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Parasites of Fishes from Dauphin Lake, Manitoba, 1985 - 1987

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Central and Arctic Region
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Winnipeg, Manitoba R3T 2N6

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ERRATUM

- p. 11. Table 2. *Rhabdochona canadensis* also consists of specimens of *Cystidicoloides* sp. and *Rhabdochona* sp. other than *R. canadensis*.
- p. 13. Table 3. *Rhabdochona canadensis* includes *Cystidicoloides* sp.
- p. 20. Table 10. *Contracecum* sp. is a tentative identification.
- p. 21. Table 11. *Contracecum* sp. also includes *Raphidascaris* sp. larvae.
- (Above identifications confirmed by T.A. Dick).

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PARASITES OF FISHES
FROM DAUPHIN LAKE, MANITOBA,

1985 - 1987

by

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ABSTRACT

Szalai, A. J., J. F. Craig, and T. A. Dick. 1992. Parasites of fishes from Dauphin Lake, Manitoba, 1985 - 1987. Can. Tech. Rep. Fish. Aquat. Sci. 1735: iv + 36 p.

Twenty-three species of fish from Dauphin Lake, Manitoba were examined for parasites; 20 of these harbored parasites and 91% (N=1 680) of the fish examined had at least one parasite. In total, 97 028 parasites comprising 51 species (39 genera and 30 families) were found. Viral lymphocystis and one plant-parasitic nematode (*Dorylaimida*) were also found. Six of the parasite species recovered from fish have piscivorous birds as the definitive host; the remaining species have fish as the definitive host. Fifteen parasite species were not previously reported from Manitoba and three species (*Lissorchis crassicrurum*, *Neoechinorhynchus distractus* and *Rowardleus pennensis*) are new Canadian records. The diets of Dauphin Lake fishes vary between species and determine, to a large extent, the types of parasites carried by each species.

Key words: parasites; diets; walleye; *Stizostedion vitreum vitreum*; northern pike; *Esox lucius*; yellow perch; *Perca flavescens*; smallmouth bass; *Micropterus dolomieu*; cisco; *Coregonus artedii*; white sucker; *Catostomus commersoni*; shorthead redhorse; *Moxostoma macrolepidotum*; quillback; *Carpioles cyprinus*.

RESUME

Szalai, A. J., J. F. Craig, and T. A. Dick. 1992. Parasites of fishes from Dauphin Lake, Manitoba, 1985 - 1987. Can. Tech. Rep. Fish. Aquat. Sci. 1735: iv + 36 p.

On a procede a un examen des parasites chez 23 especes de poissons du lac Dauphin, au Manitoba; 20 de ces especes hebergeaient des parasites et 91% (N = 1680) des poissons examines portaient au moins un parasite. Au total, 97 028 parasites appartenant a 51 especes (39 genres et 30 familles) ont ete deceles. On a egalement decele la lymphocystite virale et un nematode parasite des plantes (*Dorylaimida*). Six des especes de parasites decelees chez les poissons avaient comme hote definitif des oiseaux piscivores; le reste des especes avait pour hote definitif des poissons. Quinze especes des parasites n'avaient pas encore ete signalees au Manitoba et trois (*Lissorchis crassicrurum*, *Neoechinorhynchus distractus* et *Rowardleus pennensis*) etaient signalees au Canada pour la premiere fois. Les regimes alimentaires des poissons du lac Dauphin varient selon l'espece et determinent en grande partie le type de parasite

porte par chacune des especes.

Mots-clés: parasites; regimes alimentaires; dore; *Stizostedion vitreum vitreum*; grand brochet; *Esox lucius*; perchaude; *Perca flavescens*; aigle a petit bouche; *Micropterus dolomieu*; cisco de lac; *Coregonus artedii*; meunier noir; *Catostomus commersoni*; sucre rouge; *Moxostoma macrolepidotum*; couette; *Carpioles cyprinus*.

INTRODUCTION

Reports of parasites of fishes of Manitoba are well documented and the most comprehensive account of ichthyoparasite records for Manitoba is the review by Lubinsky and Loch (1979). In this review, Lubinsky and Loch reported 161 species of parasites from 50 species of fish but they gave no information on parasite communities in each species of fish. Although ichthyoparasites of medical or economic importance (e.g. Diphyllobothrium latum and Triaenophorus crassus) have received more attention than other parasites there is still relatively little information on this group.

This report presents the results of a survey of the ichthyoparasites of Dauphin Lake, Manitoba. Information gathered on the stomach contents of fishes is included as this can be related to the types and numbers of parasites infecting each species. The occurrence of many previously unreported species of parasites and marked changes in the prevalence and intensity of some parasites have occurred since the biological investigation of Dauphin Lake by Stewart-Hay (1951), indicating the dynamic nature of the ichthyoparasite fauna. Changes in the aquatic environment and the invertebrate, bird and fish communities have allowed these changes.

MATERIALS AND METHODS

STUDY SITE

Dauphin Lake ($51^{\circ}17'23''$ N lat., $99^{\circ}48'12''$ W long.; elevation 260 m) is approximately 42 km long and 20 km wide (Fig. 1) with a mean depth of 2.1 m, a maximum depth of 3.5 m and a total volume of $1.645 \times 10^9 \text{ m}^3$. The lake has only a single island of negligible size (1 ha) and a surface area of 700 km^2 . A number of small rivers and streams discharge into the southwest portion of the lake (Fig. 1), draining an area of 8 700 km^2 . The Mossy River (Fig. 1) has been regulated since 1933; it is the only outlet on Dauphin Lake and flows into Lake Winnipegosis to the east. Dauphin Lake can be separated into two distinct habitat zones: (1) the shallower, southern basin which receives most of the inflowing water, has a sandy to muddy shoreline characterized by dense vegetation (mostly Phragmites spp., Scirpus spp. and Carex spp.) and a narrow littoral zone; and (2) the deeper, northern basin which has steep, rocky shorelines with sparse vegetation. Extreme fluctuations in water depth occur between and within years and wind-driven seiches can temporarily raise the water level in some portions of the lake as much as 50 cm in a few hours. Average daily air temperature ranges from -20°C in January to 17.5°C in July; 'freeze-up' occurs on about 15 November and 'ice-off' on about 7 May.

Dauphin Lake has a diverse fish fauna with 23

species of fish collected during the course of this study. Little angling takes place on the lake and most of this is confined to river inflows. Commercial harvests are limited to the winter season. The lake supports resident colonies of American white pelicans (Pelicanus erythrorhynchos), double-crested cormorants (Phalacrocorax auritus) and gulls and terns (Laridae). A few grebes (Podicipedidae) and great blue herons (Ardea herodias) nest in the area. Large numbers of ducks and geese (Anseriformes) are present during the spring and fall migrations. No fish eating mammals were observed during the period of study.

SAMPLING PROCEDURES

Fish were collected in 1985, 1986 and 1987 using gill nets, pound nets, fyke nets and beach seines. These sampling gears are described fully in Everhart et al. (1976) and a brief description of our sampling procedure follows. From 1985 to 1987, gill net samples were collected during the spring (26 May to 6 June), summer (21 July to 1 August) and fall (22 September to 2 October) using variable mesh size gill nets (15 nets per season per year) (Craig and Babaluk 1989). Gill nets consisted of gangs of six adjacent 20 x 2 m panels of 38, 64, 89, 102, 108 and 140 mm stretched mesh and each was set in one of 38 randomly chosen quadrats (4 x 4 km) on the lake (Fig. 1). Each year, 46 to 56% of the nets were set in quadrats that intersected the shoreline. Winter samples were collected annually from the commercial harvest (November to December). The commercial fishermen used 108 mm stretched mesh gill nets and caught mostly northern pike (Esox lucius), white sucker (Catostomus commersoni) and walleye (Stizostedion vitreum).

In total, 14 737 fish were collected with gill nets. All of these were (1) inspected for external parasites, tumors, or lesions, (2) measured for the fork length (FL; mm) and weighed for the round weight (W; g), (3) had ageing structures removed and (4) had the sex and maturity of each fish determined. A random subsample of fish (N=2 865) was examined for ectoparasites and a complete necropsy was performed on 1 864 individuals to provide estimates of internal parasites.

Fish were trapped annually (7 August to 12 September) using pound nets installed at two inshore stations on the lake (Fig. 1). A total of 3 869 fish were captured, examined and their ectoparasites removed. Three-thousand four-hundred and seventy-eight (90%) of these were weighed, measured, marked with individually numbered jaw or spaghetti tags (Everhart et al. 1976) and released. The left pectoral fin of each tagged fish was clipped as an additional means of identification.

Small (age-0) fish and minnows (N=2 153) were collected using fyke nets and seines (Fig. 1) in 1986 and 1987. All of these were examined for ectoparasites and a complete necropsy was performed

on 123 individuals. The remaining fish were inspected for plerocercoids of Ligula intestinalis.

PARASITE ENUMERATION AND IDENTIFICATION

For complete necropsies the eyes, gills, heart, swimbladder and viscera of fish were removed, sealed in leak-proof plastic bags and transported to the laboratory for immediate inspection or freezing (-20°C). The coelom of eviscerated fish was inspected and the fish filleted. The presence of intramuscular parasites was checked by slicing (transversely) through the coelomic side of the fillet to the skin and inspecting the exposed surfaces of the musculature. This process was repeated along the full length of both fillets with parallel slices ~1 cm apart. Thawed or fresh samples were examined in the laboratory using a Wild M3 dissecting microscope. Each organ was isolated, slit open longitudinally and the contents removed by scraping the inner surface with a blunt probe. All organs were examined under tap water (frozen specimens) or physiological saline (fresh specimens). The number and types of parasites found and their sites of infection were recorded for each fish. Stomach contents of fish were also identified.

Monogeneans, digeneans, cestodes, acanthocephalans and leeches were fixed overnight in formalin-acetic acid-alcohol (FAA). Copepods and nematodes were fixed in 70% ethanol. Cysts containing myxosporan trophozoites were punctured and their contents smeared onto glass slides and air dried. Leeches and parasitic crustaceans, collected from fish captured in pound nets, were temporarily stored in lake water, relaxed at 4°C overnight and narcotized in a dilute solution of chloroform in distilled water (three drops chloroform per 10 mL water). Parasitic crustaceans were killed by immersion in hot (35°C) ethanol (70%) and leeches were fixed in FAA. All specimens were stored in 70% ethanol. Monogeneans, digeneans, cestodes, acanthocephalans and leeches were stained with dilute (1% aqueous) Semichon's acetocarmine. All metazoans were dehydrated, cleared in xylene and mounted in Permount. Trophozoites were stained with Wright's stain (Humason 1979), air dried and mounted in Permount. Non-parasitic invertebrates and fish remains recovered from fish stomachs were identified according to Ward and Whipple (1966) and Scott and Crossman (1973), respectively. Seasonal data on stomach contents were summarized for each fish species. Parasites were identified with the aid of taxonomic keys (Kabata 1988; Schell 1985; Beverly-Burton 1981; Davies 1971; Hoffman 1970). The presence of lymphocystis, identified by characteristic wart-like growths on the skin of fish (Roberts 1978), was recorded and these are referred to as tumors throughout the text. A complete set of specimens is available from the National Museum of Natural Sciences (Ottawa, Ontario, Canada, K1A 0M6; Accession numbers NMCP1989-0551 to NMCP1989-0618, inclusive).

