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Checklist of the parasites of the black-necked swan, *Cygnus melanocoryphus* (Aves: Anatidae), with new records from Chile

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Abstract

Black-necked swans (*Cygnus melanocoryphus*) are endemic to the southern cone of South America. Their range extends from Brazil and Paraguay south to Argentina and Chile. A total of 16 parasite species were collected from 7 swans from the Biobío region, Chile, of which 12 are new records for Chile and 11 represent new host records, *Echinostoma trivolvis, Paranomostomum* sp., *Microsomacanthus* sp., *Nadejdolepis* sp., *Retinometra* sp., *Avioserpens* sp., *Capillaria skrjabini, Ingrassia cygni, Anatoecus penicillatus, A. icterodes* and *A. keymeri*. A checklist is presented that summarizes sites of infections, localities, life cycles and their intermediate hosts (if known), and the pertinent references to demonstrate the wide diversity of parasites of black-necked swans. Our review of the existing literature (23 publications) along with our own records provided information on a total of 18 families and 27 genera, including 33 described species (some only identified to genus), of which 11 were recorded only in Chile (8 endoparasites and 3 ectoparasites), and 6 only in Argentina (4 endoparasites and 2 ectoparasites). Five parasites are known only from captive swans in European zoos. Parasites recorded from *C. melanocoryphus* include 23 helminths and 10 ectoparasites (one leech and 9 arthropods).

Key words: checklist, parasites, helminths, Phthiraptera, acari, black necked swans, *Cygnus melanocoryphus*, trematode, cestode, nematode, lice, mites

Introduction

The black-necked swan (*Cygnus melanocoryphus* (Molina, 1782)) is endemic to the southern cone of South America. Originally described as *Anas melanocoripha* by Molina (1782), it is believed to form a complex of species with mute swans (*Cygnus olor* (Gmelin, 1789)) and black vultures (*Coragyps atratus* (Bechstein, 1793)). It is sometimes placed in the monotypic genus *Sthenelides* (del Hoyo *et al.* 1992). The total population is estimated at approximately 100,000 individuals distributed among Chile, Argentina, southeastern Brazil and Paraguay (Schlatter *et al*. 1991). In Chile, climatic influences cause opportunistic displacements of black-necked swans among different wetland areas occurring near the Pacific coast (Vilina *et al*. 2002). The species is considered as not globally threatened in Cites II (del Hoyo *et al*. 1992).

The purpose of this study is to present a checklist of the parasites described in black-necked swans that summarizes sites of infections, localities, life cycles and their intermediate hosts (if known), along with the pertinent references, to demonstrate the wide diversity of parasites of this host species. In addition, new host and geographic records from Chile are reported.

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Material and methods

This list was prepared on the basis of data published from 1916 to present. Parasites are presented in order according to taxa; each record contains information on the species name, authority and year, synonyms under which original records appeared, location (particular site of infection), localities (particular locality when possible and province), data on life history when known (H1 and H2 are the first and second intermediate host), and references. Bibliographic references are arranged chronologically. When a parasite was identified only to the generic level, we only list location, locality, and references. Parasites recorded from swans in captivity are also included.

Taxonomy for helminths follows Gibson *et al*. (2002), Jones *et al*. (2005), and Bray *et al*. (2008) for Digenea; Anderson *et al*. (1974), Moravec (1982), and Anderson (2000) for Nematoda, and Khalil *et al*. (1994) for Cestoda. For the ectoparasites, taxonomy follows Arnold (2005), Price (1971), Keler (1960), Clay (1974), and Price *et al*. (2003) for the Phthiraptera; Mironov and Galloway (2002) and Fain and Bochkov (2003) for Acari; and Sawyer (1986) for leeches.

To supplement the checklist, we necropsied 7 bird specimens from different localities of the Biobío Region, Chile: three from Bulnes (36°48’S; 72°22’W), two from Chillán (36°34’S; 72°06’W), one from Quinchamalí (36°36’S; 72°10’W) and one from Concepción (36º43’S; 73º07’W). The swans were submitted to the wildlife rehabilitation center of the Faculty of Veterinary Sciences of the University of Concepción, Chile but since their condition precluded returning them to the wild, they were euthanized and the carcasses were stored in a freezer until further examination. Chewing lice and mites were extracted from feathers and, preserved in 70 % ethanol. Lice were mounted in Canada balsam following the technique in Palma (1978) and Price *et al*. (2003), and mites were cleared in lactophenol and mounted in Hoyer´s medium (Evans 1992). For the isolation of endoparasites each bird was dissected and the organs examined under a stereoscopic microscope in the laboratory. Helminths were preserved in 70% ethanol or 10% formalin. Cestodes, trematodes and digeneas were stained with Semichon´s carmine, dehydrated and mounted in Canada balsam. Nematodes and acanthocephalans were studied in temporary mounts of lacto-phenol.

