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PARASITE RECRUITMENT BY STOCKED WALLEYE, *STIZOSTEDION VITREUM VITREUM* (MITCHILL), FRY IN A SMALL BOREAL LAKE IN CENTRAL CANADA

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ABSTRACT: Six species of parasites were recovered 4 mo after walleye fry were stocked in Heming Lake, Manitoba. The species of parasites acquired most rapidly were those that were non-host-specific and common to the indigenous populations of both walleye and yellow perch (*Perca flavescens*). Parasite species overlap (Jaccard's indices) was greatest within age groups of walleye and yellow perch, but was also high between older walleye and yellow perch. The higher numbers of parasites recruited by stocked walleye, particularly ones known to induce pathology, raises questions on the success of walleye introductions to aquatic systems with a diverse indigenous parasite fauna and a fish population with a large proportion of yellow perch.

INTRODUCTION

The stocking of freshwater fishes into lakes and rivers to increase the numbers of an already existing species of fish or the introduction of a new species of fish into a lake is a common practice in fisheries management. However, little information is available on the rate of recruitment of parasites by these introduced fish. If the species of fish introduced is already present in the system then the most likely parasites acquired by these fish are those that are indigenous to the same species of native fish or perhaps fish with similar feeding patterns. Furthermore, since parasites may be exchanged between fish belonging to the same family (Leong and Holmes, 1981) it is important to know the parasite community and the overlap of species of parasites between hosts in that community.

The objectives of this study were to (1) determine the parasite fauna of two species of fish belonging to the same family (walleye and yellow perch) in a small boreal lake, and (2) assess the species of parasites and the rate of parasite recruitment by walleye introduced into the lake.

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MATERIALS AND METHODS

Heming Lake is a eutrophic lake located in north-western Manitoba, Canada (54°53′N, 101°07′W) with a maximum depth of 5.0 m ($\bar{x}$ = 2.7 m) and surface area of 264 ha (Babaluk et al., 1980). All samples of walleye and yellow perch were collected with gill nets, otter trawls (6.0-mm stretched, knotless mesh in the inner bag), and Beamish live traps (Beamish, 1973) during the open water season (June to October) of 1980 and 1981 to establish the parasite community indigenous to these fishes (see Table 1 for fish sample sizes) and to assess seasonal changes in parasite numbers. Ninety-three walleye collected from 1977 to 1979 were also examined for ageing data only. Gill nets were 2 m deep with 20-m panels made into gangs of 38-, 70-, and 89-mm stretched mesh, and were set in 2–5 m of water. One and a half million walleye fry were hatched at the Grand Rapids Hatchery, Grand Rapids, Manitoba, and introduced into Heming Lake in June 1981. Twenty-one young-of-the-year (yoy) walleye were live-trapped with otter trawls in October of 1981, and 35 1-yr-old walleye in September of 1982.

Fish were either examined at necropsy fresh or frozen within 6 hr of capture for later processing. The fork length and round weight were recorded, and opercle bones were removed for ageing purposes. The gastrointestinal (GI) tract was removed and slit longitudinally. The mucosa was scraped, and the contents diluted in water, stirred, and examined using a Wild M3 dissecting microscope. Filets were removed and the flesh was cut dorsoventrally (1–10-mm sections) and checked for the presence of larval parasites. The skin, fins, eyes, kidney, gills, swim bladder, gall bladder, heart, spleen, liver, and brain were also examined for parasites, the latter three with the aid of a trichinoscope. All stomach contents were recorded.

Trematodes, cestodes, and acanthocephalans were removed, washed in water, fixed in formalin–acetic acid–alcohol (FAA) for 24 hr, stored in 70% ethanol, stained with Semichon's carmine, cleared in xylene, and mounted in permount. Nematodes and copepods were removed, washed in water, and stored in 70% ethanol. The former were cleared in lactophenol and glycerin, and mounted in glycerin jelly. Copepods were dehydrated to 100% ethanol, cleared in xylene, and mounted in permount.

Prevalence and mean intensity were determined for each species of parasite recovered from samples of yoy and 1-yr-old stocked walleye, 1-yr-old indigenous walleye, 2 yr and older (2+) indigenous walleye, and yoy, 1-yr-old, and 2 yr and older (2+) yellow perch.