Mean intensity, prevalence and abundance of

parasites was calculated according to Margolis et al. (1982). All analyses were done using the Statistical Analysis Systems (SAS Institute Inc., Box 8000, Cary, NC) as implemented by the University of Manitoba Computer Services.

RESULTS AND DISCUSSION

PARASITE SURVEY

Twenty-three species of fish were collected. Four of these (sauger, Stizostedion canadense; silver redhorse, Moxostoma anisurum; freshwater drum, Aplodinotus grunniens; and smallmouth bass, Micropterus dolomieu) were not reported by Stewart-Hay (1951) and must have been either rare or absent in Dauphin Lake in 1951. Twenty fish species harbored parasites. Burbot (Lota lota, N=1), carp (Cyprinus carpio, N=3) and fathead minnows (Pimephales promelas, N=14) were not infected. In total, 97 028 parasites were found and 91% (N=1 680) of the necropsied fish had at least one parasite. The number of parasite species recovered was positively correlated to the number of hosts that were examined (Spearman's coefficient of rank correlation, $r_s=0.92$), indicating that rarer species were recovered as the number of fish examined increased. Fifty-one species of parasites spanning 39 genera and 30 families, plus viral Lymphocystis and one plant-parasitic nematode (Dorylaimida), were found (Table 1). Six of the parasite species recovered use piscivorous birds as the definitive host (Table 1). The remaining parasites were found as adults in fish; 33% (15 species) of these are directly transmitted and 62% (28 species) are transmitted via the food-web (Table 1). The life-cycles of two species (Paurorhynchus hiodontis and Creptotrema funduli) are unknown (Table 1). The total number of parasites and the number and types of parasites found in each fish species are summarized in Tables 2-18. Fifteen parasite species were not previously reported from Manitoba and three species (Lissorchis crassicrurum, Neoechinorhynchus distractus and Rowardleus pennensis) are new Canadian records (Table 2).

The only available historical record of ichthyoparasites of Dauphin Lake is the biological survey by Stewart-Hay (1951). However, because this survey was based on a small sample (N=125) of fish and only seven species of fish (walleye, northern pike, yellow perch, white sucker; shorthead redhorse, Moxostoma macrolepidotum; quillback, Carpoides cyprinus; and cisco, Coregonus artedii) were examined, comparisons between our results and those of Stewart-Hay (1951) must be made cautiously. Furthermore, Stewart-Hay collected all of his fish in summer, when numbers of parasites are lower.

Stewart-Hay (1951) described only 11 species of parasites from Dauphin Lake, but left others

unidentified. Based on Stewart-Hay's descriptions and this survey of the ichthyoparasites of fishes of Dauphin Lake, we propose the following for these unidentified species. It is most likely that the 'unrecognized flukes' and 'Neoechinorhynchus' reported from quillback were Lissorchis gullaris and N. carpodi, respectively. The 'Pomphorhynchus' reported from walleye was probably N. tenellus. Most of the 'metacercariae' described from minnows by Stewart-Hay (1951) were probably Centrovarium lobotes, but some of these may have been metacercariae of Neascus spp.. Finally, some of the Neoechinorhynchus crassus Stewart-Hay recovered from catostomids may have been N. cristatus or N. distractus. Considering these synonomies, it is likely that Stewart-Hay collected a total of 17 species of ichthyoparasites from Dauphin Lake in 1951.

Prior to comparing the results of our survey to those of Stewart-Hay (1951), we eliminated parasite species from our list that: (1), were found only in fish species that Stewart-Hay failed to collect (Crepidostomum illinoiense, Paurorhynchus hiodontis and Ergasilus herkae from goldeye, Hiodon alosoides); (2), were found only in fish species poorly represented ($N \leq 5$ fish) in Stewart-Hay's collection (Anonchohaptor anomalum, Lissorchis gullaris and Rowardleus pennensis from quillback; Proteocephalus pearsei, Caecincola sp. and Creptotrema funduli from yellow perch), (3), were probably missed by Stewart-Hay because they are rare today (Azygia longa, Dorylaimida, Hirudinea, Hunterella nodulosa, Lernaea cyprinacea, Philometroides nodulosa and Khawia iowensis) and (4), were probably present but not recorded by Stewart-Hay (Lymphocystis and Myxosoma sp.).

After modifying the parasite list of Stewart-Hay for unidentified species, eliminating some parasite species from our list as outlined above and disregarding any parasites common to Stewart-Hay's survey and ours, we are still left with a record of 15 new species of parasites for Dauphin Lake. Six of these are directly transmitted ectoparasites (Urocleidus adspectus, Tetraonchus monenteron, Ergasilus lizae, E. luciopercarum, E. versicolor and Unionidae); four are transmitted to fish by piscivorous birds (Diplostomulum sp., Posthodiplostomum m. minimum, Tetracotyle sp. and Contracaecum sp.); and five have invertebrate intermediate hosts (Lissorchis crassicrurum and Biacetabulum sp. infect oligochaetes, Crepidostomum cooperi and Rhabdochona canadensis infect mayflies and clams and Proteocephalus wickliffi infects Cyclops sp.)

DIETS OF FISHES

The diets of Dauphin Lake fishes (Fig. 2-8) will be dealt with only briefly. Northern pike, walleye and sauger are piscivorous and their prey consists mainly of yellow perch, cisco and smaller fish species (mostly trout-perch, Percopsis omiscomaycus) (Fig. 2, 3). Yellow perch feed on a

wide variety of fish and invertebrates (Fig. 4), while cisco and goldeye feed primarily on invertebrates (Fig. 5). Silver redhorse (Moxostoma anisurum), shorthead redhorse, white sucker, quillback and smaller fish species feed on a variety of invertebrates with molluscs, trichopterans and ephemeropterans being the primary food items (Fig. 6-8).

CONCLUSIONS

PARASITE COMMUNITIES AND DIETS OF FISHES

Each of the fish species examined had a characteristic assemblage of parasites. On average, each fish from Dauphin Lake harboured a community of parasites comprised of two species of parasites and 4 to 130 individual. Similar results were reported by Kennedy et al. (1986) for various freshwater fishes from Alberta, Canada where fish harboured from 0.5 to 1.8 parasite species and from 2 to 140 individual parasites per host.

Kennedy et al. (1986) believed omnivory and host movements relative to their prey (vagility) were essential for the production of diverse helminth communities in fish. Catostomids are generalist omnivores and their ingestion of a wide range of invertebrates in Dauphin Lake probably accounts for the high species richness of their parasite community. Although some information is available on fish movements in Dauphin Lake, the extent to which increased host movement might affect parasite community diversity is not easily determined. Northern pike, walleye and catostomids captured, tagged and released from pound nets in the southern half of the lake were captured throughout the lake by commercial fishermen in winter and by sport fisherman throughout the year. Furthermore, northern pike, white sucker, quillback, shorthead redhorse, walleye, yellow perch, goldeye and sauger are known to migrate into streams in the spring to spawn (Harbicht and Franzin 1988). Although these fish harbour many parasite species, we have no direct evidence that increased vagility is linked directly to increased complexity of the parasite community. In fact, because most spawning fish feed infrequently (Scott and Crossman 1973), it is likely that few parasite species are recruited during these spawning migrations.

The low species richness of the parasite community in cisco, the only member of the Salmonidae (Coregoninae) in Dauphin Lake, supports the hypothesis of Wisniewski (1958) that the parasite community within an ecosystem is characterized by parasites of the numerically dominant hosts. However, the rarity of bird-transmitted parasites and the absence of mammal-transmitted parasites in Dauphin Lake contradicts the suggestions made by Wisniewski (1958) and Esch (1971) that eutrophic systems should be

characterized by large numbers of these types of parasites. Interactions between mammals and fish and between birds and fish may be restricted due to the physical constraints imposed by Dauphin Lake. The shallowness and large surface area of Dauphin Lake means that (1) the roughness of the lake's surface forces most piscivorous birds to forage mainly in the few protected bays and (2) the lake is very turbid and this limits the abilities of sight predators.

Several of the parasites reported here are known pathogens of fish. Infections of the gills or muscle tissue by Myxosporidea can cause extensive damage to the host (Dogiel et al. 1961); metacercariae can cause mortalities of young fish (Lemly and Esch 1984); and plerocercoids of *I. nodulosus* in fishes can severely damage the liver (Mathey 1963; Lawler 1969). Furthermore, *Pomphorhynchus bulbocollis* is considered a serious fish pathogen (Bullock 1963) and mortalities among fish have been attributed to *Contracaecum* spp. (Dechiar 1972), *Argulus* spp. (Allum and Huggins 1959) and *L. cyprinacea* (Dechiar 1972). Examples of pathogenic parasites from our study of Dauphin Lake include (1) plerocercoids of the cestode *Ligula intestinalis* which cause suppression of development and maturation of the gonads and mortality in infected spottail shiners, *Notropis hudsonius* (Szalai et al. 1989) and (2) larvae of the nematode *Raphidascaris acus* which cause increased mortality in yellow perch (Szalai 1989).

PARASITE SURVEY

Due to the restricted sampling times, techniques and sizes of samples reported by Stewart-Hay (1951), direct comparison between the results of our survey and those of the survey by Stewart-Hay requires careful qualification. However, after adjusting Stewart-Hay's list of parasites for reasons given in the 'Results and Discussion' section, we believe the comparisons are accurate. It is apparent that major changes have occurred in the parasite community in Dauphin Lake since 1951. First, in the past 'metacercariae' were abundant only in small forage fishes (longnose dace, *Rhinichthys cataractae*; pearl dace, *Semotilus atromaculatus*; and common shiner, *Notropis cornutus* (Stewart-Hay 1951). In 1987 metacercariae were more numerous and found in all fish species except goldeye. Second, plerocercoids of *L. intestinalis* ('*Schistocephalus*' of Stewart-Hay) were present but Stewart-Hay (1951) found few and found them only in spottail shiners. In 1987, the number of *L. intestinalis* was higher and plerocercoids were found in goldeye, spottail shiners, quillback and white suckers. Third, in 1951, *Triaenophorus nodulosus* (*I. stizostedionis* of Stewart-Hay) was rare and found only in walleye. In 1987 adults of *I. nodulosus* were numerous in northern pike and plerocercoids were abundant in spottail shiners and yellow perch (Tables 8, 15). Furthermore, a single plerocercoid recovered from cisco represents a new host record for Canada

(Table 4) and perhaps for North America. *Triaenophorus nodulosus* was not reported from cisco by Margolis and Arthur (1979), but Hoffman (1970) cites a report by Lawler and Scott (1954) of *I. nodulosus* from *Coregonus* spp.. The evidence presented by Lawler and Scott (1954) is for lake whitefish (*C. clupeaformis*) and even this is unclear (see their Table I, II and IV). Finally, there are at least four species of fish (sauger, freshwater drum, silver redhorse and smallmouth bass) in Dauphin Lake today that were not reported by Stewart-Hay (1951).

The increased numbers and wider host distributions for *L. intestinalis* and metacercariae of digenarians are undoubtedly a reflection of the increased use of Dauphin Lake by piscivorous birds since 1951, when Stewart-Hay noted:

"... relatively few water birds are seen ... it is obvious then that little loss of fish can be charged to birds ..."

Furthermore, we are certain that *Contracaecum* sp. and perhaps *Posthodiplostomum m. minimum*, were introduced into Dauphin Lake by the recent, accidental introductions of smallmouth bass (*Micropterus dolomieu*). There is no doubt that these parasites will eventually spread to other fish species as these parasites are bird-transmitted.

