

# Helminth and arthropod parasites of the brown pelican, *Pelecanus occidentalis*, in Puerto Rico, with a compilation of all metazoan parasites reported from this host in the Western Hemisphere

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Seven species of helminths and six species of arthropods are reported from 23 of 40 brown pelicans, *Pelecanus occidentalis*, collected from various localities in Puerto Rico. Helminth parasites include three nematodes (*Contraecaecum multipapillatum*, *Contraecaecum mexicanum*, and *Eustrongylides* sp.), three trematodes (*Galactosomum darbyi*, *Mesostephanus appendiculatoides*, and *Ribeiroia ondatrae*), and one cestode (*Tetrabothrium sulae*). Arthropod parasites include *Colpocephalum occidentale*, *Neottialges apunctatus*, *Ornithodoros capensis*, *Phalacrodectus pelecani*, *Phalacrodectus punctatissimus*, and *Phalacrodectus* sp. The presence of *R. ondatrae* in the brown pelican is a new species host record, and *P. pelecani*, *P. punctatissimus* and *N. apunctatus* are new subspecies host records. *C. multipapillatum*, *C. mexicanum*, *G. darbyi* and *M. appendiculatoides* are new locality records for Puerto Rico, and *N. apunctatus*, *P. pelecani*, *P. punctatissimus* and *T. sulae* are new locality records for the Caribbean. Necrosis produced by *C. multipapillatum*, *C. mexicanum*, and *R. ondatrae* may have contributed to the emaciation and death of the brown pelicans examined in the present study.

## Introduction

The high prevalence of morbidity and mortality of brown pelicans, *Pelecanus occidentalis*, in Puerto Rico has held this population at the endangered species level (Norton, 1988; Williams, 1989a,b; Williams *et al.*, 1992). There is an urgent need to determine the cause of this unusual mortality among brown pelicans and to ascertain the threat posed to this population by infectious diseases, parasites, and

pollution. We stress the importance of initiating studies to determine the dietary patterns associated with the various age groups of brown pelicans, the prevalence and intensity of parasitic infections, and possible differences in parasitic faunas associated with age and geographical localities.

With the exception of comprehensive surveys of the helminth parasites infecting brown pelicans in Florida and Louisiana (Courtney & Forrester, 1974; Humphrey *et al.*, 1978), most reports have been

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**Table 1.** Helminths and arthropods recorded from brown pelicans in the Western Hemisphere

