994, Nelder & Reeves 2005) and in South America, parasitizes Mottled Owls (*Strix virgata*) and Rusty-barred Owls (*Strix hylophila*) (Bequaert 1954, Graciolli & Carvalho 2003). *Ornithoica vicina* also parasitizes other Neotropical owl species such as the Ferruginous Pygmy-Owl (*Glaucidium brasilianum*), Striped Owl (*Pseudoscops clamator*), Stygian Owl (*Asio stygius*), White-throated Screech Owl (*Megascops albogularis*), Burrowing Owl (*Athene cunicularia*), and Barn Owl (Bequaert 1954, Vaz & Teixeira 2016). Other Neotropical hosts include storks, falcons, passerines, and flickers (Tonn & Arnold 1963, Arnold 1970, Graciolli & Carvalho 2003, Santos *et al.* 2014, Vaz & Teixeira 2016).

Long before us, Bequaert (1954) isolated *O. vicina* from a Rufous-legged Owl collected in southern Chile. Thus, our findings constitute an additional record of this fly species in the Rufous-legged Owl. The presence of *O. vicina* in a Rufous-legged Owl's ears is explainable because this fly species prefers to lay its eggs in that organ (Hunter *et al.* 1994). In Chile, hippoboscid flies appear rarely to parasite owls. *Ornithomyia remota* is another hippoboscid fly species parasitizing the Austral-Pygmy Owl (Bequaert 1950). The limited collection of hippoboscid flies could be explained because of their small size, being easily overlooked during the inspection of birds (Bequaert 1954). Considering that *O. vicina* parasitizes a broad spectrum of avian hosts (Bequaert 1954, Maa 1966), this fly species may be present in other Chilean owl species.

The finding of a hippoboscid fly is remarkable since these ectoparasites are uncommon in Neotropical raptors (Bequaert 1954, Vaz & Teixeira 2016). Hippoboscid flies are vectors for hemoparasites such as *Haemoproteus,* which could be potentially harmful to owls (Krone & Cooper 2002, Atkinson *et al.* 2008). Additional surveys are necessary to determine whether hippoboscid flies transmit hemoparasites to native owls, considering that high fly infestation causes severe lesions in nestlings (Hunter *et al.* 1994).

Endoparasite diversity in Rufous-legged Owls

Regarding the nematodes of the genus *Capillaria* retrieved from Rufous-legged Owls, we could not identify them to the species level because all were female worms. Male worms are necessary to identify the species of the genus *Capillaria* (Anderson *et al.* 2009). Although we could not identify the specimens of *Capillaria* at the level species, they may have been *Capillaria tenuissima.* This nematode species parasitizes several owl species, including Little Owl (*Athene noctua*), Long-eared Owl (*Asio otus*), Tawny Owls (*Strix aluco*), Short-eared Owl, Great Horned Owl, Northern Barred Owl, and Barn Owl (Kinsella *et al.* 2001, Krone & Cooper 2002, Borgsteede *et al.* 2003, Sanmartín *et al.* 2004). Its life cycle is unknown, but earthworms could act as intermediate hosts (Oyarzún-Ruiz *et al.* 2016). In Chile, *C. tenuissima* parasitizes Magellanic Horned Owls (Grandón-Ojeda *et al*. 2018), Chimango Caracaras (*Milvago chimango*), and Harris's Hawks (*Parabuteo unicinctus*) (Oyarzún-Ruiz *et al.* 2016, 2022). Thus, it represents the first record of the genus *Capillaria* in the Rufous-legged Owl.

The nematode *P. spinosa* is a cosmopolitan species inhabiting mainly the stomach of diurnal and nocturnal birds of prey (Illescas Gomez *et al.* 1993, Borgsteede *et al.* 2003, Oyarzún-Ruiz *et al.* 2016). Species of this genus have an indirect life cycle with coleopterans and orthopterans as intermediate hosts (Santoro *et al.* 2012). Other species parasitizing owls are *Procyrnea excisiformis*, *P. leptoptera*, *P. longispiculata*, and *Procyrnea* sp. (Ramalingam & Samuel 1978, Taft *et al.* 1993, Borgsteede *et al.* 2003, Ferrer *et al.* 2004, Sanmartín *et al.* 2004, Santoro *et al.* 2012). In Chile, *P. spinosa* is present in Chimango Caracaras (Oyarzún-Ruiz *et al.* 2016), although González-Acuña *et al*. (2011) found unidentified specimens of *Procyrnea* in American Kestrels (*Falco sparverius*). In consequence, our finding *P. spinosa* represents a new host-parasite association.

