

Gastrointestinal and external parasites of the Variable hawk *Geranoaetus polyosoma* (Accipitriformes: Accipitridae) in Chile

Parasitas gastrointestinais e externos do Falcão Variável *Geranoaetus polyosoma* (Accipitriformes: Accipitridae) de Chile

Alexandra Grandón-Ojeda¹; Patricio Cortés¹; Lucila Moreno²; John Mike Kinsella³; Armando Cicchino⁴; Carlos Barrientos⁵; Daniel González-Acuña¹ 

¹ Laboratorio de Enfermedades y Parasitos de Fauna silvestre, Facultad de Ciencias Veterinarias, Universidad de Concepción, Chillán, Chile

² Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción, Concepción, Chile

³ Helm West Lab, Missoula, Montana, United States of America

⁴ Universidad Nacional de Mar del Plata, Mar del Plata, Argentina

⁵ Escuela de Medicina Veterinaria, Universidad Santo Tomás, Concepción, Chile

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Abstract

Information about parasites associated with diurnal raptors from Chile is scarce. Between 2006 and 2017, a total of 15 specimens of the Variable hawk, *Geranoaetus polyosoma* (Quoy & Gaimard, 1824) were collected, 14 of them from different localities in the Biobío region and one specimen from the Valparaíso region. An external examination of the plumage was made to collect ectoparasites, and necropsies were performed, focusing primarily on the gastrointestinal tract. Chewing lice (Phthiraptera) were found on five (33.3%) of the birds corresponding to three species: 97 specimens of *Degeeriella fulva* (Giebel, 1874), six specimens of *Colpocephalum turbinatum* Denny, 1842 and nine belonging to an unidentified species of the genus *Craspedorrhynchus* Kéler, 1938. Endoparasites found in three (20%) of the birds included round worms (Nematoda) of the genus *Procyrnea* Chabaud, 1958, and spiny-headed worms (Acanthocephala) of the genus *Centrorhynchus* Lühe, 1911. The species *Colpocephalum turbinatum* and the genera: *Craspedorrhynchus* sp., *Procyrnea* sp. and *Centrorhynchus* sp. are new records for the Variable hawk.

Keywords: Parasites, lice, Nematoda, Acanthocephala, birds, raptors.

Resumo

No Chile, informações sobre parasitas associados a aves de rapina diurnas são escassas. Entre os anos 2006 e 2017, um total de 15 espécimes do Falcão Variável *Geranoaetus polyosoma* (Quoy & Gaimard, 1824) mortos, foram examinados, 14 deles provenientes de diferentes localidades da região do Biobío e um espécime na região de Valparaíso. Um exame externo da plumagem foi feito para coletar os ectoparasitas e necropsias do tracto gastrointestinal para coleta de endoparasitas. Cinco aves (33,3%) foram positivas para três espécies de piolhos (Phthiraptera): 97 espécimes de *Degeeriella fulva* (Giebel, 1874), seis espécimes de *Colpocephalum turbinatum* Denny, 1842 e nove espécimes não identificados do gênero *Craspedorrhynchus* Keler, 1938. Endoparasitas foram encontrados em três aves (20%), incluindo vermes redondos (Nematoda) do gênero *Procyrnea* Chabaud, 1958, e vermes achatados (Acanthocephala) do gênero *Centrorhynchus* Lühe, 1911. As espécies *Colpocephalum turbinatum* e os dos gêneros *Craspedorrhynchus*, *Centrorhynchus* e *Procyrnea* corresponderam a novos registros para o Falcão Variável.

Palavras-chave: Parasitas, piolhos, Nematoda, Acanthocephala, aves, raptos.

Introduction

Parasites play important roles in trophic chains (DUNNE et al., 2013) and in the regulation of community composition (WOOD et al., 2007). It is also thought that the loss of the parasitic fauna can

predispose hosts to infections by generalist parasites or emerging diseases (DUNN et al., 2009). The Variable hawk, *Geranoaetus polyosoma* (Quoy & Gaimard, 1824), is a medium-sized accipitiform with a body length between 45 and 62 cm (CHESTER, 2008), with at least 27 different morphs described according to its very variable plumage due to age (JARAMILLO, 2005). It has a wide

*Corresponding author: Daniel González-Acuña. Facultad de Ciencias Veterinarias, Universidad de Concepción, Casilla, 537, Chillán, Chile.
e-mail: danigonz@udec.cl



