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A COPROLOGICAL SURVEY OF HELMINTH PARASITES OF THE HAWAIIAN MONK SEAL FROM THE NORTHWESTERN HAWAIIAN ISLANDS

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ABSTRACT

In conjunction with an Hawaiian monk seal, *Monachus schauinslandi*, breeding enhancement program, fecal samples were examined for the presence of helminth parasite products (eggs, larvae, and proglottids). Eighty-two samples were examined from four island groups in the northwestern Hawaiian Islands: 38 from Kure Atoll, 32 from French Frigate Shoals, 11 from Laysan Island, and one from Lisianski Island. Identified helminth products include those of *Diphyllobothrium* sp., *D. cameroni*, *Contracaecum turgidum*, *Anisakis* sp., *Corynosoma rauschi*, and Trematoda. In addition, eggs from *Halarachne laysanae* (Acari) were found in 3 samples. Eggs of *C. turgidum* were present in the highest percentage (>64%) of samples from all locations. Eggs of *Anisakis* sp. and Trematoda are reported from this host for the first time.

Key words: Hawaiian monk seal, *Monachus schauinslandi*, helminth parasites, coprological survey.

The genus *Monachus* includes three species: *M. monachus*, *M. schauinslandi*, and *M. tropicalis*, all considered endangered; of these, the Caribbean monk seal (*M. tropicalis*) is believed to be extinct (Kenyon 1977, Le Boeuf *et al.* 1986). For the past several decades the Hawaiian monk seal (*M. schauinslandi*) has declined sharply within its breeding range in the northwestern Hawaiian Islands (NWHI) (Kenyon and Rice 1959, Rice 1969, Johnson *et al.* 1982), from Nihoa Island northwesterly to Kure Atoll (Fig. 1). Recent studies on the inter-island movement of Hawaiian monk seals (Johnson and Kridler 1983, Stone 1984, Johanos and Kam 1986) suggest that although some movement occurs

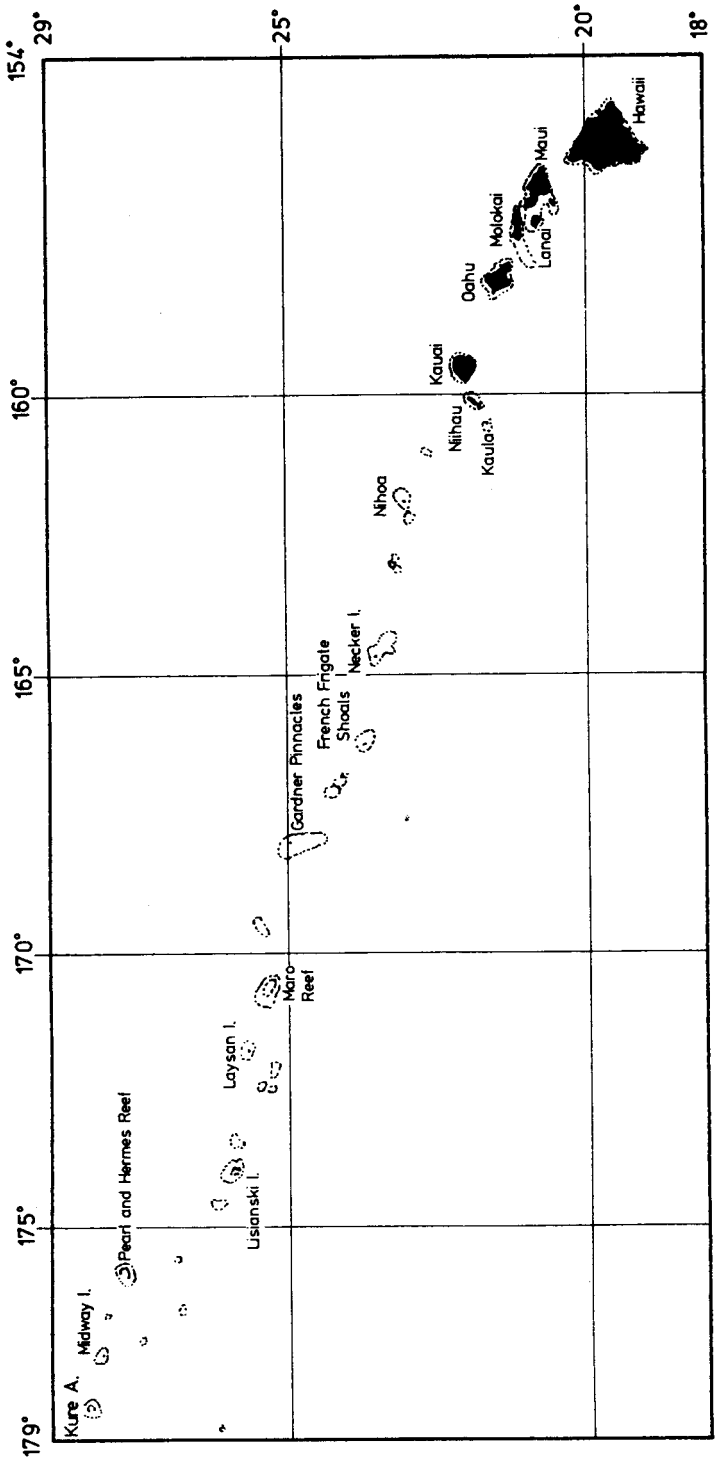

Figure 1. Map of the Hawaiian Archipelago showing sampling locations.

among the islands, in general the seals have a high fidelity to the beaches where they are born.