Based on our analysis, the isolated tapeworms belonged to the Paruterinidae family. The two genera in this family which parasitize birds of prey are *Paruterina* and *Cladotaenia* (Yamaguti 1959, Khalil *et al.* 1994, Sanmartín *et al.* 2004). In Chile, several authors have found specimens of *Cladotaenia* in American Kestrels and Harris's Hawks (González-Acuña *et al.* 2011, Oyarzún-Ruiz *et al.* 2022). The *Paruterina* and *Cladotaenia* species use small mammals as intermediate hosts (Yamaguti 1959). Thus, like other raptor species, the Rufous-legged Owl could have acquired Paruterinidae tapeworms by consuming small mammals. Our record of Paruterinidae is the first in the Rufous-legged Owl and the third among Neotropical birds of prey. Specific identification of these tapeworms remains pending (Oyarzún-Ruiz *et al.* 2022).

We classified one of the trematodes isolated from a Rufous-legged Owl within the family Echinostomatidae. There are scarce records of echinostomes in owls. A few cases are *Echinostoma apiculatum* in Tawny Owls, *E. revolutum* in Eurasian Eagle-Owls (*Bubo bubo*), Long-eared Owls, and Tawny Owls from Europe (Ewald & Crompton 1993, Sitko 2001, Borgsteede *et al.* 2003), *E. revolutum* and *E. trivolvis* in Great Horned Owls from North America (Ramalingam & Samuel 1978, Taft *et al.* 1993). There are no previous records of echinostomes parasitizing Neotropical owls. However, species of *Echinostoma*, *Microparyphium*, *Paryphostomum*, and *Prionosoma* genera are present in Neotropical vultures and hawks (Fernandes *et al.* 2015). Echinostomes seem to be less prevalent in owls in comparison with other flukes (Ramalingam & Samuel 1978, Taft *et al.* 1993, Sitko 2001), which could be a consequence of their complex life cycles (Ramalingam & Samuel 1978, Atkinson *et al.* 2008).

Unlike echinostomes, the trematode *N. travassosi* appears more common in Neotropical owls. This trematode species parasitizes Spectacled Owls (*Pulsatrix perspicillata*), Crested Owls (*Lophostrix cristata*), Burrowing Owls, and *Strix* owls from Argentina and Brazil (Dubois 1937, Drago *et al.* 2015). However, *N. travassosi* is not restricted to owls. Other avian hosts include Red-billed Toucans (*Ramphastos tucanus*), Neotropic Cormorants (*Phalacrocorax brasilianus*), Southern Crested Caracaras (*Caracara plancus*), and Savanna Hawks (*Buteogallus meridionalis*) (Dubois 1937, Lunaschi & Drago 2005, Drago *et al.* 2014). Moreover, *N. travassosi* was recently found in the Harris's Hawk from Chile (Oyarzún-Ruiz *et al*. 2022). Although the *N. travassosi*'s life cycle is unknown, species of this genus have an indirect life cycle, with amphibians as intermediate hosts and reptiles and mammals as paratenic hosts (Gibson *et al.* 2002). There are other *Neodiplostomum* species present in Neotropical owls, such as *N. conicum* in Short-eared Owls and Rusty-barred Owls, *N. reflexum* in Great Horned Owls, and *Neodiplostomum* sp. in Magellanic Horned Owls from Chile (Fernandes *et al.* 2015, Grandón-Ojeda *et al.* 2018). Thus, this finding represents a new host-parasite association and the second record in Chilean territory.

