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FIRST DESCRIPTIONS OF ENDOPARASITE FAUNA OF ELASMOBRANCH AND MESOPELAGIC TELEOST BYCATCH FISHES FROM THE WESTERN NORTH ATLANTIC PELAGIC LONGLINE FISHERY

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Abstract: *Natural mortality is a poorly known aspect of fisheries biology, despite its importance in stock assessments and population analysis. Of potential sources of mortality and morbidity in fishes, the effect of internal parasites is perhaps the least studied even though these organisms are known to inhibit nutrient uptake and stimulate an inflammatory response in fish. Parasite taxa of the pelagic elasmobranchs silky and night sharks and pelagic stingray* (Carcharhinus falciformis, C. signatus *and* Pteroplatytrygon violacea), *and the mesopelagic teleosts sailfin lancetfish, oilfish, snake mackerel, escolar and Atlantic pomfret* (Alepisaurus ferox, Ruvettus pretiosus, Gempylus serpens, Lepidocybium flavobrunneum, *and* Brama brama) *are described from the western North Atlantic and Gulf of Mexico. Parasite taxa included cestodes, trematodes, acanthocephalans, and nematodes. Suggested protocol revisions to current accepted laboratory methods will enhance future parasite taxa descriptions from pelagic marine fishes. This work serves as the first parasite taxa and load descriptions for pelagic stingray, lancetfish, oilfish, snake mackerel, escolar and pomfret.*

Key Words: Natural mortality, pelagic elasmobranch, mesopelagic teleost, internal parasite taxa, protocol revisions

The decrease in populations of top predators and the increase of the animals that they predate has led to a cascading effect across the ocean's food web communities (Bonfil et al., 2000; Heithaus et al., 2008). In recent years, the pelagic longline fishery targeting swordfish *Xiphias gladius* and tunas has faced increasing criticism for bycatch and bycatch mortality (Stevens et al., 2000). In particular, the status of many pelagic elasmobranch populations have become a concern due to their high incidental catch rate and slow reproduction abilities (Dulvy et al., 2008; Gilman et al., 2008). Similar concerns likely apply for many mesopelagic teleost bycatch species, although their life histories and relative importance in pelagic-mesopelagic trophic dynamics remain poorly known.

Despite its importance in stock assessment and population analysis, natural mortality (M) is one of the most understudied aspects of fisheries biology (Vetter, 1988). Endoparasites contribute to this underlying natural

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mortality by causing morbidity or even premature mortality in their host fishes (Anderson, 1978; Bolker and Castro, 2005; Latham and Poulin, 2002; Sindermann, 1987). Internal parasite taxa commonly encountered in the marine environment include cestodes, trematodes, acanthocephalans, and nematodes. Cestodes are the most prevalently documented internal parasite in elasmobranchs (Palm, 2004), and all four of these parasite taxa have been recovered from the economically important western North Atlantic pelagic teleosts king mackerel *Scomberomorus cavalla* and dolphinfish *Coryphaena hippurus* (Williams and Williams, 1996). Few systematic examinations of many pelagic elasmobranch and mesopelagic teleost fishes and their expected endoparasite fauna and burdens have been performed to date.

In this study, eight common bycatch fish species in the western North Atlantic pelagic longline fishery were macroscopically examined for endoparasites. The spiral valve, the modified intestine in elasmobranch fishes, is the organ most commonly studied for elasmobranch internal parasitology due to its location in the digestive system for nutrient uptake and where the highest concentrations of parasites are typically found (Palmer and Greenwood-Van Meerveld, 2001). This study examined the spiral valve parasites of three elasmobranchs: pelagic stingray *Pteroplatytrygon violacea*, silky shark *Carcharias falciformis*, and night shark *Carcharhinus signatus*. Because many endoparasites in teleost fishes are known to be intramuscular (Rohde, 2005), both skeletal muscle tissue and the coelomic cavity were examined for parasites from five mesopelagic teleosts: sailfin lancetfish *Alepisaurus ferox,* oilfish *Ruvettus pretiosus*, snake mackerel *Gempylus serpens*, escolar *Lepidocybium flavobrunneum*, and Atlantic pomfret *Brama brama*.