In 1984, the Marine Mammals and Endangered Species Program at the National Marine Fisheries Service, Southwest Fisheries Center, Honolulu Laboratory, began relocation of three to five young female monk seals per year from French Frigate Shoals to Kure Atoll to enhance reproduction. Concern that there may be some potential for spread of parasitic infections to the Kure Atoll population prompted this survey.

Although the Hawaiian monk seal has not been studied extensively, helminths reported include: four species of cestodes, *Diphyllobothrium hians* (Markowski 1952) = *Bothriocephalus* sp. (Chapin 1925), *D. elegans* and *D. cameroni* (Rausch 1969), and *D. rauschi* (Andersen 1987) = *D. hians* (Rausch 1969); one species of nematode, *Contracaecum turgidum* (Chapin 1925); one species of acanthocephalan, *Corynosoma rauschi* (Golvan 1959). In addition, one species of lung mite, *Halarachne laysanae* (Furman and Dailey 1980), has also been reported. This survey represents the first time trematode or *Anisakis* sp. (Nematoda) eggs have been reported from Hawaiian monk seals.

The terminology used herein follows that set forth by Margolis *et al.* (1982).

Materials and Methods

During the 1985 field season, fresh fecal samples (all under 24 h old) were collected from the beaches of four island groups (Kure, Laysan, Lisianski, and French Frigate Shoals) in the NWHI. Beaches were checked at least once daily for fresh scats. Many (30) samples were from individually identifiable seals, which were knowingly sampled only once, and represented all age and sex groups. The remaining scats were collected from unidentified seals, but of known size and sex, or collected from the beach without any information on the source seal. The latter group of samples were certain to be from individual seals because they were collected in areas of low seal density where it was easy to follow seal tracks on the sandy beach. The possibility exists that a few samples from the nonidentified seals may be duplicates from the same seal, collected days or weeks apart. The summary findings reported reflect the percentage of samples (not individuals) that were positive for a particular parasite.

All collected material was fixed in 70% ethanol or 10% formalin, and transported to the laboratory. After suspending the material in the fluid medium a drop of the suspension was placed on a slide, under a coverslip and examined under a light microscope. Magnifications of between 40× and 400× were used.

Whole mounts of cestodes and acanthocephalans from necropsied seals and cestode proglottids from scat samples were placed in 70% ethanol. They were then stained with Semichon's carmine, destained in 1% acid alcohol, dehydrated in an ethanol series, cleared in xylene, and mounted on slides, under coverslip in Permount.

Whole nematodes from necropsied seals were cleared in glycerine alcohol and mounted on slides, under coverslip in glycerine jelly.

Table 1. Numbers and percents of fecal samples from monk seals infected with different parasites; percents are in parentheses.

No. of parasites	Number and percent of samples			
	Kure $n = 38$	French Frigate Shoals $n = 32$	Laysan Island $n = 11$	Lisianski Island $n = 1$
No parasites	0	1 (3.1)	0	0
One parasite	5 (13.2)	9 (28.1)	2 (18.2)	0
Two parasites	12 (31.6)	15 (46.9)	2 (18.2)	0
Three parasites	17 (44.7)	6 (18.8)	7 (63.6)	0
Four parasites	4 (10.5)	1 (3.1)	0	1 (100)

Results

Analysis of the samples indicated that parasitism was highly prevalent in the seals from all sites sampled. Of the 82 samples examined, 81 (98.8%) were positive for parasite products of some type (eggs, larvae, or proglottids): all samples from Kure Atoll, Laysan Island, and Lisianski Island and 31 of 32 (97%) from French Frigate Shoals (Table 1). The numbers and percentages of fecal samples infected with different parasites are in Table 1. The prevalence of parasite products in fecal samples from each location and the probable identity of those parasites are in Table 2.

