Results of Three Investigations of the Parasite Fauna of Several Marine Fishes of British Columbia

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ABSTRACT

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This report deals with three small-scale investigations of parasite fauna of marine fishes off the coast of British Columbia.

(1) Parasites of two populations of pollock (Theragra chalcogramma) in the Strait of Georgia were studied to determine their suitability as biological tags for stock identification. The study showed that these two fish populations cannot be distinguished from each other with the aid of their parasites.

(2) Parasites of sablefish (Anoplopoma fimbria) were studied for similar purposes. The study was not extensive enough to accomplish the intended objective. It established the general paucity of the parasite fauna of this fish. The occurrence of the intestinal trematodes appeared to be incompatible with the biology of the host species, the worms beginning to appear at the time when the fish should have lost contact with the intermediate hosts, i.e. with the source of infection.

(3) Parasites of four flatfish species (Atheresthes stomias, Lepidopsetta bilineata, Parophrys vetulus and Microstomus pacificus) were examined. Many species were added to the previously known ones occurring in these species. There appeared to be no differences in the composition of the parasite fauna that could be related to the ecology of the host fish. The parasite fauna of the fish in the vicinity of Vancouver Island was much more abundant than that of the same fish in the Queen Charlotte area.

RÉSUMÉ

Kabata, Z. and D. J. Whitaker. 1984. Results of three investigations of the parasite fauna of several marine fishes of British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 1303: 19 p.

Le présent rapport porte sur trois études restreintes de la faune parasite des poissons marins peuplant les eaux hauturières de la Colombie-Britannique.

(1) On a étudié les parasites de deux populations de morue du Pacifique occidental (Theragra chalcogramma) dans le détroit de Géorgie afin de déterminer s'ils pouvaient servir comme marqueurs biologiques pour l'identifcation des stocks. L'étude a révélé que les deux populations ne peuvent être distinguées l'une de l'autre au moyen de leurs parasites.

(2) Aux mêmes fins, les parasites de la morue charbonnière (Anoplopoma fimbria) ont été examinés, mais l'étude n'était pas assez poussée pour réaliser l'objectif fixé; elle a quand même servi à établir la rareté générale de la faune parasite du poisson. La présence de trématodes intestinaux semble incompatible avec la biologie de l'hôte car les vers ont commencé à apparaître au moment où le poisson aurait dû avoir perdu contact avec les hôtes intermédiaires, c'est-à-dire avec la source d'infection.

(3) On a étudié les parasites de quatre espèces de poissons plats, soit Atheresthes stomias, Lepidopsetta bilineata, Parophrys vetulus et Microstomus pacificus. A la liste des parasites connus de ces espèces, on en a ajouté de nombreux autres. Il ne semble pas y avoir de différence dans la composition de la faune parasite qui pourrait être liée à l'écologie de l'hôte. Les parasites des poissons près de l'île Vancouver étaient beaucoup plus abondants que chez les mêmes poissons dans la région des îles Reine-Charlotte.

INTRODUCTION

This report contains an account of three small projects dealing with parasites of several commercial species of marine fishes in the waters of British Columbia. The first of them concerns walleye pollock (Theragra chalcogramma). The objective of this project was to determine whether two populations of this species, resident in the southern part of the Strait of Georgia (east of Gabriola Island and near Active Pass), can be distinguished as separate stocks by their parasite faunas. The second project was intended as a preliminary investigation of the parasites of sablefish (Anoplopoma fimbria), aimed at determining the possible insights they might give into the general biology and, in particular, migrations of their host. The third project dealt with the parasites of four species of flatfishes: rock sole (Lepidopsetta bilineata), turbot (Atheresthes stomias), Dover sole (Microstomus pacificus) and English sole (Parophrys vetulus). This project was prompted by inquiries of DFO Pacific Region Inspection Branch personnel, who were faced with difficulties of identifying and evaluating parasites encountered in these fishes. In particular, turbot, a relatively recent arrival on the market, posed problems that they were anxious to resolve. At the same time, an opportunity arose to make some interesting parasitological comparisons, hitherto not attempted.

MATERIALS AND METHODS

POLLOCK

Two samples were collected within the Strait of Georgia; one of 26 fish was taken on Feb. 24, 1981, east of Gabriola Island (49°12'N 123°40'W) in 350-400 fms by the M.V. Arctic Harvester; the second of 41 fish was taken on Apr. 21 north of Active Pass (48°52'N 123°13'W) in 95-110 fms by the M.V. G.B Reed. For the sake of comparison with a presumably separate stock, a third sample of 53 fish was collected by M.V. Callistratus in 30-50 fms on La Pérouse Bank (48°35'N 125°36'W), off the west coast of Vancouver Island, in July 1981. All samples were collected using a midwater trawl. The fish were individually bagged and frozen directly after capture and remained in that condition until the time of necropsy. Examinations, using dissecting and compound microscopes, were made of the fins, nasal cavities, eyes, gills, heart, kidney, liver, spleen, stomach, caeca, intestine and its contents, gall bladder, urinary bladder, swim bladder, gonads, brain and musculature.

