Northwest Science Notes

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Parasites of Juvenile Yellowfin Sole and Rock Sole in Southeast Alaska

Introduction

Identification of fish parasites is emerging as a low-cost alternative to more expensive methods of tagging to study migration and stock structure (Williams et al. 1992). Parasites acquired in different habitats can reflect differences in water quality, the distribution of intermediate hosts, or other habitat changes (Landsberg et al. 1998). Parasites have been successfully used to trace migration routes (Groot et al. 1989, Avdeev and Avdeev 1998), determine feeding habits (MacKenzie 1983, Houston and Haedrich 1986), and many studies have used parasites as natural tags to identify discrete stocks (recent studies summarized in MacKenzie 2002). Parasites are also widely used as bioindicators of pollution and habitat change (reviews by Khan and Thulin 1991, MacKenzie et al. 1995). Unlike conventional tagging studies, fish need only be caught once if the parasite is present in most of the fish in a given stock.

Flatfishes (family *Pleuronectidae*) constitute some of the most important groundfish resources in the northeast Pacific Ocean, accounting for a large proportion of the total groundfish catch. In Alaska waters, total biomass for yellowfin sole (*Limanda aspera*) and rock sole (*Lepidopsetta bilineata*) in the Bering Sea alone was estimated at 1.6 and 2.1 million metric tons, respectively, in 2000 (Witherell et al. 2000). Both species are found in the waters of the continental shelf and often co-occur. Commercial catches of these flatfishes in the Bering Sea and Gulf of Alaska averaged 170,000 metric tons per year during the last decade, with an ex-vessel value of $30 million (Witherell et al. 2000).

The purpose of the present note is to provide basic information on the identity and variance of infection of parasites present in the juvenile stage of these important flatfishes in Southeast Alaska. This survey was undertaken to identify parasites that might have ecological significance or be useful as biological markers in future studies.

Methods

Juvenile yellowfin sole and rock sole were obtained from three locations within the estuarine portion of Auke Bay, Alaska, in June, and from two locations outside the bay (Lynn Canal) in September using a 6-mm mesh beach seine (Figure 1). A total of 100 fish (10 of each species from each location) was examined for parasites. The fish in the bay were recruits <100 mm in total length (TL), and the juveniles in the marine areas were 100-500 mm TL. Fish were transported live to the laboratory and then quick-frozen.

After thawing, TL of each fish was recorded and fish were examined for the presence of parasites. The external surfaces, including skin, gills, and fins were examined under a dissecting microscope for the presence of ectoparasites. The body cavity was opened, and the internal musculature was similarly examined for encysted parasites. The contents of the digestive cavity were mixed with sodium bicarbonate and allowed to settle to