Cestoda—Diphyllobothrium sp. eggs were found in fecal samples from all locations: Kure Atoll 26 of 38 (68.4%), French Frigate Shoals 9 of 32 (28.1%), Laysan Island 3 of 11 (27.3%), and Lisianski Island 1 of 1 (100%). These eggs were identified as such on the basis of their size (average 0.047 mm × 0.035 mm) and shape, and by cross matching them with eggs teased from the mature proglottids of *D. cameroni* collected from two necropsied Hawaiian monk seals, one each from Kure Atoll and Laysan Island. These *Diphyllobothrium* sp. could not be identified to species because congeners have similar eggs. Gravid proglottids were found in 3 samples, 2 from Kure Island and 1 from French Frigate Shoals. The proglottids were identified as *D. cameroni* on the basis of shape (length/width ratio, approximately 1:3), possessing a single genital opening located midventrally at the anterior end of the segment, and covered by velum of the preceding segment, and possessing eggs of the same size (*see* above) and ellipsoidal shape.

Nematoda—Eggs of *Contracaecum turgidum* were the most prevalent parasite product identified (>63% at all locations). These eggs were identified as such by their spherical shape and size (0.054–0.060 mm, average 0.056 mm). Samples were cross matched with eggs from whole *C. turgidum* collected from necropsied seals on French Frigate Shoals (2), Kure Atoll (1), and Laysan Island (1).

Eggs of *Anisakis* sp. were found in samples from all locations at >53% prevalence. These eggs were identified as such on the basis of their characteristic

Table 2. Numbers and percents of fecal samples containing different types of parasite products at each location; percents are in parentheses.

Parasite	Number and percent of parasite products			
	Kure Atoll $n = 38$	French Frigate Shoals $n = 32$	Laysan Island $n = 11$	Lisianski Island $n = 1$
Diphyllobothrium sp.	26 (68.4)	9 (28.1)	3 (27.3)	1
Contracaecum turgidum	33 (86.8)	28 (87.5)	7 (63.6)	1
Anisakis sp.	28 (73.7)	17 (53.1)	7 (63.6)	1
Trematoda	4 (10.5)	3 (9.4)	1 (9.1)	1
Corynosoma rauschi	4 (10.5)	2 (6.3)	0	0
Halarachne laysanae	1 (2.6)	2 (6.3)	0	0

features (embryonic material not filling entire shell) as given by Dailey and Gilmartin 1980. This represents the first report of this genus from Hawaiian monk seals.

Trematoda—A low prevalence of trematode eggs was found at Kure Atoll (4 of 38; 10.5%), French Frigate Shoals (3 of 32, 9.4%), and Laysan Island (1 of 11, 9.1%). The eggs were identified as Trematoda on the basis of a pronounced operculum and ovoid shape. Trematodes have not been previously reported from this host and cross matching from whole specimens was not possible. Therefore, this identification has not been verified and should be regarded as a probable finding.

Acanthocephala—Eggs of *Corynosoma rauschi* were found in samples from Kure Atoll (4 of 38, 10.5%) and French Frigate Shoals (2 of 32, 6.3%) whereas samples from Laysan and Lisianski Islands were negative. These eggs were cross-matched with eggs from four whole specimens from one necropsied seal at French Frigate Shoals. The type location for this parasite, as reported by Golvan (1959), is Midway Island.

Acari—Eggs of *Halarachne laysanae* were found in samples from Kure Atoll (1 of 38, 2.6%) and French Frigate Shoals (2 of 32, 6.3%). Samples from Lisianski and Laysan Islands were negative although the latter is the type location for the parasite (Furman and Dailey 1980).

Discussion

The data show that no new parasitic infections will be introduced to a previously uncontaminated area when moving animals from French Frigate Shoals to Kure Atoll. Given that Kure Atoll and French Frigate Shoals are at opposite ends of the NWHI and the fact that there is some inter-island movement occurring among the Hawaiian monk seals, the authors would expect to see a continuum of these parasite infections throughout the NWHI. The lack of a continuum shown here from Laysan and Lisianski Islands can most likely be

attributed to small sample sizes. While rates of infection vary, the population as a whole is apparently homogeneous in terms of types of parasite infections present.

No statistics are available on the percentages of parasite-caused mortality in the Hawaiian monk seal. However, infection by *Contracaecum* sp. and resulting gastrointestinal ulcers have been implicated in the death of a Hawaiian monk seal (Whittow *et al.* 1979). Infections by ascaridoid nematodes, to which *Contracaecum* sp. and *Anisakis* sp. belong, is considered to be a significant mortality factor in other pinniped populations (Keyes 1965).

Deardorff *et al.* (1982) examined 134 species of finfishes (29 families) and 8 species of invertebrates (7 families) from the main Hawaiian Islands. All specimens examined were found to be infected with at least one of eight species of ascaridoid larvae: two species of *Anisakis*, three of *Hysterothylacium*, one of *Raphidascaris*, and one of *Terranova*. A summary of food items from Hawaiian monk seal scat and regurgitation samples (Gilmartin, personal observation) shows that many of the prey species are of the same families as those reported by Deardorff *et al.* (1982) as infected with ascaridoid worms. While the distance between the southeast and northwest Hawaiian Islands is hundreds of miles, infected individuals of the same families may serve as the intermediate host for some of the parasite infections in the Hawaiian monk seal.

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