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FOOD STUDIES OF LAKE NIPIGON FISHES

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In any study of fishery problems in a body of water especially relating to conservation and increased production, it is obviously essential that definite information concerning the food materials for fish be obtained. In the investigation of Lake Nipigon, carried out during the three summers, 1921, 1922, and 1923, qualitative and quantitative studies have been made of the microscopic organisms (plankton) and of the organisms living on the bottom of the lake. In conjunction with these studies, an attempt has been made to obtain fairly comprehensive data as to the food materials taken by all the species of fish occurring in the lake. As a result the links in the food chain have been fairly well worked out, except that the studies of the inter-food relationships among the smaller organisms have not progressed very far as yet.

The results of the examination of the contents of the alimentary tracts of 1,520 fish are given in this paper. In addition Clemens and others (1923) published the results of the examination of 455 fish, Harkness (1924) a study of the food of 58 sturgeon, and Bigelow (1924) a study of the food of 316 small common suckers. The total for the three years is therefore 2,349. The distribution is as follows, the figures in brackets being of those fish previously reported upon: sturgeon (70), northern sucker 58 (16), common sucker 130 (349), lake red horse 4, spot-tailed minnow 62 (12), lake chub 2 (15), long-nosed dace 7, lake shiner 11, speckled trout 25, lake trout 63 (42), round whitefish 59 (29), common whitefish 179 (65), ciscoes 167 (89), pike 23, brook stickleback 13, nine-spined stickleback 58, trout perch 9 (23), small-mouthed black bass 3 (6), pike perch 101 (20), sauger 76, yellow perch 189 (14), tessellated darter 68, Iowa darter 28, log perch 5, miller's thumb 5, lake sculpin 12, ling 163 (79).

In the cases of the larger piscivorous fishes (lake trout, pike, pike perch, sauger, and ling) the numbers in the columns give the actual number of fish found and an X sign indicates material unidentified. In dealing with the other species an attempt has been made to estimate the percentages of the most abundant organisms found and the numbers represent these percentage estimates, while an X sign indicates occurrence in small amounts not estimated, usually representing one per cent. or less.

Unless otherwise stated *Oligochaeta* refers to the presence of podal spines; *Epischura* refers to the species *lacustris; Limnocalanus* to *L. macrurus; Sida* to *S. crystallina; Latona* to *L. setifera; Simocephalus* to *S. vetulus; Bosmina* to *B. longirostris; Eurycercus* to *E. lamellatus; Camptocercus* to *C. rectirostris; Acroperus* to *A. harpae; Rhynchotalona* to *R. falcata; Chydorus* to *C. sphaericus; Monospilus* to *M. dispar; Polyphemus* to *P. pediculus; Leptodora* to *L. kindtii; Mysis* to *M. relicta; Hyalella* to *H. knickerbockeri; Pontoporeia* to *P. hoyi; Ulothrix* to *U. zonata.*

The length in inches is taken from the end of the snout to the fork of the tail fin and length in centimeters from the end of the snout to the end of the vertebral column.

NORTHERN SUCKER, *Catostomus catostomus*

No.	Date	Length in inches	Length in cm.	*Pontoporeia*	*Chironomidae*	*Mollusca*	Miscellaneous
8	June, '21-'22	2½-4½	5-10		11		*Ulothrix* 45; diatoms 33; ooze 5; *Ephemeridae* nymphs 1; Misc. 5 (*Centropyxis, Difflugia, Nebela, Poriferа* spicules, *Oligochaeta, Nothola striata, N. foliacea, Monostyla lunaris, M. quadridentata, Keratella cochlearis, Plumatella* statoblasts, *Cyclops, Cantocamptus, Bosmina, Acroperus, Alona costata, A. guttata, Chydorus, Alonella nana, A. excisa, Ostracoda, Hydracarina, Trichoptera* larvae, *Simulium* larvae, *Closterium, Docidium, Cosmarium, Cladophora, Mougeotia*).
13	June-Aug., '21-'23	4⅛-6½	10-15	3	28	6	*Ulothrix* 21; diatoms 13; *Trichoptera* larvae 10; ooze 5; Misc. 14 (*Centropyxis, Difflugia, Stephanodiscus, Porifera* spicules, *Oligochaeta, Monostyla lunaris, Bryozoa* statoblasts, *Cyclops, Canthocamptus, Bosmina, Acroperus, Eurycercus, Alona affinis, A. costata, A. quadrata, Pleuroxus denticulatus, Chydorus, Alonella nana, A. excisa, Ostracoda, Hyalella, Hydracarina, Ephemeridae* nymphs, *Corixa,* thrips, *Tipulidae* pupae, *Culicidae* pupa, *Coleoptera* fragments, *Hymenoptera*).
2	June, '22	6⅝-7¼	15-20	47	3	X	*Ulothrix* 49; Misc. 1 (*Simulium* larva, higher plant tissue, sand).

NORTHERN SUCKER—*Continued*

No.	Date	Length in inches	Length in cm.	*Pontoporeia*	*Chironomidae*	*Mollusca*	Miscellaneous
1	July 22, '22	10¾	20-25	70	25	X	Misc. 5 (*Centropyxis, Porifera* spicules, *Plumatella, Cyclops, Daphnia, Bosmina, Ostracoda, Hydracarina, Ephemeridae* nymph, diatoms, *Cladophora*, seed).
15	June-Sept., '21-'23	11⅛-12¾	25-30	70	6	18	*Cladophora* 4; Misc. 2 (*Plumatella, Cyclops, Bosmina, Alona quadrangularis, Ostracoda, Hydracarina, Ephemeridae* nymph, diatoms).
11	June-Aug., '21-'22	13¼-16	30-35	62	8	3	*Plumatella* 16; diatoms 4; *Cladophora* 3; ooze 3; Misc. 1 (*Difflugia, Cyclops, Bosmina, Ostracoda, Hydracarina*, muscoid larva, insect fragments).
5	June-July, '21-'22	16-17	35-40	82	10	1	*Hyalella* 2; ooze 1; Misc. 4 (*Centropyxis, Difflugia, Oligochaeta, Cyclops, Canthocamptus, Bosmina, Alona costata, Chydorus, Ostracoda, Mysis, Hydracarina, Ephemeridae* nymph, *Trichoptera* larva, diatoms).
4	July-Aug., '21-'22	18¾-20½	40-45	41	24	27	*Ephemeridae* nymphs 6; *Trichoptera* larva 1; Misc. 1 (*Difflugia, Canthocamptus, Bosmina, Leptodora, Hydracarina, Plecoptera* nymph, *Campylodiscus*).
1	?	22½	45-50	80	10	5	Misc. 5 (Statoblast, *Cyclops, Ostracoda, Hydracarina, Trichoptera* larva, *Cladophora*).
Average 23		2½-7½	5-20	6	23	3	*Ulothrix* 32; diatoms 15; *Trichoptera* larvae 6; ooze 5; Misc. 10.
35		10¾-22½	20-50	66	9	12	*Plumatella* 5; *Cladophora* 3; ooze 1, Misc. 4.

COMMON SUCKER, *Catostomus commersonnii*

No.	Date	Length in inches	Length in cm.	*Pontoporeia*	*Ephemeridae*	*Trichoptera*	*Chironomidae*	*Mollusca*	Miscellaneous
18	June 22, '21	2½-6½	5.0-14.8				35		Diatoms 30; *Canthocamptus* 10; debris and sand 10; Misc. 15 (*Centropyxis, Difflugia, Oligochaeta, Notholca foliacea, Cyclops, Bosmina, Drepanothrix, Eurycercus, Acroperus, Alona affinis, A. costata, A. quadrangularis, Pleuroxus denticulatus, Chydorus, Alonella nana, Leydigia, Ostracoda, Hyalella, Hydracarina, Docidium, Cosmarium, Closterium, Ulothrix*).
5	June 20, '21	4	8.0				20	X	Diatoms 60; Misc. 20 (*Centropyxis, Difflugia, Oligochaeta, Lecane luna, Monostyla lunaris, Cyclops, Canthocamptus, Eurycercus, Acroperus, Alona affinis, A. costata, A. quadrangularis, Chydorus, Alonella nana, Ostracoda, Hydracarina, Tardigrada, Ulothrix*).
6	July 28, '21	6¼	14.0		5	5	40	15	*Hydracarina* 15; Misc. 20 (*Difflugia, Canthocamptus, Bosmina, Ilyocryptus, Eurycercus, Alona affinis, A. costata, Chydorus, Alonella nana, Ostracoda, Hyalella, Corixa*, diatoms).
3	June, '22	3-5¾	6.0-12.8		2		50		Debris and sand 25; *Canthocamptus* 6; Misc. 17 (*Centropyxis, Lecqueresia, Difflugia, Oligochaeta, Lecane luna, Monostyla, Cyclops, Camptocercus, Acroperus, Alona affinis, A. costata, A. quadrangularis, Rhynchotalona, Leydigia, Chydorus, Alonella nana, Monospilus, Ostracoda, Hydracarina, Corixa, Simulium* larvae, *Ulothrix*, diatoms).

COMMON SUCKER—*Continued*

No.	Date	Length in inches	Length in cm.	*Pontoporeia*	*Ephemeridae*	*Trichoptera*	*Chironomidae*	*Mollusca*	Miscellaneous
4	Aug. '22	6-7	13.2-15.0				13	62	Misc. 25 (*Centropyxis, Difflugia pyriformis, D. cratera, Oligochaeta, Canthocamptus, Daphnia, Bosmina, Eurycercus, Camptocercus rectirostris, Acroperus, Alona affinis, A. costata, A. quadrangularis, Graptoleberis testudinaria, Pleuroxus denticulatus, Chydorus, Leydigia, Ostracoda, Hyalella, Cambarus virilis, Hydracarina, Tardigrada, Corixa*, diatoms, debris, ooze).
4	July-Aug. '23	6-7	13.0-15.5	8	1	2	32	15	Sand 15; diatoms 12; *Ostracoda* 5; Misc. 10 (*Difflugia cratera, Euglypha*, sponge spicules, *Oligochaeta, Cyclops, Canthocamptus, Latona, Daphnia, Eurycercus, Alona costata, A. guttata, A. quadrangularis, A. rectangula, Chydorus, Hydracarina, Tipulidae* pupa).
21	June-Sept., '21-'23	11-13½	25-30	10	14	8	18	25	Misc. 25 (*Arcella, Centropyxis, Difflugia, Oligochaeta*, statoblasts, *Cyclops, Canthocamptus, Sida, Latona, Daphnia, Simocephalus, Ceriodaphnia, Eurycercus, Camptocercus, Acroperus, Alona affinis, A. costata, A. quadrangularis, Pleuroxus denticulatus, Ostracoda, Hyalella, Hydracarina, Odonata* nymphs, *Corixa, Tipulidae* pupae, *Tabanidae* larva, seeds, *Cladophora, Ulothrix*, diatoms, sand, detritus.)