This work represents the first systematic examination of endoparasitism for these host species and includes a description of macroscopic endoparasite fauna and individual host load. The incidence of endoparasitism in these bycatch fishes is contrasted with total host size, gender, and maturity stage. In addition, problems encountered with the initial collection protocols and subsequently amended parasite handling and storage techniques are discussed.

MATERIALS AND METHODS—Host specimens were collected as incidental bycatch aboard commercial pelagic longline fishing vessels in the western North Atlantic and Gulf of Mexico (GOM) between 2007 and 2010. All elasmobranchs and teleosts were identified to species and measured for total length (TL) or disk width (DW; pelagic stingray only), with elasmobranchs also sexed by an on-board scientific observer. Night and silky shark spiral valves were excised on deck whole, and then individually frozen. Pelagic stingrays were simply frozen whole. For elasmobranchs only, the collection protocol was amended during the course of the study; the spiral valves collected in the latter part of the study were preserved upon collection in a 90:10 seawater/formalin solution instead of freezing, as was originally done for up to two weeks. (For pelagic stingrays, the revised protocol included the excision of the spiral valve on deck similar to the night and silky sharks.) Original and revised elasmobranch protocols were compared using a χ^2 test for differences in the number of individual recovered endoparasites and the percentages of hosts parasitized.

All mesopelagic teleosts were stored whole on ice or frozen from a period ranging from 24 hours to two weeks dependent upon the length of time at sea. In the laboratory, each teleost was opened ventrally and sexed, if possible. All visible endoparasites were removed and stored in containers with 70% ethanol, then stained and viewed under a stage microscope equipped with a digital camera (Olympus SZX7, 3.3 MPX resolution) using the software Rincon (version 7.4; IMT I-Solution, Inc.). A horsehair paintbrush was used when separating cestodes to avoid deformation of the proglottids. Mesopelagic teleost specimens were also observed over a candling box for endoparasites encysted within in the skeletal muscle. However, the muscle tissue was visually inspected instead for the thin and laterally compressed pomfret.

All recovered cestode, trematode, and acanthocephalan specimens were separated under a dissecting microscope and stored individually. All samples were stained with Semichon's aceto-carmine stock stain, cleared with methyl salicylate, and mounted on glass slides using Canadian balsam (United States, 1974). Due to the thickness of their tegument, nematodes were cleared without staining and set on slides sealed with glycerin jelly (United States, 1974). The spiral valves for all elasmobranchs were retained in 10% formalin following the initial examination.

Sexual maturity was determined with published maturity lengths for each elasmobranch species: pelagic stingray: males 37.5–47.8 cm DW, females 40–50 cm DW (Neer, 2008; Castro, 1983); silky shark: males 210–225 cm TL, females 225–246 cm TL (Castro, 2011); and night shark: males 185–190 cm TL, females 200–205 cm TL (Hazin et al., 2000). Length at sexual maturity is not known for the five mesopelagic fishes. Data analyses using Pearson's Product-Moment Correlation, ANOVA and T-Tests were conducted using "R" (version 2.11.1, 2010-05-31; The R Foundation for Statistical Computing), with significance assessed at $\alpha < 0.05$. Measures of central tendency and variance for lengths are represented as mean ± 1 standard deviation.

RESULTS—*Elasmobranchs*—Throughout the collection process, pelagic stingrays (n=97) were the most abundantly collected elasmobranch, followed by silky sharks (n=17) and night sharks (n=14); of these, 30 stingrays, 17 silky sharks, and 13 night sharks yielded parasites (Table 1). For all three elasmobranch species, the males yielded a higher amount of parasites (Table 2). Cestodes had the highest incidence of parasites among all three elasmobranch hosts (Table 2).