Voucher specimens were deposited in the United States National Parasite Collection at Beltsville, Maryland, USA under accession numbers 103292 to 103296 and in the helminthological collections of the Laboratory of Zoology of the University of Concepción under accession numbers UdecAnCm-1 to UdecAnCm-15.

Results

Class Digenea

Superfamily Diplostomoidea Poirier, 1886

Family Strigeidae Railliet, 1919

Apatemon Szidat, 1928

Apatemon gracilis (Rudolphi, 1819) Szidat, 1928

Site of infection: intestine.

Localities: Argentina (locality not reported); Biobío Region (Chile).

Life history: H1: *Lymnaea peregra* (Muller, 1774) (Gastropoda, Lymnaeidae). H2: *Oncorhynchus mykiss* (Walbaum, 1792) (Pisces: Salmonidae)

Reference: Boero *et al.* (1972). Present study.

Comments: first record from Chile.

***Australapatemon* Sudarikov, 1959**

Australapatemon bdellocystis (Lutz, 1921)
Site of infection: small intestine.
Localities: La Plata Zoological Garden (captivity), La Plata, Buenos Aires Province (Argentina).
References: Boero and Led (1968), Ostrowski de Núñez (1992).
Comments: Ostrowski de Núñez (1992) erroneously reported that Boero and Led (1968) found this species in coscoroba swan (*Coscoroba coscoroba* (Molina, 1782)).

Superfamily Echinostomatoidea

Family Echinostomatidae (Looss, 1899) Poche, 1926

***Echinostoma* Rudolphi, 1809**

***Echinostoma mendax* Dietz, 1909**

Site of infection: small intestine.
Locality: not reported (Argentina).
Reference: Boero *et al.* (1972).

***Echinostoma trivolvis* (Cort, 1914)**

Site of infection: small intestine.
Locality: Biobío Region (Chile).
Life history: H1: *Helisoma trivolvis* (Say, 1817) *Lymnaea stagnalis* (Linnaeus, 1758) (and other freshwater gastropods; H2: *Biomphalaria glabrata* (Say, 1818), *Viviparus viviparus* (Linnaeus, 1758) and other freshwater gastropods, mussels (*Anodonta cygnea* (Linnaeus, 1758)) and tadpoles (*Rana temporaria* (Linnaeus, 1758) and *Rana ridibunda* Pallas, 1771).
Reference: Present study.
Comments: New host record and first record from Chile

Superfamily Pamanphistomoidea Fischoeder, 1901

Family Zygocotylidae Ward, 1917

***Zygocotyle* Stunkard, 1917**

***Zygocotyle lunata* (Diesing, 1836) Stunkard, 1917**

Site of infection: cecum.
Localities: Buenos Aires Zoological Garden, Buenos Aires city (captivity); Del Burro lagoon, Buenos Aires Province; Pellegrini Lake, Río Negro Province (Argentina).
Life history: H1: *Biomphalaria peregrina* (d'Orbigny, 1835) (natural host); *H. trivolvis*, *H. anceps* (Menke, 1830), and *H. antrosum* (Conrad, 1834). *B. straminea* (Dunker, 1848), *B. orbignyi* Paraense, 1975, *B. tenagophila* (d'Orbigny, 1835), *B. oligoza* Paraense, 1974, *B. glabrata* (Say, 1818) (Experimental host). No H2- cercariae encyst on vegetation.
Reference: Digiani (1997).
Comments: Ostrowski de Núñez *et al*. (2003) fed mice and chicks with metacercariae released from experimentally infected *B. peregrina* in Argentina and recovered gravid adults.

Superfamily Pronocephaloidea Looss, 1899

Family Notocotylidae Lühe, 1909

***Notocotylus* Diesing, 1839**

***Notocotylus attenuatus* (Rudolphi, 1809) Kossack, 1911**

Site of infection: gizzard, intestine, cecum.
Locality: De Monte lagoon, Buenos Aires Province (Argentina).
Life history: H1: *Physa acuta* Draparnaud, 1805. No H2- cercariae encyst on vegetation.
Reference: Boero *et al.* (1972).
Comments: After an experimental study on infections of this trematode in ducks and rodents, Graczyk and Shiff (1993) felt it was unlikely that transmission in the wild could be dependent on mice and rats.