Prevalence and mean intensity were defined by Margolis et al. (1982). Parasite species overlap between hosts (e.g., yoy walleye and 1-yr-old walleye) were determined using Jaccard's index (J) where $J = 100c/a + b - c$ and a = number of parasite species in host x, b = number of parasite species in host y, and c = number of parasite species shared by host x and host y (Leong and Holmes, 1981).

RESULTS

One hundred and twenty walleye were sampled between 1977 and 1981 but no yoy and only four 1-yr-old walleye (3.3%) were collected indicating very low recruitment into the walleye population. Consequently, most if not all yoy and 1-yr-olds recovered following stocking could be assumed to be the introduced walleye. The proportion of fish species in the 1981 sample were (walleye 4.3%, yellow perch 20.0%, white sucker [*Catostomus commersoni*] 39.8%, northern pike [*Esox lucius*] 32.5%, lake whitefish [*Coregonus clupeaformis*] 3.1%, burbot [*Lota lota*] 0.3%). Yellow perch and walleye were the only species of fish examined in Heming Lake that belonged to the same family. Johnny darters (*Etheostoma nigrum*) also belonged to the family Percidae, but were less abundant and not examined.

Seasonal data for the parasites of indigenous walleye and yellow perch were not a factor in our interpretation of recruitment into the stocked walleye and were therefore not included in this paper.

The parasite fauna of indigenous walleye and yellow perch and the stocked walleye are listed in Table 1. The indigenous 1-yr-old and 2+ walleye had seven and 13 species of parasites, respectively. The indigenous yoy, 1-yr-old and 2+ yellow perch had eight, eight, and 20 species of parasites, respectively. The introduced yoy and 1-yr-old walleye had a maximum of six species. Five of these six species were common to both the indigenous walleye and yellow perch but *Proteocephalus luciopercae* was restricted to walleye (indigenous and stocked populations). The indigenous 1-yr-old walleye compared to the stocked walleye had *Diplostomum* sp. and *Triaenophorus nodulosus* but did not have *Rhipidocotyle papillosus* (Table 1). The mean intensities of *Bothriocephalus cuspidatus*, *P. luciopercae*, and *Raphidascaris acus* larvae in the stocked walleye (yoy and 1-yr olds) were consistently higher than for the indigenous 1-yr-old walleye, but it should be noted that the sample size of indigenous 1-yr-old walleye was small. On the other hand, the intensity of *Ergasilus luciopercarum* was lower in stocked yoy, but much higher in the stocked 1-yr olds. Mean intensities of *Ergasilus luciopercarum* in 1-yr-old stocked walleye were comparable to the much larger 2+ indigenous walleye. The prevalence of *R. acus* larvae was higher in yoy and 1-yr-old stocked walleye than for indigenous walleye, but similar to values for 1-yr-old and 2+ yellow perch. Mean intensities of *R. acus* larvae in yoy and 1-yr-old stocked walleye were similar to 2+ walleye.

Jaccard's indices for species of parasites showed greatest overlap between yoy and 1-yr-old fish within both walleye and yellow perch (Table 2). The within species overlap for all age combinations for both walleye and yellow perch was greater than between species overlaps. The one exception was the overlap (50.0) for 2+ walleye and yellow perch (Table 2).

The mean number of all parasites/g of fish was about 10× higher in yoy than in 2+ fish for both walleye and yellow perch while actual weight differences between yoy and 2+ for walleye and yellow perch were 165× and 35×, respectively (Table 1).

The proportion of food items ranged from 47.6% zooplankton, 23.8% benthic invertebrates and 23.8% fish for yoy walleye to 100% fish for 2+ walleye. Yellow perch food items ranged from 92.0% zooplankton and 4.0% benthic invertebrates for yoy to 1.2% zooplankton, 38.0% benthic invertebrates, 17.5% fish and 8.4% other food items for 2+ yellow perch.