COMMON SUCKER—*Continued*

6	June-Aug., '21-'22	13½-16	30-35	2	21	23	20	16	*Hyalella* 7; Misc. 11 (*Centropyxis, Difflugia, Oligochaeta*, statoblasts, *Monostyla lunaris, Cyclops, Canthocamptus, Eurycercus, Acroperus, Alona costata, Pleuroxus denticulatus, Chydorus, Ostracoda, Hyalella, Hydracarina, Sialis* larva, *Corixa*, terrestrial insects, *Cladophora*, diatoms, sand, debris).
7	June-Aug., '21-'22	16-18	35-40	18	30	1	30	6	Misc. 15 (*Centropyxis, Oligochaeta, Cyclops, Canthocamptus, Sida, Diaphanosoma, Daphnia pulex, Simocephalus, Scapholeberis, Ceriodaphnia reticulata, Bosmina, Eurycercus, Alona affinis, Chydorus, Ostracoda, Hyalella, Gammarus, Cambarus virilis, Hydracarina, Arachnida, Sialis* larva, *Corixa, Corethra* pupa, dipterous larvae, fish remains, higher plant tissue, *Ulothrix*, diatoms).
7	July-Aug., '22	18-20	40-45	25	20	3	10	22	Misc. 20 (*Centropyxis*, sponge spicules, statoblasts, *Canthocamptus, Daphnia* ephippia, *Bosmina, Eurycercus, Chydorus, Ostracoda, Hyalella, Hydracarina, Odonata* nymph, *Corixa, Hydroporus* larvae, *Corethra* pupae, eyed fish eggs, fish remains, seeds, higher plant tissue, *Bulbochaeta*, diatoms, detritus, ooze).
1	July 26, '23	20	45.0	5	10		10	25	Detritus and ooze 50; (*Hydracarina, Cladophora.*)
Average									
40		2½-7	5-15.5	1	1	1	33	10	Diatoms 22, sand and detritus 8; *Canthocamptus* 5; *Hydracarina* 2; Misc. 17.
42		11-20	25-45	13	19	8	19	20	Misc. 21.

In addition to these larger fish, the alimentary tracts of 48 specimens of lengths less than 5.0 cm. have been examined. The details need not be given here since they are essentially similar to those given by Bigelow (1924) in his study of the food of 316 young individuals.

LAKE RED HORSE, *Moxostoma aureolum*

No.	Date	Length in inches	Length in cm.	
1	July 6, '22	17½	39.2	*Ephemeridae* nymphs 95 (*Hexagenia bilineata* 40, *Ephemera simulans* 55), *Trichoptera* larvae 1, *Chironomidae* larva 1, silt, etc., 3.
1	July 15, '22	18	41.0	*Ephemeridae* nymphs 90 (*Hexagenia bilineata*), Misc. 10 (*Chironomidae* larvae, fragments of moss, silt).
1	July 6, '22	19½	44.0	*Ephemeridae* nymphs 100 (*Hexagenia bilineata* 95, *Ephemera simulans* 5), *Ostracoda*.
1	July 6, '22	21½	47.3	*Ephemeridae* nymphs 20 (*Hexagenia bilineata* 5, *Ephemera simulans* 15, *Caenis*), *Chironomidae* larvae 60, *Mollusca* 5, silt 10, Misc. 5 (*Difflugia, Oligochaeta, Cyclops, Alona affinis, Eurycercus, Ostracoda, Pontoporeia, Hydracarina, Trichoptera* larvae, *Chironomidae* pupae, *Tipulidae* pupa, *Stratiomyidae* larvae, diatoms).
Average 4		17½-21½	39.2-47.3	*Ephemeridae* nymphs 76, *Chironomidae* larvae 16, silt 3, Misc. 5.

SPOT-TAILED MINNOW, *Notropis hudsonius*

No.	Date	L. cm.	*Daphnia*	*Bosmina*	*Leptodora*	*Ephemeridae*	*Chironomidae*	Miscellaneous
1	June 19, '22	5.9	10			30		Terrestrial insects 45, filamentous algae and diatoms 15.
14	June 30, '22	3.1-4.0	77	6	7		7	Misc. 3 (*Hydracarina*, dipterous larvae, diatoms).
14	July 12, '22	3.5-6.4				1	21	Dipterous larvae 66; *Simulium* larvae 7; Misc. 5 (*Oligochaeta, Polyphemus, Corixa*, terrestrial insects, fish eggs).
5	July 14, '22	3.6-4.2	78				14	*Sida* 5; Misc. 3 (*Eurycercus*, terrestrial insects, diatoms).
1	July 14, '22	5.9						*Trichoptera* larvae 60; *Mollusca* 30; *Hydracarina* 10.
10	Aug. 1, '22	4.0-5.7	99	X	X			
3	Aug. 1, '22	4.0-6.5	10	3	23		12	Terrestrial insects 27; *Mollusca* 5; Sand 5; Misc. 15 (*Oligochaeta, Epischura, Eurycercus, Acroperus, Alona affinis, Ostracoda, Amphipoda, Trichoptera*, diatoms).
4	July 12, '23	3.5-5.5	X			50	17	*Hydracarina* 32; Misc. 1 (*Cyphoderia, Cyclops, Ostracoda, Trichoptera*).
5	July 27, '23	1.9-6.4			X		25	*Sida* 47; *Epischura* 13; *Corethra* 5; Misc. 10 (*Oligochaeta, Diaptomus, Cyclops, Latona, Eurycercus, Acroperus, Chydorus, Amphipoda*, fish eggs).
3	Aug. 16, '23	3.2-5.1				25	39	*Corixa* 35; Misc. 1 (*Hydracarina, Tipulidae* pupa, terrestrial *Diptera*).
2	Sept. 11, '23	2.5-2.9		100				*Alona*.
Average 62		1.9-6.5	40	5	3	5	13	*Dipterous* larvae 15, Sida 4, Misc. 15.

LAKE SHINER, *Notropis atherinoides*

No.	Date	L. cm.	*Corixa*	*Ephemeridae*	*Trichoptera*	*Chironomidae*	Terrestrial Insects	Miscellaneous
1	June 22, '21	6.4	10				90	
1	July 12, '22	4.2	30			20	50	*Hydracarina.*
1	" "	6.2				50	45	*Arachnida* 5.
1	" "	6.3				50	45	*Arachnida* 5.
1	" "	6.6		50			45	*Hydracarina* 5.
1	" "	6.8				100		
1	" "	6.9			90	10		
1	" "	8.0		3		1	1	Fish eggs 95; *Bosmina.*
1	" "	8.1				50*	25	Fish eggs 25; *Hydracarina.*
1	July 23, '22	3.8				80		*Daphnia longispina* 10; Misc. 10 (*Oligochaeta, Diaptomus, Bosmina, Hydracarina, Arachnida*).
1	" "	4.2				50	30	Misc. 20 (*Diaptomus, Daphnia retrocurva, Eurycercus, Polyphemus, Hydracarina*).
Average 11		3.8-8.1	4	5	8	37	30	Fish eggs 11, Misc. 5.

*Adults.

LONG-NOSED DACE, *Rhinichthys cataractæ*

No.	Date	L. cm.	
6	July 27, '23	3.8-7.2	*Chironomidae* larvae 77; *Sida* 11; *Ephemeridae* 7; Misc. 5 (*Difflugia pyriformis, Cyclops, Chydorus, Polyphemus, Amphipoda, Trichoptera, Chironomidae* pupae, *Simulium* larva, *Ulothrix*, diatoms).
1	July 30, '23	5.0	Fish eggs 100; Insect fragment.

LAKE CHUB. *Couesius plumbeus*

Two individuals taken in Ombabika Bay

No.	Date	L. c.m	
1	Aug. 9, '22	5.5	*Trichoptera* larvae 55; *Chironomidae* 30; *Mollusca* 15; filamentous algae.
1	Aug. 9, '22	6.7	*Mollusca* 60; *Ephemeridae* 20; *Trichoptera* 20; *Mougeotia.*

ROUND WHITEFISH, *Coregonus quadrilateralis*

No.	L. in.	L. cm.	*Ephemeridae*	*Trichoptera*	*Chironomidae*	*Mollusca*	Miscellaneous
10	7¼	16.0	1	65	20	10	Misc. 4 (*Chydorus, Ostracoda, Pontoporeia, Hydracarina, Corixa*, higher plant tissue).
1	7¾	17.5	X	20	40		*Hyalella* 30; Misc. 10 (*Eurycercus, Alonella nana, Ostracoda*, diatoms).
20	8	18.0	35	60	X	X	Misc. 5 (*Difflugia, Hydracarina, Corixa*, ants, diatoms, plant debris).
6	8	18.0	5	15	63		*Hyalella* 12; Misc. 5 (*Alona affinis, Ostracoda, Hydracarina, Corixa, Tipulidae* pupa, insect fragments, diatoms, *Ulothrix*, higher plant tissue).
1	8¼	19.5	X		x	99	
2	8¾	20.0	12	63	5		Ants 20; diatoms.
1	9½	21.5		95	2	X	*Chara* and higher plant tissue 3.
1	10¼	24.5	45	52	1	2	
2	10⅞	25.4	45	13	2	40	*Bosmina*, seed, diatoms.
4	11½	26.5	3	90	x	4	Misc. 3 (*Difflugia*, statoblasts, *Pleuroxus denticulatus, Monospilus, Ostracoda, Mysis, Odonata* nymphs, diatoms, *Campylodiscus, Mougeotia*).
6	11¾	27.5	15	45	7	19	*Mysis* 12; Misc. 2 (statoblasts, *Oligochaeta, Cyclops, Bosmina, Alona affinis, Ostracoda, Hydracarina, Corixa*, diatoms, *Cladophora*, plant fragments).
1	12¼	28.2	5	90	3	2	
1	13⅓	30.7	X		X		Fish remains 100.
2	14	31.5	6	90	X		Misc. 4 (*Hydracarina, Coleoptera*, diatoms, *Cladophora*, seeds, conifer needles).
1	14½	32.5	2	X		15	Plant debris 80; Misc. 3 (*Hydracarina*, dipterous adult, seeds).
Average 59		16.0-32.5	17	54	12	7	Misc. 10.

COMMON WHITEFISH, *Coregonus clupeaformis*

No.	Date	L. in.	L. cm.	*Pontoporeia*	*Ephemeridae*	*Chironomidae*	*Mollusca**	Miscellaneous
5	Aug. 4, '21	2⅜	5.7			35		*Bosmina* 40; *Eurycercus* 5; *Trichoptera* larvae 5; Misc. 15 (*Oligochaeta, Cyclops, Sida, Ilyocryptus, Acroperus, Alona affinis, A. quadrangularis, Chydorus, Alonella exigua, Polyphemus, Leptodora, Ostracoda, Hydracarina, Arachnida, Corixa*, diatoms).
1	Aug. 9, '22	6	13.8		30		65	Sand 5.
6	June-Aug., '21-'22	6¼	14.5	20	X	40	10	*Mysis* 20; Misc. 10 (*Centropyxis, Difflugia, Porifera* spicules, *Oligochaeta*, statoblasts, *Canthocamptus, Eurycercus, Leptodora, Ostracoda, Hydracarina, Corixa, Cladophora*, diatoms).
20	Aug. 12, '21	6½	15.0		25	35	20	Misc. 20 (*Cyclops, Ostracoda, Hyalella, Hydracarina, Arachnida, Corixa, Trichoptera, Cladophora*).
3	June-Aug., '21-'23	6½	15.5		5	30	15	*Mysis* 35; Misc. 15 (*Cyclops, Ostracoda, Hydracarina, Corixa, Cicadillid, Simulium* larvae, *Hymenoptera*, diatoms).
5	July 6, '21	6¾	16.0	1	1	15	1	*Mysis* 70; Misc. 12 (*Ostracoda, Hydracarina, Corixa*).
1	Aug. 4, '23	7⅛	16.3			2	10	*Eurycercus* 60; Sand 15; Misc. 13 (*Cyclops, Bosmina, Ostracoda, Mysis, Hydracarina*, diatoms).
15	Aug. 4, '21	7½	17.5	X		5	90	Misc. 5 (*Bosmina, Leptodora, Ostracoda, Hydracarina, Corixa, Cladophora, Bryophyta*).
3	June-July, '21-'22	7½	17.5	2		45	12	*Mysis* 38; Misc. 5 (Statoblasts, *Cyclops, Bosmina, Ostracoda, Hyalella, Hydracarina, Hydroporus* larva).
1	June 29, '22	7¾	18.2	40		30		*Ostracoda* 30; *Daphnia* ephippium.