Neotropical distribution (FERGUSON-LEES & CHRISTIE, 2001), from the central Andes of Colombia to Tierra del Fuego (VAURIE, 1962). In Chile, the Variable hawk can be seen in a large section of the continental territory, from the coast up to 5000 meters above sea level in the Andes mountain range (JARAMILLO, 2005). It lives in all types of environments, including suburban and scrub areas with or without trees, cultivated fields, river edges, foothill forests, mountain ridges and ranges covered with *Nothofagus* trees (FERGUSON-LEES & CHRISTIE, 2001). The prey of the Variable hawk is diverse, including the European hare (*Lepus europaeus* Pallas, 1778), European rabbit (*Oryctolagus cuniculus* (Linnaeus, 1758)) (MONSERRAT et al., 2005), and different species of native rodents, birds and insects (FIGUEROA-ROJAS et al., 2003; TREJO et al., 2006). In Chile, only the chewing louse species *Degeeriella fulva* (GIEBEL, 1874) has been collected from *G. polyosoma* in the following locations: Nueva Aldea, Angol, Linares, Alhué, Aconcagua, Longotoma, Colina and Santa Clara (MORENO & GONZÁLEZ-ACUÑA, 2015). No reports of endoparasites from the Variable hawk in Chile have been published (MORENO & GONZÁLEZ-ACUÑA, 2015). The aim of this research project was to study and increase knowledge of the parasitic fauna of the Variable hawk.

Materials and Methods

A total of 15 carcasses of *Geranoaetus polyosoma* collected between 2006 and 2017 from different locations in central Chile, ranging from the Valparaíso region in the north (33°03'47"S, 71°38'22"W) to the Biobío region (36°46'22" S, 73°03'47"W) in the south, were examined externally and internally for parasites. The cause of death of the birds varied from collisions with vehicles and electric cables, poaching and poisoning. The birds were kept individually in separate bags, frozen and then necropsied. Ectoparasites were collected by inspecting the plumage visually and were subsequently preserved in 70% ethanol. Lice were cleared and slide-mounted in Canada balsam, as described by Palma (1978) and Price et al. (2003). The collection and preparation of helminths followed the techniques proposed by Kinsella & Forrester (1972). Roundworms and spinyheaded worms were cleared temporarily in lacto-phenol, and were returned to the preservative after their identification.

The identification of lice was made using keys and descriptions published by Giebel (1874), Denny (1842), Clay (1958), Price &

Beer (1963) and Price et al. (2003). Keys published by Chabaud (1975) were used for the identification of roundworms, and a key in Amin (1987) for the identification of spiny-headed worms. The GIMP 2.8.22 program was used to edit all the figures.

All the specimens studied are deposited in the collection at the Laboratory of Parasites and Diseases of Wildlife, Faculty of Veterinary Science, University of Concepción, Chillán, Chile.

Results and Discussion

Eight of the 15 birds examined were positive for at least one parasite (53.3%). Prevalence for ectoparasites was 33.3% with five birds infested, while prevalence for endoparasites was 20% with only three birds infected (see Table 1). Three species of lice (Insecta: Phthiraptera) belonging to three genera, as well as two species of parasitic worms belonging to two phyla (Nematoda and Acanthocephala) were recorded.

Phthiraptera

A total of 97 specimens of *Degeeriella fulva* (Figures 1 and 2) was collected on three (20%) of the Variable hawks studied. The genus *Degeeriella* Neumann, 1906 comprises a total of 41 species parasitic on diurnal raptors of the families Falconidae and Accipitridae with a relatively uniform morphology, which makes their identification difficult (CLAY, 1958; PRICE et al., 2003; MARTÍN-MATEO, 2009). *Degeeriella fulva* has a worldwide distribution parasitizing a broad spectrum of hosts, having been collected from individuals in captivity and in the wild (INCI et al., 2010; OLIVEIRA et al., 2011). Moreno & González-Acuña (2015) reported *Degeeriella fulva* on the Variable hawk from several localities in Chile; it has also been found on the Long-legged Buzzard (*Buteo rufinus* (Cretzschmar, 1827)) and the Common Buzzard (*Buteo buteo* (Linnaeus, 1758)) in Turkey and Portugal, respectively (DIK, 2006; TOMÁS et al., 2016), the Red-tailed hawk (*B. jamaicensis* (Gmelin, 1788)) in the USA and México (MORISHITA et al., 2001; OLIVEIRA et al., 2011), and on the Mountain hawk-eagle (*Spizaetus nipalensis* Hodgson, 1836) in Japan (YOSHINO et al., 2012). *Degeeriella fulva* was the most abundant species collected in this study.