The only acanthocephalan species we isolated from Rufous-legged Owls was *C. spinosus*, which parasitizes mainly owls. However, Kinsella *et al*. (2001) suggested that diurnal raptors are additional definitive hosts of *C. spinosus*. Some hosts in the Americas are the Swallow-tailed Kite (*Elanoides forficatus*), Eastern Screech-Owl (*Megascops asio*), Great Horned Owl, and Northern Barred Owl (Kinsella *et al.* 2001, Coulson *et al.* 2010), and a probable Galapagos Hawk (*Buteo galapagoensis*) (Van Cleave 1940). Other *Centrorhynchus* species present in Neotropical owls are *C. tumidulus* in Tropical Screech-Owl (*Megascops choliba*) and Barn Owl from Brazil, *C. millerae* in Tropical Screech-Owl, and *Centrorhynchus* sp. in Burrowing Owl and Barn Owl from Argentina, Nicaragua, and Paraguay (Schmidt & Neiland 1966, Smales 2013, Drago *et al.* 2015).

There are previous records of cystacanths encysted in the tissues of Neotropical reptiles and amphibians, which could act as paratenic hosts for *Centrorhynchus* (Puga & Torres 1999, Drago *et al.* 2015). The Rufous-legged Owl hosts *C. conspectus* in Chile (Yamaguti 1963) and *C. nahuelhuapensis* in Argentina (Steinauer *et al.* 2020). The Magellanic Horned Owl is an additional definitive host of *C. spinosus* in Chile (Grandón-Ojeda *et al.* 2018), while the Andean fox (*Lycalopex culpaeus*) is an accidental host (Oyarzún-Ruiz *et al.* 2020). The present finding represents a new host-parasite association.

The helminth species richness in the Rufous-legged Owls we examined is low in comparison with other owl species studied from other countries. The helminth species richness in other owl species can vary from eight to 16 species (Ramalingam & Samuel 1978, Taft *et al*. 1993, Ferrer *et al*. 2004, Sanmartín *et al.* 2004). The low helminth species richness we found is possibly an artifact of our small sample size and the limited geographical area considered in this study.

Several authors have suggested that prey-specialist owls would harbor a lower richness of helminth in comparison to generalist species (Ewald & Crompton 1993, Kinsella *et al.* 2001, Ferrer *et al.* 2004, Sanmartín *et al.* 2004, Santoro *et al.* 2010, 2012). The overall diet of the Rufous-legged Owl consists chiefly of rodents (Figueroa *et al*. 2017, Pavez 2019), which would turn out in a lower richness of helminths. However, Rufous-legged Owls strongly increase predation upon invertebrates during spring and summer (Figueroa *et al*. 2017). The evidence suggests that seasons and different populations of certain owl species across a geographic distribution could influence the parasite communities because of differences in the predation of distinct prey taxa (Hoberg *et al*. 1989, Kinsella *et al*. 2001). Future studies considering a larger sample size from different localities and seasons could elucidate if prey types influence the helminth species richness in the Rufous-legged Owl.

Some of the endoparasites taxa recorded in our study cause pathological changes and health impairment in birds of prey (*e.g*., *Procyrnea*, *Neodiplostomum*, *Capillaria*, and tapeworms; Krone & Cooper 2002, Santoro *et al*. 2010). However, the recorded parasitic loads were lower in comparison with such studies. Although we did not conduct a histopathological analysis, we found no severe lesions associated with helminth presence. Notwithstanding the above, further studies considering clinical and histopathological analyses are necessary to assess the potential impact of these and other parasites on the health of these birds (Krone & Cooper 2002, Atkinson *et al.* 2008).

A call to contribute to the study of parasites in raptors

For now, our values of parasitological descriptors are preliminary. A more comprehensive study is necessary to increase the robustness of the parasitological descriptors computed in our study. We encourage ornithologists to participate in parasite samplings in birds of prey, not only from carcasses but also through the collection of ectoparasites while handling these birds. This collaboration would enhance knowledge about the parasitic fauna of owls and other birds of prey. This is particularly necessary in the case of birds of prey which are under legal protection, and because obtaining proper samples is a difficult achievement (Sanmartín *et al.* 2004, Moreno & González-Acuña 2015).

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