COMMON WHITEFISH—*Continued*

No.	Date	L. in.	L. cm.	*Pontoporeia*	*Ephemeridae*	*Chironomidae*	*Mollusca**	Miscellaneous
5	Aug. 12, '21	8¼	19.0		X	70	5	*Hydracarina* 20; Misc. 5 (*Porifera* spicules, *Nematoda*, statoblasts, *Cyclops*, *Daphnia longi, spina*, *Leptodora*, *Ostracoda*, insect fragments-diatoms).
1	July 4, '21	9	20.0	75		25		
1	July 28, '21	9¾	22.0			85	X	Misc. 15 (*Leptodora*, *Mysis*, *Hydracarina*, *Corixa*).
1	Aug. 9, '22	10¼	23.5		70	3	25	Misc. 2 (*Hydracarina*, *Tipulidae* pupa).
2	Aug. ,'22	10½	24.3		40	1	55	Misc. 4 (*Hydracarina*, insect fragments, higher plant tissue, diatoms).
4	June-July, '21-'22	11	25.5	50		35	4	*Ostracoda* 5; Misc. 6 (*Codonella*, *Oligochaeta*, *Canthocamptus*, *Hydracarina*, insect fragments, higher plant tissue, *Cladophora*, *Ulothrix*, diatoms).
8	June-Aug., '21-'23	11¼	26.0	25	8	25	17	Misc. 25 (*Difflugia*, *Cyphoderia*, *Porifera* spicules, *Plumatella* tubules, *Epischura*, *Diaptomus*, *Limnocalanus*, *Cyclops*, *Daphnia longispina*, *Bosmina*, *Leptodora*, *Ostracoda*, *Hydracarina*, insect fragments, higher plant tissue, *Chaetophora*, *Pediastrum Cosmarium*, diatoms).
3	June-July, '21-'23	12	27.5	12	25	7	48	Misc. 8 (*Difflugia*, *Ostracoda*, *Hydracarina*, *Corixa*, *Trichoptera*, insect fragments, *Cladophora*, diatoms).
14	June-July, '21-'22	12¼	28.3	48	5	31	1	Misc. 15 (*Cyclops*, *Eurycercus*, *Ostracoda*, *Hemiptera*, *Coleoptera*, ants, eyed fish eggs, seeds, higher plant tissue).

COMMON WHITEFISH—*Continued*

No.	Date	L. in.	L. cm.	*Pontoporeia*	*Ephemeridae*	*Chironomidae*	*Mollusca**	Miscellaneous
2	June-July, '21-'22	12¾	29.5	60		35		Misc. 5 (Statoblasts, insect fragments, seeds, *Cladophora*).
3	June-Aug., '22	13½	31.3	50		7	3	Sand and ooze 27; Misc. 13 (*Cyclops*, *Kurzia latissima*, *Ostracoda*, insect fragments, eyed fish eggs, seeds, higher plant tissue, diatoms).
3	July, '22-'23	13¾	32.0	7	30	28	10	Ooze 10; Misc. 15 (*Porifera* spicules, *Oligochaeta*, *Bryozoa*, *Epischura*, *Diaptomus*, *Daphnia*, *Ostracoda*, *Mysis*, *Hydracarina*, *Trichoptera*, *Coleoptera*, seeds, diatoms).
2	June, '21-'22	15⅛	34.3		1	1	97	Misc. 1 (*Ostracoda*, *Hydracarina*, *Trichoptera*, seeds, conifer needles).
5	June-Aug., '21-'23	15¼	35.0	10	2	8	28	Fish remains 20; terrestrial insects 14; *Trichoptera* 10; Misc. 8 (*Chydorus*, *Hydracarina*, higher plant tissue, *Cladophora*, diatoms).
4	June-July, '21-'22	15½	36.0	27	1	10	15	*Trichoptera* 10; caterpillars and cocoons 10; higher plant tissue 10; Misc. 17 (*Bryozoa*, *Ostracoda*, *Hydracarina*, *Corixa*, *Simulium* larvae and pupa, *Diptera*, *Coleoptera*, fish remains, *Cladophora*).
1	June 16, '22	16	37.5	83		10	X	Misc. 7 (Leech, *Corixa*, *Coleoptera*, ants, eyed fish eggs, seeds).
21	June-July, '21-'22	17	38.5	30	1	30	1	Insect fragments 30; (*Orthoptera*, *Hemiptera*, *Diptera*, *Coleoptera*, *Hymenoptera*) eyed fish eggs 6; Misc. 2 (*Hydracarina*, seeds, conifer needles).
1	Aug. 8, '21	17½	39.6			3	X	Fish remains 45; balsam cone 40; *Trichoptera* 5; Misc. 7 (*Ostracoda*, *Cladophora*, twigs, conifer needles).

COMMON WHITEFISH—*Continued*

No.	Date	L. in.	L. cm.	*Pontoporeia*	*Ephemeridae*	*Chironomidae*	*Mollusca**	Miscellaneous
12	June-Sept., '21-'23	17½	40.0	17	1	8	30	Fish remains 15; terrestrial insects 10; Misc. 19 (Statoblasts, *Alona*, *Hydracarina*, *Corixa*, *Trichoptera*, *Simulium* larvae, eyed fish eggs, seeds, needles, higher plant tissue, *Cladophora*, diatoms, ooze, sand, pebbles).
2	June-July, '21-'22	18	41.0	35		10	45	Misc. 10 (*Alona affinis*, *Ostracoda*, *Hydracarina*, *Thysanura*, seeds, Conifer needles, cedar foliage, ooze, sand).
4	July, '21-'22	18¼	42.0	20	45	10	17	Misc. 8 (*Porifera* spicules, *Gordius*, *Keratella quadrata*, *Ostracoda*, *Hydracarina*, *Corethra* larvae and pupae, *Coleoptera*, seeds, higher plant tissue, *Cladophora*).
12	July-Aug., '21	19	43.0	35	X	42	1	Misc. 22 (*Hydracarina*, *Diptera*, *Coleoptera*, ants, seeds, conifer needles, higher plant tissue, *Cladophora*.)
12	July '21, '21	20	44.0	40		52	1	Misc. 7 (*Sialis* larva, *Hemiptera*, *Coleoptera*, ants, eyed fish eggs, seeds, higher plant tissue).
2	July '21, '21	20	45.0	75		10		Misc. 15 (*Hemiptera*, *Coleoptera*, eyed fish eggs, seeds, spruce needles, higher plant tissue).
2	July 21, '21	20½	46.0	25		55		Misc. 20 (*Hemiptera*, *Coleoptera*, ants, eyed fish eggs, seeds).
1	July 21, '21	21	47.0	45		50		Misc. 5 (Insect fragments, seeds).
1	June 30, '21	21¼	48.0	50	X	30		Misc. 20 (*Hemiptera*, *Coleoptera*, ants, higher plant tissue).
Average								
55		2⅛-8	5.7-19.0	3	10	28	20	*Mysis* 13, Misc. 26.
124		9-21¼	20-48	31	5	27	11	Terrestrial insects 7, Misc. 19.

*Adamstone, as reported in another paper in the present series, found that the most common species of mollusca consumed by whitefish were *Valvata sincera*, *V. tricarinata*, *Amnicola pallida*, *A. limosa*, *A. limosa porata* and various species of sphaeriidae.

CISCOES, *Leucichthys* spp.

No.	Date	L. in.	L. cm.	*Limnocalanus*	*Leptodora*	*Daphnia*	*Mysis*	*Chironomidae*	Miscellaneous
30	June 22, '21	2¾	6.0					75	Misc. 25 (*Hydracarina*, *Arachnida*, *Plecoptera* nymph, *Ephemeridae* nymph and subimago, *Odonata* nymph, *Trichoptera* larvae, *Simulium* larvae, *Diptera*, *Coleoptera*, *Hymenoptera*).
3	Aug. '21, '22	4	8-10					50	*Bosmina* 30; *Cyclops* 3; Misc. 17 (*Hydracarina*, *Diaptomus*, *Polyphemus*, *Corixa*, *Psocidae*, insect fragments).
3	June-July, '22	4½	10-12		15	27*l*			*Diaptomus sicilis* 38; *Cyclops* 20; *Bosmina*.
4	June-Aug., '21-'22	5¾	12-14		X	31*r*	17	28	*Ephemeridae* nymphs 11, *Corixa* 10; Misc. 3 (*Epischura*, *Diaptomus minutus*, *D. sicilis*, *Cyclops*, *Sida*, *Ostracoda*, *Hydracarina*).
39	July-Aug., '21-'22	6½	14-16	3	3	5*l-r*	80	2	*Diaptomus sicilis* and *minutus* 1; *Cyclops* 1, Misc. 5 (Statoblasts, *Epischura*, *Sida*, *Diaphanosoma*, *Bosmina*, *Ostracoda*, *Pontoporeia*, *Hydracarina*, *Ephemeridae* nymphs, *Coleoptera*, *Mollusca*, *Melosira*).
14	June-Aug., '21-'23	7¼	16-18	13	2	5*l-r*	50	1	*Diaptomus* 5; *Bosmina* 5; *Ephemeridae* nymphs (*Hexagenia bilineata*) 14; Misc. 3 (*Keratella quadrata*, *Cyclops*, *Epischura*, *Sida*, *Diaphanosoma*, *Chydorus*, *Hydracarina*, *Hemiptera*, *Trichoptera* pupae, *Coleoptera*, *Culicidae* pupa, *Cladophora*, diatoms).
10	July, '21-'22	8½	18-20		5	40*l*	50		Misc. 5 (Statoblasts, *Epischura*, *Diaptomus*, *Cyclops*, *Bosmina*, *Polyphemus*, *Hyalella*, *Hydracarina*, *Diptera* adults, *Sphaerium*).

CISCOES—*Continued*

No.	Date	L. in.	L. cm.	*Limnocalanus*	*Leptodora*	*Daphnia*	*Mysis*	*Chironomidae*	Miscellaneous
2	June-Aug., '22-'23	9¼	20-22				100		
31	June-Aug., '21-'23	10	22-24	2		X	85	10	Misc. 3 (*Diaptomus, Cyclops, Bosmina, Hydracarina, Hexagenia bilineata, Psocidae,* ants, *Sphaerium, Melosira*).
7	June-Aug., '21-'23	11	24-26	25			70	1	Misc. 4 (*Cyclops, Ostracoda, Hexagenia bilineata* nymphs, insect fragments, *Mollusca*).
14	June-Aug., '21-'23	12	26-28	33			60	X	Misc. 7 (*Difflugia, Oligochaeta, Diaptomus, Hexagenia bilineata* nymphs, *Bibionidae* adults, *Hymenoptera* adult, *Sphaerium*).
3	June-Sept., '22-'23	12¾	28-30	10			73	4	*Ephemeridae* nymphs 11; Misc. 2 (Statoblasts, *Diaptomus, Ostracoda, Pontoporeia, Cladophora,* diatoms).
5	June-July, '22	13¼	30-32	24			74		*Diaptomus* 2; *Melosira.*
2	June-July, '21-'22	16¼	36-38	47			52	X	Misc. 1 (*Diaptomus, Hydracarina*).

l-D. longispina; *r*-D. retrocurva.