Table 1. Summary and parasitological descriptors of external and gastrointestinal parasites found from 15 Variable hawks in Chile.

Species	Prevalence (%)	Range	Mean intensity	Mean abundance	Number of parasitized birds	Total of parasites
Phthiraptera: Ischnocera						
<i>Degeeriella fulva</i>	20	0–83	32.3	6.47	3	97
<i>Craspedorrhynchus</i> sp.	6.7	0–9	9	0.6	1	9
Phthiraptera: Amblycera						
<i>Colpocephalum turbinatum</i>	13.3	0–3	3	0.4	2	6
Nematoda: Spirurida						
<i>Procyrnea</i> sp.	13.3	0–10	5.5	0.7	2	11
Acanthocephala: Polymorphida						
<i>Centrorhynchus</i> sp.	6.7	0–3	3	0.2	1	3



Figure 1. *Degeeriella fulva*. Male. Ventral view. Magnification 100X.



Figure 2. *Degeeriella fulva*. Female. Ventral view. Magnification 100X.

Colpocephalum turbinatum Denny, 1842 (Figures 3 and 4) was found on two (13.3%) of all the Variable hawks examined. As indicated by Price et al. (2003), *C. turbinatum* is a cosmopolitan species parasitic on about 50 bird species of the families Accipitridae, Falconidae, Pandionidae, Strigidae and Tytonidae, as well as on the Common pigeon (*Columba livia* Gmelin, 1789; Columbidae). Subsequently, Martín-Mateo (2006) recorded *C. turbinatum* on several diurnal raptors and even on a nocturnal raptor, the Common Barn Owl (*Tyto alba* (Scopoli, 1769)), in Spain. Also, it has been reported parasitizing the Galápagos hawk (*Buteo galapagoensis* (Gould, 1837)) in the Galápagos Islands (WHITEMAN et al., 2007), the Roadside hawk (*Rupornis magnirostris* (Gmelin, 1788)) in Colombia (PARRA-HENAO et al., 2011), as well as in Iran (DIK & HALAJIAN, 2013) and Pakistan (NAZ et al., 2012), confirming its cosmopolitan distribution.

In Chile, González-Acuña et al. (2008) recorded *C. turbinatum* from three diurnal raptors: the Rufous-tailed hawk (*Buteo ventralis* Gould, 1837), the Black-chested buzzard-eagle (*Geranoaetus melanoleucus* (Vieillot, 1819)) and the Bicolored hawk (*Accipiter bicolor* (Vieillot, 1819)), collected from preserved specimens held in the National Museum of Natural History in Santiago.

Nine specimens belonging to the genus *Craspedorrhynchus* Kéler, 1938 were collected from one (6.7%) of the 15 Variable hawks examined (Figures 5 and 6). This genus comprises about 40 described species, all of which parasitize raptors worldwide (PRICE et al., 2003) but are absent from vultures (DIK et al.,

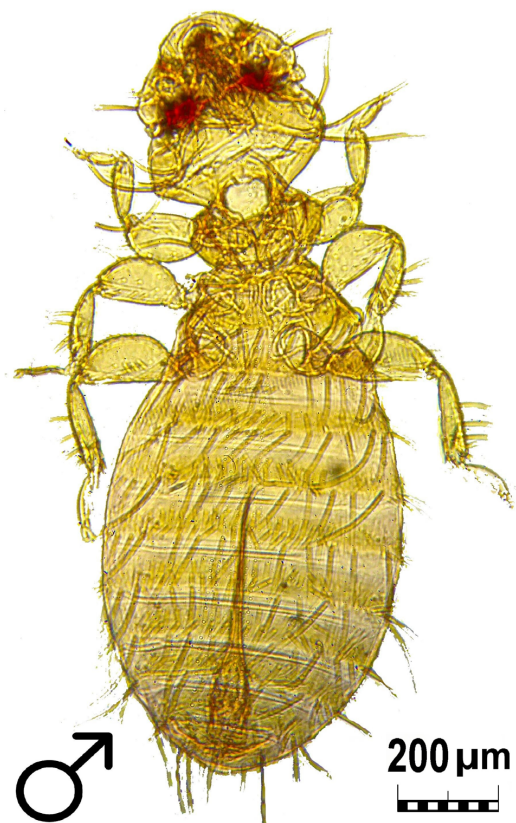


Figure 3. *Colpocephalum turbinatum*. Male. Ventral view. Magnification 100X.