Species	Geographic locality	Reference
<b>Acanthocephala</b>		
<i>Corynosoma</i> sp.	Florida	Courtney & Forrester (1974)
<i>Southwellina hispida</i> (Van Cleave, 1925)	Florida, Louisiana	Courtney & Forrester (1974)
<b>Cestoda</b>		
<i>Cyclusteria ibisae</i> (Schmidt & Bush, 1972)	Florida, Louisiana Cuba	Courtney & Forrester (1974) Rysavy & Macko (1971)
<i>Paratetrabothrius orientalis</i> Yamaguti, 1940	Mexico	Flores-Barroeta (1955)
<i>Parvitaenia heardi</i> Schmidt & Courtney, 1973	Florida, Louisiana Cuba	Courtney & Forrester (1974) Rysavy & Macko (1971)
<i>Tetrabothrius sulae</i> (Baird, 1853)	Mexico	Flores-Barroeta <i>et al.</i> (1958)
<i>Tetrabothrius</i> sp.	Florida, Louisiana	Courtney & Forrester (1974)
<b>Nematoda</b>		
<i>Capillaria</i> sp. like <i>contorta</i>	Florida, Louisiana	Courtney & Forrester (1974)
<i>Capillaria</i> sp. like <i>mergi</i>	Florida	Courtney & Forrester (1974)
<i>Contracaecum mexicanum</i> Flores-Barroeta, 1957	Mexico Venezuela	Flores-Barroeta (1957) Diaz-Ungria (1979)
<i>Contracaecum multipapillatum</i> (von Drasche, 1882)	Puerto Rico Florida, Louisiana Deardorff & Overstreet (1980)	Present study Courtney & Forrester (1974)
<i>Contracaecum rudolphii</i> Hartwich, 1964	Florida, Louisiana Florida Florida Florida Puerto Rico	Present study Courtney & Forrester (1974) Hutton (1964) Huizinga (1966, 1971) Courtney & Forrester (1977) Bunkley-Williams & Williams (1994)
<i>Contracaecum</i> sp.	Peru	Vásquez & Chávez-García (1962)
<i>Cosmocephalus obvelatus</i> (Crepl., 1825)	Florida, Louisiana	Courtney & Forrester (1974)
<i>Cyathostoma phenisci</i> Baudet, 1937	Florida	Courtney & Forrester (1974)
<i>Eustrongylides</i> sp.	Puerto Rico	Present study
<i>Paracuaria tridentata</i> (Linstow, 1877)	Florida, Louisiana	Courtney & Forrester (1974)
<i>Physaloptera maxillaris</i> Molin, 1860	Mexico	Flores-Barroeta (1957)
<i>Physaloptera</i> sp.	Florida	Courtney & Forrester (1974)
<i>Syngamus</i> sp.	Peru	Vásquez & Chávez-García (1962)
<i>Synhimantus invaginatus</i> (Linst., 1901)	Louisiana	Courtney & Forrester (1974)
<i>Tetrameres inerme</i> (Alegret, 1941)	Florida	Courtney & Forrester (1974)
<b>Trematoda</b>		
<i>Ascocotyle (Leighia)</i> sp.	Florida	Courtney & Forrester (1974)
<i>Austrobilharzia</i> sp.	Florida	Courtney & Forrester (1974)
<i>Bolbophorus confusus</i> (Krause, 1914)	Arkansas, Louisiana, Mississippi Mississippi	Mitchell & Dupree (2000) Coblentz (2000)
<i>Bursacetabulus pelecanus</i> Dronen <i>et al.</i> , 1999	Texas	Dronen <i>et al.</i> (1999)
<i>Bursatintinnabulus macrobursus</i> Dronen <i>et al.</i> , 1999	Texas	Dronen <i>et al.</i> (1999)
<i>Carneophallus turgidus</i> Leigh, 1958	Florida	Courtney & Forrester (1974)
<i>Echinochasmus</i> sp. like <i>dietzevi</i>	Florida	Courtney & Forrester (1974)
<i>Galactosomum darbyi</i> Price, 1934	Dominican Republic Florida, Louisiana Florida Florida Puerto Rico	Price (1934) Courtney & Forrester (1974) Pearson (1973) Courtney & Forrester (1977) Present study
<i>Galactosomum fregatae</i> Prudhoe, 1949	Florida	Courtney & Forrester (1974, 1977)

Table 1. (Continued)