LAKE TROUT, *Cristivomer namaycush*

No.	Date	L. in.	L. cm.	Ciscoes	Fish Remains	Miscellaneous
1	Aug. 30, '23	11¾	27.8			1 Cottid.
1	June 27, '23	13	30.0		X	2 Diptera adults (*Bibio* sp.).
1	July 26, '22	13	30.0	2		
1	Aug. 3, '22	12⅞	30.7			1 Cottid.
1	Sept. 3, '23	13¼	31.0			6 Nine-spined sticklebacks.
1	June 29, '22	18¾	43.0	6	2	
1	Sept. 4, '23	19	43.8	1	X	
1	July 2, '22	19¼	44.7	8		
1	June 29, '22	19¾	46.0	6	2	
1	Sept. 4, '23	20	46.5	2	[illegible]	
1	" "	20		2	4	
1	" "	20½	47.8	2	2	
1	June 30, '21	20¾	48.0	2		
1	Sept. 4, '23	21		4		
1	Sept. 4, '23	21		2	4	
1	Aug. 28, '23	22⅜	52.2	1	1	1 Northern sucker and 1 sucker sp.?
1	June 29, '22	23	53.0	3	X	
1	Sept. 10, '23	24-28		2		
1	Sept. 10, '23	"		3		
4	" "			1 each		
1	Sept. 5, '23	24-30		3		
1	July 22, '22	25¾	60.0	1	2	
1	Sept. 6, '23	25-30			2	2 Common whitefish.
1	Sept. 6. '23	"		4	4	

LAKE TROUT—*Continued*

No.	Date	L. in.	L. cm.	Fish Ciscoes	Fish Remains	Miscellaneous
1	Sept. 6, '23	25-30		3		
1	Sept. 6, '23	"		2	1	
1	Sept. 6, '23	"		1	5	
1	Sept. 6, '23	25-30		1	1	
1	" "	25-30		4	6	
6	" "	25-30		1 each		
1	" "	25-30		2		
1	" "	25-30		1	2	
1	Sept. 4, '23	27	63.0	1		
1	Aug. 2, '22	29½	68.5	1	1	
1	Sept. 4, '23	32	72.2	3		1 Lake trout.
1	July 22, '22	33¼	78.5			1 Common sucker.
1	June 30, '21	36	85.0			1 Ling.
1	Aug. 4, '22	40				1 Common sucker.
*1	Sept. 10, '23					6 Cottids.
*1	Sept. "					2 Nine-spined sticklebacks.
*1	Sept. "					1 Cottid, 16 Nine-spined sticklebacks.

In addition 14 specimens taken during the months of July, August and September, 1923, ranging in length from 14 to 33 inches, were each found to have eaten from one to four fish which could not be positively identified.

*The lengths of these three fish were not obtained but they were taken in a gill net of 4½ inch stretched mesh.

SPECKLED TROUT, *Salvelinus fontinalis*

No.	Date	L. in.	L. cm.	Fish	Fish Remains	Miscellaneous
1	July 30, '22	?		1 cisco		
1	July 22, '23	4½	10.1			*Coleoptera* 60%; *Plecoptera* nymph 30; *Chironomidae* larvae 10.
1	July 22, '23	5⅜	12.2			*Coleoptera* 60; *Trichoptera* larva 40.
1	Sept. 10, '23	6½	14.7			*Trichoptera* larvae 80; *Mollusca* 20.
1	Sept. 13, '23	7¼	16.6			*Trichoptera* larvae 80; *Simulium* larvae 20; dipterous larva.
1	July 18, '23	7¾	17.0		X	Ants 50; *Coleoptera* 25.
1	Sept. 10, '23	7¾	17.5			*Trichoptera* larva 50; caterpillar 50.
1	Sept. 13, '23	8	18.1			*Trichoptera* larvae 100.
1	July 14, '23	8	18.5	2 trout perch		
1	July 18, '23	8¾	19.5	2 " "		
1	July 14, '23	8¾	20.0	2 " "		
1	July 18, '23	9	20.0		X	
1	July 16, '23	9	20.2		X	
1	Sept. 10, '23	9½	21.5	1 cottid		
1	July 16, '23	10½	24.0	1 trout perch?	X	
1	Sept. 13, '23	12⅛	28.0		X	*Coleoptera* 2% (*Gyrinus* adult).
1	July 16, '23	12½	28.4	2 trout perch?		
1	Sept. 3, '23	12⅞	29.5	1 Cottus cognatus		
1	Sept. 10, '23	13½	31.0		X	*Acarina*.
1	Sept. 13, '23	13½	31.3		X	
1	Sept. 7, '23	14	32.0		X	*Coleoptera*.
1	July 16, '23	15	33.0	4 trout perch?		
1	July 12, '23	15½	34.0	12 nine-spined sticklebacks		Dipterous adults—*Ortalididae* 25, *Bibio* 5; Misc. 10 (*Homoptera*, *Trichoptera* adults, *Chironomidae* pupa, dipterous adult, *Monohamus scutellatus*, *Lampyridae*.
1	Sept. 13, '23	14⅝	34.0	1 cisco		
1	Sept. 1, '23	16½	38.0	1 cottid		*Membracidae* 35; *Ichneumonidae* 5.
1	July 28, '24	20¾	46.5		X	

PIKE, *Esox lucius*

No.	Date	L. in.	L. cm.	
1	July 27, '23	3⅓	8.0	Remains of 2 fish, *Sida crystallina*.
1	Aug. 1, '22	3¾	8.8	Fish remains, dipterous larva, *Daphnia*.
1	" "	4	9.3	Fish remains, *Bosmina*.
1	July 31, '22	5⅛	12.0	1 trout perch (*Percopsis omisco-maycus*).
1	Sept. 11, '23	10½	24.0	1 yellow perch (*Perca flavescens*), 1 Iowa darter (*Etheostoma iowae*).
1	July 14, '22	11½	26.8	1 spot-tailed minnow (*Notropis hudsonius*), 2 yellow perch.
1	Sept. 11, '23	13¾	31.4	Fish remains.
1	June 30, '22	17½	40.0	1 small fish, 1 dragonfly nymph (*Aeschna umbrosia*).
1	July 27, '23	18	41.5	Remains of 2 fish.
1	Sept. 8, '23	19½	46.0	1 cisco (*Leucichthys* sp.).
1	July 31, '23	21½	50.0	Remains of 1 fish.
1	Aug. 1, '22	21½	50.5	1 mole shrew (*Blarina brevicauda*).
1	Aug. 22, '23	23¾	55.2	1 common sucker (*Catostomus commersonnii*).
1	July 12, 22	24¾	57.2	3 spot-tailed minnows, 2 tessellated darters (*Boleosoma nigrum*), 3 small fish, unidentified.
1	Aug. 9, '22	25½	59.3	3 ciscoes.
1	Aug. 23, '23	25½	59.5	1 cisco (*Leucichthys zenithicus*).
1	Sept. 3, '23	27	62.8	1 cisco (*Leucichthys zenithicus*).
1	July 20, '22	28	65.0	1 leech.
1	Sept. 3, '23	28		1 cisco (*Leucichthys* sp.).
1	Sept. 3, '23	30	70.7	1 ling (*Lota maculosa*).
1	June 1, '22	32	86.0	2 pikeperch (*Stizostedion vitreum*).
1	May 27, '22	35	95.0	1 pikeperch.
1	July 6, '22	40	106.0	1 whitefish (*Coregonus clupeaformis*).

BROOK STICKLEBACK, *Eucalia inconstans*

No.	Date	L. cm.	*Sida*	*Ostracoda*	*Trichoptera*	*Chironomidae*	Miscellaneous
1	July 25, '21	2.1	X	75		20	Misc. 5 (*Cyclops, Alona affinis, A. costata, Pleuroxus denticulatus, Chydorus, Alonella exigua*).
4	Aug. 11, '21	1.8-3.3	8	7	7	42	*Corixa* 16; *Hyalella* 5; Misc. 15 (*Oligochaeta, Cyclops, Bosmina, Eurycercus, Acroperus, Alona affinis, Pleuroxus denticulatus, Chydorus, Alonella excisa, Mollusca, Ephemeridae, Hydroporus* larvae, *Zygnema, Mougeotia,* diatoms).
4	July 14, '22	3.2-3.8	5	X		25	*Eurycercus* 40; *Ephemeridae* 15; Misc. 15 (*Difflugia corona, Oligochaeta, Epischura, Diaptomus, Cyclops, Canthocamptus, Daphnia, Simocephalus, Bosmina, Acroperus, Pleuroxus denticulatus, P. procurvatus, Chydorus, Alonella nana, Hyalella*).
1	July 12, '23	3.3	X			X	Fish eggs 98; Misc. 2 (*Cyclops, Acroperus*).
1	" "	3.6	55		35	5	*Cyclops* 5; *Hydracarina*.
2	Aug. 13, '23	4.7		42	25	25	Misc. 8 (*Trichocerca lata, Cyclops, Latona, Leptodora, Hyalella, Sphaerium, Ephemeridae*).
Average 13		1.8-4.7	8	14	9	26	*Eurycercus* 12, Misc. 31.

NINE-SPINED STICKLEBACK, *Pungitius pungitius*

No.	Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Bosmina*	*Chironomidae*	Miscellaneous
14	July 20, '21	2.9-4.4	2	2	6	1	45	*Chydorus* 13; *Ephemeridae* 10; *Trichoptera* 6; Misc. 15 (*Centrophyxis, Oligochaeta, Canthocamptus, Eurycercus, Camptocercus, Acroperus, Alona affinis, A. quadrangularis, A. costata, Pleuroxus denticulatus, Alonella nana, A. exigua, Polyphemus, Ostracoda, Hydracarina, Corixa, Hydrobius* larva, terrestrial insects).
9	July 25, '21	3.2-4.2	3	5	4	70	2	Fish eggs 11; Misc. 5 (*Monostyla, Sida, Alona costata, Chydorus, Polyphemus, Leptodora,* diatoms).
8	July 29, '21	1.0-4.5			20	10	10	*Eurycercus* 20; fish eggs 12; *Sida* 6; Misc. 22 (*Oligochaeta, Scapholeberis, Camptocercus, Acroperus, Alona affinis, A. quadrangularis, Rhyncholalona, Pleuroxus denticulatus, Chydorus, Alonella nana, A. exigua, Monospilus, Polyphemus, Leptodora, Ostracoda, Hyalella, Hydracarina, Trichoptera, Tabanidae* larvae).
12	July 30, '21	4.0	X	X	X	60	20	Misc. 20 (*Canthocamptus, Sida, Eurycercus, Alona costata, Leptodora, Hyalella, Hydracarina, Ephemeridae, Corixa, Trichoptera,* terrestrial insects).

NINE-SPINED STICKLEBACK, *Pungitius pungitius—Continued*

No.	Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Bosmina*	*Chironomidae*	Miscellaneous
1	July 30, '21	4.4				90	8	Misc. 2 (*Chydorus, Leptodora,* dipterous pupa).
1	July 9, '22	3.9		5	5	X	10	*Trichoptera* 75; Misc. 5 (*Canthocamptus*).
1	July 27, '23	4.4	10	5				*Scapholeberis* 25; *Polyphemus* 25; *Sida* 20; *Hyalella* 10; Misc. 5 (*Latona, Chydorus, Ostracoda*).
2	July 27, '23	3.9-4.4					25	*Ephemeridae* 70; *Corixa* 5.
5	July 27, '23	3.2-4.4	40	2	1	X	47	Misc. 10 (*Oligochaeta, Sida, Daphnia, Eurycercus, Chydorus, Polyphemus, Leptodora, Ostracoda, Ephemeridae,* diatoms).
5	Aug. 27, '23	1.4-3.1	8	22	27	8	30	Misc. 5 (*Daphnia longispina, D. retrocurva, Alona guttata, A. costata, Pleuroxus denticulatus, Chydorus, Polyphemus, Hydracarina*).
Average 58		1.0-4.5	5	4	7	27	25	*Ephemeridae* 5, Misc. 27.