The percentage occurrence for each class of parasite per host sex was compared to total length (Table 3). The average maturity stage of parasitized stingrays was adult, while the average maturity stage of parasitized silky and night sharks was juvenile. Variable relationships for elasmobranchs were not significant between total parasite load and sex, nor total parasite load and total length.

The orders of cestodes found in pelagic elasmobranchs were Tetraphyllidea and Trypanorhyncha, cestodes in the genus *Anthobothrium* were recovered from the silky and night sharks, and a specimen of the cestode genus *Paraorygmatobothrium* was recovered from the night shark. Trematodes (including the species *Botulus microporous*, identified by genetic analysis, in the pelagic stingray and silky shark), acanthocephalans, and nematodes were also recovered from the pelagic stingray and night shark (Table 4).

Mesopelagic teleosts—A total of 124 teleost specimens were examined, with 10 of 20 escolar, 14 of 27 snake mackerel, 19 of 44 oilfish, 21 of 25 lancetfish, and four of eight pomfret yielding parasites. Nematodes were recovered from both the coelomic connective tissue and inside the stomach, cestodes and acanthocephalans were most commonly recovered from inside the

TABLE 1. Pelagic elasmobranchs and mesopelagic teleosts captured as pelagic longline incidental bycatch parasitized per sex, with length range (mean and SD ± 1) with species totals. Also included are the percent parasitized for males, females and unknowns with all totals.

	Male	Female	Unknown	Total
Elasmobranch				
Stingray *Pteroplatytrygon violacea*	n=47	n=45	n=5	n=97
length range	40–140 cm DW	0–140 cm DW	0–60 cm DW	0–140 cm DW
mean/SD ± 1	68.9 / 28.0	65.8 / 28.2	9.6 / 21.4	63.7 / 30.9
percent parasitized	48%	46%	6%	30.90%
Night Shark *Carcharhinus signatus*	n=7	n=5	n=2	n=14
length range	80–200 cm TL	80–140 cm TL	60–100 cm TL	60–200 cm TL
mean/SD ± 1	145 / 37.1	118 / 18.5	80 / 13.1	120.3 / 48.0
percent parasitized	50%	36%	14%	92.80%
Silky Shark *Carcharhinus falciformis*	n=9	n=8	n=0	n=17
length range	60–120 cm TL	60–140 cm TL		60–140 cm TL
mean/SD ± 1	89.5 / 14.3	97.6 / 18.7		94.6 / 16.4
percent parasitized	52.90%	47.10%		94.40%
Mesopelagic Teleost				
Escolar *Lepidocybium flavobrunneum*	n=1	n=6	n=13	n=20
length range	75 cm TL	54.6–84cm TL	65–87 cm TL	54.6–87 cm TL
mean/SD ± 1		76.9 / 11.5	72.5 / 7.2	74.1 / 8.6
percent parasitized	0%	50%	46.10%	50%
Snake Mackerel *Gempylus serpens*	n=4	n=10	n=13	n=27
length range	82–105.6 cm TL	101–121.2 cm TL	68–125 cm TL	68–125 cm TL
mean/SD ± 1	92.4 / 9.7	102.1 / 16.9	101.5 / 18.7	100.3 / 16.7
percent parasitized	20%	60%	53.80%	52%
Oilfish *Ruvettus pretiosus*	n=1	[none]	n=43	n=44
length range	88.5 cm TL		21.4–66.7 cm TL	21.4–88.5 cm TL
mean/SD ± 1			36.8 / 11.9	38.0 / 14.1
percent parasitized	100%		41.80%	43%
Lancetfish *Alepisaurus ferox*	[none]	n=9	n=15	n=25
length range		111–136 cm TL	56.5–118 cm TL	56.5–136 cm TL
mean/SD ± 1		125.8 / 9.09	96.4 / 20.9	107.0 / 22.5
percent parasitized		77.70%	73.30%	84%
Pomfret *Brama brama*	[none]	[none]	n=8	n=8
length range			18–59.4 cm TL	18–59.4 cm TL
mean/SD ± 1			36.9 / 15.9	36.9 / 15.9
percent parasitized			50%	50%

intramuscular tissue, and in some instances at the top of the stomach near the heart, and trematodes were all recovered from the intestinal tract.