The following specimens have been deposited in the parasite collection, National Museum of Canada. All numbers are for adult specimens except for larval forms where indicated: *Urocleidus adspectus* NMCPC 1985-0021; *Urocleidus aculeatus* NMCPC 1985-0022; *Ornithodiplostomum ptychocheilus* NMCPC 1985-0023 (metacercaria); *Diplostomum* spp. NMCPC 1985-0024 and NMCPC 1985-0025 (metacercaria); *Apophallus brevis* NMCIC(P) 1983-0069 (metacercaria); *Lissorchis kritskyi* NMCPC 1985-0026; *Bunoderina sacculata* NMCPC 1985-0027; *Crepidostomum farionis* NMCPC 1985-0028; *Crepidostomum cooperi* NMCPC 1985-0029; *Rhipidocotyle papillosus* NMCPC 1985-0030; *Prosorhynchoides pusilla* NMCPC 1985-0031; *Bothriocephalus cuspidatus* NMCPC 1985-0032; *Proteocephalus luciopercae* NMCPC 1985-0033; *Proteocephalus pearsei* NMCPC 1985-0034; *Triaenophorus nodulosus* NMCIC 1985-0035 (plerocercoid); *T. nodulosus* NMCIC 1985-0036; *Schistocephalus solidus* NMCIC 1985-0037 (plerocercoid); *Diphyllobothrium latum* NMCIC 1985-0038 (plerocercoid); *Spinitectus gracilis* NMCIC 1985-0039; *Raphidascaris acus* NMCIC 1985-0040 (larvae); *R. acus* NMCIC 1985-0041; *Neoechinorhynchus strigosus* NMCIC 1985-0042; *Neoechinorhynchus rutili* NMCIC 1985-0043; *Pomphorhynchus bulbocolli* NMCIC 1985-0044; *Ergasilus luciopercarum* NMC-C1985-116.

DISCUSSION

Stocked walleye quickly acquired six of 13 species of parasites from the indigenous population of walleyes and five of 20 species of parasites from the indigenous population of yellow perch. First impressions could lead one to conclude that walleye parasites prefer walleye. However, only one of the six species (i.e., *P. luciopercae*) acquired by the stocked walleye was host-specific suggesting that parasites with the least degree of host-specificity were more likely to be acquired by a newly introduced fish host. This apparent lack of host-specificity could be due to a number of ecological factors, i.e., (1) parasites with very high dominance values (Leong and Holmes, 1981) in the community, (2) proportion of fish in the community, (3) type of parasite life cycle and (4) feeding preference of fish.

The most abundant parasites in the stocked walleye could be correlated, in general, with parasites having the highest dominance values in the walleye–yellow perch community. For example, parasites with the highest dominance values in the indigenous walleye were *E. luciopercarum* (58%), *B. cuspidatus* (22%) and *R. acus* (9.6%) and for yellow perch were *R. acus* (40%), *Apophallus brevis* (24%) and *E. luciopercarum* (9%). Similarly, parasites with the highest dominance values in the combined yoy and 1-yr-old stocked walleye were *E. luciopercarum* (67%), and *R. acus* (20%). Three factors appear to be interconnected to ensure high numbers of parasites in the stocked walleye: (1) high abundances of parasites in a small population of indigenous walleye, (2) low abundances in a large population of yel-

TABLE 1. Prevalences and mean intensities of parasites in young-of-the-year, 1-yr-old, and overall populations of walleye (*Stizostedion vitreum vitreum*) and yellow perch (*Perca flavescens*) in Heming Lake, Manitoba.