SABLEFISH

A sample of 30 fish was taken by trawl in 200-300 fms west of Swiftsure Bank at the mouth of the Strait of Juan de Fuca, on Oct. 1978. The

fish were processed and examined in the same manner as the samples of pollock. In addition, otoliths were removed for age determination.

The data on the prevalence and intensity of infections by individual species of parasites are presented for each fish separately (Tables 2 and 3), in contrast with those for the pollock, where data for each sample were combined.

FLATFISHES

With one exception, samples of flatfishes were collected from commercial catches by the Fisheries Research Branch port samplers in 1981. One sample of 24 Lepidopsetta bilineata (29.0-50.0 cm long), collected on June 28, was taken in Hecate Strait (Potholes). The fish were in very poor condition, so that only partial examination of the viscera could be made. Organs, tissues, and cavities examined included urinary bladder, gall bladder, buccal cavity, gills and somatic musculature. All other samples consisted of 25 fish. One sample of Atheresthes stomias, consisting of fish 42.0-61.0 cm long, was taken on July 3 from the catch of M.V. Tenacious, made in Hecate Strait. The second sample of this species (Fish 45.5-71.0 cm long) was collected in June from a catch made in Area 21 (west coast of Vancouver Island). One sample from the commercial catch of Microstomus pacificus (37.0 -69.5 cm long) was taken on July 3 in Hecate Strait and another (fish 30.0-43.0 cm long) in June from a commercial catch taken in Area 21. A commercial catch of Parophrys vetulus (30.3 - 44.3 cm long), taken in Hecate Strait, was sampled on July 12. One sample of P. vetulus (fish 26.5-35.0 cm long) was collected by the Fisheries Research vessel, G.B. Reed in Hecate Strait, on Oct. 5.

Examination of all samples was carried out in a standard fashion, with limitations imposed by the condition of preservation of most of the fish. Because of the poor condition of a substantial part of the samples, comparisons between species and localities could be conducted only by using organs and tissues that were examined in all fish, i.e. gall bladder, urinary bladder, gills, buccal cavity and musculature. This left out many helminth parasites and rendered comparisons incomplete. However, most protozoan parasites and some ectoparasitic species could be used for these comparisons.

RESULTS

POLLOCK

In all, 28 species of parasites were found. They are listed in Table 1. Protozoa were represented by Myxosporea (three species) and Microsporea (two species). Eleven species of Trematoda were present, as well

as five species of Cestoda, two of Acanthocephala and four of Nematoda. Arthropod parasites were represented by one copepod species. Of the 28 species, 18 were present in all three localities sampled. One species (unidentified microsporean) was found in both Strait of Georgia locations and three (Kudoa thyrsites, Lepidapedon gadi and Parahemiurus merus) were exclusive to Active Pass. The Gabriola location shared two species (Hemiurus levinseni and larval spirurids) with the West Coast. Four species were unique to the West Coast sample (Brachyphallus crenatus, Copiatestes filiferus, Prosorhynchoides basargini and Prosorhynchus sp. metacercariae).

Among Myxosporea, the most widespread species was Zschokkella hildae, with over 50% prevalence in all three localities and reaching 76.9% in the Gabriola site. The two most common trematodes were Podocotyle (?) sp. and Rhipidocotyle sp. The former showed prevalences of 62.3-87.8% and intensities of 1-90. The corresponding figures for the latter species were 86.8-92.7% and 1-3,072. Among Cestoda, prevalence and intensity of infection with plerocercoids of Nybelinia surmenicola was 45.3-58.5% and 1-60 respectively. Another abundant tapeworm was Scolex pleuronectis (51.2-73.6% and 1-205). Of the two acanthocephalans, Echinorhynchus gadi, with prevalence of 47.2-80.8% and intensity of infection of 1-451, was more abundant than Cornyosoma sp.. Anisakis sp. and Hysterothylacium aduncum (Nematoda) were very prevalent, the former reaching 100% and the latter 94.3%. Intensity figures were 1-43 for the former and 1-100 for the latter.

Pollock from the Strait of Georgia carried, in all, 24 species of parasites, 19 of which were present in both localities. Two species (Hemiurus levinseni and spirurid larvae) were present in the Gabriola region alone and three (Kudoa thyrsitis, Lepidapedon gadi and Parahemiurus merus) in Active Pass alone. The parasite fauna of pollock from the West Coast comprised 24 species, 20 of them shared with the fish in the Strait of Georgia.

SABLEFISH

The parasite fauna of the sablefish examined consisted of 14 species, seven of which were trematodes. This group, therefore, constituted the dominant type of parasites of this particular fauna. The most common species of trematode was Lecithaster gibbosus, with prevalence of 26.7% and intensity of 1-48, followed by Derogenes varicus (20% and 1-30, respectively). Three fish carried also Parahemiurus merus (intensity 1-2) and three an unidentified trematode (intensity 1-8). Opecoelina sp. and an unidentified didymozoid were present each in one fish.