Given the limited historical data on Dauphin Lake it is difficult to account for the increase in the number of invertebrate-transmitted parasites. We have indirect evidence from Stewart-Hay (1951) that this increase might be related to increased availability of zooplankton in Dauphin Lake. Regarding the invertebrate fauna of Dauphin Lake, Stewart-Hay (1951) stated:

"The picture then is of a moderate plankton characterised by diatoms and crustaceans. Total number of species found is slight ... A total of four tubificid oligochaetes was found (and) none was found in any fish. No gill copepods ... were observed."

The increased number of ichthyoparasites requiring invertebrate intermediate hosts and the increased number and species of directly transmitted ectoparasites, appears to have occurred concomitant with increased eutrophication of Dauphin Lake since 1951. Furthermore, this study and others (Cunningham 1935; Butler 1949; Babaluk et al. 1984), have documented major shifts in the species composition of the fish community in Dauphin Lake, particularly the steady decline in the number of walleye and the recent introductions of smallmouth bass.

The Dauphin Lake fish-parasite community is dominated by copepod-vectored parasites, which to a large extent have fish as their definitive hosts. Although there is good evidence for increasing

complexity of the ichthyoparasite and fish communities in Dauphin Lake since 1951, the absence of mammal-transmitted parasites, including fish parasites infective to humans, indicates this component of the community has not changed in 35 years.

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Table 1. Parasites of Dauphin Lake fishes. Asterisks (*) indicate species found in this study and also reported by Stewart-Hay (1951) and his terminology is given in brackets where this differs from ours.

Family	Species	Life Cycle
Myxosomatidae		
	<u>Myxosoma</u> sp.	direct
Dactylogyridae		
	<u>Anonchohaptor anomalam</u>	direct
	<u>Urocleidus adspectus</u>	direct
Tetraonchidae		
	<u>Tetraonchus monenteron</u>	direct
Diplostomatidae		
	<u>Diplostomulum</u> spp.	snail-fish-bird
	<u>Neascus</u> sp. (metacercariae)	snail-fish-bird
	<u>Posthodiplostomum minimum</u>	<u>Physa</u> -fish-bird
Strigeidae		
	<u>Tetracotyle</u> spp.	fish-bird
Azygiidae		
	<u>Azygia longa</u>	snail-fish
Bucephalidae		
	<u>Paurorhynchus hiodontis</u>	unknown
Lissorchiidae		
	<u>Lissorchis crassicrurum</u> ^a	snail-oligochaete-fish
	<u>L. gullaris</u> (unrecognized fluke)	snail-oligochaete-fish
Allocreadiidae		
	<u>Crepidostomum cooperi</u>	clams-mayfly-fish
	<u>C. illinoiense</u>	clams-mayfly-fish
	<u>Creptotrema funduli</u>	unknown
Cryptogonimidae		
	<u>Caecincola</u> sp.	snail-fish-fish
	<u>Centrovarium lobotes</u> *	snail-fish-fish
Caryophyllaeidae		
	<u>Biacetabulum infrequens</u>	<u>Tubifex</u> -fish
	<u>Biacetabulum</u> sp.	oligochaete-fish
	<u>Hunterella nodulosa</u>	oligochaete-fish
	<u>Monobothrium hunteri</u> * (<u>Spartoides wardi</u>)	oligochaete-fish
	<u>Rewardleus pennensis</u> ^a	oligochaete-fish
Lytocestidae		
	<u>Khawia iowensis</u>	oligochaete-fish
Bothricephalidae		
	<u>Bothricephalus cuspidatus</u> *	<u>Cyclops</u> -fish-fish
Ligulidae		
	<u>Ligula intestinalis</u> * (<u>Schistocephalus solidus</u>)	copepod-fish-bird

Table 1. Continued.

Family	Species	Life Cycle
Triaenophoridae		
	<u>Triaenophorus nodulosus*</u> (<u>T. stizostedionis</u>)	<u>Cyclops</u> -fish-fish
Proteocephalidae		
	<u>Proteocephalus luciopercae*</u>	<u>Cyclops</u> -fish
	<u>P. pearsei</u> *	<u>Cyclops</u> -fish
	<u>P. pinguis</u> *	<u>Cyclops</u> -fish
	<u>P. wickliffi</u>	<u>Cyclops</u> -fish
Anisakidae		
	<u>Contracaecum</u> sp.	fish-fish-bird
	<u>Raphidascaris acus*</u> (<u>R. canadensis</u>)	<u>Cyclops</u> -fish-fish
Philometridae		
	<u>Philometroides nodulosa</u>	<u>Cyclops</u> -fish
Cystidicolidae		
	<u>Spinitectus gracilis</u>	mayfly-fish
Thelaziidae		
	<u>Rhabdochona canadensis</u>	mayfly-fish
Dorylaimidae ^a		plant-parasitic
Neoechinorhynchidae		
	<u>Neoechinorhynchus carpiodi*</u> (<u>Neoechinorhynchus</u> sp.)	crustacean-fish
	<u>N. crassus*</u>	crustacean-fish
	<u>N. cristatus*</u>	crustacean-fish
	(<u>N. crassus</u>) ^{a*}	
	<u>N. distractus</u> ^{a*}	crustacean-fish
	(<u>N. crassus</u>)	
	<u>N. tenellus</u> (<u>Pomphorhynchus</u>)	crustacean-fish
Pomphorhynchidae		
	<u>Pomphorhynchus bulbocoli</u> *	<u>Hyallela</u> -fish
Glossiphoniidae		
	<u>Placobdella montifera</u>	direct
Piscicolidae		
	<u>Cystobranchus verrilli</u>	direct
	<u>Myzobdella moorei</u>	direct
Unionidae		
	glochidium	direct
Argulidae		
	<u>Argulus appendiculatus*</u> (<u>A. stizostethi</u>)	direct
Lernaeidae		
	<u>Lernaea cyprinacea</u>	direct

Table 1. Continued.

Family	Species	Life Cycle
Ergasilidae		
	<u>Ergasilus lizae</u>	direct
	<u>E. luciopercaum</u>	direct
	<u>E. nerkae</u>	direct
	<u>E. versicolor</u>	direct

^a new record for Canada according to Margolis and Arthur (1979).

Table 2. Mean intensity (MI), range (R) and prevalence (P) of infection (R) for parasites from 1 842 fish from Dauphin Lake, Manitoba.

Parasite Species Authority	Stage ^a	MI ^b	R	P ^c
<u>Anonchohaptor anomalum</u> Mueller, 1938	A	5.37±5.92	1-25	1.03
<u>Argulus appendiculosus</u> Wilson, 1907	A	1.08±0.28	1-2	0.34
<u>Azygia longa</u> (Leidy, 1851) Manter, 1926	A	1.50±0.76	1-3	0.43
<u>Biacetabulum infrequens</u> Hunter, 1927	A	1	1	0.16
<u>Biacetabulum</u> sp.	A	3.47±3.85	1-15	1.03
<u>Bothriocephalus cuspidatus</u> Cooper, 1917	A	57.03±114.25	1-1656	23.62
<u>Caecincola</u> sp.	M	1	1	0.05
<u>Centrovarium lobotes</u> (MacCallum, 1885) Stafford, 1904	M,A	6.69±10.48	1-74	12.54
<u>Contraeacum</u> sp.	L	6.58±7.78	1-41	5.27
<u>Crepidostomum cooperi</u> Hopkins, 1931	A	20.11±53.32	1-300	5.80
<u>C. illinoiense</u> Faust, 1918	A	14.78±22.87	1-75	0.49
<u>Creptotrema funduli</u> Mueller, 1934	A	2.25±1.24	1-5	0.87
<u>Cystobranchus verrilli</u> Meyer, 1940	A	1	1	0.03
<u>Diplostomulum</u> sp.	M	3.57±4.82	1-28	2.66
<u>Dorylaimida</u> Pearse, 1942	A	5.16±6.81	1-30	1.36
<u>Ergasilus lizae</u> Kroyer, 1863	A	3.00±2.65	1-10	0.60
<u>E. lucioperca</u> Henderson, 1926	A	19.71±23.80	1-113	7.38
<u>E. nerkae</u> Roberts, 1963	A	7.74±9.21	1-42	1.03
<u>E. versicolor</u> Wilson, 1911	A	7.74±8.12	1-40	1.03
<u>Hunterella nodulosa</u> Mackiewicz and McCrae, 1962	A	2.00±1.41	1-3	0.11
<u>Khawia iowensis</u> Calentine and Ulmer, 1961	A	2	2	0.05
<u>Lernaea cyprinacea</u> Linnaeus, 1758	A	1	1	0.15
<u>Ligula intestinalis</u> (Linnaeus, 1758) Gmelin, 1790	P	1.38±0.52	1-2	0.43

Table 2. Continued.

Parasite Species Authority	Stage ^a	MI ^b	R	P ^c
<u>Lissorchis crassicrurum</u> Haderlie, 1953	A	8.78±24.01	1-163	2.66
<u>L. gullaris</u> Self and Campbell, 1956	A	1.10±11.46	1-46	1.25
<u>lymphocystis</u>	T			0.11
<u>Monobothrium hunteri</u> Mackiewicz, 1963	A	4.67±2.66	2-9	0.33
<u>Myxosoma</u> sp.	C	1.73±2.14	1-10	1.19
<u>Myzobdella moorei</u> (Meyer, 1940) Meyer and Moore, 1954	A	2.91±8.91	1-52	0.88
<u>Neascus</u> sp.	M			0.54
<u>Neoechinorhynchus carpiodi</u> Dechtiar, 1968	A	20.92±19.03	1-88	2.06
<u>N. crassus</u> Van Cleave, 1919	A	4.45±5.43	1-45	10.59
<u>N. cristatus</u> Lynch, 1936	A	6.03±9.06	1-43	1.57
<u>N. distractus</u> unknown	A	5.45±11.59	1-66	2.99
<u>N. tenellus</u> (Van Cleave, 1913) Van Cleave, 1919	A	70	70	0.05
<u>Paurorhynchus hiodontis</u> Dickerman, 1954	A	3.00±2.83	1-5	0.11
<u>Philometroides nodulosa</u> (Thomas, 1929) Dailey, 1967	A	1	1	0.05
<u>Placobdella montifera</u> Moore, 1906	A	1.11±0.37	1-3	1.73
<u>Pomphorhynchus bulbocollis</u> Linkins in Van Cleave, 1919	A	14.52±36.29	1-337	10.80
<u>Posthodiplostomum minimum</u> Hoffman, 1958	M	28.5±31.82	6-51	0.11
<u>Proteocephalus luciopercae</u> Wardle, 1932	A	12.09±16.86	1-88	9.88
<u>P. pearsei</u> La Rue, 1919	A	6.53±13.44	1-83	4.61
<u>P. pinguis</u> La Rue, 1911	A	22.20±33.41	1-233	11.45
<u>P. wickliffi</u> Hunter and Bangham, 1933	A	122.34±186.11	1-1188	13.08
<u>Raphidascaris acus</u> (Bloch, 1779) Ralliet and Henry, 1915	L,A	18.04±25.93	1-216	39.69
<u>Rhabdochona canadensis</u> Moravec and Arai, 1971	A	8.00±10.52	1-45	1.47

Table 2. Continued.