	Fish host		
Parasite species	Young-of-the-year stocked walleye (21)[a]	1-yr-old stocked walleye (18)	1-yr-old indigenous walleye (4)
Prosorhynchoides pusilla	33.3 (2.3 ± 1.6)[b]	—	25.0 (8.0 ± 0)
Rhipidocotyle papillosus	4.8 (1.0 ± 0)	—	—
Crepidostomum cooperi	—	—	—
Crepidostomum farionis	—	—	—
Bunoderina sacculata	—	—	—
Lissorchis kritskyi	—	—	—
Apophallus brevis[c]	—	—	—
Diplostomum sp.[c]	—	—	25.0 (1.0 ± 0)
Ornithodiplostomum ptychocheilus[c]	—	—	—
Urocleidus aculeatus	—	—	—
Urocleidus adspectus	—	—	—
Bothriocephalus cuspidatus	52.4 (23.8 ± 30.8)	77.8 (5.6 ± 3.9)	100 (3.3 ± 1.7)
Proteocephalus luciopercae	19.1 (1.25 ± 0.5)	22.2 (3.0 ± 3.4)	25.0 (1.0 ± 0)
Proteocephalus pearsei	—	—	—
Triaenophorus nodulosus (liver)[c]	—	—	—
T. nodulosus (intestinal)	—	—	25.0 (1.0 ± 0)
Schistocephalus solidus[c]	—	—	—
Diphyllobothrium latum[c]	—	—	—
Spinitectus gracilis	—	—	—
Raphidascaris acus (liver)[c]	100 (12.9 ± 5.7)	97.1 (16.6 ± 6.7)[d]	50.0 (8.0 ± 2.8)
R. acus (intestinal)	9.5 (2.0 ± 1.4)[c]	—	25.0 (2.0 ± 0)
Neoechinorhynchus strigosus	—	—	—
Neoechinorhynchus rutili	—	—	—
Pomphorhynchus bulbocolli	—	—	—
Ergasilus luciopercarum	61.9 (9.8 ± 9.2)	100 (75.9 ± 42.5)[d]	100 (27.8 ± 21.5)
$\bar{x}$ fish weight (g)	5.2 ± 2.3	43.0 ± 11.9	52.3 ± 6.7
$\bar{x}$ no. parasites/g fish[e]	5.3 ± 3.5	2.6 ± 1.1	0.8 ± 0.5

[a] (Sample size).
[b] Prevalence (mean intensity ± SD).
[c] Larval parasites.
[d] Sample size = 35.
[e] Parasites recorded only as present were not included in this calculation.

low perch and (3) the fact that *E. luciopercarum* and *R. acus* can be acquired directly from copepodids and embryonated eggs, respectively.

An examination of parasite species overlap gives us some insight into transmission dynamics. It is clear that both walleye and yellow perch, of all ages, have more similarity in their parasite faunas within the host species than between them and is probably accounted for, in part, because some parasites (e.g., *P. luciopercae*) are host specific. The high overlap between 2+ walleye and 2+ yellow perch may be related to longevity of some parasite species and food habits, as fish become a more important component in the diet, even for yellow perch. The high overlap of parasite species for yoy and 1-yr-old walleye and yellow perch, respectively, indicates that food items consumed are similar for the two age classes but could

TABLE 1. Continued.

Fish host			
2-yr and older indigenous walleye (23)	Young-of-the-year yellow perch (25)	1-yr-old yellow perch (5)	2-yr and older yellow perch (171)
56.5 (13.2 ± 22.3)	—	—	28.4 (13.6 ± 30.7)
8.7 (1.0 ± 0)	—	—	5.9 (7.5 ± 9.7)
—	16.0 (2.0 ± 1.4)	20.0 (8.0 ± 0)	48.5 (8.3 ± 24.8)
—	—	—	4.7 (3.0 ± 2.0)
4.4 (1.0 ± 0)	—	—	3.5 (1.3 ± 0.5)
—	—	—	0.6 (1.0 ± 0)
—	100 (6.1 ± 3.8)	100 (9.2 ± 4.6)	91.8 (19.3 ± 18.3)
8.7 (1.5 ± 0.7)	16.0 (1.0 ± 0)	20.0 (1.0 ± 0)	51.5 (3.5 ± 5.1)
present	—	40.0 (2.0 ± 1.4)	21.1 (4.6 ± 8.8)
21.7 (4.4 ± 3.6)	—	—	—
—	—	—	29.2 (8.2 ± 8.4)
95.7 (31.6 ± 44.3)	84.0 (3.7 ± 3.2)	—	32.2 (5.1 ± 13.0)
52.2 (11.4 ± 13.5)	—	—	—
—	76.0 (13.1 ± 22.1)	60.0 (5.0 ± 6.1)	55.0 (7.0 ± 11.9)
—	40.0 (1.7 ± 0.7)	60.0 (1.0 ± 0)	17.5 (1.2 ± 0.5)
13.0 (1.3 ± 0.6)	—	—	1.2 (1.5 ± 0.7)[c]
—	—	—	0.6 (1.0 ± 0)
present	—	—	0.6 (1.0 ± 0)
—	—	—	26.3 (2.0 ± 0)
30.4 (12.4 ± 15.5)	20.0 (2.2 ± 1.6)	100 (3.0 ± 1.0)	93.0 (31.5 ± 38.2)
30.4 (30.0 ± 47.4)	—	20.0 (1.0 ± 0)[c]	26.9 (3.4 ± 8.8)[c]
4.4 (1.0 ± 0)	—	—	—
—	—	—	1.8 (8.0 ± 12.1)
—	—	—	0.6 (1.0 ± 0)
82.6 (92.3 ± 133.9)	12.0 (1.3 ± 0.6)	40.0 (3.0 ± 1.4)	53.2 (12.9 ± 17.9)
856.8 ± 552.2	1.4 ± 0.3	4.3 ± 0.6	49.6 ± 29.6
0.5 ± 0.9	15.1 ± 13.0	5.9 ± 2.3	1.7 ± 1.3