Cestoda were represented by Scolex pleuronectis, present in 20% of the fish examined, with intensity of 1-4. The only acanthocephalan present was Corynosoma sp., occurring in 16.7% of the fish, with an intensity of 1-5. There were four nematode species, one of which, Anisakis sp. larva, occurred in all but the single one-year old fish (intensity 1-454) and was the most common parasite encountered. Hysterothylacium aduncum was much less common (23% and 1-17), followed by Pseudoterranova decipiens (16.7% and 1-6). Capillaria sp. was found in only one fish that carried four specimens of the

worm. Finally, the only copepod present, Naobranchia occidentalis, was fairly common (prevalence 56.7%) and reached a maximum intensity of 17 (mean value 4.9).

FLATFISHES

The results of the examinations of the four flatfishes will be presented separately for each species. They are tabulated in Tables 4-7.

Parophrys vetulus

The necropsies revealed the presence of 19 species of parasites (Table 4). Protozoa were represented by three species, the most common of which was Ceratomyxa hopkinsi (prevalence 68%). Unicapsula muscularis and Davisia sp. were relatively scarce (2.0 and 4.0% respectively). Five species of Trematoda were present, of which Otodistomum veliporum was the most abundant (22%). Three species of Cestoda ranged in prevalence from 8 to 18%. There were two species of Acanthocephala and four of Nematoda. Half of the fish examined carried Cucullanus annulatus, the range of intensity being 14-90. A leech, Oceanobdella sp., was found on three fishes, one of which carried two worms. Two unidentified copepods were found, an Acanthochondria sp. and a Lepeophtheirus sp., both represented by single specimens and occurring on one fish only. The figures for prevalence of all parasites were likely to be depressed by the fact that one of the samples of this fish was very poorly preserved.

Microstomus pacificus

The sample from Hecate Strait (Table 4) carried 12 species of parasites. Three species of Protozoa were found, with Ceratomyxa hopkinsi being present in 50% of the fish and Conispora meridionalis in 20.8%. Ortholinea divergens was much less common (8.3%). Four species of trematodes were present, Otodistomum veliporum occurring in 22 out of 24 fish. No tapeworms were found but two species of Acanthocephala (Corynosoma sp. and Echinorhynchus gadi) were present, at low prevalence and intensities of infection. No ectoparasites were found.

The sample from Area 21 (Table 5) had eight more species of parasites. Two of them were protozoans (Davisia sp. and Kudoa thyrsitis). The fish also carried one more trematode, one cestode, one monogenean and three nematodes. In addition, two fish each carried a copepod, an unidentified Acanthochondria sp.

Lepidopsetta bilineata

This species was sampled only in Hecate Strait (Table 6). The poor condition of the sample limited the examination and allowed discovery of only eight species of parasites, five of which were Protozoa, two Copepoda and one

unidentified leech. No endoparasitic metazoans were found.

Atheresthes stomias

In Hecate Strait (Table 6) this fish carried nine species of parasites, four of them Protozoa. Only one endoparasitic metazoan was found (a nematode, Pseudoterranova decipiens). The remaining three were ectoparasitic: two monogeneans and one copepod. Theses results were clearly affected by the poor condition of the examined fish.

In contrast, the better preserved sample from Area 21 (Table 7) was infected with 20 species of parasites. There were six Protozoa, five of them abundant (from 48 to 80% prevalence). Only Ortholinea divergens was scarce (8%). Similar differences of prevalence were found among the four species of trematodes (from 4% for Derogenes varicus to 40% for metacercariae of Prosorhynchus sp. and for Steganoderma formosum). One monogenean was present, Neoheterobothrium pugetensis, and two tapeworms (Nybelinia surmenicola and Scolex pleuronectis biloculatus), both with prevalence of 44%. Acanthocephala were represented by three species, all belonging to the genus Corynosoma, and Nematoda by four species, the most common of which was Anisakis sp. This last species was present in all fish examined, in many different sites and in great numbers (as many as 407 specimens in the mesentery of a single fish). Other nematodes were also common, the least widespread being unidentified spirurid larvae, which were found as single specimens in four out of 24 fish. No ectoparasites, other than the monogenean N. pugetensis, were discovered.

DISCUSSION

POLLOCK

To assess the possibility of distinguishing between the two populations of pollock in the Strait of Georgia by differences in their parasitic faunas, it is necessary to compare the two faunas both from the qualitative and quantitative point of view. In the former case, absence of some species from one population and their presence in the other would suggest lack of contact between them. In the latter case, high prevalence and intensity of a particular parasite in one population and low in another might indicate (i) different host-parasite equilibrium; (ii) difference in environmental or other conditions. Both might indicate lack of contact between stocks and even (if (i) is applicable) of possible genetic differences between them.