TROUT PERCH, *Percopsis omisco-maycus*

No.	Date	L. cm.	*Amphipoda*	*Ephemeridae*	*Chironomidae*	Miscellaneous
2	July 12, '23	4.4-4.8		30	70	Misc. (*Oligochaeta, Cyclops, Daphnia longispina, Ostracoda,* diatoms).
5	July 27, '23 Whitesand Windigo	4.5-7.2	33H*	15	45	Misc. 7 (*Oligochaeta, Epischura, Cyclops, Sida, Latona, Eurycercus, Alona costata, Chydorus, Hydracarina,* beetle larvae, *Tipulidae* pupa).
1	July 27, '23 Whitesand	6.5	10?		80	Misc. 10 (*Oligochaeta, Eurycercus, Alona costata, Ostracoda,* diatoms).
1	Aug. 23, '23 Ombabika	5.5	95P*		5	
Average 9		4.4-7.2	30	15	50	Misc. 5.

*H. = Hyalella. P. = Pontoporeia.

SMALL-MOUTHED BLACK BASS, *Micropterus dolomieu*

No.	Date	L. cm.	
1	July 31 '23	3.0	One small fish 90; Misc. 10 (*Ephemeridae, Chironomidae*).
1	" "	3.3	One small fish 95; Misc. 5 (*Cyclops, Ephemeridae, Corixa*).
1	" "	3.4	Three small fish 95; Misc. 5 (*Cyclops, Latona, Ephemeridae, Chironomidae*).

PIKE PERCH, *Stizostedion vitreum*

No.	Date	L. in.	L. cm.	Ciscoes	Nine-spined sticklebacks	Fish Remains	Miscellaneous
1	July 31, '23	1⅜	3.5				*Daphnia longispina,* 99%; *Cyclops, Epischura.*
1	" "	1¾	4.0			1	*Cyclops, Epischura, Bosmina, Daphnia* 1%.
1	" "	1⅞	4.5			2	*Daphnia, Chironomidæ* larvae and pupa.
1	Aug. 9, '22	4¼	9.4				*Epischura* 45%; *Leptodora* 45%; *Chironomidae* pupa 10%.
1	July 12, '23	6¾	15.1		1		
1	July 6, '23	7	15.6				*Trichoptera* pupa 85%; *Ephemeridae* nymphs 15%.
1	July 30, '23	7¼	16.4				1 tessellated darter.
1	July 28, '22		24.0	1			
1	Aug. 9, '22	11	25.0				*Ephemeridae* nymphs (burrowing) 100%.
1	July 26, '23	11⅛				1	*Ephemeridae* nymphs.
1	July 28, '22	11¾	25.5		2	X	
1	July 11, '22	12⅜	29.0			X	1 pike perch.
1	" 26, '22		29.5			X	1 cottid.
1	Aug. 9, '23		30.0	1	2		
1	July 26, '23	13				X	*Ephemeridae* nymphs.
1	July 27, '22		30.5				6 cottids.
1	Aug. 2, '22	13½	30.5				2 cottids.
1	July 11, '22	13¾	31.0		3	X	
1	July 26, '23	13¾					*Ephemeridae* nymphs 100% (*Hexagenia*).
1	July 26, '23	14				1	*Ephemeridae* nymphs.
1	Aug. 2, '22	14⅝	33.0				*Ephemeridae* nymphs 100% (*Hexagenia*).
1	July 26, '22		41.0		1		
1	Aug. 3, '22	17⅞	41.0		1		
1	Aug. 3, '22	18	41.0		1	X	
1	July 22, '22	18½	41.5				*Ephemeridae* nymphs 100%.
1	July 11, '22	19⅓	43.5	1			

PIKE PERCH—*Continued*

No.	Date	L. in.	L. cm.	Ciscoes	Nine-spined sticklebacks	Fish Remains	Miscellaneous
1	Aug. 3, '22	20	44.3		4	X	
1	July 28, '22	19¾	45.5	1			
1	" "	20	46.5	6			
5	" "	20¾	47.0	1 each			
1	" "	20¾	47.0	2			
1	July 15, '22	21½	48.0	2			
1	July 28, '22	21½	48.0				1 Common whitefish.
1	Aug. 15, '22	21½	49.0	2			
1	Aug. 15, '22	21½	49.0		3	X	
1	July 19, '22	22¼	50.5	1			
1	Sept. 6, '23	19-21		1		10	
1	" "	"		1		3	
1	" "	"		2		2	
1	" "	"		4		2	
1	" "	"		1		7	
4	" "	"		1 each			
1	Sept. 3, '23	19-23		2*			**Leucichthys zenithicus.*
1	" "	"		5			
1	" "	"		2*			**L. zenithicus* and *L. nigripinnis.*
1	" "	"		4			
1	" "	"		1*			**L. nigripinnis.*
1	" "	"		2			
2	" "	"		1 each			
1	Aug. 9, '23	20½	46.0	1	5		

24 specimens taken Sept. 6, '23, in gill nets of 4½ inch mesh, each contained fish remains all apparently of ciscoes, since 9 others taken at the same time contained ciscoes.

19 specimens taken during the summers of 1922 and 1923 ranging in size from 5¾ in. to 19½ in. *(12.7 to 45.5 cm.)* each contained the remains of one or more fish which could not be definitely identified.

SAUGER, *Stizostedion canadense*

No.	Date	L. in.	L. cm.	*Ephemeridae* nymphs*	Fish	Fish remains	Miscellaneous
1	Aug. 10, '22	8⅝	19.0		1 percoid fish		
1	" "	11½	26.0		1 " "		
1	July 26, '23	12¼		100%			
1	Aug. 23, '23	12½	27.6		1 yellow perch		
3	July 26, '23	12½		100			
1	Aug. 10, '22	12¾	28.0		1 cisco		
1	" "	12¾	28.8		2 ciscoes		
1	July 26, 23	12¾		100			*Trichoptera* adult.
1	" "	13		90		X	*Trichoptera* pupa.
2	" "	13¼		100			
3	" "	13½		100			
1	July 28, '23	13½			fish eggs		
4	July 26, '23	13¾		100			
1	July 28, '23	13¾		90†		X	†1 individual of *Ephemera simulans*
6	July 26, '23	14		100			
1	Aug. 23, '23	14⅛	31.5		1 trout perch		
5	July 26, '23	14¼		100			
3	" "	14½		100			
1	" "	"		50		X	
1	July 28, '23	14½			1 cisco		
3	July 26, '23	14¾		100			
1	" "	14¾			1 cottid		
1	" "	15		90		X	
1	" "	15		90			*Trichoptera* adults.

SAUGER—*Continued*

No.	Date	L. in.	L. cm.	*Ephemeridae* nymphs*	Fish	Fish remains	Miscellaneous
1	July 26, '23	15¼	34.6	50		X	
1	" "	"		100			
1	July 28, '23	15¼			1 trout perch		
5	July 26, '23	15½		100			
1	" "	15¾		100			
4	July 26, '23	16	36.5	100			
1	" "	16	36.5	75		X	
1	" "	16¼	37.2	50		X	

16 specimens taken during the summer of 1923 ranging in size from 11 inches (25.0 cm.) to 15¾ inches (36.0 cm.) each contained the remains of one or more fish which could not be definitely identified.

*All the *Ephemeridae* nymphs which were in a condition to be identified were found to be *Hexagenia bilineata*, except for an individual *Ephemera simulans*.

YELLOW PERCH, *Perca flavescens*

No.	Locality, Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Daphnia*	*Bosmina*	*Ephemeridae*	*Chironomidae*	*Fish	Miscellaneous
16	Macdiarmid, July 19, '21	2.1-3.3	77	10	X	6	X			5	Misc. 2 (*Sida, Simocephalus, Polyphemus, Leptodora, Hydracarina*).
5	S. McL. bay, July 25, '21	3.0-3.6	20	X	X	X	X	25	30	20	Misc. 5 (*Alona costata, Polyphemus, Leptodora, Corixa*).
2	Refuse bay, July 29, '21	3.5-3.7		X	8		X	2	X		*Eurycercus* 53; *Corixa* 32; Misc. 5 (*Sida, Acroperus, Chydorus, Alonella nana, Polyphemus, Hydracarina*).
2	West of Cooke Pt., July 30, '21	3.6-3.8	80		X	X	X		5		Misc. 15 (*Acroperus, Alona costata, Alonella nana, A. exigua, Polyphemus, Leptodora, Ostracoda, Hydracarina*).
3	Shakespeare bay, Aug. 4, '21	2.9	87		X		3		7		Misc. 3 (*Alona affinis, Pleuroxus denticulatus, P. procurvatus, Chydorus, Corixa, Trichoptera*).
9	Lone Wolf H., Aug. 12, '21	2.8-3.7	35	15	3	10	10		15		*Corixa* 7; Misc. 5 (*Difflugia, Canthocamptus, Eurycercus, Alona costata, Pleuroxus procurvatus, Chydorus, Polyphemus, Leptodora*).

YELLOW PERCH—*Continued*

No.	Locality, Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Daphnia*	*Bosmina*	*Ephemeridae*	*Chironomidae*	*Fish	Miscellaneous
4	Orient bay, Aug. 15, '21	2.5-3.8	5	X	26	2	26		10		*Diaphanosoma brachyurum* 9; *Polyphemus* 7; Misc. 15 (*Oligochaeta, Sida, Eurycercus, Acroperus, Pleuroxus denticulatus, Alonella exigua, Leptodora, Hydracarina*).
20	Station 5, Aug. 1, '22	2.2-3.5	30	12	2	12	15		X		*Sida* 17, *Leptodora* 6; Misc. 6 (*Keratella cochlearis, Canthocamptus, Diaphanosoma, Ophryoxus, Eurycercus, Acroperus, Alona affinis, A. guttata, A. costata, Pleuroxus denticulatus, P. procurvatus, Alonella nana, Monospilus, Polyphemus, Ostracoda, Hydracarina*, diatoms).
1	Station 5, Aug. 3, '22	2.7		50	30	5	15				
7	Station 5, July 12, '23	2.2-2.7		3	8	3		4	12	15	*Latona* 55; *Difflugia lobostoma*.
1	Windigo bay, July 27, '23	2.3	95	1	1	1			1		*Sida* 1.

YELLOW PERCH—*Continued*

No.	Locality, Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Daphnia*	*Bosmina*	*Ephemeridae*	*Chironomidae*	Fish*	Miscellaneous
5	Sta. 5 (Weeds) July 31, '23	2.1-3.6	4	6	2	12	48	15	6		*Latona* 5; Misc. 2 (*Monostyla lunaris, Rhynchotalona, Pleuroxus denticulatus, Polyphemus*, water beetle larvae).
5	Sta. 5 (Open) July 31, '23	2.3-3.6	8	1	1	38	32	17	1		Misc. 2 (*Latona, Eurycercus, Chydorus, Leptodora, Corixa*).
5	Bell's bay, Aug. 16, '23	2.0-3.2	20	X	1	X	18	13	6	22	*Chydorus* 10; Misc. 10 (*Oligochaeta, Keretalla cochlearis, Lecane luna, Canthocamptus, Eurycercus, Acroperus, Alona affinis, A. guttata, A. rectangula, Rhynchotalona, Pleuroxus denticulatus, Chydorus, Alonella nana, A. excisa, Polyphemus, Leptodora, Ostracoda, Hydracarina, Corixa*).
5	Virgin Is., Aug. 27, '23	2.2-2.6	2	53	8	22	1		3	10	Misc. 1 (*Sida, Acroperus, Ostracoda*).
4	Station 5, Sept. 11, '23	3.0-3.7	1	1	1	1	95				Misc. 1 (*Acroperus, Pleuroxus denticulatus, Chydorus, Leptodora*).