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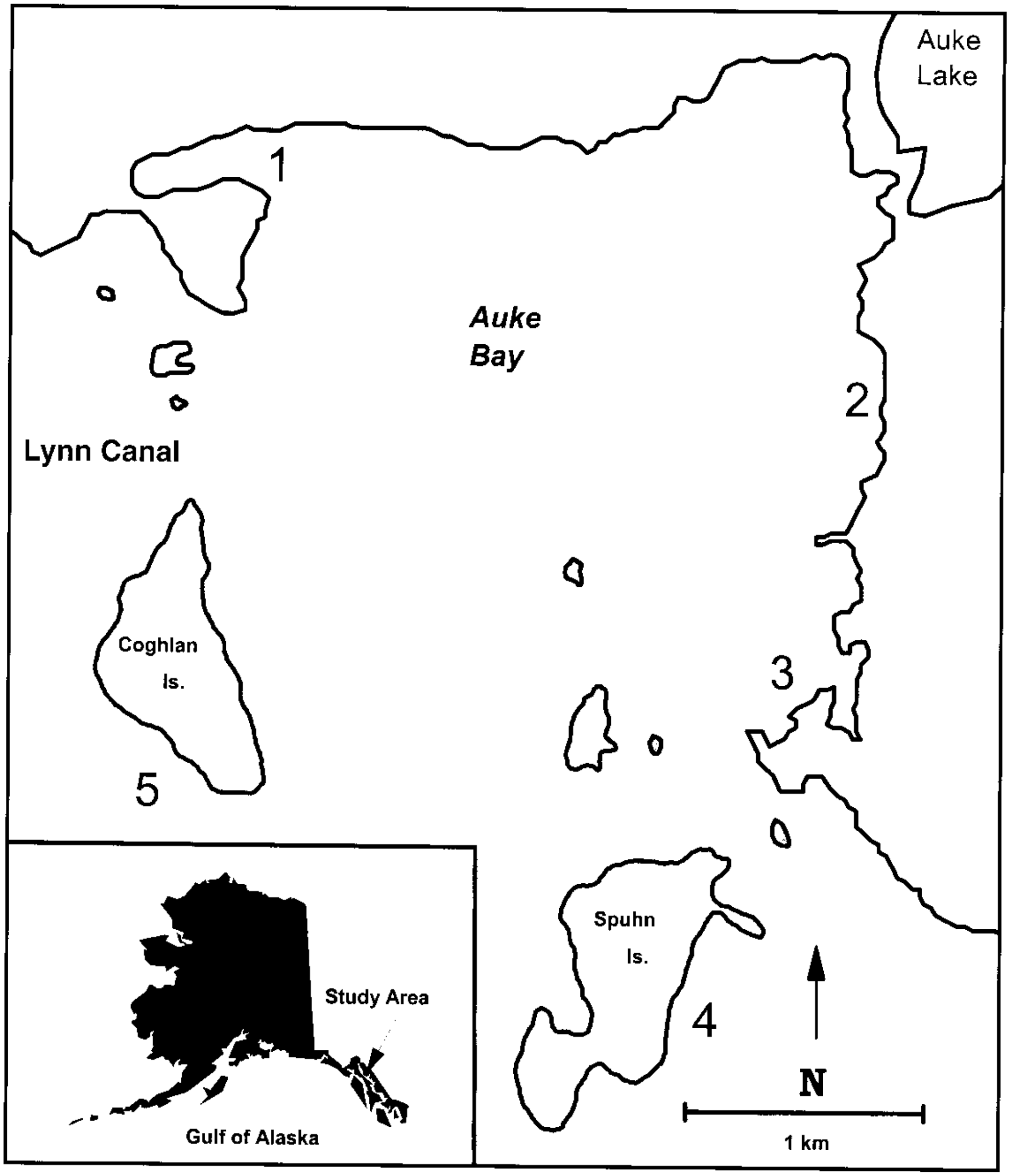

Figure 1. Map of Auke Bay and surrounding waters of Lynn Canal, Alaska. Sampling sites 1, 2, and 3 are within the bay and estuary. Sites 4 and 5 are in the marine waters of Lynn Canal.

remove parasites for examination. Squash preparations were made from samples of liver, spleen, kidney, intestine, gall bladder, and urinary bladder and examined using a compound microscope at 400 X for myxosporeans. Parasites were fixed in 10% buffered formalin and then transferred to 70% ethanol for preservation and identification. Cestodes and nematodes were transferred to ethanol/glycerol for gradual clearing. Parasites were identified to species and counted. Prevalence and mean intensity were calculated for each parasite species. Prevalence refers to the proportion of fish infected with a given parasite and mean intensity refers to the mean number of parasites of a given species per infected host (Bush et al. 1997).

Results

The same helminth parasites were found in yellowfin sole and in rock sole (Table 1). Altogether, 10 species of parasites were present: the digeneans *Brachyphallus crenatus*, *Derogenes varicus*, *Lecithaster gibbosus*, *Podocotyle gibbonsia*, and *Tubulovesicula lindbergi*; the larval cestode *Nybelinia surmenicola*; the larval nematodes *Anisakis simplex* and *Hysterothylacium aduncum*; the juvenile acanthocephalan *Corynosoma villosum;* and the adult acanthocephalan *Echinorhynchus gadi*. No protozoans were detected during screening.