Qualitative differences between the two stocks in the Strait of Georgia were not significant, the overlap of species being 80%. Only five of 21 species did not occur in both populations. All five were rare. A single specimen of Hemiurus levinseni and one spirurid larva were found in one fish out of a sample of 26, five specimens of Lepidapedon gadi in two out of 41,

only two of Parahemiurus merus in the same number of fish. The protozoan Kudoa thyrsites occurred in two out of 41 fish. The rarity of these species makes them unsuitable as biological tags. Only a considerable increase in the size of the sample would allow a more definite conclusion as to their value for this purpose.

Quantitative differences between the prevalence of individual species were also not significant. These data suggest that the stocks of pollock off Gabriola Island and Active Pass cannot be distinguished from each other on the basis of their parasite faunas.

SABLEFISH

The original intent of this project was an assessment of the feasibility of using parasites as biological tags for stock identification. With only one sample examined, this purpose cannot be achieved. However, some interesting facts have been established. One of them is the relative paucity of parasite species occurring in sablefish. It is probably associated with the fact that sablefish, after moving into deeper water, feed relatively sparsely and have fewer opportunities of acquiring parasites with intermediate hosts than a more voracious fish would have. Hence, with the exception of Anisakis sp., a non-specific and ubiquitous nematode, few species can be considered abundant in sablefish. However, Myxosporea, which have no intermediate hosts (as far as is known), are completely absent; the reasons for their absence are obscure.

As mentioned earlier, half of the parasite species present in sablefish are Trematoda. These worms, however, appear rather late in the life of the fish. Of the two-year old fish (which constituted half of the sample) (Table 2), only two specimens were infected with trematodes and they were the only fish of this age group that had exceeded a weight of 1,000 g. The gradual build-up of the trematode fauna of sablefish with age can be seen from the figures below.

	Prevalence	Intensity	Mean No. of species
Age 2	16.6%	14.0	1.5
Ages 3-10	50.0%	8.2	2.0
Ages 10-26	100.0%	23.1	1.7

The intensity for the age 2 fish was high due to the occurrence of 23 specimens of Lecithaster gibbosus in one of the two infected fish of this group. There is a noticeable trend towards increase in prevalence and intensity, but not in number of species. This situation is puzzling. The infective stages (metacercaria) of the dominant trematodes involved (L. gibbosus and D. varicus) are most commonly harboured by planktonic and/or littoral crustaceans, mainly copepods. Other possible hosts, such as echinoderms, are also littoral or sub-littoral in habits. The data obtained from this examination suggest, however, that during the first two years of life, i.e. during the period when sablefish feed on the potential intermediate hosts most intensively, they do not acquire trematodes. These parasites begin to appear very closely to the time when the fish move into deeper water and

very substantially reduce their intake of planktonic Crustacea and other shallow-water organisms. This apparent paradox can be explained in several ways: (1) our information on the feeding habits of sablefish is not entirely correct; the fish are able to maintain in some way their intake of shallow-water organisms in later life at a level compatible with the observed increase in trematode infection; (2) the trematodes have intermediate hosts living in deeper waters and readily accessible to the fish during their deep-water phase; (3) the life cycle of the trematodes involves an additional link that makes it possible for the parasite and its definitive host, the sablefish, to be brought together, and (4) a definitive host of trematodes becomes prey of sablefish and passes on the infection.

Of the other groups of parasites, Cestoda are much less common than Trematoda. The small size of the sample does not allow a clear conclusion to be drawn, but no apparent age preference can be observed in the distribution of these worms in the sablefish population. In contrast, juvenile Corynosoma sp., an acanthocephalan with a marine mammal as its definitive host, was not found in fish less than 10 years' old. In fish 10 years old or older its prevalence reached 62.5%, with maximum intensity of 5. Since Corynosoma, like the trematodes, must pass through a shallow-water intermediate host to become infective, its distribution in the sablefish population raises the same questions.

No age pattern of infection was discernible among Nematoda, heavily dominated by the presence of Anisakis sp. larvae. Hysterothylacium aduncum appears able to build up small populations in older fishes (ages 27 and 30), but otherwise is only sporadic, as is Pseudoterranova decipiens. Capillaria sp. seems to be only an occasional parasite.

Naobranchia occidentalis (Copepoda), which has a one-host cycle, tended to accumulate on the gills of the fish, though the increase was modest. Age 2 fish were 50% infected, with mean intensity of 2.6. The 3-6 year old group had the same prevalence of the copepod, with a slight increase in intensity of infection (3.5). The group of over-10 year old fish was 85.7% infected, with mean intensity of 5.3. This increase seems compatible with the increase in the area of the substrate available for colonization in older fishes.

FLATFISHES

The first and the most obvious outcome of the examination of the four flatfish species for their parasite fauna was an extension of the previously recorded lists of parasites they carry in British Columbian waters. (The previous Canadian records are taken from Margolis and Arthur 1979. Check of subsequent literature did not add any records to their lists.) Thus, the list of parasites of Parophrys vetulus was enlarged from 11 to 25 species. The survey produced records of 19 species, five of which were already known to occur in this fish. The findings included three new records of Myxosporea, four of Trematoda, three of Cestoda (not previously represented in the parasite fauna of P. vetulus in British Columbia), three of Nematoda and one leech.