YELLOW PERCH—*Continued*

No.	Locality, Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Daphnia*	*Bosmina*	*Ephemeridae*	*Chironomidae*	Fish*	Miscellaneous
4	Aviator's bay, Sept. 11, '23	3.0-4.0	1	1	40	1	45	1	1		Misc. 10 (*Oligochaeta, Canthocamptus, Sida, Latona, Acroperus, Alona affinis, A. guttata, Graptoleberis, Rhynchotalona, Pleuroxus denticulatus, Chydorus, Alonella excisa, Monospilus, Polyphemus, Ergasilus*).
5	Aviator's bay, Sept. 11, '23	2.8-4.0		1	18	2	35	15	2		*Sida* 17; Misc. 10 (*Canthocamptus, Simocephalus, Acroperus, Alona costata, A. rectangula, A. quadrangularis, Graptoleberis, Rhynchotalona, Alonella excisa, Pleuroxus denticulatus, Chydorus sphaericus, C. globosus, Polyphemus, Hyalella, Hydracarina, Closterium* diatoms).
5	McL. bay, July 25, '21	4.0-6.0			X			58	10		*Corixa* 32; *Latona, Pleuroxus denticulatus, Leptodora.*
3	Orient bay, July 27, '21	4.0-4.5			X			40	15		*Sida* 37; Misc. 8 (*Eurycercus, Hydracarina, Corixa, Dytiscidae* larvae, *Corethra* pupae).

YELLOW PERCH—*Continued*

No.	Locality Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Daphnia*	*Bosmina*	*Ephemeridae*	*Chironomidae*	Fish*	Miscellaneous
16	Refuse bay, July 29, '21	4.0	X		X		X	32	5	40	*Eurycercus* 5; *Trichoptera* 5; *Corethra* pupae 5; Misc. 8 (*Canthocamptus, Alona affinis, A. costata, Pleuroxus denticulatus, Chydorus, Alonella nana, Polyphemus, Leptodora, Ostracoda, Hyalella, Hydracarina, Corixa*).
12	Lone Wolf H., Aug. 12, '21	4.0-6.0	5	X	X	1	X	3	1	52	*Corixa* 37; Misc. 1 (*Sida, Polyphemus, Leptodora, Ostracoda*).
2	Orient bay, Aug. 15, '21	4.7-5.4			X			65	10		Fish eggs 10; *Trichoptera* 5; Misc. 10 (Statoblasts, *Sida, Alona affinis, Ostracoda, Hydracarina*).
3	Station 5, June 30, '22	5.1-5.8		4	4	8	14		10	60	*Acroperus, Hydracarina.*
16	Station 5, Aug. 12, '22	5.0-7.8	15	X	X	27	3	4	1	34	*Trichoptera* 5; Misc. 11 (*Difflugia lobostoma, Limnocalanus, Sida, Diaphanosoma brachyurum, Eurycercus, Acroperus, Alona costata, Pleuroxus denticulatus, Chydorus, Alonella nana, A. excisa, Leptodora, Mysis, Dytiscidae* larvae, insect fragments, diatoms).

YELLOW PERCH—*Continued*

No.	Locality, Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Daphnia*	*Bosmina*	*Ephemeridae*	*Chironomidae*	Fish*	Miscellaneous
5	Station 5, July 12, '23	4.0-7.3				X	X	45	X		*Corixa* 35; fish eggs 20; *Canthocamptus, Latona, Ostracoda, Hydracarina.*
1	Windigo bay, July 27, '23	6.5						90			Misc. 10 (*Sida, Hyalella,* beetle larvae).
2	Whitesand R., July 27, '23	5.5-6.3	80					X	X		Fish eggs 10; *Trichoptera* 5; Misc. 5 (*Eurycercus, Leptodora, Ostracoda, Amphipoda, Corixa*).
2	Bell's bay, Aug. 16, '23	4.9-6.5	5	X	X		X	37	8	40	Misc. 10 (*Lecane luna, Acroperus, Alona guttata, Pleuroxus denticulatus, Chydorus, Alonella excisa, Ostracoda, Hydracarina, Corixa, Tipulidae* pupa).
3	Aviator's bay, Sept. 11, '23	4.2-4.6		1	10	27	4		2		*Hyalella* 48; insect fragments 6; Misc. 2 (*Eurycercus, Leptodora*).
4	Macdiarmid, July 20, '21	8.3-10.8			X		X	45	X	25	*Corixa* 30; *Chydorus, Ostracoda.*
2	Bell's bay, Aug. 16, '23	9.5-11.8					2	17	5		*Corixa* 75; Misc. 1 (*Hydracarina, Dytiscidae* larvae).
2	Ombabika bay, Aug. 10, '22	11.8-12.0						100			*Corixa.*

YELLOW PERCH—*Continued*

No.	Locality, Date	L. cm.	*Epischura*	*Diaptomus*	*Cyclops*	*Daphnia*	*Bosmina*	*Ephemeridae*	*Chironomidae*	Fish*	Miscellaneous
2	Macdiarmid, July 9, '22	12.0-13.0							X	100	*Corixa.*
3	Humboldt bay, Aug. 9, '22	13.5-13.7						85	X	12	Misc. 3 (*Oligochaeta, Lepadella ovalis, Sida, Pleuroxus denticulatus, Ostracoda, Trichoptera,* higher plant tissue, diatoms).
1	Ombabika bay, Aug. 10, '22	14.3						25			*Cambarus virilis* 75.
1	Ombabika bay, Aug. 21, '22	13.0						90	5		*Pontoporeia* 5; snail, *Sphaerium.*
1	Ombabika bay, Aug. 21, '22	20.3						55			*Cambarus virilis* 45.
Average											
103		2-4	29	9	6	8	17	5	6	4	Misc. 16.
70		4-8	7	X	1	8	1	25	4	30	*Corixa* 11, Misc. 13.
16		8-20.3	0	0	X	0	X	52	1	21	*Corixa* 17, *Cambarus virilis* 8, Misc. 1.

*The fish remains were too fragmentary for identification.

LOG PERCH, *Percina caprodes*

No.	Date	L. cm.	
1	Aug. 9, '22	5.2	*Chironomidae* larvae and pupae 50; *Ephemeridae* 40; Misc. 10 (*Epischura, Diaptomus, Sida, Latona, Polyphemus*).
1	" "	5.3	*Latona* 85; *Ephemeridae* 13; Misc. 2 (*Cyclops, Acroperus, Ostracoda, Chironomidae* larvae and pupa).
1	" "	5.3	*Latona* 60; *Eurycercus* 30; Misc. 10 (*Cyclops, Hyalella, Ephemeridae, Chironomidae* larvae).
1	" "	5.5	*Chironomidae* 75; *Ephemeridae* 20; *Hyalella* 5.
1	" "	5.8	*Chironomidae* 95; Misc. 5 (*Eurycercus, Alona affinis, Ephemeridae*).
Average 5		5.2-5.8	*Chironomidae* larvae and pupae 44; *Latona setifera* 29; *Ephemeridae* nymphs 15; Misc. 12.

TESSELLATED DARTER, *Boleosoma nigrum*

No.	Date	L. cm.	*Cyclops*	*Eurycercus*	*Ephemeridae*	*Chironomidae*	Miscellaneous
10	July 25, '21	2.3-5.0	1		7	84	Misc. 8 (*Centropyxis, Oligochaeta, Diaptomus, Sida, Bosmina, Ilyocryptus acutifrons, Alona affinis, A. rectangula, Rhynchotalona, Chydorus, Monospilus, Polyphemus, Ostracoda, Amphipoda, Mollusca, Corixa, Trichoptera*, diatoms).
6	July 27, '21	1.7-4.7	2	3	12	73	Misc. 10 (*Centropyxis, Difflugia, Bosmina, Chydorus, Polyphemus, Ostracoda*, diatoms).
8	July 29, '21	2.8-5.1				92	*Hyalella* 5; Misc. 3 (*Oligochaeta, Ilyocryptus acutifrons, Alona affinis, A. costata, Rhynchotalona, Pleuroxus denticulatus, Chydorus, Monospilus, Ostracoda, Hydracarina*, diatoms).
10	Aug. 12, '21	1.7-4.4	X			85	*Ostracoda* 7; *Drepanothrix dentata* 5; Misc. 3 (*Oligochaeta, Canthocamptus, Sida, Acroperus, Alona quadrangularis, A. costata, Pleuroxus procurvatus, Chydorus, Alonella nana, A. exigua, Amphipoda, Mollusca, Hydracarina, Trichoptera, Botryococcus braunii*, diatoms).
11	Aug. 15, '21	1.8-3.7	1	16	X	51	*Dytiscidae* larvae 6; *Trichoptera* 5; *Corixa* 4; *Mollusca* 4; Misc. 13 (*Centropyxis, Oligochaeta, Diaptomus, Canthocamptus, Sida, Bosmina, Ophryoxus gracilis, Acroperus, Alona affinis, A. costata, A. quadrangularis, Pleuroxus denticulatus, P. procurvatus, Chydorus, Alonella nana, A. exigua, Leptodora, Ostracoda, Hyalella, Hydracarina, Gyrinidae* larva, diatoms).

TESSELLATED DARTER—*Continued*

No.	Date	L. cm.	*Cyclops*	*Eurycercus*	*Ephemeridae*	*Chironomidae*	Miscellaneous
2	July 27, '23	3.3-4.1	X	X	27	63	Misc. 10 (*Difflugia pyriformis, Oligochaeta, Diaschiza, Monostyla lunaris, Canthocamptus, Latona, Bosmina, Acroperus, Alona affinis, A. guttata, Chydorus, Ostracoda, Trichoptera, Tipulidae* pupa, diatoms).
1	July 27, '23	4.4	X			99	Misc. 1 (*Chydorus, Amphipoda, Ulothrix zonata*).
7	Aug. 16, '23	1.2-3.4	10	1	6	70	Misc. 13 (*Centropyxis, Oligochaeta, Canthocamptus, Ilyocryptus, Alona affinis, A. quadrangularis, A. costata, A. rectangula, Chydorus, Alonella nana, A. excisa, Leydigia, Leptodora, Ostracoda, Hydracarina*, diatoms).
5	Aug. 27, '23	1.5-4.0	20	X	X	40	*Ostracoda* 18; *Hyalella* 7; Misc. 15 (*Canthocamptus, Sida, Bosmina, Camptocercus, Acroperus, Alona affinis, A. rectangula, Pleuroxus denticulatus, P. procurvatus, Chydorus, Alonella nana, A. excisa, Monospilus, Polyphemus, Mollusca, Hydracarina, Plecoptera* nymph, diatoms).
8	Sept. 11, '23	2.2-2.7	18		5	37	*Hyalella* 13; *Drepanothrix dentata* 10; Misc. 17 (*Cyphoderia, Oligochaeta, Distyla, Monostyla lunaris, Canthocamptus, Latona, Alona costata, Rhyncotalona, Pleuroxus denticulatus, Chydorus, Alonella nana, A. excisa, A. rostrata, Monospilus, Ostracoda, Trichoptera, Ulothrix*, diatoms).
Average 68		1.2-5.1	5	3	4	68	*Ostracoda* 2, *Hyalella* 2, Misc. 16.