The sex of teleosts sampled and total number parasitized were compared to determine if a gender bias existed within each individual teleost species (Table 2). However, there were not enough teleost specimens with identifiable

TABLE 2. Classes of individual parasites recovered (cestodes, trematodes, nematodes and acanthocephalans) from pelagic elasmobranchs and mesopelagic teleosts with totals of parasites recovered and total percentage per parasite taxa.

	Cestode	Trematode	Nematode	Acanthocephalan	Total
Pelagic Elasmobranch					
Pelagic Stingray *Pteroplatytrygon violacea*					
Male					
Parasites recovered	n=96	n=1	n=1	n=1	n=99
% of total parasites	96.90%	1%	1%	1%	
Female					
Parasites recovered	n=45	n=1			n=46
% of total parasites	97.80%	2.20%			
Unknown					
Parasites recovered		n=1		n=1	n=2
% of total parasites		50%		50%	
Silky Shark *Carcharhinus falciformis*					
Male					
Parasites recovered	n=131	n=4	n=1		n=136
% of total parasites	96.30%	2.90%	0.70%		
Female					
Parasites recovered	n=203	n=1		n=3	n=207
% of total parasites	98%	0.40%		1.40%	
Night Shark *Carcharhinus signatus*					
Male					
Parasites recovered	n=122				n=122
% of total parasites	100%				
Female					
Parasites recovered	n=103	n=1			n=104
% of total parasites	98%	1%			
Unknown					
Parasites recovered	n=25				n=25
% of total parasites	100%				
Mesopelagic Teleost					
Escolar *Lepidocybium flavobrunneum*					
Parasites recovered	n=9	n=6	n=27	n=1	n=43
% of total parasites	38%	25%	33%	4%	
Snake mackerel *Gempylus serpens*					
Parasites recovered	n=6	n=7	n=89	n=18	n=120
% of total parasites	5%	6%	74%	15%	
Oilfish *Ruvettus pretiosus*					
Parasites recovered	n=10	n=5	n=187	n=29	n=231
% of total parasites	4%	2%	81%	13%	
Lancetfish *Alepisaurus ferox*					
Parasites recovered	n=99	n=32	n=99	n=3	n=233
% of total parasites	42%	14%	42%	2%	
Pomfret *Brama brama*					
Parasites recovered	n=2		n=171		n=173
% of total parasites	1%		99%		

TABLE 3. Pelagic elasmobranchs and mesopelagic teleosts total parasitized by sex, per species with average length of species parasitized, and known length of sexual maturity of host fish.

	Total Sex	Total Parasites	Amount Parasitized	Percent Parasitized for Species	Average Length of Parasitized	Known Length at Sexual Maturity
Pelagic Elasmobranch						
Pelagic Stingray ***Pteroplatytrygon violacea***						
Male	47	99	15	34%	69 cm	37.5–47.8 cm (disk width)
Female	45	46	13	13%	64 cm	40–50 cm (disk width)
Silky Shark ***Carcharhinus falciformis***						
Male	10	136	9	50%	90 cm	210–225 cm (TL)
Female	8	207	8	44%	98 cm	225–246 cm (TL)
Night Shark ***Carcharhinus signatus***						
Male	7	122	7	58%	145 cm	185–190 cm (TL)
Female	5	104	4	33%	118 cm	200–205 (TL)
Mesopelagic Teleost						
Escolar ***Lepidocybium flavobrunneum***						
Male	1	0	0	0%	0	Unknown
Female	6	13	3	15%	74.2 cm	Unknown
Unknown	13	30	7	35%	61.3 cm	Unknown
Snake Mackerel ***Gempylus serpens***						
Male	4	1	1	4%	91 cm	Unknown
Female	10	45	6	22%	110.57 cm	Unknown
Unknown	13	74	7	26%	107.21 cm	Unknown
Oilfish ***Ruvettus pretiosus***						
Male	1	7	1	2%	88.5 cm	Unknown
Female	0	0	0	0%	0	Unknown
Unknown	43	224	18	41%	40.07 cm	Unknown
Lancetfish ***Alepisaurus ferox***						
Male	0	0	0	0%	0	Unknown
Female	9	32	8	32%	125.3 cm	Unknown
Unknown	16	201	11	44%	93.8 cm	Unknown
Pomfret ***Brama brama***						
Male	0	0	0	0%	0	Unknown
Female	0	0	0	0%	0	Unknown
Unknown	8	173	4	50%	38.6 cm	Unknown