Species	Geographic locality	Reference
<b>Trematoda (Continued)</b>		
<i>Galactosomum puffini</i> Yamaguti, 1949	Panama	Caballero <i>et al.</i> (1953)
	Panama	Hutton & Sogandares-Bernal (1960)
<i>Galactosomum</i> sp.	Florida	Hutton & Sogandares-Bernal (1960)
	Florida	Hutton (1964)
<i>Gigantobilharzia</i> sp.	Florida	Leigh (1957)
<i>Mesostephanus appendiculatoides</i> (Price, 1934)	Dominican Republic	Price (1934)
	Panama	Caballero <i>et al.</i> (1953)
	Florida	Hutton & Sogandares-Bernal (1960)
	Florida	Hutton (1964)
	Florida	Courtney & Forrester (1977)
	Florida, Louisiana	Courtney & Forrester (1974)
	Puerto Rico	Present study
<i>Mesostephanus microbursa</i> Caballero <i>et al.</i> , 1953	California, Mexico	Caballero <i>et al.</i> (1953)
	Panama	Caballero <i>et al.</i> (1953)
	Florida, Louisiana	Courtney & Forrester (1974)
<i>Mesostephanus yedeeae</i> Dennis, 1970	Florida	Dennis (1968)
<i>Microparyphium facetum</i> Dietz, 1909	Florida	Courtney & Forrester (1974)
<i>Paracoenogonimus ovatus</i> Katsurada, 1914	Unknown	Odening (1963)
<i>Phagicola longus</i> (Ransom, 1920)	Florida	Hutton & Sogandares-Bernal (1960)
	Florida	Hutton (1964)
	Florida, Louisiana	Courtney & Forrester (1974)
	Florida	Courtney & Forrester (1977)
<i>Phagicola</i> sp. like <i>minutus</i>	Florida, Louisiana	Courtney & Forrester (1974)
<i>Phagicola</i> sp.	Florida	Courtney & Forrester (1977)
<i>Pholeter anterouterus</i> Fischthal & Nasir, 1974	Florida	Pearson & Courtney (1977)
<i>Renicola thapari</i> Caballero <i>et al.</i> , 1953	Panama	Caballero <i>et al.</i> (1953)
	Florida	Courtney & Forrester (1974)
<i>Ribeiroia ondatrae</i> (Price, 1931)	Puerto Rico	Present study
<i>Stephanoprora denticulata</i> (Price, 1934)	Florida, Louisiana	Courtney & Forrester (1974)
	Florida	Courtney & Forrester (1977)
<b>Arthropoda</b>		
<i>Colpocephalum occidentalis</i> Price, 1967	Puerto Rico	Price (1967), present study
	Columbia, Cuba, Gulf of California (Mexico), Panama	Price (1967)
	California, Florida, Louisiana, Mississippi, Puerto Rico, Texas	Price (1967)
<i>Neottialges apunctatus</i> (Pence & Courtney, 1973)	Florida, Louisiana	Pence & Courtney (1973)
	Puerto Rico	Present study
<i>Ornithodoros (Alectorobius) capensis</i> Neuman, 1901	St Martin	Kohls (1969)
	Texas	King <i>et al.</i> (1977)
	Peru	Duffy (1983)
	Georgia, North & South Carolina	Keirans <i>et al.</i> (1992)
	Puerto Rico	Present study
<i>Pectinogygus occidentalis</i> Thompson, 1948	Jamaica	Thompson (1948)
	Florida	Dunn (1996)
<i>Phalacrodectes pelecani</i> (Pence & Courtney, 1973)	Florida, Louisiana	Pence & Courtney (1973)
	Puerto Rico	Present study
<i>Phalacrodectes punctatissimus</i> Cerný, 1969	Florida, Louisiana	Pence & Courtney (1973)
	Puerto Rico	Present study
<i>Piagetiella bursaepelecani</i> (Perry, 1876)	Florida	Perry (1876)
	Florida	Deyrup & Franz (1994)
<i>Piagetiella chilensis</i> (Grosse, 1885)	Chile	Grosse (1885, 1886)
<i>Womersia strandtmanni</i> Wharton, 1947	Texas	Vercammen-Grandjean & Kolebinova (1968)

restricted to descriptions of new parasite species, life history studies of a single species, or the examination of small numbers of brown pelicans for parasites (Table 1). Because of the endangered species status of the brown pelican in Puerto Rico, comparatively little information is available on its parasites.

## Materials and Methods

Because the brown pelican is an endangered species in Puerto Rico, we were restricted to the examination of stranded, dying, or dead specimens. We examined 40 brown pelicans between 1988 and 1996 from different localities in Puerto Rico (Table 2). Due to the rapid deterioration of specimens and their parasites in the tropics, 17 of the brown pelicans examined lacked parasites, and those with parasites probably lost many species and numbers before they were examined. Examinations were conducted at two local stranding networks, a US Fish and Wildlife station, two university parasitology laboratories, and the National Wildlife Health Center. Although some variation occurred in the methods and goals of these examinations, the parasite data could be collated.

Standard methods were followed in examining brown pelicans, recovering and processing parasites, and in identifying parasites. Voucher specimens were deposited in the US National Parasite Collection, Beltsville, MD, USA. Federal and local permits to handle endangered birds were obtained from US Fish and Wildlife Service and the Department of Natural and Environmental Resources, respectively, issued in the beginning of this study to the Caribbean Stranding Network, and later to the Caribbean Center for Marine Studies.