***Paramonostomum* (Lühe, 1909).**

***Paramonostomum* sp.**

Site of infection: cecum.
Locality: Biobío Region (Chile).
Reference: Present study.
Comments: New host record.

Class Cestoda

Order Cyclophyllidea

Family Hymenolepididae Railliet et Henry, 1909

***Cladogynia* Baer, 1937**

***Cladogynia bulbocirrosus* Pfeiffer, 1960**

Syn.: Hymenosphenacanthus bulbocirrosus Pfeiffer, 1960
Site of infection: small intestine.
Locality: Vienna Zoological Gardens (captivity) (Austria).
Reference: Pfeiffer (1960).
Comments: *C. bulbocirrosus* was found in three *C. melanocoryphus* which died at the Schonbrunn Zoological Gardens at Vienna only three weeks after importation from Buenos Aires, Argentina.

***Gastrotaenia* Wolffhügel, 1938**

***Gastrotaenia cygni* Wolffhügel, 1938**

Site of infection: gizzard lining.
Localities: Montevideo (Uruguay). Biobío Region (Chile).
References: Wolffhügel (1938). Present study.
Comments: First record from Chile.

***Hymenolepis* Weinland, 1858**

***Hymenolepis megalops* (Nitzsch in Creplin, 1829)**

Syn.: *Cloacotaenia megalops* (Nitzsch in Creplin, 1829) Wolfhügel, 1938
Site of infection: cloaca.
Localities: not reported (Brazil). Chascomús, Buenos Aires Province (Argentina).
Life history: H1: *Cypris pubera* Müller, 1776, *Eucypris inflata* Sars, 1903 and *Heterocypris incongruens* (Ramdohr, 1808) (Ostracoda, Cyprididae).
Reference: Muniz-Pereira and Amato (1998), Digiani (2000).

***Microsomacanthus* Lopez–Neyra, 1942**

***Microsomacanthus* sp.**

Site of infection: jejunum, ileum.
Locality: Biobío Region (Chile).
References: Present study.
Comments: New host record and first record from Chile

***Nadejdolepis* Spasskii and Spasskaia 1954**

***Nadejdolepis* sp.**

Site of infection: duodenum, jejunum, and upper ileum.
Locality: Biobío Region (Chile).
Reference: Present study.
Comments: New host record and first record from Chile.

***Retinometra* Spassky, 1955**

***Retinometra* sp.**

Site of infection: small intestine.
Locality: Biobío Region (Chile).
Reference: Present study.
Comments: New host record and first record from Chile

Class Nematoda

Orden Ascaridida

Superfamily Heterakoidea

Family Ascaridiidae Blanchard, 1849

***Ascaridia* Dujardin, 1845**

***Ascaridia* sp.**

Site of infection: small intestine.
Locality: Paris Zoological Garden (France) (captivity).
Reference: Saëz *et al*. (1981).

Family Heterakidae Railliet et Henry, 1914

***Heterakis* Dujardin, 1845**

***Heterakis dispar* Dujardin, 1845**
Syn.: *Ascaris dispar* (Schrank, 1790), *Fussaria dispar* Zeder, 1800
Site of infection: small intestine.
Locality: Lodz Zoological Garden (Poland) (captivity).
Reference: Zuchowska (1997), as *Ganguleterakis dispar* (Schrank, 1790).

Order Enoplida

Superfamily Trichinelloidea

Family Trichuridae

***Capillaria* Zeder, 1800**

***Capillaria droummondi* Travassos, 1915**
Site of infection: small intestine.
Locality: not reported (Brazil).
Reference: Yamaguti (1961).

***Capillaria skrjabini* (Lubimova, 1947) Moravec, 1982**
Syn.: *Thominx skrjabini* Lubimova 1947
Site of infection: small intestine.
Locality: Biobío Region (Chile).
Reference: Present study.
Comments: New host record and first record from Chile

***Baruscapillaria* Moravec, 1982**

***Baruscapillaria obsignata* (Madsen, 1945)**
Site of infection: small intestine.
Locality: not reported.
Reference: Okulewics (1993).