No published information existed previously on the parasite fauna of Microstomus pacificus in Canadian waters. All the species discovered in the course of this survey are, therefore, new records for the Canadian fauna. They include 21 species (five of Myxosporea, five of Trematoda, one of Monogenea, one of Cestoda, two of Acanthocephala, six of Nematoda and one of Copepoda).

The third flatfish species, Lepidopsetta bilineata, had 19 recorded species of parasites in British Columbian waters. Because of the poor condition of the sample studied, only eight species were found. Three of them were previously known from L. bilineata (Kudoa sp. (=K. thyrsitis), Naobranchia occidentalis and Nectobrachia indivisa). Five were additions to the list, though one of them was identified only as a "leech". The other four were all protozoan species (Ceratomyxa hopkinsi, Davisia sp., Unicapsula muscularis and Zschokkella sp.).

In spite of its commercial interest, Atheresthes stomias had only two parasite species listed in the literature (Kudoa sp. and Phrixocephalus cincinnatus). The latter of the two is quite common but was not found in the course of the present survey. The results of the survey boost the number of parasite species from two to 22 (six of Myxosporea, four of Trematoda, one of Monogenea, two of Cestoda, three of Acanthocephala, four of Nematoda and three of Copepoda). Two of the protozoan species found appear to be new and will be described in a separate report (Davisia sp. and Zschokkella sp.). The most widespread protozoan was Ceratomyxa hopkinsi, occurring in all four species of flatfishes.

Eleven species of parasites were found for the first time in the Canadian Pacific. These new records comprise two species of Protozoa (Ceratomyxa hopkinsi and Ortholinea divergens), three of Trematoda (Fellodistomum brevum, Genitocotyle acirra and Otodistomum veliporum), two of Monogenea (Entobdella pugetensis and Neoheterobothrium pugetensis), three subspecies of Cestoda (Scolex pleuronectis, S. pleuronectis bilocularis, and S. pleuronectis triloculatus) and one species of Acanthocephala (Corynosoma wegeneri). This account does not include parasites that were identified only to the generic level.

The survey resulted also in a number of new host records for this region. For the sake of clarity, these are listed below in tabular form.

Parasite	New host
Conispora meridionalis	Atheresthes stomias
	Microstomus pacificus
Unicapsula muscularis	Atheresthes stomias
	Lepidopsetta bilineata
	Parophrys vetulus
Derogenes varicus	Atheresthes stomias
	Microstomus pacificus
Lecithaster gibbosus	Parophrys vetulus
Steganoderma formosum	Atheresthes stomias
Bothriocephalus scorpii	Parophrys vetulus
*Nybelinia surmenicola	Atheresthes stomias

Table cont'd.

Parasite	New host
Corynosoma villosum	Atheresthes stomias
Ascarophis sebastodis	Parophrys vetulus
	Microstomus pacificus
Cucullanus annulatus	Microstomus pacificus
*Hysterothylacium aduncum	Atheresthes stomias
*	Parophrys vetulus
	Microstomus pacificus
*Pseudoterranova decipiens	Atheresthes stomias
	Microstomus pacificus
Naobranchia occidentalis	Atheresthes stomias

(Records marked with an asterisk indicate that the parasite has been recorded in this host off the Pacific coast of the United States.)

As mentioned above, to ensure comparability, comparisons of parasites found on the four flatfish species were limited to those parasites that were less likely to be seriously affected by the condition of sample preservation. This restriction left only 21 species of parasites for the purposes of comparison. Taken into account were the parasites of the gall bladder (Ceratomyxa hopkinsi, Zschokkella sp. and Scolex pleuronectis), those of the urinary bladder (Davisia sp., Conispora meridionalis, Ortholinea divergens, Phyllodistomum sp. and gorgoderid trematodes), gills (an unidentified leech, Oceanobdella sp. a discocotylid monogenean, Neoheterobothrium pugetensis, Entobdella pugetensis, Acanthochondria sp., Naobranchia occidentalis and Nectobrachia indivisa) and fins (metacercariae of Prosorhynchus sp. and Stephanostomum sp., and Lepeophtheirus sp.).

In broad terms, the four flatfish species could be divided into two pairs with similar ecology. Parophrys vetulus and Microstomus pacificus are soft bottom dwellers with largely demersal diet, whereas Atheresthes stomias and Lepidopsetta bilineata dwell largely on harder bottoms and are distinctly predatory.