## Results and Discussion

There are reports of 56 metazoan parasites from brown pelicans in the Western Hemisphere, including 24 trematodes, five cestodes, 16 nematodes, two acanthocephalans, and nine arthropods (Table 1). This report is based on a collection of helminths and arthropods recovered from 23 brown pelicans out of 40 (57.5%) examined in Puerto Rico. Included are new host and geographical range extension records. In the present study, we found three species of trematodes, one of cestode, three of nematodes and six species of arthropods (Table 2). Acanthocephalans were not detected.

The most prevalent helminths were two species of the anisakid nematode genus *Contracaecum*, which were detected in all parasite-infected brown pelicans, including 22 (55%) with *Contracaecum multipapillatum* (Drasche, 1882) and one (2.5%) with *Contracaecum mexicanum* (Flores-Barroeta, 1957). These nematodes ranged from 11 to 3500 specimens per host and, while the usual site of infection is the proventriculus, many migrated into the esophagus and intestine after death of the host. While some *Contracaecum* were found free in the lumen of the proventriculus, others had migrated into the mucosa, where they produced minor to extensive areas of necrosis. Bacterial isolates from these lesions were negative. Histological preparations of these lesions were not saved, deposited, or photographed, but the diagnosis was made by staff histopathologists/veterinarians (National Wildlife Health Center (NWHC), unpublished case report). This necrosis

may have contributed to the emaciation and death of the brown pelicans examined in the present study (Ernest H. Williams, unpublished data).

Species of *Contracaecum* are cosmopolitan and have been reported in a wide variety of fishes, birds, and piscivorous mammals (Yamaguti, 1961). Huizinga (1971) reported that *C. multipapillatum* and *Contracaecum rudolphii* (Hartwich, 1964) cause gross haemorrhage and ulceration on penetration of the mucosa of the proventriculus of peleciform birds collected in Connecticut, Florida, and South Dakota. In the present study, the food bolus within the proventriculus contained migrating worms. Huizinga (1971) made a similar observation and commented that the migration of worms through the food bolus in the proventriculus appears to aid the bird's digestive process by mechanically breaking up and facilitating the entrance of digestive enzymes into the food. The phenomenon of parasitic and mutualistic tendencies in *Contracaecum* is another example of the overlap between the various categories of symbiotic relationships given by Cheng (1970).

The finding of *C. multipapillatum* and *C. mexicanum* in brown pelicans of Puerto Rico constitutes a new geographical locality record for these nematodes. Bunkley-Williams & Williams (1994) reported *Contracaecum spiculigerum* (now *C. rudolphii*) from brown pelicans in Puerto Rico. Brown pelicans in Puerto Rico are infected with a complex of species of *Contracaecum*. Larval *Contracaecum* spp. are common in the tissues of freshwater fishes (Williams & Bunkley-Williams, 1994) and marine fishes (Lucy Bunkley-Williams and Ernest H. Williams, unpublished data) in Puerto Rico. These forms infect brown pelicans after the fishes are ingested.

Several specimens of *Eustrongylides* sp. were found on the external surface of the serosa of the proventriculus of two brown pelicans. Species of this genus have a wide host spectrum in birds from widely separated geographical localities (Yamaguti, 1961). Our specimens were in poor condition and could not be identified to the species level, but a search of the literature failed to reveal a report of this nematode in pelicans. These worms cause epizootics in nesting wading birds (Spalding *et al.*, 1993). Immature forms of *Eustrongylides ignotus* (Jägerskiöld, 1909) were reported as a new Caribbean record in Puerto Rican fishes by Bunkley-Williams & Williams (1994). This species may be the same as that in the brown pelican.

Four brown pelicans (10%) were infected with one to three cestodes identified as *Tetrabothrius sulae* (Baird, 1853). This species was collected by Flores-Barroeta *et al.* (1958) from a single *Pelecanus occidentalis carolinensis* in Veracruz, Mexico. Hence, our record is the second report of this tapeworm from a brown pelican. Its occurrence in Puerto Rico represents a new record for the Caribbean.