IOWA DARTER, *Etheostoma iowæ*

No.	Date	L. cm.	*Hyalella*	*Ephemeridae*	*Trichoptera*	*Chironomidae*	*Sphaeriidae*	Miscellaneous
2	Sept. 11, '23	2.6	3		X	45		*Drepanothrix dentata* 15; *Acantholeberis curvirostris* 12; *Cyclops* 5; Misc. 20 (*Oligochaeta, Keratella cochlearis; Epischura, Canthocamptus, Sida, Daphnia longispina, Simocephalus, Bosmina, Acroperus, Chydorus, Alonella excisa, Ostracoda, Hydracarina*).
2	Sept. 11, '23	2.8	30	25	10	2		*Ostracoda* 23; Misc. 10 (*Diaptomus, Cyclops, Canthocamptus, Sida, Bosmina, Camptocercus macrurus, Acroperus, Alona guttata, Pleuroxus procurvatus, Alonella excisa*, snail, *Corixa*).
1	Sept. 11, '23	3.0		60				*Corixa* 20; Misc. 20 (*Oligochaeta, Cyclops, Canthocamptus, Simocephalus, Bosmina, Drepanothrix, Eurycercus, Alona affinis, Ostracoda*, diatoms).
2	July 12, '23	3.1			17	35	45	Misc. 3 (*Difflugia corona, Oligochaeta, Cyclops, Canthocamptus, Sida, Simocephalus, Eurycercus, Pleuroxus denticulatus, Ostracoda*, diatoms).
2	Aug. 1, '22	3.2	10	20		45		*Eurycercus* 20; Misc. 5 (*Cyclops, Sida, Ostracoda*, diatoms).
3	July 12, '23	3.3		8	25	55	10	Misc. 2 (*Oligochaeta, Cyclops, Corixa*, dipterous larva, diatoms).

IOWA DARTER—*Continued*

No.	Date	L cm.	*Hyalella*	*Ephemeridae*	*Trichoptera*	*Chironomidae*	*Sphaeriidae*	Miscellaneous
2	? '21	3.3	2	48	10	25		Misc. 15 (*Oligochaeta, Diaptomus, Cyclops, Canthocamptus, Sida, Daphnia longispina, Simocephalus, Pleuroxus denticulatus, Corixa*).
1	Aug. 1, '22	3.4				45	35	*Corixa* 10; Misc. 10 (*Oligochaeta, Cyclops, Canthocamptus, Simocephalus, Eurycercus*, snail).
1	July 12, '23	3.4		25	20	50		Misc. 5 (*Oligochaeta, Sida, Ilyocryptus acutifrons, Ostracoda*).
1	Aug. 1, '22	3.5	25			60	10	Misc. 5 (*Difflugia constricta, Centropyxis aculeata, Oligochaeta, Cyclops, Alona affinis, Chydorus, Acantholeberis curvirostris, Ilyocryptus*, diatoms).
1	July 12, '23	3.5		5	70	25		
1	Sept. 11, '23	3.6	50			20	30	
1	Aug. 1, '22	3.7	70			15		Misc. 15 (*Sida, Daphnia pulex*, snail).
2	July 12, '23	3.7	2		45	30	6	*Corixa* 15; Misc. 2 (*Oligochaeta, Cyclops, Sida*, snail).
2	Aug. 1, '22	3.8			25	30	45	*Oligochaeta, Cyclops, Acantholeberis, Eurycercus, Ostracoda.*
1	July 12, '23	4.0		4	60	35		Misc. 1 (*Oligochaeta, Cyclops, Latona*).
1	Aug. 1, '22	4.1	1					*Sida* 95; Misc. 4 (*Eurycercus, Acroperus, Corixa*)
1	Sept. 11, '23	4.2	50	50				*Daphnia.*
1	Sept. 11, '23	4.4	100					
Average 28		2.6-4.4	18	13	16	30	11	Misc. 12.

MILLER'S THUMB, *Cottus cognatus*

Only one specimen from the lake has been examined for food. It had eaten *Trichoptera* larvae and a beetle.

LAKE SCULPIN, *Triglopsis thompsoni*

No.	Date	L. cm.	*Pontoporeia*	*Chironomidae*	Miscellaneous
1	June 22, '22	5.0	100		
1	July 13, '22	6.7	50	50	*Trichoptera* pupa.
1	June 22, '22	7.0	75	20	*Mysis* 5.
1	July 13, '22	7.3		100	Small beetle.
1	" "	7.3		90	*Mysis* 10; small beetle.
1	" "	7.5	85	15	
1	" "	7.5	10	90	*Hemiptera, Trichoptera* pupa.
1	" "	7.6	60	40	*Ostracoda*, insect fragments, *Sphaerium.*
1	" "	7.8	55	42	Misc. 3 (*Ostracoda, Mysis*, insect fragments).
1	" "	8.1	100		*Diaphanosoma.*
1	" "	8.5	60	1	Fish eggs 35; *Mysis* 4.
1	" "	8.7	100		
Average 12		5.0-8.7	58	37	Misc. 5.

LING, *Lota maculosa*

No.	Date	L. in.	L. cm.	Ciscoes	Nine-spined Sticklebacks	Cottids	Fish Remains	*Mysis*	Miscellaneous
1	Aug. 30, '23	12⅞	29.2			3		30%	*Pontoporeia, Chironomidae* larva.
1	Aug. 10, '23	12¾	30.6					97	*Bosmina, Pontoporeia, Chironomidae* larvae, *Sphaerium.*
1	Aug. 30, '23	13⅝	31.1				X	95	*Bosmina, Leptodora, Pontoporeia, Chironomidae* larva.
1	Sept. 1, '23	13⅝	32.3					99	*Pontoporeia, Chironomidae* larva, snail.
1	Aug. 17, '23	13¾	32.4				X	95	*Pontoporeia, Chironomidae* larva, *Mollusca.*
1	Sept. 8, '23	13¾	32.8		1		4		1 trout perch.
1	July 19, '22	14¼	33.0		1		X		*Ephemeridae* nymphs 40%, (*Hexagenia bilineata*) *Chironomidae* larvae.
1	Aug. 18, '23	14⅜	33.3				X	80	*Ostracoda, Pontoporeia, Chironomidae* larva and pupa.
1	Aug. 28, '23	14½	33.3			1		20	*Pontoporeia* 15%.
1	Sept. 1, '23	14½	33.5					98	*Bosmina, Pontoporeia.*
1	July 21, '22	14½	34.0				X	70	*Chironomidae* larvae.
1	Aug. 30, '23	14½	34.1			1		75	*Pontoporeia.*
1	Aug. 16, '23	14⅝	34.3			1		X	
1	Aug. 21, '23	15	34.6				X	X	*Chironomidae* larva.
1	Aug. 3, '22	14¾	35.0				X	70	*Ephemeridae* nymphs 20% (*Hexagenia bilineata*).
1	Sept. 1, '23	14¾	35.3					90	*Pontoporeia* 10%.
1	Sept. 3, '23	16	36.4					98	*Pontoporeia* 2%.
1	Aug. 3, '22	16	36.5	1		1	X	50	*Pontoporeia, Ephemeridae* nymph (*Hexagenia bilineata*).

LING—*Continued*

No.	Date	L. in.	L. cm.	Ciscoes	Nine-spined Sticklebacks	Cottids	Fish Remains	*Mysis*	Miscellaneous
1	Aug. 30, '23	16⅛	36.6				X	20	
1	Aug. 16, '23	16¼	37.1			1	X		
1	Aug. 21, '23	16¼	37.6		1		X	50	
1	Aug. 30, '23	16¼	37.8				X	40	*Mollusca.*
1	June 29, '22	16⅜	38.0	5					
1	Sept. 1, '23	16¼	38.0				X	65	*Pontoporeia* 5%.
1	" "	16¼	38.0			1		38	*Pontoporeia* 2%.
1	" "	16¼	38.5					75	
1	June 22, '22	16½	39.0						*Ephemeridae* nymphs 100% (*Hexagenia bilineata*).
1	Aug. 30, '23	16½	39.5			2		2%	Pebbles.
1	Sept. 1, '23	16¾	39.6					98	*Pontoporeia* 2%.
1	Sept. 1, '23	16¾	40.0	1					
1	July 22, '22	16¾	40.4						*Ephemeridae* nymphs 100% (*Hexagenia bilineata*).
1	Aug. 23, '23	17½	40.3	1					
1	July 26, '22	17⅞	42.2			1			
1	Sept. 10, '23	18½	42.8				X	85	*Pontoporeia.*
1	Aug. 21, '23	18¾	43.1			1		90	*Pontoporeia, Chironomidae* larva and pupa.
1	Sept. 10, '23	19½		1	1		1		
1	Sept. 10, '23	19¾		1			X		
1	" "	20		2					
1	" "	20½						100	
1	" "	20½		1			2		
1	Sept. 5, '23	20¾				1		75	
1	" "	21¼		1			1		

LING—*Continued*

No.	Date	L. in.	L. cm.	Ciscoes	Nine-spined Sticklebacks	Cottids	Fish Remains	*Mysis*	Miscellaneous
1	Aug. 22, '23	21¼	46.7				X	50	
1	Sept. 5, '23	21½		1			1		
1	" "	21½						95	*Pontoporeia* 5%.
1	Sept. 10, '23	21½		1					
1	July 28, '22	21½	46.0	6					
1	Sept. 5, '23	21¾		1					
1	" "	21¾		4					
1	July 28, '22	22	47.0					100	
1	Aug. 22, '23	22	48.0	1			1	10	
1	Sept. 5, '23	22		2			2		
1	Sept. 10, '23	22		1				10	*Pontoporeia.*
1	Sept. 10, '23	22			1		X		
1	Aug. 2, '22	22¼	51.5			8			
1	Aug. 16, '23	22¼	52.5	1*					**Leucichthys hoyi.*
1	Sept. 5, '23	22½		2			3		
1	" "	22½		2			2		
1	" "	22½		1					
1	Sept. 10, '23	22½					X	X	
1	" "	22½						98%	*Pontoporeia, Chironomidae* larvae, *Cladophora.*
1	Aug. 28, '23	22½	52.5	1*	1		1		**L. artedi.*
1	" "	22½	53.0	1					
1	Aug. 16, '23	22¾	53.7	1			1		
2	Sept. 5, '23	22¾		1 each					
1	" "	22¾		3					
1	July 12, '22	22¾	54.0	3					
1	Aug. 30, '23	22⅞	54.2	1			X		

LING—*Continued*

No.	Date	L. in.	L. cm.	Ciscoes	Nine-spined Sticklebacks	Cottids	Fish Remains	*Mysis*	Miscellaneous
1	Aug. 17, '23	23	54.2	4					
1	Sept. 1, '23	23	54.5	4*		1			*One individual was *L. hoyi.*
3	Sept. 5, '23	23		1 each					
1	" "	23		1		1	1		
1	Sept. 3, '23	23		1			2		
1	Sept. 10, '23	23		2					
1	July 12, '22	23	55.0	2		20	X		
1	Aug. 3, '22	23	55.5	1					
2	Sept. 5, '23	23¼		1 each					
1	Sept. 10, '23	23¼		1			1		
1	Sept. 5, '23	23½		1			1		
1	Sept. 5, '23	23½		1			3		
2	" "	23½		1 each					
1	Sept. 3, '23	23½		3					
1	Sept. 10, '23	23½					1	X	
1	Sept. 5, '23	23¾		1					
1	Sept. 3, '23	24		3					
1	Sept. 10, '23	24		2					
1	Sept. 10, '23	24		3					
1	Sept. 5, '23	24¼						100%	
2	Sept. 3, '23	24½		1 each					
1	Sept. 10, '23	24½		1					
1	Sept. 10, '23	24¾		2	3				
1	Sept. 5, '23	24⅝		2			3		
1	Sept. 3, '23	25		2					
1	Sept. 10, '23	25		2	1				
1	Sept. 5, '23	26		1					