The first of these two pairs had 16 of the 21 species compared, whereas the second carried 14. The first pair had seven species not found in the second, while the second had five not found in the first. The extent of overlap was 42.8%, indicating substantial differences in the composition of the parasite fauna. The overlap between the members of each pair was, however, much smaller (18.7% in the first pair and 21.4% in the second). In fact, the overlap between Atheresthes stomias and Microstomus pacificus, members of different pairs and species with substantial biological differences, had an overlap of 42.8%, identical with that between the two ecologically distinct pairs. The prevalence and intensity of infections with all parasites was similar in all four host species. On the basis of this evidence, there does not appear to be any correspondence between the ecology of the host species and its parasite fauna. The data used for the comparisons, however, are not abundant enough to allow any definitive conclusions.

Only two of the four flatfish species (Atheresthes stomias and Microstomus pacificus) were sampled in two well-separated areas (Hecate Strait and the west coast of Vancouver Island, Area 21). A comparison of their parasite faunas in these two regions shows that the southern one in both instances had a richer fauna (21 and 12 species for M. pacificus, 20 and 9 for A. stomias). When only the species considered as comparable are taken into account, M. pacificus in Area 21 had 8 species and only half that number in Hecate Strait. For A. stomias, the corresponding figures were 11 and 8. The comparison is more complete, when presented in a tabular form.

M. pacificus		A. stomias	
Area 21	Hecate Strait	Area 21	Hecate Strait
C. hopkinsi	C. hopkinsi	C. hopkinsi	C. hopkinsi
C. meridionalis	-	C. meridionalis	C. meridionalis
Davisia sp.	Davisia sp.	-	-
K. thyrsitis	-	K. thyrsitis	K. thyrsitis
O. divergens	O. divergens	O. divergens	-
-	-	U. muscularis	U. muscularis
-	-	Zschokkella sp.	Zschokkella sp.
Prosorhynchus sp.	Prosorhynchus sp.	Prosorhynchus sp.	-
Discocotylidae	-	-	-
-	-	Stephanostomum sp.	-
-	-	-	E. pugetensis
-	-	N. pugetensis	N. pugetensis
Acanthochondria sp.	-	-	-
-	-	-	N. occidentalis

Table 1. Parasites of pollock found in three localities in British Columbia.

Parasite	Gabriola Island Prev. (%)	Gabriola Island Int. Mean	Gabriola Island Int. Range	Active Pass Prev. (%)	Active Pass Int. Mean	Active Pass Int. Range	West Coast Prev. (%)	West Coast Int. Mean	West Coast Int. Range
Protozoa									
Myxidium theragrae	26.9			43.9			5.66		
Kudoa thyrsitis	-			2.4			-		
Zschokkella hildae	76.9			48.7			54.7		
Plistophora sp.	26.9			19.6			11.3		
Unidentified Microsporea	7.7			2.4			-		
Trematoda									
Aporocotyle theragrae	3.8	1.0	1	2.0	1.0	1	11.3	1.3	1-3
Brachyphallus crenatus	-	-	-	-	-	-	3.7	2.5	1-4
Copiatestes filiferus	-	-	-	-	-	-	9.4	2.0	1-2
Derogenes varicus	57.7	5.3	1-25	48.0	4.4	1-13	13.2	1.3	1-2
Hemiurus levinseni	3.8	1.0	1	-	-	-	3.8	3.0	1-5
Lepidapedon gadi	-	-	-	4.8	2.5	2-3	-	-	-
Parahemiurus merus	-	-	-	4.8	1.0	1	-	-	-
Podocotyle (?) sp.	84.6	14.0	1-69	87.8	19.7	1-90	62.3	8.7	1-50
Prosorhynchoides basargini (metacercariae)	-	-	-	-	-	-	3.7	2.0	1-3
Prosorhynchus sp. (metacercariae)	-	-	-	-	-	-	18.9	11.6	1-34
Rhipidocotyle sp. (metacercariae)	92.3	38.9	1-591	92.7	153.3	1-3072	86.7	25.3	1-126
Cestoda									
Abothrium gadi	73.1	2.3	1-6	73.2	3.3	1-12	43.4	2.0	1-10
Grillotia heptanchi (plerocercoids)	3.8	1.0	1	4.8	1.5	1-2	5.7	1.0	1
Nybelinia surmenicola (plerocercoids)	57.7	4.5	1-38	58.5	4.5	1-32	45.3	6.5	1-60
Scolex pleuronectis	57.7	22.9	1-205	51.2	11.3	1-77	73.6	7.2	1-55
Trypanorhyncha (larvae)	3.8	1.0	1	2.4	1.0	1	9.4	1.6	1-3
Acanthocephala									
Echinorhynchus gadi	80.8	57.6	1-224	82.9	54.7	1-451	47.2	7.6	1-38
Corynosoma sp. (juvenile)	15.4	1.2	1-2	2.4	2.0	2	3.8	1.0	1
Nematoda									
Anisakis sp. (larvae)	96.1	13.6	4-41	100.0	12.5	1-43	100.0	13.5	3-42
Hysterothylacium aduncum	80.8	8.6	1-32	92.7	15.2	3-100	94.3	10.2	1-31
Pseudoterranova decipiens (larvae)	17.5	1.7	1-3	9.8	1.5	1-3	30.2	1.9	1-5
Spirurida (larvae)	7.7	1.0	1	-	-	-	7.5	1.5	1-3