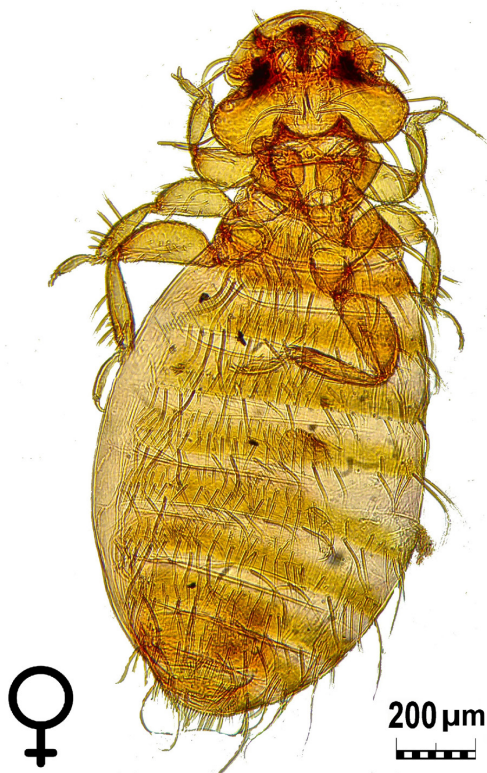


Figure 4. *Colpocephalum turbinatum*. Female. Ventral view. Magnification 100X.

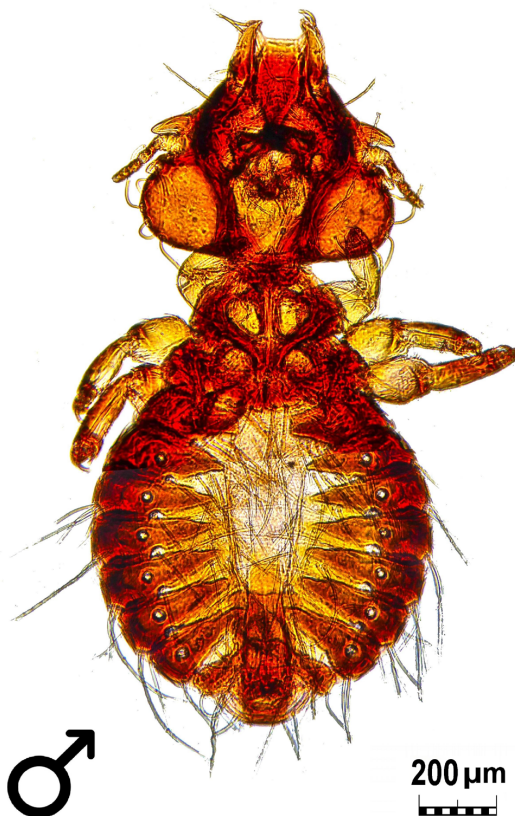


Figure 5. *Craspedorrhynchus* sp. Male. Ventral view. Magnification 100X.

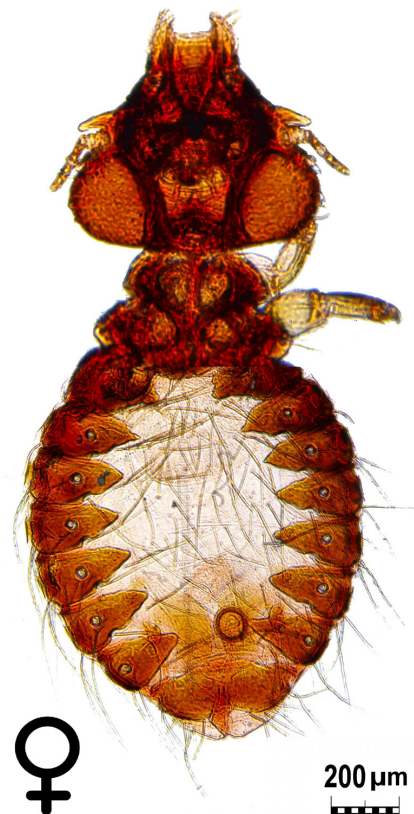


Figure 6. *Craspedorrhynchus* sp. Female. Ventral view. Magnification 100X.