**Table 2.** Metazoan parasites collected from 23 infected brown pelicans in Puerto Rico from 1988 to 1996

Parasite species	Intensity	Locality	Anatomical location	US National Parasite Collection number
<b>Digenea</b>				
<i>Galactosomum darbyi</i>				
1 host infected	1	Lajas	Small intestine	88953
<i>Mesostephanus appendiculatoides</i>				
2 hosts infected	5–11	La Parguera	Small intestine	
1 host infected	3	Juana Díaz	Small intestine	
1 host infected	15	Lajas	Small intestine	88952
<i>Ribeiroia ondatrae</i>				
1 host infected	1	Juana Díaz	Small intestine	
1 host infected	15	Lajas	Small intestine	88951
<b>Cestoda</b>				
<i>Tetrabothrius sulae</i>				
2 hosts infected	1–2	La Parguera	Small intestine	90281, 92283
2 hosts infected	1–3	Mayagüez	Small intestine	
<b>Nematoda</b>				
<i>Contracaecum mexicanum</i>				
1 host infected	11	Rincón	Esophagus	88111
<i>Contracaecum multipapillatum</i>				
6 hosts infected	200–3500	La Parguera	Proventriculus	90276–7, 90280, 90282, 90286, 90288
4 hosts infected	750–3500	Lajas	Proventriculus	88961, 90287, 90297–8
3 hosts infected	500–2000	Cabo Rojo	Proventriculus	90284, 90289, 90290
3 hosts infected	100–1500	Mayagüez	Proventriculus	90278, 90292, 90294
2 hosts infected	800–1200	Ponce	Proventriculus	90293, 90295
2 hosts infected	1000–2500	San Juan	Proventriculus	90291, 90296
1 host infected	110	Aguadilla	Proventriculus	90279
1 host infected	1500	Juana Díaz	Proventriculus	90285
<i>Eustrongylides</i> sp.				
1 host infected	3	Juana Díaz	Proventriculus	
1 host infected	2	Lajas	Proventriculus	88962
<b>Arthropoda</b>				
<i>Colpocephalum occidentalis</i>				
6 hosts infected	— <sup>b</sup>	La Parguera	Feathers, skin, external	92337
4 hosts infected	— <sup>b</sup>	Lajas	Feathers, skin, external	
3 hosts infected	— <sup>b</sup>	Cabo Rojo	Feathers, skin, external	
3 hosts infected	— <sup>b</sup>	Mayagüez	Feathers, skin, external	
2 hosts infected	— <sup>b</sup>	Ponce	Feathers, skin, external	
2 hosts infected	— <sup>b</sup>	San Juan	Feathers, skin, external	
1 host infected	— <sup>b</sup>	Aguadilla	Feathers, skin, external	
1 host infected	— <sup>b</sup>	Juana Díaz	Feathers, skin, external	
1 host infected	— <sup>b</sup>	Rincón	Feathers, skin, external	
<i>Neotialges apunctatus</i>				
1 <sup>a</sup> host infected	— <sup>b</sup>	Cabo Rojo	Subcutaneous	
1 <sup>a</sup> host infected	— <sup>b</sup>	Juana Díaz	Subcutaneous	
1 <sup>a</sup> host infected	— <sup>b</sup>	Lajas	Subcutaneous	
<i>Ornithodoros capensis</i>				
6 hosts infected	— <sup>b</sup>	La Parguera	Feathers, skin, external	
4 hosts infected	— <sup>b</sup>	Lajas	Feathers, skin, external	
3 hosts infected	— <sup>b</sup>	Cabo Rojo	Feathers, skin, external	
3 hosts infected	— <sup>b</sup>	Mayagüez	Feathers, skin, external	
2 hosts infected	— <sup>b</sup>	Ponce	Feathers, skin, external	
2 hosts infected	— <sup>b</sup>	San Juan	Feathers, skin, external	
1 host infected	— <sup>b</sup>	Aguadilla	Feathers, skin, external	
1 host infected	— <sup>b</sup>	Juana Díaz	Feathers, skin, external	
1 host infected	— <sup>b</sup>	Rincón	Feathers, skin, external	
<i>Phalacrodes pulex</i>				
1 <sup>a</sup> host infected	— <sup>b</sup>	Juana Díaz	Subcutaneous	
<i>Phalacrodes punctatissimus</i>				
1 <sup>a</sup> host infected	— <sup>b</sup>	Juana Díaz	Subcutaneous	
1 <sup>a</sup> host infected	— <sup>b</sup>	Lajas	Subcutaneous	
<i>Phalacrodes</i> sp.				
1 <sup>a</sup> host infected	— <sup>b</sup>	Lajas	Mesenteries	