Parasite Species Authority	Stage ^a	MI ^b	R	P ^c
<u>Rowardleus pennensis</u> Mackiewicz and Deutsch, 1976	A	9.78±7.07	1-23	0.49
<u>Spinitectus gracilis</u> Ward and Magath, 1917	A	2.45±2.43	1-12	2.88
<u>Tetracotyle</u> sp.	M	4.56±7.85	1-37	2.11
<u>Tetraonchus monenteron</u> (Wagener, 1857) Diesing, 1858	A	13.83±15.23	2-90	4.40
<u>Triaenophorus nodulosus</u> (Pallas, 1760), Rudolphi, 1819	P,A	22.89±51.11	1-452 11.18	
Unionidae	G	29.98±80.85	1-358	2.48
<u>Urocleidus adspectus</u> Mueller, 1936	A	10.10±13.28	1-82	3.91
Total	T,G,C,M,L,P,A	57.75±107.78	1-1663 91.21	

^a A, adults; L, larvae; P, plerocercoids; M, metacercariae; C, cysts containing trophozoites; G, glochidia; T, tumors.

^b mean ± standard deviation.

^c %.

Table 3. Parasites of goldeye (Hiodon alosoides) from Dauphin Lake, Manitoba. For Tables 3-18, inclusive; N=number of fish examined, S=number of parasite species (mean \pm SD), MI=mean intensity, R=range, P=prevalence, RA=relative abundance. Where available, comparative data from Stewart-Hay (1951) and Lubinsky and Loch (1979) is included (round brackets and square brackets, respectively). A single asterisk (*) after the parasite name indicates a new host record for this species.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
<u>Azygia longa*</u>	A	1	1	7.69	0.31	intestine
<u>Bothrioccephalus cuspidatus</u>	A	12.08 \pm 23.43	1-78	92.31	45.60	intestine
<u>Crepidostomum illinoiense</u>	A	14.78 \pm 22.87	1-75	69.23	41.80	intestine
<u>Ligula intestinalis*</u>	P	2	2	7.69	0.63	stomach
<u>Lissorchis crassicirrurum*</u>	A	1	1	7.69	0.31	intestine
<u>Paurorhynchus hiodontis</u>	A	3.00 \pm 2.83	1-5	15.38	1.89	intestine, coelom
<u>Raphidascaris acus*</u>	A	2.00 \pm 1.41	1-3	15.38	3.46	intestine
	L	3.50 \pm 3.54	1-6	15.38	liver	
<u>Rhabdochona canadensis*</u>	A	3.80 \pm 3.03	1-8	38.46	5.97	intestine, stomach
Combined	L, P, A	23.00 \pm 28.38	2-86			

^a Ergasilus nerkae was also found but no other data is available. Plerocercoids of L.

^b A, adults; L, larvae; P, plerocercoids.

^c mean \pm standard deviation.

^{d,e} %.

Table 4. Parasites of cisco (*Coregonus artedii*) from Dauphin Lake, Manitoba.

N=286 (11)
S^a=8 (0) [21], 1.28±0.48

Parasite	Stage ^b	MJ ^c	R	P ^d	RA ^e	Sites
<i>Argulus appendiculosus*</i>	A	1	1	12.50	0.120	skin
<i>Dorylaimida</i>	A	1	1	0.35	0.003	intestine
<i>Ergasilus luciopercarum*</i>	A	3.67±3.20	2-10	2.10	0.074	gills
<i>Proteocephalus wickliffi</i>	A	122.34±186.10	1-1118	84.27	99.300	stomach, intestine
<i>Raphidascaris acus*</i>	L	2.25±1.72	1-10	20.98	0.454	liver, serosa
<i>Spinitectus gracilis</i>	A	2.13±1.55	1-5	2.80	0.057	swim bladder
<i>Tetracotyle</i> sp.	M	1.50±1.00	1-3	1.40	0.020	stomach, intestine
<i>Triaenophorus nodulosus*</i>	P	1	1	0.35	0.003	pericardium
Combined	M,L,P,A	118.19±183.79	1-1118	87.76		liver

^a data for *A. appendiculosus* is from 8 cisco captured in fyke nets.

^b A, adults; L, larvae; P, plerocercoids; M, metacerariae.

^c mean ± standard deviation.
^{d,e} %.

Table 5. Parasites of northern pike (*Esox lucius*) from Dauphin Lake, Manitoba.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
<i>Argulus appendiculatus*</i>	A	1	1	0.11	0.003	skin
<i>Azygia longa</i>	A	1.75±0.96	1-3	1.12	0.055	intestine
<i>Bothriocephalus cuspidatus*</i>	A	2.25±1.50	1-4	1.12	0.070	intestine
<i>Centrovarium lobotes</i>	A	7.37±13.60	1-74	14.60	3.040	intestine
<i>Contracaecum sp.*</i>	L	1	1	0.56	0.016	spleen
<i>Diplostomulum sp.</i>	M	1	1	0.56	0.016	vitreous humor
<i>Lymphocystis</i>				0.38	0.011	skin
<i>Neascus sp.</i>	M	1.19±0.40	1-2	1.95	0.066	skin
<i>Placobdella montifera*</i>	A	1	1	0.56	0.016	rectum
<i>Pomphorhynchus bulbocollis</i>	A	22.40±33.51	1-233	58.71	37.140	stomach, intestine
<i>Proteocephalus pinquis</i>	A	(12.15±9.05)	(2-31)(71.43)			
<i>Raphidascaris acus</i>	A	7.44±8.90	1-54	64.04	13.450	stomach, intestine
		(2.89±3.52)	(2-12)(42.86)			
<i>Spinitectus gracilis*</i>	L	1	1	0.28		
	A	1.33±0.52	1-2	1.69	0.064	stomach, intestine
<i>Tetracotyle sp.</i>	M	2	2	0.56	0.032	stomach, intestine
<i>Tetraonchus monenteron</i>	A	13.83±15.23	2-90	22.75	8.880	pericardium
<i>Triaenophorus nodulosus</i>	A	24.53±52.73	1-452	53.65	37.100	gills
<i>Unionidae*</i>	G	4	4	0.28	0.032	gills
Combined	G,M,L,P,A	36.87±51.83	1-453	96.07		

^a data for *A. appendiculatus*, lymphocystis and *P. montifera* is from 449 northern pike captured in pound nets.

^b A, adults; L, larvae; P, plerocercoids; M, metacercaiae; G, glochidia.

^c mean ± standard deviation.

^{d,e} %.

Table 6. Parasites of emerald shiners (*Notropis atherinoides*) from Dauphin Lake, Manitoba.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
<i>Argulus appendiculatus*</i>	A	1	1	0.70	0.113	skin
<i>Centrovarium lobotes*</i>	M	8.33±14.82	1-47	69.23	93.650	musculature
<i>Contracaecum sp.*</i>	L	1	1	7.69	1.250	stomach
<i>Diplostomulum sp.</i>	M	4	4	7.69	4.990	vitreous humor
Combined	M,L,A	7.27±13.48	1-47	84.61		

^a data for *A. appendiculatus* is based on 994 emerald shiners captured in fyke nets.

^b A, adults; L, larvae; M, metacercariae.

^c mean ± standard deviation.

^{d,e} %.

Table 7. Parasites of common shiner (*Notropis cornutus*) from Dauphin Lake, Manitoba.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
<i>Centrovarium lobotes*</i>	M	4.00±3.09	1-9	66.67	36.34	
<i>Diplostomulum</i> sp.	M	3.60±3.58	2-10	55.56	27.26	
<i>Pomphorhynchus bulbocollis*A</i>	1		1	11.11	1.51	vitreous humor
<i>Spinitectus gracilis*</i>	A	2.56±1.59	1-5	100	34.90	intestine
Combined	M,A	7.33±6.08	3-22	100		intestine

^a the 'metaceriae' reported by Stewart-Hay (1951) probably correspond to *C. lobotes*.

^b A, adults; M, metaceriae.

^c mean ± standard deviation.

^{d,e} %.

Table 8. Parasites of spottail shiner (*Notropis hudsonius*) from Dauphin Lake, Manitoba.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
<i>Bothrioccephalus cuspidatus</i> A		1		3.03	0.525	
<i>Centrovarium lobotes</i>	M	13.86±18.39	2-55	21.21	50.960	intestine
<i>Contracaecum</i> sp.	L	3.33±1.21	2-5	18.18	10.490	musculature
<i>Diplostomulum</i> sp.	M	4.55±2.54	2-10	33.33	26.290	intestine
<i>Ligula intestinalis</i>	P	1.25±0.50	1-2	12.12	2.630	vitreous humor
		(1)	(1)	(50.0)		coelom
<i>Myzobdella moorei</i> *	A	2	2	0.49	0.170	skin
<i>Pomphorhynchus bulbocollis</i>	A	1	1	3.03	0.525	intestine
<i>Proteocephalus pinguis</i>	A	1	1	6.06	1.050	intestine
<i>Raphidascaris acus</i> *	L	2.17±1.60	1-5	18.18	6.840	serosa, intestine,
<i>Triaenophorus nodulosus</i>	P	1	1	3.03	0.525	liver
Combined	L,M,P,A	9.05±13	1-62	63.64		liver

^a *Scistoccephalus* sp. plerocercoids reported by Stewart-Hay (1951) were probably L.

^b A, adults; P, plerocercoids; L, larvae; M, metacercariae.

^c mean ± standard deviation.

^{d,e} %.

Table 9. Parasites of quillback (*Carpoides cyprinus*) from Dauphin Lake, Manitoba.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
<u>Anoncohaptor anomala</u>	A	5.60±5.90	1-25	17.30	2.810	gills
<u>Argulus appendiculatus*</u>	A	1	1	0.37	0.011	skin
<u>Diplostomulum sp.*</u>	M	4.50±2.60	2-7	3.80	0.496	vitreous humor
<u>Ergasilus lizzae*</u>	A	3.10±2.80	1-10	9.60	0.864	gills
<u>Lissorhichis quillaris*</u> ^f	A	9.40±11.7	1-46	23.00	6.270	intestine
<u>Monobothrium hunteri*</u> ^g	A	(1)	(1)	(25.00)		
<u>Myxosoma</u> sp.		3	3	2.90	0.250	intestine, liver
<u>Neoechinorhynchus carpoidi</u> ^h	C	2.00±1.80	1-12	5.80	0.337	skin, intestine
<u>Pomphorhynchus bulbocoli</u>	A	33.60±20.00	1-136	88.00	85.810	intestine
<u>Rowardleus pennensis*</u>	A	(19±15.6)	(8-30)(50.00)			
<u>Unionidae</u>	G	1	1	0.90	0.026	intestine
Combined	G, C, M, A	31.39±23.71	3-101	78.85		

^a plerocercoids of L. intestinalis were occasionally seen in quillback but no other data is available on these.

^b A, adults; M, metacercariae; C, cysts containing trophozoites; G, glochidia of an unidentified unionid mollusc.

^c mean ± standard deviation.
^{d, e} %.

^f 'flukes' in Stewart-Hay (1951).

^g probably Spartooides wardi of Stewart-Hay (1951).

^h 'Neoechinorhynchus sp.' of Stewart-Hay (1951).