Four species of parasites were present in both the small flatfishes captured in the estuary and in the larger juveniles present in the marine sample. Parasites from yellowfin sole collected in Auke Bay were the stomach digenean *Podocotyle gibbonsia*, the intestinal nematode *Hysterothylacium aduncum*, and the intestinal acanthocephalans *Corynosoma villosum* and *Echinorhynchus gadi*. *Podocotyle gibbonsia* and *E. gadi* were present in similar prevalence in the marine samples. In contrast, the prevalence and intensity of infection with *C. villosum* and *H. adundum* was significantly greater in the marine flatfishes than in the estuarine samples. *Corynosoma villosum* was the only estuarine parasite with a greater prevalence in rock sole than in yellowfin sole.

TABLE 1. Parasites of juvenile yellowfin sole and rock sole from estuarine and marine locations in or near Auke Bay, Southeast Alaska. Prevalences are in percentages and mean intensity is followed by standard error estimates.

	Estuarine (n=30)		Marine (n=20)	
Parasite	Prevalence	Intensity	Prevalence	Intensity
Yellowfin Sole				
Digenea				
Brachyphallus crenatus			15	7 ± 5
Derogenes varicus			25	1 ± 1
Lecithaster gibbosus			10	2 ± 1
Podocotyle gibbonsia	30	2 ± 1	30	19 ± 14
Tubulovesicula lindbergi			90	20 ± 12
Cestoidea				
Nybelinia surmenicola			10	3 ± 10
Nematoda				
Anisakis simplex			45	5 ± 19
Hysterothylacium aduncum	10	1 ± 0	60	3 ± 5
Acanthocephala				
Corynosoma villosum	27	4 ± 5	100	2 ± 9
Echinorhynchus gadi	27	2 ± 3	30	3 ± 1
Rock Sole				
Digenea				
Brachyphallus crenatus			20	5 ± 17
Derogenes varicus			20	1 ± 0
Lecithaster gibbosus			5	4 ± 3
Podocotyle gibbonsia	13	10 ± 5	10	15 ± 23
Tubulovesicula lindbergi			100	36 ± 49
Cestoidea				
Nybelinia surmenicola			10	5 ± 17
Nematoda				
Anisakis simplex			65	11 ± 27
Hysterothylacium aduncum	17	1 ± 0	30	5 ± 5
Acanthocephala				
Corynosoma villosum	57	5 ± 8	100	2 ± 7
Echinorhynchus gadi	3	1 ± 0	0	0

The remaining 6 parasite species were present only in the marine samples of yellowfin sole and rock sole. *Brachyphallus crenatus*, *Derogenes varicus*, *Lecithaster gibbosus*, *Tubulovesicula lindbergi*, and *Nybelinia surmenicola* were mostly present in the stomach and mesenteries, and the larval *Anisakis simplex* were present in both mesenteries and musculature. The prevalence and intensity of infection of these parasites were greater in the marine samples than in the estuarine samples and were similar for yellowfin sole and rock sole.

Discussion

Most of the parasites reported here have not been previously reported from yellowfin sole or rock sole in Alaska. This is the first survey of parasites in yellowfin sole reported in the literature. There have been only two parasites previously noted for yellowfin sole. During a study of leech parasites on crabs in British Columbia, Canada, Sloan et al. (1984) noted several *Calliobdella* sp. leeches on a single yellowfin sole and the protozoan *Cryptobia* sp. in the blood of six yellowfin sole. In contrast, all parasites found in this study were previously reported from rock sole (summarized by Love and Moser 1983), but of these only *Derogenes varicus* has been reported from rock sole in Alaska (Kruse 1977). These parasites display little host specificity and are reported from a wide range of marine fishes throughout the North Pacific Ocean (Moles 1982, Love and Moser 1983).