<sup>a</sup> Only four brown pelican specimens were properly examined for these parasites, and all four were infected.<sup>b</sup> Intensity not determined.

Of the three species of trematodes encountered, *Mesostephanus appendiculatoides* (Price, 1934) was the most prevalent, occurring in four (10%) of the brown pelicans with a range of three to 15 specimens. This species was described by Price (1934) as *Prohemistomum appendiculatoides* from *Pelecanus occidentalis occidentalis* in Samana Bay, Dominican Republic. It was re-described by Cable *et al.* (1960) from a brown booby, *Sula leucogaster leucogaster*, collected in Lajas (La Parguera), Puerto Rico. This species is morphologically similar to *Mesostephanus fajardensis* (Price, 1934) from *Sula leucogaster* in Fajardo Roads, between Palominos Island and Fajardo, Puerto Rico. It is curious that the only brown booby examined by Cable *et al.* (1960) harbored two specimens of *M. appendiculatoides* and several hundred *M. fajardensis*. The finding of *M. appendiculatoides* in the brown pelican in Puerto Rico is a range extension for this host.

*Ribeiroia ondatrae* (Price, 1931) occurred in two of 40 (5%) brown pelicans, with a range of one to 15 specimens. This trematode was detected deep in the mucosa of the proventriculus. The 15 specimens produced necrosis in the proventriculus in the tissue immediately surrounding the parasites. Bacterial isolates from these lesions were negative. Histological preparations of these lesions were not saved, deposited, or photographed, but the diagnosis was made by staff histopathologists/veterinarians (NWHC, unpublished case report). The parasite is known from several species of birds in widely separated geographical localities of the Western Hemisphere (Yamaguti, 1961). The original diagnosis was given by Price (1931), who referred to it as *Psilostomum ondatrae* from the liver of the muskrat, *Ondatra zibethicus*. Beaver (1939) re-examined Price's specimens and found them to be in poor condition. He amended the original description and commented that its occurrence in the liver seemed questionable as it is well established that the proventriculus is the normal habitat for *R. ondatrae*. Beaver also studied the life cycle and reported that snails and freshwater fish act as intermediate hosts. The prevalence of this worm its final hosts, such as the brown pelican, was low; and the prevalence in the intermediate fish hosts may also assumed to be low, as Bunkley-Williams & Williams (1994) failed to find this worm in Puerto Rican freshwater fishes. This low prevalence may explain the few, scattered reports of this worm in the Caribbean.

Riggin (1956) studied the life history of *R. ondatrae* in Puerto Rico and found natural infections in two of eight green herons (*Butorides virescens*), one from Trujillo Alto and the other from La Torrecilla Lagoon in Carolina and Loíza, Puerto Rico (near San Juan). More recently, Cable *et al.* (1960) reported *R. ondatrae* in *Florida caevulea caevulea* (=little blue heron, *Egretta caerulea*) from Boquerón, Puerto Rico. Our specimens are similar to

those found by Cable *et al.* (1960) but were detected in the intestine rather than the proventriculus. Their occurrence in this location may have been due to migration following death of the host. The finding of *R. ondatrae* in the brown pelican constitutes a new host record. Our new host record supports the suggestion of Cable *et al.* (1960) that low host specificity in all stages of the life cycle, rather than the migratory habitats of the definitive host, seems to be responsible for the occurrence of *R. ondatrae* in distant locations. Necrosis produced by *C. multipapillatum*, *C. mexicanum* and *R. ondatrae* may have contributed to the emaciation and death of some brown pelicans examined in this study (Ernest H. Williams, unpublished data). As pointed out by Peirce (1989), the degree to which parasites are pathogenic is frequently difficult to assess accurately, since sick or dying wild birds rapidly fall victim to predators or their carcasses go undetected.