be different between species of fish. It is also possible that yoy and 1-yr-old walleye frequent similar habitats, but different from that of yellow perch.

The higher prevalence and mean intensities of *R. acus* and *E. luciopercarum* in stocked walleye compared to indigenous walleye is interesting as these walleye originated from a different source and watershed. Perhaps there was a lower site specificity, i.e., habitat selection within the lake by these stocked walleye which could account for their acquiring the non-host-specific parasites and/or these walleye were more susceptible to these parasites. Whatever the reason for the higher levels of parasitic infections, we know that these parasites are pathogenic (Rogers, 1969; Poole and Dick, 1984) and that the number of parasites/g of fish was much higher for the stocked walleye, particularly yoy. In light of increased use of stocking programs as a management strategy, experimental studies are needed to determine whether these higher levels of parasitism in the young age classes of stocked walleye are sufficient to cause mortality.

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TABLE 2. Jaccard's indices for parasite species overlap within and between walleye (*Stizostedion vitreum vitreum*) and yellow perch (*Perca flavescens*) populations in Heming Lake, Manitoba. yoy = young-of-the-year, 2+ = 2 yr and older.

	1-yr-old walleye (stocked)	1-yr-old walleye (indigenous)	2+ walleye (indigenous)	yoy yellow perch (indigenous)	1-yr-old yellow perch (indigenous)	2+ yellow perch (indigenous)
yoy walleye (stocked)	66.7	62.5	46.2	27.3	16.7	23.8
1-yr-old walleye (stocked)	—	57.1	30.8	33.3	33.3	14.3
1-yr-old walleye (indigenous)	—	—	53.9	36.4	25.0	28.6
2+ walleye (indigenous)	—	—	—	23.5	23.5	50.0
yoy yellow perch (indigenous)	—	—	—	—	77.8	40.0
1-yr-old yellow perch (indigenous)	—	—	—	—	—	40.0

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LITERATURE CITED

BABALUK, J. A., J. S. CAMPBELL, AND K. D. ROWES. 1980. Morphometry of lakes and chemical analysis of water in the Heming Lake study area, Manitoba. Fish. Mar. Serv. Manuscr. Rep. (Can.), No. 1575, 21 pp.

BEAMISH, R. J. 1973. Design of a trapnet with interchangeable parts for the capture of large and small fishes from varying depths. J. Fish. Res. Board Can. 30: 587–590.

LEONG, R. T. S., AND J. C. HOLMES. 1981. Communities of metazoan parasites in open water fishes of Cold Lake, Alberta. J. Fish Biol. 18: 693–713.

MARGOLIS, L., G. W. ESCH, J. C. HOLMES, A. M. KURIS, AND G. A. SCHAD. 1982. The use of ecological terms in parasitology (report of an ad hoc committee of the American Society of Parasitologists). J. Parasitol. 68: 131–133.

POOLE, B. C., AND T. A. DICK. 1984. Liver pathology of yellow perch, *Perca flavescens* (Mitchill), infected with larvae of the nematode *Raphidascaris acus* (Bloch, 1779). J. Wildl. Dis. 20: 303–307.

ROGERS, W. A. 1969. *Ergasilus cyprinaceus* sp. n. (Copepoda: Cyclopoida) from cyprinid fishes of Alabama, with notes on its biology and pathology. J. Parasitol. 55: 443–446.