Two of the parasites species show potential as biological markers. Given the small sample size of this single-year survey, it is impossible to determine how much spatial or temporal variation there might be in either prevalence or intensity. Most of the parasites found in the larger fish from outside the estuary are ubiquitous parasites of Pacific coast marine fishes and are unlikely to be useful as biological tags. The potential exceptions may be the digenean *Podocotyle gibbonsia* and the acanthocephalan *Echinorhynchus gadi*. That these parasites were present in the same proportions in the estuarine and marine samples of yellowfin sole suggests that these parasites may be acquired during estuarine residency. Both *Podocotyle* sp. (Gibson 1972) and *Echinorhynchus* sp. (Olson and Pratt 1973) have been proposed as markers of estuarine residency in other flatfish species. The much lower prevalence of these parasites in rock sole may be the result of diet differences between the juveniles of these two species. The acanthocephalan *Corynosoma* sp. matures in pinnepeds, where it can perforate the intestine. The high prevalence of this genus in flatfish increases the chances of infection of any pinniped species that forages on these juvenile flatfishes.

Literature Cited

Avdeev, G. V., and V. V. Avdeev. 1998. Parasites as indicators of *Theragra chalcogramma* (Gadidae) populations from the Comandor Islands. Parazitologiya 32: 431-439

Bush, A. O., K. D. Lafferty, J. M. Lotz, and A. W. Shostak. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. Journal of Parasitology 83:575-583.

Gibson, D. I. 1972. Flounder parasites as biological tags. Journal of Fish Biology 4:1-9.

Groot, C., R. E. Bailey, L. Margolis, and K. Cooke. 1989. Migratory patterns of sockeye salmon (*Oncorhynchus nerka*) smolts in the Strait of Georgia, British Columbia, as determined by analysis of parasite assemblages. Canadian Journal of Zoology 67: 1670-1678.

Houston, K. A., and R. L. Haedrich. 1986. Food habits and intestinal parasites of deep demersal fishes from the upper continental slope east of Newfoundland, northwest Atlantic Ocean. Marine Biology 92: 563-574.

Khan, R. A., and J. Thulin. 1991. Influence of pollution on parasites of aquatic animals. Advances in Parasitology 30:201-238.

Kruse, G. O. W. 1977. Some digenetic trematodes from fishes of the Bering Sea with the descriptions of *Prosorhynchus mizelle* sp. n. (Bucephalidae) and *Pseudopecoelus nossamani* sp. n. (Opecoelidae). Helminthological Society of Washington Proceedings 44:73-76.

Landsberg, J. H., B. A. Blakesley, R. O. Reese, G. McRae, and P. R. Forstchen. 1998. Parasites of fish as indicators of environmental stress. Environmental Monitoring and Assessment 51:211-232.

Love, M. S., and M. Moser. 1983. A checklist of parasites of California, Oregon, and Washington marine and estuarine fishes. U.S. Department of Commerce, National Oceanic and Atmospheric Administration Technical Report NMFS SSRF-777.

MacKenzie, K. 1983. Parasites as biological tags in fish population studies. Advances in Applied Biology 7: 251-331.

MacKenzie, K. 2002. Parasites as biological tags in population studies of marine organisms: an update. Parasitology 124:S153-S163.

MacKenzie, K., H. H. Williams, A. H. McVicar and R. Siddall. 1995. Parasites as indicators of water quality and the potential use of helminth transmission in marine pollution studies. Advances in Parasitology 35:85-144.

Moles, A.1982. Parasite-host records of Alaskan fishes. U.S. Department of Commerce, National Oceanic and Atmospheric Administration Technical Report NMFS SSRF-760.

Olson, R. E., and I. Pratt. 1973. Parasites as indicators of English sole *Parophrys vetulus* nursery grounds. Transactions of the American Fisheries Society 102:405-411.

Sloan, N. A., S. M. Bower, and S. M. C. Robinson. 1984. Cocoon deposition on three crab species and fish parasitism by the leech *Notostomum cyclostoma* from deep fjords in northern British Columbia. Marine Ecology Progress Series 20:51-58.

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Williams, H. H., K. MacKenzie, and A. M. McCarthy. 1992. Parasites as biological indicators of population biology, migrations, diet, and phylogenetics of fish. Reviews in Fish Biology and Fisheries 2:144-176.

Witherell, D., N. Kimball, and J. DiCosimo. 2000. Status and trends of principal groundfish and shellfish stocks in the Alaska EEZ, 2001. North Pacific Fishery Management Council, 605 W. 4th Avenue, Anchorage, AK. 99501.