Table 10. Parasites of white sucker (*Catostomus commersoni*) from Dauphin Lake, Manitoba.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
<i>Argulus appendiculatus</i>	A	1.13±0.35 (1)	1-2 (1)	1.50 (2.17)	0.100	skin
<i>Biacetabulum</i> sp.	A	4.00±4.60	1-15	3.16	0.746	intestine
<i>Contraaecum</i> sp.	L	1.50±0.71	1-2	0.79	0.070	intestine
<i>Diplostomulum</i> sp.	M	4.90±5.32	1-14	3.95	1.150	vitreous humor
<i>Ergasilus versicolor*</i>	A	6.75±4.27	1-10	1.58	0.630	gills
<i>Hunterella nodulosa†</i>	A	2.00±1.41	1-3	0.79	0.094	intestine
<i>Iernaea cyprinacea‡</i>	A	1	1	0.30	0.020	skin
<i>Ligula intestinalis</i>	P	1.33±0.58	1-2	1.19	0.090	coelom
<i>Lissorchis crassicrurum*</i>	A	12.00±32.53	1-163	10.28	7.300	intestine
<i>Lymphocystis</i> sp.	T			0.18	0.011	skin, musculature
<i>Myxosoma</i> sp.	C	5.00±3.83	2-10	1.58	0.470	gills
<i>Myzobdella moorei*§</i>	A	1	1	0.18	0.010	skin
<i>Neascus</i> sp. §	M			4.05	0.240	skin
<i>Neoechinorhynchus crassus</i>	A	4.15±5.65	1-45	55.33	13.160	intestine
<i>N. cristatus</i>	A	8.28±11.37	1-43	6.72	3.300	intestine
<i>N. distractus*</i>	A	7.31±13.99	1-66	14.23	6.160	intestine
<i>Philometroides nodulosa</i>	A	1	1	0.40	0.024	fins
<i>Placobdella montifera*§</i>	A	1.05±0.23	1-2	3.49	0.217	skin, pericardium
<i>Pomphorhynchus bulbocotlli</i>	A	19.3±43.43	1-337	51.78	5.920	intestine
<i>Raphidascaris acus*</i>	L	3.38±4.07	1-12	3.16	0.630	intestine, vitreous humor
<i>Rhabdochona canadensis*</i>	A	9.25±12.82	1-28	1.58	0.866	intestine
<i>Tetracotyle</i> sp.	M	6.65±9.70	1-37	9.09	3.580	pericardium
Unionidae	G	1	1	0.79	0.050	gills
Combined	T, G, C, M, P, L, A	19.01±39.85	1-405	87.75		

^a *A. stizostethi* of Stewart-Hay (1951) is probably *A. appendiculatus*.^b A, adults; L, larvae; P, plerocercoids; M, metacercariae; C, cysts containing trophozoites; G, glochidia of an unidentified unionid mollusc; T, tumors.^c mean ± standard deviation.^{d,e} g[†] based on 292 white suckers captured in fyke nets.[§] based on 543 white suckers captured in pound nets.

Table 11. Parasites of silver redhorse (*Moxostoma anisurum*) and shorthead redhorse (*M. macrolepidotum*) from Dauphin Lake, Manitoba.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
Silver redhorse:	N=2 (0)	S ^a =1 [11]				
Shorthead redhorse:	N=124 (9)	S ^a =21 (2)	[1], 2.07±1.23			
Biacetabulum <u>infrequens</u> *	A	1	1	0.81	0.082	intestine
Biacetabulum sp.*	A	3.09±3.39	1-13	8.87	2.790	intestine
Contracaecum sp.*	L	1.20±0.45	1-2	4.03	0.493	intestine
Cystobranchus <u>verilli</u> ^f	A	1	1	0.17	0.017	skin
Diplostomulum sp.	M	1	1	0.34	0.035	vitreous humor
Dorylaimidae	A	30	30	50.00	stomach, intestine	
Ergasilus <u>versicolor</u> *	A	8.00±10.23	1-42	12.10	9.860	gills
Khawia <u>iowensis</u> *	A	2	2	0.81	0.165	intestine
Lissorchis <u>crassicornutum</u> *	A	5.27±5.40	1-20	17.74	9.520	intestine
Myxosoma sp.*	C	1	1	4.03	0.410	gills
Myzobdella <u>moorei</u> ^f	A	1	1	0.17	0.017	skin
Neascus sp.*	M			0.17	0.017	skin
Neoechinorhynchus <u>crassus</u> *	A	5.22±4.76	1-20	44.35	23.570	intestine
N. <u>cristatus</u> *	A	2.83±2.48	1-9	9.68	2.790	intestine
N. <u>disttractus</u> *	A	1.95±1.47	1-5	15.32	3.040	intestine
Placobdella <u>montifera</u> ^f	A	1	1	0.99	0.100	skin, pericardium
Pomphorhynchus <u>bulboacanthus</u>	A	6.16±11.04	1-67	44.35	27.820	intestine
Raphidascaris <u>acus</u> *	L	1	1	0.81	0.082	intestine, vitreous
Rhabdochona <u>canadensis</u> *	A	9.35±11.65	1-45	13.71	13.050	intestine
Tetracotyle sp.	M	1.83±2.04	1-6	4.84	0.900	pericardium
Unionidae*	G	7.00±3.46	4-12	3.23	2.300	gills
Combined						
<i>M. macrolepidotum</i> G, C, M, L, A		9.93±10.66	1-67	86.29		
<i>M. anisurum</i>	A	30	30	50		

^a *A. stizostethi* of Stewart-Hay (1951) is probably *A. appendiculosus*.

^b A, adults; L, larvae; M, metacercariae; C, cysts containing trophozoites; G, glochidia of an unidentified unionid mollusc.

^c mean ± standard deviation.

^{d,e} %.

^{f,g} based on 603 shorthead redhorses captured in pound nets.

Table 12. Parasites of trout-perch (*Percopsis omiscomaycus*) from Dauphin Lake, Manitoba.

Parasite	Stage ^b	MI ^c	R	P ^d	RA ^e	Sites
<i>Argulus appendiculatus*</i> ^a	A	1	1	4.15	0.392	skin
<i>Centrovarium lobotes</i>	M, A	5.71±5.18	2-22	41.18	22.200	intestine (A), vitreous humor (M)
<i>Crepidostomum cooperi*</i>	A	7.67±4.93	2-11	5.88	45.100	intestine
<i>Diplostomulum</i> sp.	M	10.67±15.01	2-28	5.88	5.930	vitreous humor
<i>Myzobdella moorei*</i>	A	1	1	3.92	0.370	skin
<i>Raphidascaris acus*</i>	L	9.03±12.54	1-62	64.70	55.180	liver
<i>Rhabdochona canadensis*</i>	A	1	1	1.96	0.185	skin
<i>Spinitectus gracilis</i>	A	3.53±3.93	1-12	29.41	9.810	intestine
<i>Tetracotyle</i> sp.	M	1	1	1.96	0.185	skin, musculature
<i>Urocleidus adspersus*</i>	A	2	2	7.84	1.480	gills
Combined	M, L, A	14.13±17.59	1-90	74.51		

^a data for *A. appendiculatus* is based on 193 trout-perch captured in fyke nets.

^b A, adults; M, metacerariae; L, larvae.

^c mean ± standard deviation.

^{d,e} %.

Table 13. Parasites of smallmouth bass (Micropterus dolomieu) from Dauphin Lake, Manitoba.

Parasite	Stage ^a	MI ^b	R	P ^c	RA ^d	Sites
<u>Bothrioccephalus cuspidatus</u> A	L	1				
<u>Contracaecum</u> sp.	L	7.33±2.08	5-9	33.33	0.84	intestine
<u>Ergasilus luciopercarum</u> * A	A	10.67±9.87	4-22	100.00	18.48	mesentary
<u>Pomphorhynchus bulbocollis</u> A	A	7	7	33.33	26.89	gills
<u>Posthodiplostomum minimum</u> M	M	28.5±31.82	2	66.67	5.88	intestine
Combined	M, L, A	39.67±28.22	20-72	100.00	47.89	liver, spleen

^a A, adults; M, metacerariae; L, larvae.

^b mean ± standard deviation.
^{c,d} %.

Table 14. Parasites of longnose dace (Rhinichthyes cataractae), johnny darter (Etheostoma nigrum) and freshwater drum (Aplodinotus grunniens) from Dauphin Lake, Manitoba.

Parasite	Stage ^a	MI ^b	R	P ^c	RA ^d	Sites
Diplostomulum sp. ^e	M	2	2	100.00	100.00	vitreous humor
Pomphorhynchus bulbocollis ^f	A	3	3	33.33	100.00	intestine
Longnose dace:	N=1	(9)	S=0	[4]		
Johnny darter:	N=1	(2)	S=1	(0)	[6]	
Freshwater drum:	N=3		S=1			

^a M= metacercariae.

^b mean.

^{c,d} %.

^e johnny darter.

^f freshwater drum.

Table 15. Parasites of yellow perch (*Perca flavescens*) from Dauphin Lake, Manitoba.

Parasite	Stage ^a	MI ^b	R	P ^c	RA ^d	Sites
N=292 (5)						
S=19 (0) [29] 2.97±1.62						
<i>Azygia longa</i>	A	1.33±0.58	1-2	1.03	0.024	stomach
<i>Bothrioccephalus cuspidatus</i>	A	8.42±12.82	1-85	36.99	5.500	intestine
<i>Caecincola</i> sp.*	M	1	1	0.34	0.006	vitreous humor
<i>Centrovarium lobotes</i>	A	5.78±10.45	1-46	6.16	0.630	intestine
<i>Contracaecum</i> sp.	L	7.49±8.35	1-41	26.71	3.540	spleen, stomach
<i>Crepidostomum cooperi</i>	A	20.47±54.51	1-300	34.93	12.640	intestine
<i>Creptotrema funduli*</i>	A	2.46±1.27	1-5	4.45	0.190	intestine, stomach
<i>Diplostomulum</i> sp.	M	1.18±0.40	1-2	3.77	0.079	vitreous humor
<i>Ergasilus luciopercarum</i>	A	3.33±4.03	2-16	4.11	0.240	gills
<i>Lymphocystis</i>	T			0.79	0.790	skin, musculature
<i>Myzobdella moorei</i> ^e	A	3.41±9.75	1-52	21.40	0.014	skin
<i>Placobdella montifera</i> *	A	1.50±1.00	1-3	3.15	0.083	skin
<i>Proteocephalus pearsei</i>	A	6.53±13.44	1-83	29.11	3.360	intestine
<i>Raphidascaris acus</i>	A	1.50±0.71	1-2	0.68		
<i>Spininctectus gracilis</i>	A	35.77±32.69	1-216	95.21	60.220	stomach, intestine
<i>Tetractytle</i> sp.	M	1.15±0.55	1-3	4.45	0.090	liver, rectum, heart
<i>Triaenophorus nodulosus</i>	P	2.15±1.82	1-7	4.45	0.018	pericardium
Unionidae	G	56.73±110.51	2-358	7.53	7.550	hindgut, liver
<i>Urocleidus adspectus</i>	A	10.72±13.57	2-82	22.95	4.350	gills
Combined	T,G,M,P,L,A	58.22±71.11	1-499	95.89		

^a A, adults; L, larvae; M, metacercariae; P, plerocercoids; G, glochidia of an unidentified unionid mollusc; T, tumors.^b mean ± standard deviation.^{c,d} %.^e based on 127 yellow perch captured in pound nets.

Table 16. Parasites of logperch (Percina caprodes) from Dauphin Lake, Manitoba.