One (2.5%) brown pelican contained a single *Galactosomum darbyi* (Price, 1934) in the intestine; a species originally described as *G. darbyi* in brown pelicans from Dominica. This is the second report of this species in the brown pelican, and its occurrence in Puerto Rico is a geographic range extension.

Pence & Courtney (1973) described the subcutaneous mites *Pelecanectes* (= *Neottialges*) *apunctatus* and *Phalacrodoctes pelecani*, and re-described *Phalacrodoctes punctatissimus* from *P. occidentalis carolinensis* collected in Florida and Louisiana. In the present study, *P. pelecani* was found in one, *P. punctatissimus* in two, *N. apunctatus* in three, and *Phalacrodoctes* sp. in one of all four brown pelicans carefully examined for these parasites. These species were probably overlooked in most gross examinations. Our reports for *P. occidentalis occidentalis* represent new subspecies host records for all three species of parasites; and new Caribbean locality records for each species of parasite.

We found one species of external tick (*Ornithodoros capensis*) and one species of biting lice (*Colpocephalum occidentale*) on the 23 specimens of brown pelicans examined. Samples were taken and identified, but complete counts were not made. The few remaining on dead birds were probably not indicative of the numbers in life, and the priority with live birds was treatment to remove lice and ticks, not collection and counting. The 17 brown pelican specimens lacking parasites were most probably infested with ticks and lice, but these were probably lost due to rough handling and the deteriorated condition of these birds. Bird ticks and lice often leave the host soon after it dies. Puerto Rican fishermen commonly report that local brown pelicans have many ticks and lice (J.A. Mari Mutt, University of Puerto Rico at Mayagüez, personal communication, 2000). Price (1967) reported *C. occidentale* from the brown pelican in Puerto Rico and Cuba, and Kohls (1969) reported *O. capensis* from the brown pelican in St Martin. The present report appears to be the first published of this tick

on the brown pelican in Puerto Rico, but this parasite has been previously reported on other bird species in Puerto Rico.

The contribution of parasites to the high morbidity and mortality of brown pelicans in Puerto Rico, that has held the population at the endangered species level, is difficult to ascertain. While theoretical models of host–parasite associations have been used to assess the regulatory influence of parasites on host population growth (Anderson, 1978), the knowledge needed to model a parasitic infection requires information on numerous parameters not available in this study.

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## RÉSUMÉ

### Helminthe et arthropode, parasites du pélican brun, *Pelecanus occidentalis*, à Porto Rico avec une compilation de tous les parasites métazoaires décrits chez cet hôte dans l'hémisphère Ouest

Sept espèces d'helminthes et six espèces d'arthropodes ont été décrites à partir de 23 des 40 pélicans bruns, *Pelecanus occidentalis*, provenant de différentes localités de Porto Rico. Les helminthes parasites comprennent trois nématodes (*Contracaecum multipapillatum*, *C. mexicanum* et *Eustrongylides* sp.), trois trématodes (*Galactosomum*

*darbyi*, *Mesostephanus appendiculatoïdes*, et *Ribeiroia ondatrae*) et un cestode (*Tetrabothrium sulae*). Les arthropodes parasites comprennent *Colpocephalum occidentale*, *Neottialges apunctatus*, *Ornithodoros capensis*, *Phalacrodectus pelecani*, *P. punctatissimus* et *Phalacrodectus* sp. Le pélican brun est un nouvel hôte décrit pour *R. ondatrae*, *P. pelecani*, *P. punctatissimus* et *N. apunctatus*. En ce qui concerne *Contracaecum multipapillatum*, *C. mexicanum*, *G. darbyi* et *M. appendiculatoïdes*, ces espèces sont nouvellement décrites à Porto Rico et *N. apunctatus*, *P. pelecani*, *P. punctatissimus* et *T. sulae* sont nouvellement décrites aux Caraïbes. La nécrose produite par *C. multipapillatum*, *C. mexicanum* et *R. ondatrae* peut avoir contribué à l'émaciation et à la mort des pélicans bruns examinés dans cette étude.