Order Spirurida

Superfamily Acuaridoidea

Family Acuariidae Seurat, 1913

***Echinuria* Solovev, 1912**

***Echinuria uncinata* (Rudolphi, 1819)**
Site of infection: esophagus, proventriculus.
Localities: Paris Zoological Garden (France), Lodz Zoological Garden (Poland), Whipsnade Zoological Garden (UK) (captivity).
References: Saëz *et al*. (1981), Koch *et al*. (1987), Zuchowska (1997).

Superfamily Dracunculoidea

Family Dracunculidae

***Avioserpens* (Wehr & Chitwood, 1934).**

***Avioserpens* sp.**
Site of infection: proventriculus and duodenum.
Locality: Biobío Region (Chile).
Reference: Present study.
Comments: New host record and first record from Chile.

Superfamily Habronematoidea

Family Tetrameridae Travassos, 1914

***Tetrameres* Creplin, 1846**

***Tetrameres fissipina* (Diesing, 1861)**
Syn.: *Tropisurus fissispinus* (Diesing, 1861)
Site of infection: proventriculus.
Locality: not reported.
Reference: Yamaguti (1961).

Order Strongylida

Superfamily Trichostrongyloidea

Family Amidostomatidae Travassos, 1919

***Amidostomum* Railliet and Henry, 1909**

***Amidostomum anseris* (Zeder, 1800)**
Site of infection: gizzard.
Locality: Valdivia, Biobío Region (Chile).
References: Schlatter *et al*. (1991). Present study.

***Epomidiostomum vogelsangi* Travassos, 1937**
Syn.: *Epomidiostomum oriospinum sensu* Khalil and Vogelsang (1932).
Site of infection: gizzard.
Localities: Argentina; Rio Grande do Sur (captivity) (Brazil); Biobío Region (Chile).
References: Khalil and Vogelsang (1932), Yamaguti (1961), Oliveira (1970). Present study.
Comments: Travassos (1937) redescribed the worms collected by Khalil and Vogelsang (1932) from a captive swan in Argentina. This is the first record from swans in the wild and from Chile.

Class Euhirudinea

Subclass Branchiobdellidea Holt, 1965

Order Rhynchobdellida Blanchard, 1894

Family Glossiphonidae Vaillant, 1890

***Theromyzon* Philippi, 1867**

***Theromyzon tessulatum* (O. F. Müller, 1774)**
Site of infection: nostrils, mouth and body.
Locality: Cheshire (England) (captivity).
Reference: Curtis and Britt (1991).

Class Acarina

Order Astigmata Canestrini, 1891

Family Psoroptoididae Gaud and Atyeo, 1982

***Cygnocoptes* Fain and Bochkov, 2003**

***Cygnocoptes prasadi* Fain and Bochkov, 2003**
Site of infection: feather.
Locality: not reported (Argentina).
Reference: Fain and Bochkov (2003).
Comments: Fain and Bochkov established this genus in the content of the family Pyroglyphidae, but later Mironov (2007) moved it to the Psoroptoididae. The bird died in quarantine, import from Argentina.

Family Xolalgidae Dubinin, 1953

***Ingrassia* Oudemans, 1905**

***Ingrassia cygni* Mironov and Galloway, 2002**
Site of infection: feather.
Locality: Biobío Region (Chile).
Reference: Present study.
Comments: New host record and first record from Chile

Order Mesostigmata Canestrini, 1891

Family Rhinonyssidae Trouessart, 1895

***Rhinonyssus* Trouessart, 1895**

***Rhynonyssus rhinolethrum* (Trouessart, 1895)**
Site of infection: Nasal fossae.
Locality: Pelotas (Brazil).
Reference: Mascarenhas *et al*. (2009).

Class Insecta

Order Phthiraptera Haeckel, 1896

Suborder Ischnocera Kellogg, 1896

Family Philopteridae Burmeister, 1838

***Anatoecus* Cummings, 1916**

***Anatoecus penicillatus* Kéler, 1960**

Site of infection: contour feathers, mostly on pterylae of the head and upper neck.
Locality: Biobío Region (Chile).
Reference: Present study.
Comments: This species was previously known only from type *C. olor*. New host record and first record from Chile.

***Anatoecus icterodes* (Nitzsch, 1818)**

Site of infection: contour feather, mostly on pterylae of the head and upper neck.
Locality: Biobío Region (Chile).
Reference: Present study.
Comments: New host record.