Parasite	Stage ^a	MR ^b	R	P ^c	RA ^d	Sites
<u>Centrovarium lobotes*</u>	A	1.75±0.96	1-3	26.67	24.17	intestine
<u>Diplostomulum</u> sp.	M	1	1	6.67	3.45	vitreous humor
<u>Myzobdella moorei*</u>	A	1	1	26.67	13.81	skin
<u>Neascus</u> sp.	M			40.00	20.07	skin, musculature
<u>Pomphorhynchus bulbocollis</u>	A	1.16±0.41	1-2	40.00	24.00	intestine
<u>Raphidascaris acus*</u>	L	1	1	6.67	3.45	liver
<u>Spinitectus gracilis*</u>	A	1.50±0.71	1-2	13.33	10.36	stomach, intestine
Combined	M, L, A	4.27±6.71	1-24	73.33		

^a A, adults; M, metacercariae; L, larvae.

^b mean ± standard deviation.

^{c,d} %.

Table 17. Parasites of sauger (Stizostedion canadense) from Dauphin Lake, Manitoba.

Parasite	Stage ^a	MI ^b	R	P ^c	RA ^d	Sites
<u>Bothriocephalus cuspidatus</u> A	A	3.00±1.41	5	16.67	4.86	intestines
<u>Centrovarium lobotes</u> *	A	40	2-4	33.33	5.83	intestines
<u>Crepidostomum cooperi</u> *	A	40	40	16.67	3.89	intestines
<u>Creptotrema funduli</u>	A	2	2	16.67	1.94	intestines
<u>Proteocephalus luciopercae</u> A	A	1	1	16.67	0.97	intestines
<u>Raphidascaris acus</u>	L	28.33±18.01	16-49	50.00	81.90	liver
Combined	L,A	23.17±18.79	4-50	100.00		

^a A, adults; L, larvae.^b mean ± standard deviation.^{c,d} %.

Table 18. Parasites of walleye (Stizostedion vitreum) from Dauphin Lake, Manitoba.

Parasite	Stage ^a	MI ^b	R	P ^c	RA ^d	Sites
<i>Argulus appendiculatus</i> ^{e,f}	A	1 (1)	1 (1)	0.45 (4.76)	0.052	skin
<i>Bothriocephalus cuspidatus</i> <u>A</u>		77.07±130.37	1-1656	93.62	78.110	intestine, stomach
<i>Centrovarium lobotes</i> <u>A</u>		6.51±8.99	1-70	34.04	2.400	intestine
		(2.33±0.58)	(2-3)	(14.29)		
<i>Crepidostomum cooperi</i> <i>Creptotrema funduli*</i>	A	1	1	0.3	0.003	intestine
<i>Diplostomulum</i> sp.	M	1	1	0.3	0.003	intestine, stomach
<i>Ergasilus luciopercarum</i> <i>Lymphocystis</i> ^g	A	22.50±24.81	1-113	34.95	8.510	vitreous humor
<i>Myzobdella moorei</i>	T			2.67	0.031	skin, musculature
<i>Neascus</i> sp.	A	1.33±0.58	1-2	0.91	0.013	skin
<i>Neochinorhynchus tenuelus</i> ^f	M			0.3	0.300	skin, musculature
<i>Placobdella montifera</i> * ^g <u>A</u>		70	70	0.3	0.230	intestine
<i>Proteocephalus lucioperca</i> <u>A</u>		12.15±16.88	1-88	55.01	7.240	skin
<i>Raphidascaris acus</i> <i>Unionidae</i>	A	13.83±41.95	1-147	3.64		intestine, stomach
	L	7.82±7.87	1-46	31.31	3.20	stomach, intestine
	G	4.85±4.40	2-16	3.95	0.210	liver, rectum, eye
<i>Urocleidus adspactus</i> Combined	A	1	1	0.3	0.003	gills
	T,G,M,L,A	94.31±136.49	1-1663	97.87		

^a A, adults; L, larvae; M, metacercariae; G, glochidia; T, tumors.^b mean ± standard deviation.
^{c,d} %.^e *Argulus stizostethii* of Stewart-Hay (1951).

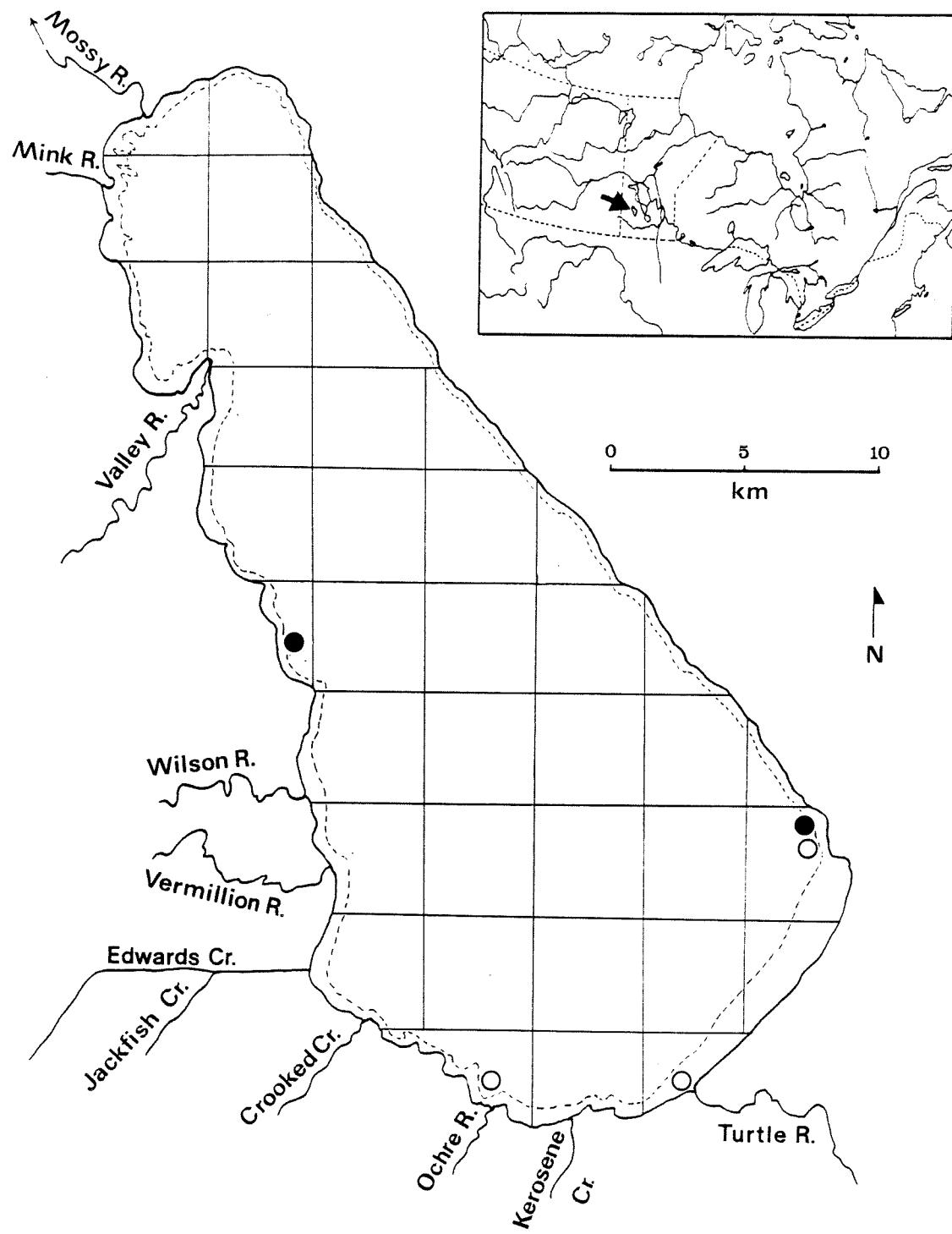


Fig. 1. Map of Dauphin lake, Manitoba showing: approximate locations of pound net sites (●); areas sampled using beach seines and fyke nets (○); and the boundaries of 38 sampling quadrats (horizontal and vertical lines) where gill nets were set.

30
northern pike

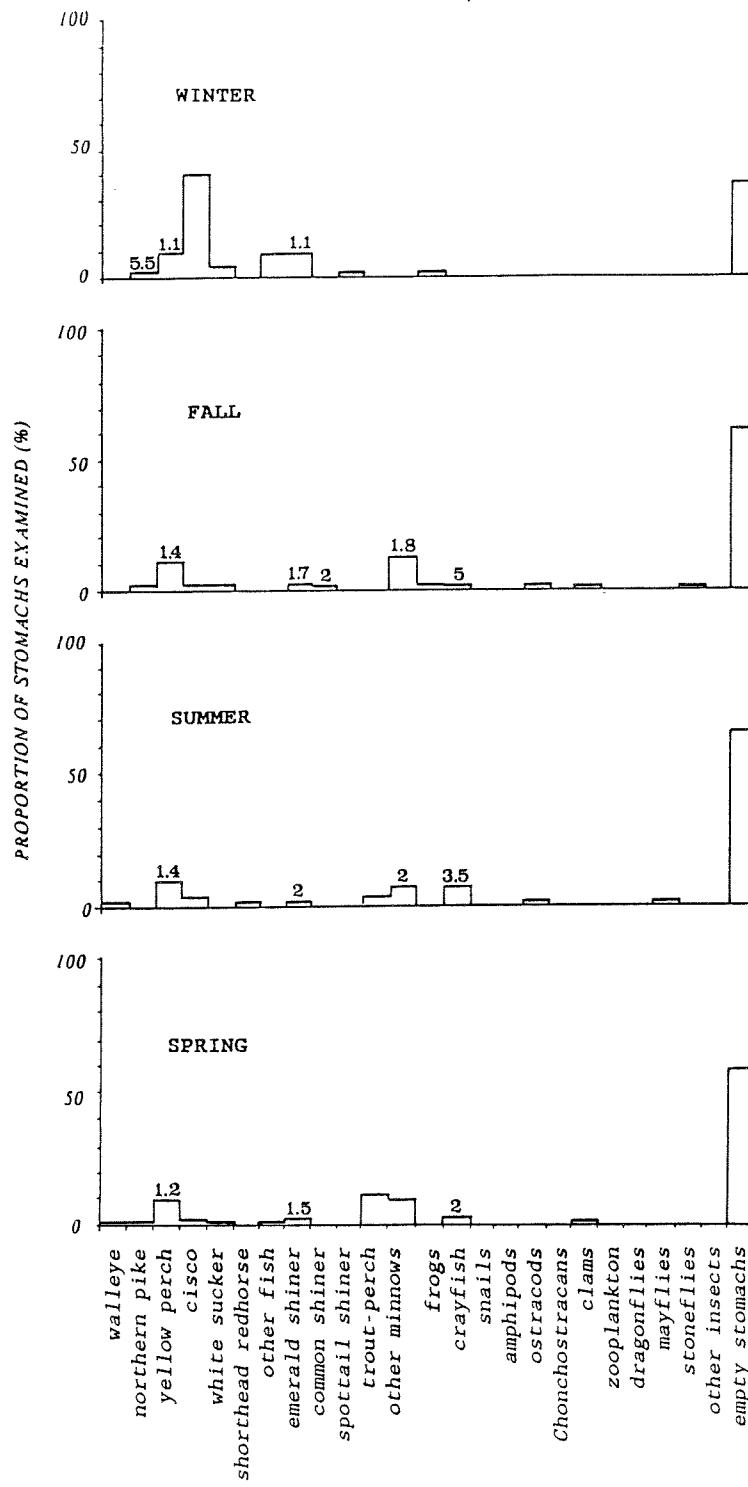


Fig. 2. Seasonal changes in the diet of northern pike from Dauphin Lake, Manitoba. The diet is presented as a frequency histogram for the proportion of fish stomachs examined containing particular food-items. Numbers above columns represent mean number of food-items per stomach where this mean was ≥ 1 .