## ZUSAMMENFASSUNG

### Parasitische Helminthen und Arthropoden des Braunpelikans, *Pelecanus occidentalis*, in Puerto Rico, mit einer Zusammenstellung aller in der westlichen Hemisphäre bei diesem Wirt beschriebenen metazoischen Parasiten

Sieben Helminthen- und sechs Arthropoden-Spezies wurden bei 23 von 40 Braunpelikanen (*Pelecanus occidentalis*) aus verschiedenen Gegenden in Puerto Rico beschrieben. Die parasitischen Helminthen umfassen drei Nematoden (*Contracaecum multipapillatum*, *C. mexicanum* und *Eustrongylides* sp.), drei Trematoden (*Galactosomum darbyi*, *Mesostephanus appendiculatoïdes* und *Ribeiroia ondatrae*) und einen Cestoden (*Tetrabothrium sulae*). Die parasitischen Arthropoden umfassen *Colpocephalum occidentale*, *Neottialges apunctatus*, *Ornithodoros capensis*, *Phalacrodectus pelecani*, *P. punctatissimus* und *Phalacrodectus* sp. Das Vorhandensein von *R. ondatrae* im Braunpelikan bedeutet eine neue Spezies in Bezug auf den Wirt, und *P. pelecani*, *P. punctatissimus* und *N. apunctatus* sind neue Subspezies in Bezug auf den Wirt. *Contracaecum multipapillatum*, *C. mexicanum*, *G. darbyi* und *M. appendiculatoïdes* sind neu in Bezug auf die Fundstellen in Puerto Rico, und *N. apunctatus*, *P. pelecani*, *P. punctatissimus* und *T. sulae* sind neu in Bezug auf die Lokalisierung in der Karibik. Die durch *C. multipapillatum*, *C. mexicanum* und *R. ondatrae* verursachte Nekrose könnte zu der Abmagerung und zum Tod der in dieser Studie untersuchten Braunpelikane beigetragen haben.

## RESUMEN

### Parásitos helmínticos y artrópodos en el pelícano pardo, *Pelecanus occidentalis*, en Puerto Rico, con una compilación de todos los parásitos metazoarios descritos en este huésped en el hemisferio occidental

Se describen siete especies de helmintos y seis especies de artrópodos de 23 de 40 pelícanos pardos, *Pelecanus occidentalis*, recogidos en varias localidades de Puerto Rico. Los parásitos helmínticos incluían tres nemátodos (*Contracaecum multipapillatum*, *C. mexicanum* y *Eustrongylides* sp.), tres trématodos (*Galactosomum darbyi*, *Mesostephanus appendiculatoïdes*, y *Ribeiroia ondatrae*) y un cestodo (*Tetrabothrium sulae*). Los parásitos artrópodos incluyen *Colpocephalum occidentale*, *Neottialges apunctatus*, *Ornithodoros capensis*, *Phalacrodectus pelecani*, *P. punctatissimus* y *Phalacrodectus* sp. La presencia de *R. ondatrae* en el pelícano pardo es un registro de una nueva especie huésped y *P. pelecani*, *P. punctatissimus* y *N. apunctatus* son registros de nuevas subespecies. *Contracaecum multipapillatum*, *C. mexicanum*, *G. darbyi* y *M. appendiculatoïdes* son nuevos registros locales de Puerto Rico y *N. apunctatus*, *P. pelecani*, *P. punctatissimus* y *T. sulae* son nuevos registros locales del Caribe. La necrosis producida por *C. multipapillatum*, *C. mexicanum* y *R. ondatrae* puede haber contribuido a la demacración y muerte de los pelícanos pardos examinados en este estudio.