***Anatoecus keymeri* Clay, 1974**

Site of infection: contour feather, mostly on pterylae of the head and upper neck.
Localities: La Plata Zoological Garden (captivity), La Plata; Laguna de Guaminí, Buenos Aires Province (Argentina)
Reference: Present study.
Comments: A frequent parasite of chilean flamingo (*Phoenicopterus chilensis* Molina, 1782) (Aves: Phoenicopteridae).

***Ornithobius* Denny, 1842**

***Ornithobius bucephalus* (Giebel, 1874)**

Site of infection: mostly wing feathers: primaries, secondaries, wing coverts; also in pterylae surrounding this area: scapulars, interscapulars and upper breast.
Localities: Buenos Aires Zoological Garden (Argentina), London Zoological Garden (England).
References: Castro and Cicchino (1996), Arnold (2005).
Comments: Probably these records are due to secondary infestations from its true host, *C. olor* because both swan species are frequently confined in the same reduced habitats in Zoological Gardens where they breed freely, as we observed repeatedly in Argentina.

***Ornithobius pricei* Arnold, 2005**

Site of infection: mostly wing feathers: primaries, secondaries, wing coverts; also in pterylae surrounding this area: scapulars, interscapulars and upper breast.
Localities: Laguna Garzon, Rocha (Uruguay), Buenos Aires Province, districts of Bahía Blanca, Guaminí and Pila (Argentina), Biobío Region (Chile).
References: Arnold (2005). Present study.
Comments: First record from Chile

Suborder Amblycera Kellogg, 1896

Family Menoponidae Mjöberg, 1910

***Holomenopon* Eichler, 1941**

***Austromenopon brevithoracicum* (Piaget, 1880).**

Site of infection: contour feathers, frequently found wandering in the breast and abdominal apterya.
Localities: Paraguay, Brazil, Argentina (Buenos Aires, Chubut and Tierra del Fuego Provinces), Biobío Region (Chile).
References: Cicchino and Castro (1998), Castro and Cicchino (1996), Brum *et al*. (2005). Present study.
Comments: First record from Chile.

Discussion

To date, 23 publications are available on parasites infecting black-necked swans, 16 of them referring to endoparasites and 7 to ectoparasites. The first species of parasite reported in *C. melanocoryphus* was *Epomidiostomum orispinum* (Trichostrongylidae) in 1932 by Khalil and Vogelsang (1932), which was later described as a new species, *E. vogelsangi*, by Travassos (1937). The most recent was *Rhinonyssus rhinolethrum* (Rhynonissidae) by Mascarenhas *et al*. in 2009. However, Wolffhügel isolated the cestode *Gastrotaenia cygni* in 1916 from *C. melanocoryphus* long before formally describing it in 1938. William and Olsen (1969) attributed the 22 year time lapse to the fact that Wolffhügel wanted "to be sure". Later Williams & Olsen (op. cit.) also gave a renewed diagnosis of the genus *Gastrotaenia* and noted its wide host and geographical distribution.

In the present work, we reported 32 parasites (23 helminths and 9 ectoparasites) in black necked swans. Of these, 12 are reported for the first time in Chile and 11 represent new host records: *Echinostoma trivolvis, Paranomostomum sp., G. cygni, Microsomacanthus* sp., *Nadejdolepis, Retinometra* sp., *Avioserpens* sp., *Capillaria skrjabini, Ingrassia cygni, Anatoecus penicillatus, A. icterodes* and *A. keymeri*. Including these new records, a total of 17 families, 26 genera, and 32 species of parasites have been reported from this host. Of them 11 have been recorded only in Chile (8 endoparasites and 3 ectoparasites), 6 only in Argentina (4 endoparasites and 2 ectoparasites). Five parasites are known only from captive swans in European zoos.

Although studies on the food habits of black-necked swans (e.g. Corti & Schlatter, 2002) have shown that they feed primarily on aquatic plants, many of the parasites reported here have indirect life cycles requiring invertebrate intermediate hosts. This indicates that invertebrates may be a more important part of the diet than previously known.

Numerous previous reports of parasites from black-necked swans were not accompanied by descriptions of the parasites and voucher specimens were not deposited.

In spite of the great variety of helminths reported (n=23) in *C. melanocoryphus*, little is known about the life cycle of these parasites. Life cycles of only 5 species of helminths have been partially or completely described, which indicates that further research is greatly needed.

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