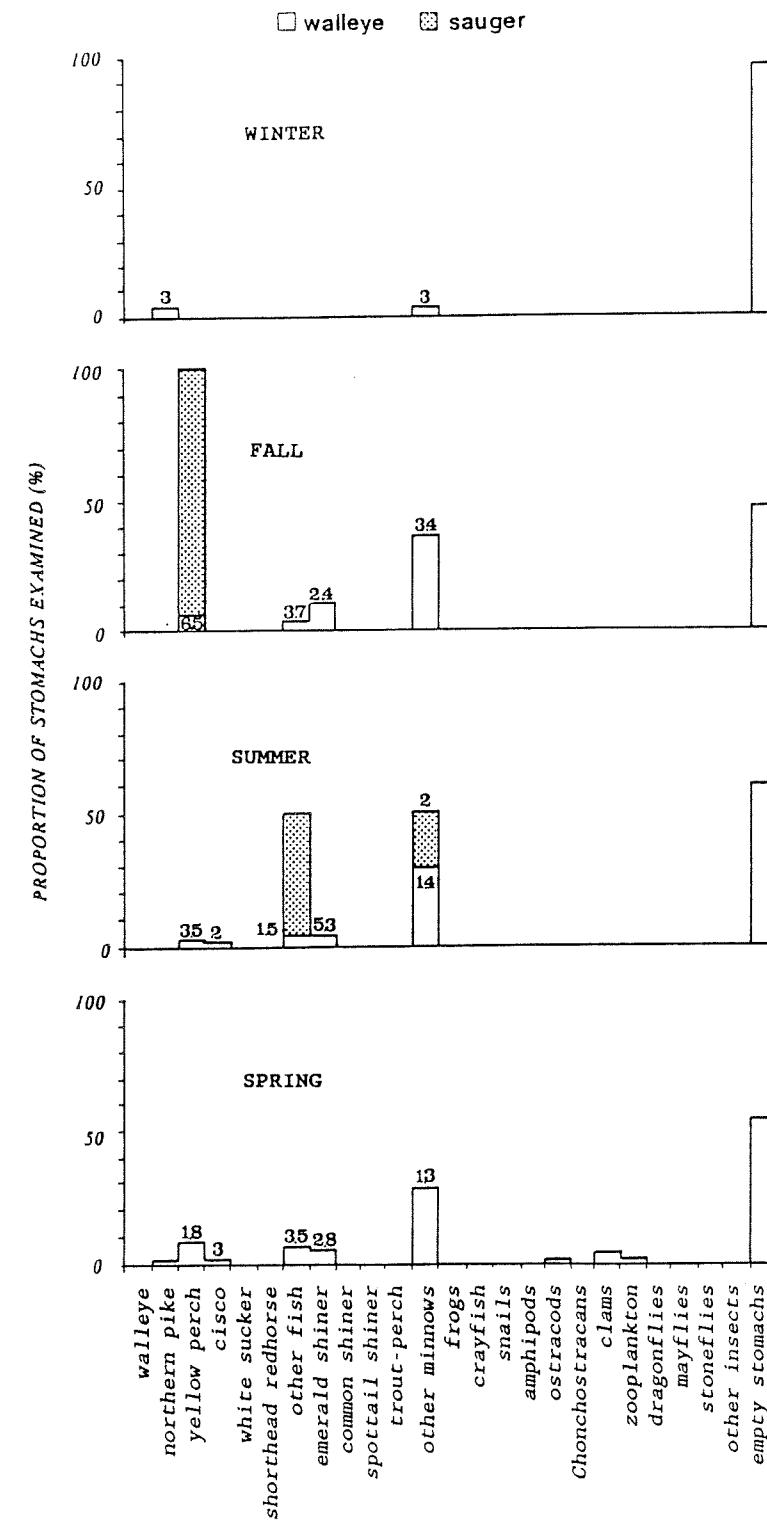


Fig. 3. Seasonal changes in the diet of walleye and sauger from Dauphin Lake, Manitoba.

The diet is presented as a frequency histogram for the proportion of fish stomachs examined containing particular food-items. Numbers above columns represent mean number of food-items per stomach where this mean was ≥ 1 .

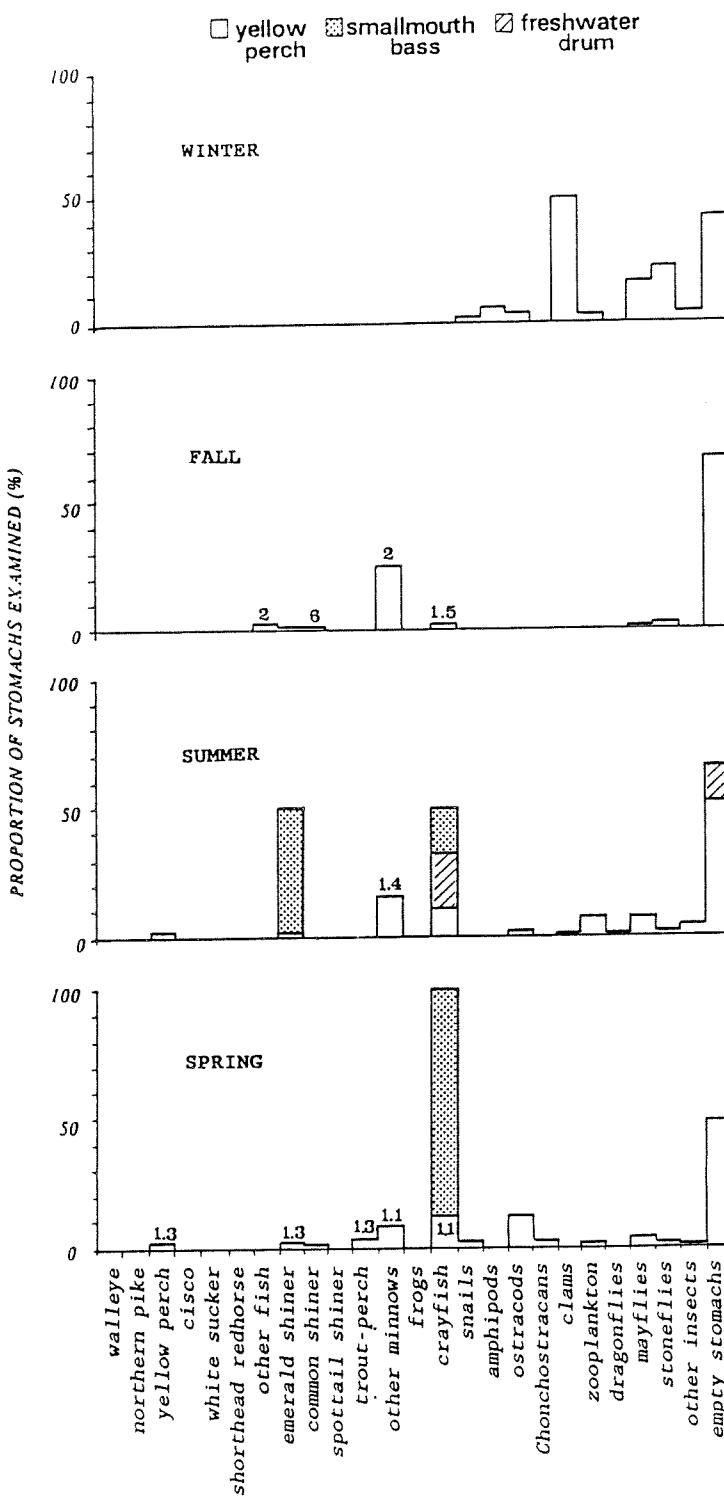


Fig. 4. Seasonal changes in the diet of yellow perch, smallmouth bass and freshwater drum from Dauphin Lake, Manitoba. The diet is presented as a frequency histogram for the proportion of fish stomachs examined containing particular food-items. Numbers above columns are mean number of food-items per stomach where this mean was ≥ 1 .

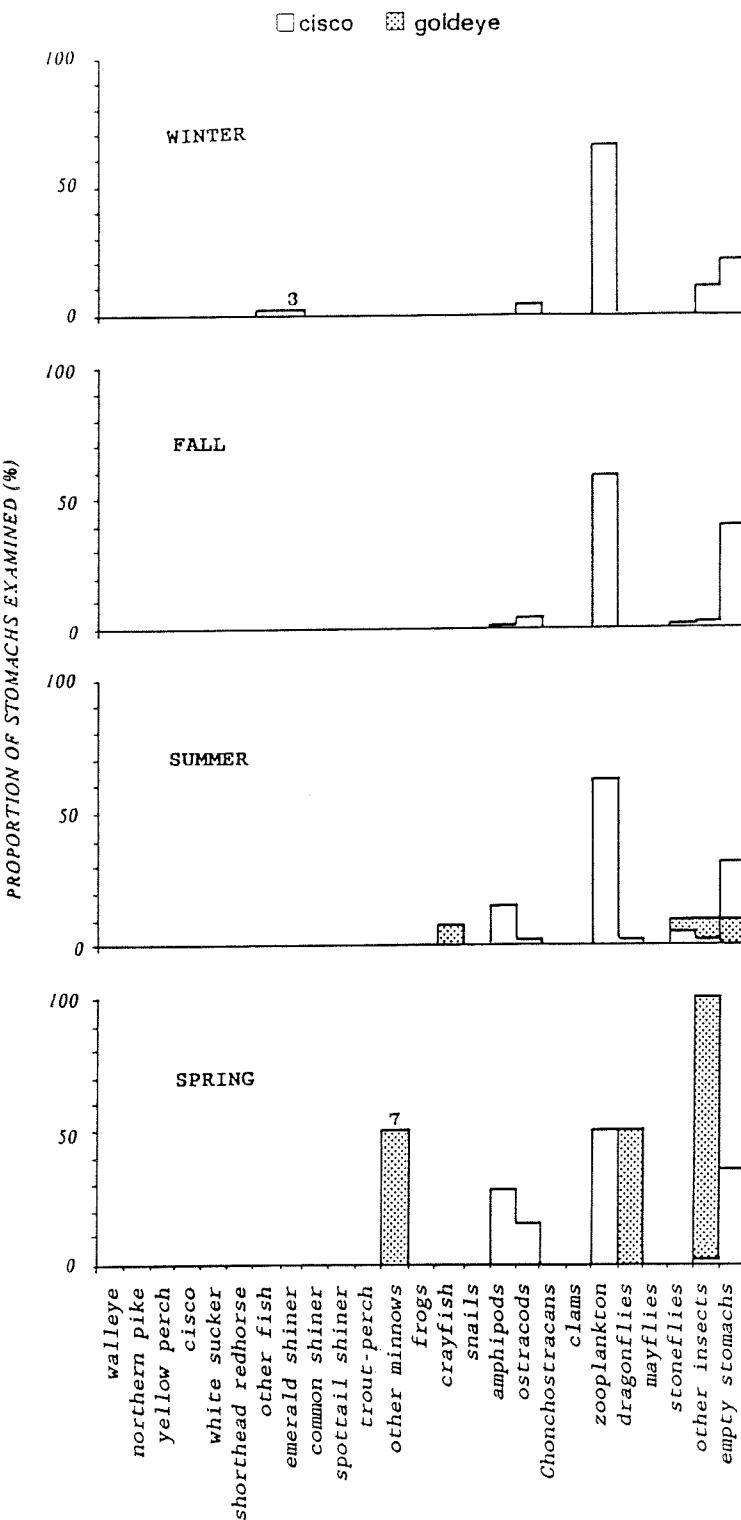


Fig. 5. Seasonal changes in the diet of cisco and goldeye from Dauphin Lake, Manitoba. The diet is presented as a frequency histogram for the proportion of fish stomachs examined containing particular food-items. Numbers above columns represent mean number of food-items per stomach where this mean was ≥ 1 .