sexes in any species to positively identify a trend for parasitism within gender. Nematodes were the dominant class parasitizing all five host species (Table 2). Regression analysis found no significant correlation in parasitization between length and weight for any mesopelagic teleost.

Mesopelagic teleost parasites included cestodes (orders Tetraphyllidea and Trypanorhyncha), cestodes of the phylum Acanthocephala from the escolar, and two cestodes of the species *Gymnorhynchus gigas* from the pomfret,

TABLE 4. Pelagic elasmobranchs and mesopelagic teleosts internal parasites identified to taxa, order and species (when possible) per host species.

			Pelagic Stingray *Pteroplatytrygon violacea*	Night Shark *Carcharhinus signatus*	Silky Shark *Carcharhinus falciformis*	Escolar *Lepidocybium flavobrunneum*	Snake Mackerel *Gempylus serpens*	Oilfish *Ruvettus pretiosus*	Lancetfish *Alepisaurus ferox*	Pomfret *Brama brama*
Cestodes			36	268	95	11	8	32	146	2
	Order Tetraphyllidea		36	259	93	9	6	10	99	
	Order Trypanorycha			9	2	2	2	22	47	
	Order Trypanorycha	Species *Gymnorhynchus gigas*								2
Trematodes			1	5	1					
	Order Plagiorchiida	Species *Botulus microporus*	1		1					
	Unidentified			5						
Acancephalans			1	3		1	18	29	3	
Nematodes			1	1		27	89	187	99	171

trematodes (including the species *Botulus microporous* from the escolar, snake mackerel, oilfish and lancetfish), other acanthocephalans, and nematodes (Table 4).

DISCUSSION—*Elasmobranchs*—Although the known transmission vectors for these elasmobranch species have yet to be definitively identified, their prey items (e.g., squid, specifically *Loligo pealeii* per Stunkard, 1977) are the suspected intermediate host in accordance with previous research (Marcogliese, 2002). A known transmission vector for parasites in the marine environment is predator-prey interactions. Pelagic stingrays are known to consume teleosts, cephalopods, crustaceans, seahorses, and octopods (Satoh et al., 2004; Camhi et al., 2008). Night sharks prey upon teleosts and cephalopods (Bowman et al., 2000), and silky shark diets include teleosts, bivalve mollusks, cephalopods, and pelagic crabs (Camhi et al., 2008). Cestodes may be transmitted to their elasmobranch hosts through their food supply (Lafferty, 1999); individual cestodes are not free swimming and require an intermediate host for transfer to the terminal host (Rohde, 2005). All cestodes recovered in this study were in their adult life stage, suggesting that elasmobranchs are the terminal hosts for the cestode species found in this study.

Multiple problems were initially encountered at the beginning stages of this research with regards to collection protocols. It was discovered that freezing the spiral valves completely destroys fragile cestode structures due to their lack of cold tolerance; the amended laboratory protocols included the storage of freshly dissected spiral valves in a seawater/formalin buffer. The protocol was altered to store the spiral valves whole in the 90:10 seawater/formalin buffer after shaking them in the solution to better preserve the parasites. It was also determined that many of the samples were too small (many <0.5 mm) to be easily seen with the naked eye. All stored spiral valve contents were subsequently reexamined with the aide of a dissecting microscope and additional microscopic parasites were recovered for staining and mounting from 45% more stingrays. The number of parasites recovered from silky and night shark numbers remained constant. The use of metal tweezers to remove the endoparasites from the host tissues during dissection was found to damage the delicate external structure of many specimens. Horsehair brushes were therefore used instead when any individual parasite needed to be transferred between solutions or mountings.