Table 1 (cont'd)

Parasite	Gabriola Island Prev. (%)	Gabriola Island Int. Mean	Gabriola Island Int. Range	Active Pass Prev. (%)	Active Pass Int. Mean	Active Pass Int. Range	West Coast Prev. (%)	West Coast Int. Mean	West Coast Int. Range
Copepoda									
Clavella perfida	11.5	1.0	1	12.2	1.0	1	24.5	1.4	1-3

NOTE: Prev.=Prevalence, i.e. percentage of the population examined carrying the parasite.

Int. =Intensity of infection, i.e. number of parasites of any given species carried by an individual host.

Table 2. Length, weight, sex, and age of sablefish examined.

No.	Length (cm)	Weight (g)	Sex	Age	No.	Length (cm)	Weight (g)	Sex	Age
1	33	330	F	1	16	50	1216	F	3
2	35	464	F	2	17	53	1723	F	3
3	37	500	M	2	18	52	1457	F	4
4	37	606	F	2	19	62	1762	F	5
5	39	516	M	2	20	60	2910	M	6
6	39	535	M	2	21	49	2099	F	7
7	39	579	F	2	22	81	5760	F	9
8	39	582	M	2	23	80	5300	F	10
9	39	590	F	2	24	75	5500	F	11
10	36	505	F	2	25	88	4790	F	14
11	44	727	F	2	26	61	2756	M	15
12	46	1045	-	2	27	83	6064	F	17
13	46	1075	F	2	28	71	3460	F	22
14	47	982	F	2	29	90	9154	F	23
15	47	985	M	2	30	82	6600	F	26

Table 3. Numbers of parasites found in individual sablefish.

Fish No.	Trematoda						
	Derogenes varicus	Unidentifiable didymozoid	*Fellodistomum brevum*	*Lecithaster gibbosus*	*Parahemiurus merus*	*Opecoelina* sp.	Unidentified trematode
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12				23		1	3
13					1		
14							
15							
16							
17							
18	1	3					
19							
20				1			
21	5			16			
22	1			4	2		
23							
24			5				1
25	12			12			
26			10				
27	30			48	1		
28							8
29				3			
30	16			16			

Table 3 (cont'd)

Fish No.	Cestoda	Acanthocephala	Nematoda				Copepoda
	Scolex pleuronectis	*Corynosoma* sp. (juvenile)	*Hysterothylacium aduncum*	*Anisakis* sp. (larva)	*Pseudoterranova decipiens* (larva)	*Capillaria* sp. (larva)	*Naobranchia occidentalis*
1							
2				1			
3				3			
4	4			7	2		2
5				6			
6	1			23			1
7				1			
8				2			2
9				4			
10			6	12			
11	1			7			2
12				20			2
13				17		4	3
14	1			16			6
15			1	9			
16	1		1	16			2
17				44			17
18				27			1
19				61			
20				154			8
21				82			
22				206	1		
23		1		369	1		
24		3		166	2		9
25		5	4	387			
26		2		86			8
27		2	17	454	6		2
28			4	387			4
29				401			1
30	3		15	142			13

Table 4. Parasites of Parophrys vetulus and Microstomus pacificus in Hecate Strait.

Parasite species	P. vetulus			M. pacificus		
	Prevalence (%)	Intensity Mean	Range	Prevalence (%)	Intensity Mean	Range
Protozoa						
Ceratomyxa hopkinsi	68.0			50.0		
Davisia sp.	4.0			20.8		
Ortholinea divergens	-			8.3		
Unicapsula muscularis	2.0			-		
Trematoda						
Derogenes varicus	-	-	-	4.2	1.0	-
Fellodistomum brevum	-	-	-	12.5	2.3	1-4
Genitocotyle acirra	4.0	1.0	1	-	-	-
Gorgoderidae gen.sp.	24.0	11.3	1-51	-	-	-
Lecithaster gibbosus	12.0	2.2	1-5	-	-	-
Otodistomum veliporum (metacecaria)	22.0	1.7	1-3	91.7	11.4	1-43
Podocotyle sp.	4.0	1.0	1	-	-	-
Prosorhynchus sp. (metacercaria)	-	-	-	12.5	1.0	1
Cestoda						
Bothriocephalus scorpii	8.0	4.2	1-12	-	-	-
Phyllobothrium sp.	10.0	2.0	1-5	-	-	-
Scolex pleuronectis triloculatus	18.0	2.8	1-6	-	-	-
Acanthocephala						
Corynosoma sp. (juvenile)	-	-	-	4.2	1.0	1
Echinorhynchus gadi	-	-	-	8.3	1.5	1-2
Nematoda						
Anisakis sp. (larva)	6.0	1.7	1-2	12.5	5.0	1-13
Ascarophis sebastodis	4.0	1.0	1	-	-	-
Cucullanus annulatus	50.0	34.6	14-90	45.8	4.6	1-10
Hysterothylacium aduncum	2.0	1.0	1	12.5	1.3	1-2
Hirudinea						
Oceanobdella sp.	6.0	1.3	1-2	-	-	-
Copepoda						
Lepeophtheirus sp. male	2.0	1.0	1	-	-	-
Naobranchia occidentalis	16.0	2.6	1-6	-	-	-
Acanthochondria sp.	2.0	1.0	1	-	-	-

Table 5. Parasites of *Microstomus pacificus* in Area 21 (west coast of V.I.).