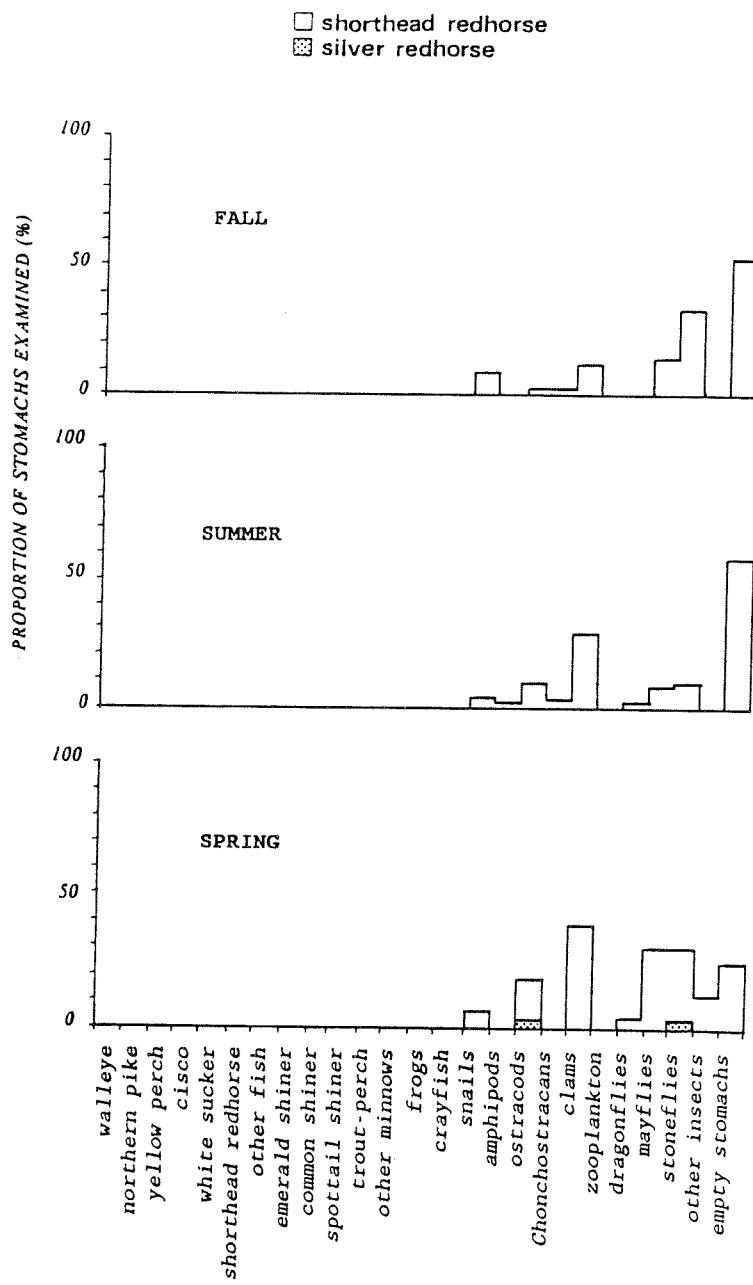


Fig. 6. Seasonal changes in the diet of shorthead redhorses and silver redhorses from Dauphin Lake, Manitoba. The diet is presented as a frequency histogram for the proportion of fish stomachs examined containing particular food-items. Numbers above columns are mean number of food-items per stomach where this mean was ≥ 1 .

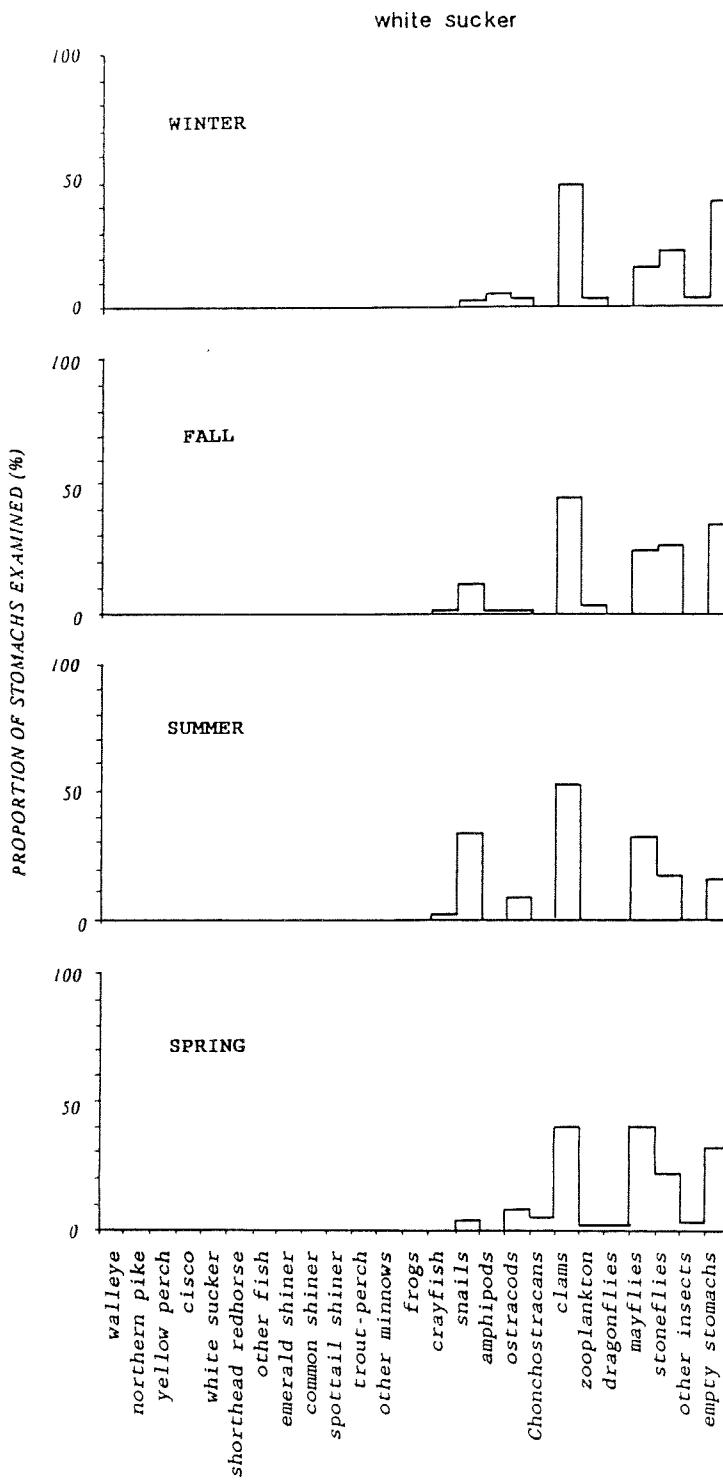


Fig. 7. Seasonal changes in the diet of white suckers from Dauphin Lake, Manitoba. The diet is presented as a frequency histogram for the proportion of fish stomachs examined containing particular food-items. Numbers above columns represent mean number of food-items per stomach where this mean was ≥ 1 .

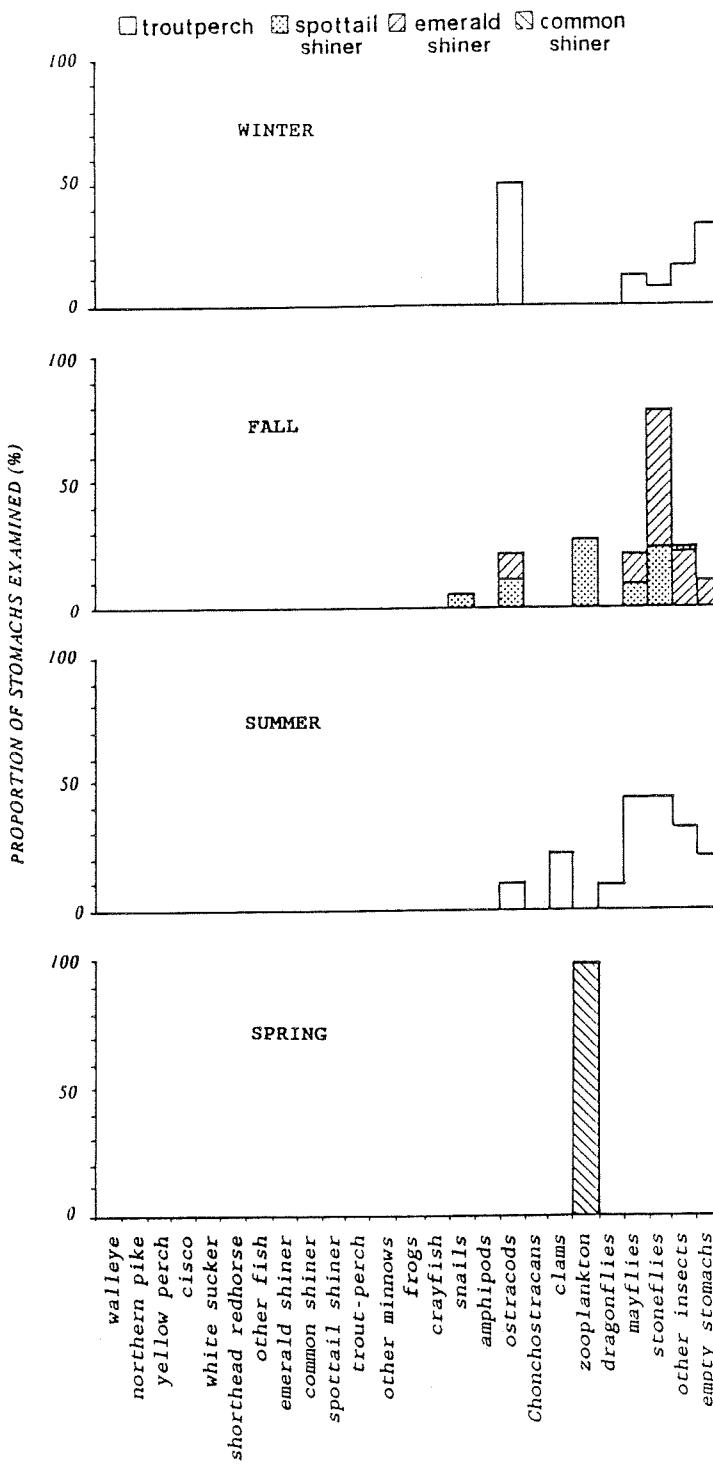


Fig. 8. Seasonal changes in the diet of trout-perch, spottail shiners, emerald shiners and common shiners from Dauphin Lake, Manitoba. The diet is presented as a frequency histogram for the proportion of fish stomachs examined containing particular food-items. Numbers above columns represent mean number of food-items per stomach where this mean was ≥ 1 .