Teleosts—The frequency of internal parasitism within the poorly known mesopelagic teleosts varied widely between species. Oilfish yielded the lowest prevalence of parasites overall for the five species with 43% having parasites, while escolar and pomfret yielded 50%, snake mackerel 52%, and lancetfish 84% for all host fish collected, although there were no significant differences for total incidence of parasites per species. There was a high presence of nematodes in all five species: 42% in lancetfish, 81% in oilfish, 74% in snake mackerel, 63% in escolar, and 99% in pomfret. There was also a high presence of cestodes found in the lancetfish (42%). Without accurate age and growth data, nor age or length at first spawning, it is unknown if the prevalence and types of parasites in these five mesopelagic species are related to maturity or other ontogenetic changes.

Stomach content information for the mesopelagic teleosts in this study is limited, but lancetfish (Satoh et al., 2004) and oilfish (Vasilakopoulos et al., 2011) are reported to consume teleost and cephalopod prey. In a recent stomach content analysis, it was found that oilfish, snake mackerel and lancetfish are preying upon shrimp (Keller, 2011; pomfret were not included in this study). Shrimp have been determined to be a secondary host for many marine nematodes, finishing out their life stages in their terminal teleost hosts (Johnson, 1995). Lancetfish were found to prey upon squid such as *Cephalopoda teuthida* and pomfret, as well as to cannibalize other lancetfish (Keller, 2011).

The common factor between all of the elasmobranch species in this study and oilfish, snake mackerel, and lancetfish is that cephalopods are known prey species. Cephalopods are known to be the second and third intermediate hosts for cestodes, trematodes, and nematodes in their larval stages (Vidal, 1999). Terminal hosts for these parasites are known to be teleosts, marine mammals, and seabirds (Vidal, 1999), as well as elasmobranchs (Stunkard, 1977). Previous parasite transmission studies have found that elasmobranchs are known terminal hosts for parasites transmitted by ingestion of squid (Stunkard, 1977). All identified intramuscular cestodes from the mesopelagic teleosts in this study were in their pleroceroid or second larval stage, suggesting that the teleosts in this study were the intermediate hosts for these cestode species, and not the terminal host.

Protocol revision—With the changes in collection protocol, the effects on total parasite loads were also compared (Table 5). The protocol changed from freezing to storing the spiral valve whole in the formalin/seawater buffered solution. The protocol change for the stingray and silky shark specimens increased the numbers of yielded parasites for these two species, although the amount of potential parasite samples lost in these elasmobranchs due to damage by freezing is unknown. The results for the night sharks showed 100% parasitism for all individuals sampled regardless of the preservation method used.

Comparisons for all three elasmobranchs with respect to the collection protocol change suggested that the pelagic stingray parasites were the most susceptible to damage by freezing. The reason for this may be that the stingray spiral valves were stored frozen for up to 30 days, as it was not yet discovered that freezing destroys the cestodes. These long-frozen spiral valves yielded a total of 20 parasites from 47 spiral valves, whereas the silky and night shark spiral valves were frozen for only 2–5 days while aboard the vessel and in transit to the laboratory. A larger impact on the total parasites collected may have been observed if the protocol change had not been made or was made later in the research. If samples were frozen for more of an extended period, the

TABLE 5. Pelagic elasmobranchs and mesopelagic teleosts parasites reported before and after protocol changes (freezing before and 90:10 formalin/seawater buffered solution after for elasmobranchs and freezing before to storing fresh after for teleosts). Individuals sampled, parasites yielded from each host species, total parasites recovered from each host species and percentage of parasitism per host species.