2013). Species of *Craspedorrhynchus* are usually located on the head and/or neck of the host (PÉREZ & MARTÍN-MATEO, 1995), where we also found them in this study; however, they have been collected on the thorax and wings of some birds (OLIVEIRA et al., 2011).

Subsequently to Price et al. (2003), species of *Craspedorrhynchus* have been reported from other members of the Accipitridae, such as Swainson's hawk (*Buteo swainsoni* Bonaparte, 1838) (MORISHITA et al., 2001; OLIVEIRA et al., 2011) and *Buteo rufinus* (Cretzschmar, 1827) (DIK, 2006). In Chile, González-Acuña et al. (2008) recorded specimens of *Craspedorrhynchus* sp. parasitizing Harris's hawk (*Parabuteo unicinctus* (Temminck, 1824)).

Ticks and mites (Acari) were not found on any of the 15 hosts examined in this study. The absence of ticks may be due to their behavior of abandoning dead hosts (NELDER & REEVES, 2005). However, that behavior does not explain the absence of mites, which may be due to our collecting technique.

Endoparasites

We collected 14 endoparasites from three (20%) of the 15 birds examined, as follows: 11 roundworms identified as belonging to the genus *Procyrnea* Chabaud, 1958 (Nematoda: Spiruroidea: Habronematidae) and three spiny-headed worms belonging to the genus *Centrorhynchus* Lühe, 1911 (Acanthocephala: Centrorhynchidae).

Roundworms of the genus *Procyrnea* (Figure 7) were found in two (13.3%) of 15 of Variable hawks examined. This is a new record for the Variable hawk. The genus *Procyrnea* includes several species parasitic in many species of birds, including diurnal raptors in many countries (SANTORO et al., 2010; ZHANG et al., 2011; SIEGEL et al., 2012). The life cycles of species of *Procyrnea* require arthropods as intermediate hosts, which must be ingested by the definitive host. The final location of *Procyrnea* worms is in the upper gastrointestinal tract (SIEGEL et al., 2012), mainly in the glandular and muscular stomach of the birds (ARRONA-RIVERA et al., 2016). In Chile, González-Acuña et al. (2011) reported *Procyrnea* sp. in specimens of the American Kestrel (*Falco sparverius* Linnaeus, 1758) from the city of Chillán.

Three spiny-headed worms belonging to the genus *Centrorhynchus* were collected in one (6.7%) of the 15 Variable hawks. This is a new record for the Variable hawk. *Centrorhynchus* includes about 90 described species which parasitize a wide variety of avian hosts, being the most speciose acanthocephalan genus parasitic in birds (GOLVAN, 1994). A great number of *Centrorhynchus* species parasitising diurnal and nocturnal raptors were reported from Italy, Ukraine, Slovakia, USA and Ivory Coast (RICHARDSON & NICKOL, 1995; DIMITROVA & GIBSON, 2005; SANTORO et al., 2010, 2012; KOMOROVÁ et al., 2015; LISITSYNA & GREBEN, 2015). In South America, there are reports of larval stages (cystacanths) of *Centrorhynchus* spp. from Brazil, Ecuador, Paraguay and Argentina, mainly infesting ophidians (LAMAS & LUNASCHI, 2009; SMALES, 2007a,b; TRAVASSOS, 1926; VIZCAÍNO, 1993). In Chile, cystacanths belonging to the genus *Centrorhynchus* were reported in anurans of the genus *Eupsophus* Fitzinger 1843 (TORRES & PUGA, 1996), which would confirm the presence of at least one type of paratenic host in this country. These acanthocephalans have a complex life cycle, infecting both diurnal and nocturnal raptors, with the first intermediate host being an isopod or an insects. Their diverse paratenic hosts (amphibians, reptiles and small mammals) have a fundamental role in their transmission to birds (BURON & GOLVAN, 1986; OYARZÚN-RUIZ et al., 2016).



Figure 7. *Procyrnea* sp. Male. Magnification 100X.

Conclusion

Geranoaetus polyosoma hosts a wide diversity of parasites. Five species are recorded in this paper, including three chewing louse species (*Degeeriella fulva*, *Colpocephalum turbinatum*, *Craspedorrhynchus* sp.), one roundworm (*Procyrnea* sp.), and one spinyheaded worm (*Centrorhynchus* sp.). Four of those species: *Craspedorrhynchus* sp., *Colpocephalum turbinatum*, *Procyrnea* sp. and *Centrorhynchus* sp. are new records for the Variable hawk.

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