Parasite species	Prevalence (%)	Intensity Mean	Intensity Range
Protozoa			
Ceratomyxa hopkinsi	52.0		
Conispora meridionalis	20.0		
Davisia sp.	16.0		
Kudoa thyrsitis	4.0		
Ortholinea divergens	16.0		
Trematoda			
Derogenes vericus	4.0	1.0	1
Fellodistomum brevum	20.0	6.6	1-25
Otodistomum veliprorum (metacercaria)	76.0	4.1	1-20
Phyllodistomum sp.	4.0	3.0	3
Prosorhynchus sp. (metacercaria)	40.0	2.3	1-8
Monogenea			
Discocotylidae gen. sp.	16.0	3.0	1-8
Cestoda			
Scolex pleuronectis	8.0	1.0	1
Acanthocephala			
Corynosoma sp. (juvenile)	8.0	1.0	1
Echinorhynchus gadi	96.0	20.7	1-107
Nematoda			
Anisakis sp. (larva)	12.0	1.3	1-2
Ascarophis sebastodis	8.0	1.5	1-2
Cucullanus annulatus	56.0	2.3	1-5
Hysterothylacium aduncum	84.0	3.8	1-12
Pseudoterranova decipiens (larva)	4.0	1.0	1
Spirurid larvae	32.0	1.0	1
Copepoda			
Acanthochondria sp.	4.0	1.0	1

Table 6. Parasites of Atheresthes stomias and Lepidopsetta bilineata in Hecate Strait.

Parasite species	A. stomias Prevalence (%)	A. stomias Intensity Mean	A. stomias Intensity Range	L. bilineata Prevalence (%)	L. bilineata Intensity Mean	L. bilineata Intensity Range
Protozoa						
Ceratomyxa hopkinsi	88.0			87.5		
Conispora meridionalis	90.5			-		
Davisia sp.	-			4.3		
Kudoa thyrsites	100.0			8.3		
Unicapsula muscularis	52.0			20.8		
Zschokkella sp.	16.7			20.8		
Monogenea						
Entobdella pugetensis	12.0	1.0	1	-	-	-
Neoheterobothrium pugetensis	40.0	2.3	1-5	-	-	-
Nematoda						
Pseudoterranova decipiens (larva)	72.0	2.2	1-4	-	-	-
Hirudinea						
Unidentified leech	-	-	-	4.2	1.0	1
Copepoda						
Naobranchia occidentalis	4.0	1.0	1	16.7	4.0	1-7
Nectobrachia indivisa	-	-	-	33.3	4.7	1-15

Table 7. Parasites of Atheresthes stomias in Area 21 (west coast of Vancouver Island).

Parasite species	Prevalence (%)	Intensity Mean	Intensity Range
Protozoa			
Ceratomyxa hopkinsi	80.0		
Conispora meridionalis	56.0		
Kudoa thyrsitis	80.0		
Ortholinea divergens	8.0		
Unicapsula muscularis	56.0		
Zschokkella sp.	48.0		
Trematoda			
Derogenes varicus	4.0	2.0	2
Prosorhynchus sp. (metacercaria)	40.0	8.3	1-29
Steganoderma formosum	40.0	6.6	1-25
Stephanostomum sp. (metacercaria)	12.0	2.0	1-3
Monogenea			
Neoheterobothrium pugetensis	40.0	2.1	1-5
Cestoda			
Nybelinia surmenicola (plerocercoid)	44.4	5.8	1-29
Scolex pleuronectis bilocularis	44.0	15.9	1-79
Acanthocephala			
Corynosoma villosum (juvenile)	20.0	3.4	1-8
Corynosoma wegeneri (juvenile)	8.0	1.5	1-2
Corynosoma sp. (juvenile)	32.0	2.4	1-7
Nematoda			
Anisakis sp. (larva) (mesentery)	100.0	146.3	31-407
Anisakis sp. (larva) (liver)	100.0	7.5	1-29
Anisakis sp. (larva) (stomach wall)	100.0	57.7	14-129
Anisakis sp. (larva) (other sites)	28.0	0.8	1-8
Hysterothylacium aduncum	40.0	6.7	1-16
Pseudoterranova decipiens (larva)	52.0	2.1	1-6
Spirurid larvae	16.0	1.0	1