	Individuals Sampled	Parasites Yielded	Total Parasites	Percentage	
Pelagic Elasmobranchs					
Pelagic Stingray *Pteroplatytrygon violacea*	50/47	5/19	20/127	0.10/0.40	before/after protocol change
Silky Shark *Carcharhinus falciformis*	1/17	0/17	0/343	0.00/1.00	
Night Shark *Carcharhinus signatus*	2/12	2/12	13/238	1.00/1.00	
Mesopelagic Teleosts					
Lancetfish *Alepisaurus ferox*	10/15	9/12	160/73	0.90/0.80	fresh/frozen
Oilfish *Ruvettus pretiosus*	18/26	8/11	28/203	0.44/0.42	
Snake Mackerel *Gempylus serpens*	6/21	3/11	19/101	0.50/0.52	
Escolar *Lepidocybium flavobrunneum*	5/15	2/8	2/41	0.40/0.53	
Pomfret *Brama brama*	4/4	2/2	25/148	0.50/0.50	

parasites may have been degraded by freezing and therefore undetected. This would have, in turn, affected the recorded spiral valve parasite load. It would have also potentially affected the orders of parasites that were recovered and reported.

The difference in internal parasites recovered from fresh to frozen teleosts suggests that freezing may not be recommended for the collection of lancetfish parasites (Table 5). This assumption is also due to the reported high prevalence of cestodes within the lancetfish. It has been noted that freezing cestodes may damage their fragile scolex and proglottids rendering them unidentifiable when they are thawed (C. Healey, Royal Ontario Museum, pers. comm.). However, the results for escolar, snake mackerel, oilfish, and pomfret suggest that freezing does not similarly damage or destroy their intestinal parasites. The reason for this is not known at this time as there is not much data published on collection techniques of intestinal parasites of these teleosts. However, it should be noted that many of the lancetfish displayed very thin muscular walls and high amounts of fat, which was not observed in the other teleosts in this study. The most prevalent parasite recovered from all four teleosts was nematodes, which are known to be very tolerant of low temperatures and freezing due to their thick tegument (Wharton, 1995; Storey and Storey, 1996).

Conclusions—This unusual prevalence of nematodes in teleost host species studied should be of concern as nematodes are known to have severe detrimental effects on fish hosts, including mortality. With the high nematode load per individual the parasite burden may be greater than the teleosts' intestinal or muscular systems tolerance. This can result in nutrient deficiency and a slower reaction when escaping potential predators. The parasite load and class identification for all eight species have not previously been described, and therefore these results may serve as a baseline for future studies.

Several classes of parasites recovered in this study are the first recorded for these host species. Trematodes, acanthocephalans, and nematodes have yet to be described in pelagic stingrays, for example. The cestode class Tetraphyllidea, trematodes, acanthocephalans, and nematodes have yet been described in the silky shark, while trematodes and the cestode class Trypanorhyncha have yet to be described in the night shark. Similarly, all the mesopelagic teleost species in this study are virtually unknown or extremely data-deficient relative to internal parasite fauna. The parasite load and class identification are significant in that cestodes, acanthocephalans, and nematodes have yet to be described in lancetfish. In the same respect, cestodes, acanthocephalans, nematodes, and the trematode *B. microporous* have yet to be documented in oilfish. Cestodes, trematodes, acanthocephalans, and nematodes are described for the first time from snake mackerel and escolar, and this study is also the first description of cestodes and nematodes in pomfret.

Ascertaining the potential causes of species mortality is a multi-layered process with parasitology being one of many approaches. Classifying parasites to species in this study was virtually impossible for most specimens as there are no prior baseline studies of expected parasites for these fishes, nor were comprehensive, species-level identification keys available for the marine parasite fauna found. Some of the parasites (e.g., nematodes) are only identifiable to lower taxa through molecular genetic analyses, which were precluded by the use of formalin as a fixation medium. Future work should therefore consider alternative preservation techniques. The results of identifying second-stage larval cestodes in teleosts and adult stage cestodes in elasmobranchs gives us a better understanding of transmission vectors for these parasites, which have historically been data-deficient for these host species. Establishing a baseline for expected parasite load as well as parasite fauna for these hosts is a first step in understanding the complex relationships between hosts and parasites in the pelagic marine environment.

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