LING—*Continued*

No.	Date	L. in.	L. cm.	Ciscoes	Nine-spined Sticklebacks	Cottids	Fish Remains	*Mysis*	Miscellaneous
1	Sept. 10, '23	26					X	25	
1	July 12, '22	21-26	50-60	2		1			
1	"	21-26	50-60	1		2	3		
2	"	21-26	50-60			1 each			
1	"	21-26	50-60	5			X		
1	"	21-26	50-60			8			
1	"	21-26	50-60			1	3		
1	"	21-26	50-60	3		1			
1	"	21-26	50-60	1			3		
1	"	21-26	50-60	1		2	5		
1	"	21-26	50-60	3					
1	July 12, '22	21-26	50-60	11		17	7		
1	"	21-26	50-60	1			5		
1	"	21-26	50-60	1		6			
1	"	21-26	50-60	6			X		
1	"	21-26	50-60	7		1	3		
6	"	21-26	50-60	1 each					
5	"	21-26	50-60	2 each					
3	"	21-26	50-60	4 each					
1	Sept. 5, '23	26½						100%	
1	Sept. 3, '23	27		1					
1	"	30½	70.5	5					
1	July 12, '22	32	75.0	1					

31 specimens taken during the summers of 1922 and 1923, ranging in size from 14½ in. (33.3 cm.) to 26¾ in. (61.5 m.) each contained the remains of one or more fish which could not be definitely identified.

THE FOOD MATERIALS

It is apparent from a study of the foregoing tables that *Chironomidae* (midges) form the most important fish food item in Lake Nipigon. They are fed upon by every species of fish except the older piscivorous fishes (lake trout, brook trout, pike, pike perch, and sauger), often to the extent of 90% of the stomach contents. Their almost universal occurrence in the lake, their fairly small size, and their immense numbers have made them the chief fish food crop, forming nearly 25% of the food of the fish other than the piscivorous species mentioned above. For sturgeon they form about 10% of the food; for common whitefish about 28%; for northern sucker approximately 15%; for common sucker approximately 25%. It is the larvae which are usually eaten, but small percentages of pupae and occasionally adults occur. There is no doubt that *Chironomidae* larvae, largely because of their abundance and small size, constitute the most important single food item of practically all young fish following the plankton-eating stage.

The *Ephemeridae* (mayflies) also form an important food supply. They are largely taken as nymphs on the bottom by bottom-feeding fish or picked off aquatic vegetation by the smaller vegetation-inhabiting species, such as yellow perch. Calculation of percentages for the same number of fish and species as for the *Chironomidae* show that they constitute about 10% of the total. However, for some fish they are extremely important. For example, they rank first in the food of sturgeon, averaging 35% of the food of 70 individuals examined. For the larger common suckers they constitute about 20%; for the common whitefish 5%; for yellow perch 30%. At the time of emergence of the subimagos of the large burrowing species *Hexagenia bilineata*, the alimentary tracts of pike perch and saugers may be filled with its nymphs. For example, of the 76 saugers examined, the nymphs and subimagos of *Hexagenia* constituted 63% of the food, and in 42 individuals no other food material was present.

As compared with the *Chironomidae* and *Ephemeridae*, the *Mollusca* (snails and small clams) form 7% of the food of the same species of fish. For sturgeon they constitute approximately 20% of the food; for the larger common suckers 20%; for the common whitefish 14%. The *Mollusca* taken belong chiefly to the species of snails of the genera *Amnicola*, *Valvata*, and two species of the genus *Planorbis*, and the small clams of the genera *Pisidium* and *Sphaerium*.

Trichoptera (caddis) larvae and, to a slight extent, pupae occur commonly in the food of fish feeding in fairly shallow water. Of the food of sturgeon they form approximately 10%; of larger common suckers 8%; of some of the smaller fish, such as minnows, sticklebacks, and darters, as high as 15%; and they form the bulk of the food of the round whitefish, constituting approximately 55%.

Pontoporeia hoyi forms the chief support of deep-water bottom-feeding fish. This fact is illustrated by the following average percentages: larger northern suckers, 66%; larger common suckers, 13%; larger common whitefish, 31%. The economic value of *Pontoporeia hoyi* thus lies chiefly in its contribution to the food of the common whitefish.

The *Oligochaeta* (bristle worms) have been shown by Adamstone (1923, 1924) to be very abundant in the bottom ooze, especially in the deeper water, having a distribution somewhat similar to *Pontoporeia hoyi*. Their podal spines appear among the stomach contents of a great many bottom-feeding fish. It is apparent that the worms disintegrate very soon after being eaten, and hence it is impossible to arrive at any estimate of the percentage they form in the food. There is little doubt that the amount is considerable, and that they may be regarded as an important source of fish food.

Mysis relicta, swimming freely in the depths of the lakes, forms the chief food of the ciscoes. In many instances it is the only organism present in the alimentary tracts. Its associate, *Limnocalanus macrurus*, occurs abundantly, and these two forms constitute practically the entire food of the larger ciscoes. *Mysis* also enters into the food of the common whitefish, and of the ling to a considerable extent.

The animals of the plankton form a very high proportion of the food of young fish and of many of intermediate size. There is every indication that the first food of the young of all species of fish is the plankton, especially the zooplankton. If further investigation shows this to be true, it follows that the productivity of the lake is correlated directly with the abundance of plankton, especially that of the shallower water.

THE FOOD OF THE VARIOUS SPECIES OF FISH

1. *Sturgeon:* As shown by Clemens *et al.* (1923), and more particularly by Harkness (1924), the sturgeon is a bottom-feeder subsisting chiefly upon *Ephemeridae* nymphs, *Mollusca*, *Trichoptera* larvae and *Chironomidae* larvae. Since it inhabits comparatively shallow water, it does not thus enter into serious competition with other commercially important fish. In view of the relatively large size attained by this species, and the large amount of food consumed, it would appear that, for a body of water to be highly productive of sturgeon, there must be large areas of rather shallow water and of such a character as to support large populations of bottom organisms.

2. *Northern Sucker:* It is apparent that young northern suckers inhabit shallow water and feed to a large extent upon *algae* such as filamentous forms and diatoms to which is added considerable amounts of plankton organisms and insect larvae, especially *Chironomidae* larvae. When they reach a length of about 20 cm. (9 in.) they move outward into deeper water, and the predominant food organism is *Pontoporeia hoyi*, which often forms 90% of the food. Of thirty-five specimens over 20 cm. in length, whose stomachs were examined, two-thirds of the food on the average was made up of *Pontoporeia*. In view of the fact that large amounts of materials are always found in the alimentary tracts and that these fish occur in large numbers in the lake, it is evident that they must consume relatively enormous amounts of the stock food stuffs. They are not marketed

at the present time and are only occasionally eaten by other fish, so do not appear to be an economic asset in the lake. Considerable numbers are removed by the commercial fishermen, but not to such an extent as to bring about an appreciable reduction.

3. *Common Sucker:* Bigelow (1924) has shown that young suckers up to 5.0 cm. in length are plankton feeders. The data given in this paper show that as they grow they add more and more of the larger bottom organisms, *Chironomidae* larvae forming a considerable proportion of the food of specimens between 5 and 20 cm. in length. Later considerable amounts of *Ephemeridae* nymphs, *Trichoptera* (caddis) larvae, *Mollusca*, and to some extent *Pontoporeia* are taken. *Algae*, especially diatoms, and bottom-haunting plankton organisms continue to form considerable proportions of the diet throughout life. The common sucker does not commonly inhabit the deeper water, and so is not as serious a competitor of the common whitefish as is the northern sucker, although it must to a considerable extent enter into competition with the young whitefish. It is, moreover, an important competitor of the sturgeon. It is very abundant in the lake, is not taken commonly by the fishermen, is only occasionally eaten by the other fish, and its numbers appear to be limited only by physical conditions and food supply. From an economic point of view, a great reduction in numbers would be very desirable.

4. *Lake red horse:* The information concerning the food of this fish is very limited, since only four specimens, all from one locality, were examined. They appear to be limited in distribution and numbers, and from the data at hand appear to consume much the same food materials as the sturgeon.

5. *Minnows:* Of the minnows, only a few specimens of lake chub, long-nosed dace, and lake shiner have been examined, but these show a decided tendency toward an insectivorous diet. Of the spot-tailed minnow, which is a much commoner species in the lake, a larger series has been examined, and it is shown to be more of a plankton feeder,

although in some cases its food consists almost entirely of insects, aquatic and terrestrial. The individuals have been grouped in the tables according to locality and date, since these factors, and not the size of the fish, appeared to determine the kind of food taken. The only fish definitely found to have fed upon minnows is the pike, two individuals of which had eaten spot-tailed minnows. It is impossible to state whether or not the small numbers of minnows affect the commercial productivity of the lake. The only fish of value as far as Lake Nipigon is concerned that might be definitely affected would appear to be the pike perch, which inhabits fairly shallow water and consumes considerable numbers of nine-spined sticklebacks. If the sauger were marketed, the case would probably be similar in respect to it. Speckled trout and lake trout might be affected to a limited extent, but in general their habitats do not correspond.

6. *Speckled trout:* With the exception of the first fish listed all the specimens were taken in a trap-net set in a creek, a short distance from its mouth. The records, therefore, do not give an adequate idea of the food taken by the trout when in the lake proper. The ciscoes and nine-spined sticklebacks were doubtless obtained in the lake, and it is quite possible that some of the invertebrates were taken there as well. From what is known of the food of trout in other bodies of water, there is little doubt that its food in Lake Nipigon consists chiefly of fish and aquatic and terrestrial insects.

7. *Lake trout:* No specimens of less than 20 cm. (9½ in.) long were examined, but from this length upward it is evident that the bulk of the food consists of ciscoes. Other forms appear incidentally. It is interesting to note that, of the fish identified in the stomachs, in only one case were whitefish found. This is doubtless the normal condition. The explanation probably lies in the fact that the whitefish habitat is a bottom one, while the cisco and lake trout habitat is much less so. The lake trout would seem to show a definite food preference, however, for ciscoes in that all three species occur together to some extent as shown by the

fact that they are all taken abundantly in gill nets set on the bottom. Lake trout production therefore appears to be correlated with abundance of ciscoes and does not appear to be antagonistic to any extent to whitefish production where ciscoes occur in large numbers.

8. *Round Whitefish:* This fish is a bottom-feeder, and shows a decided preference for *Trichoptera* larvae. This is probably partly the result of a coincidence in habitat, the round whitefish being a relatively shallow water species. However, it would seem that some species of fish have definite food preferences as in this case, and also in the cases of the lake trout for ciscoes, ling for ciscoes, brook trout for insects, etc. The round whitefish does not reach a size to be taken in commercial gill nets, and does not occur in sufficient numbers to be a serious factor in food competition with commercial species.

9. *Common Whitefish:* Young whitefish are plankton-feeders, but very early become bottom-feeders. The chief food materials of the larger fish are *Pontoporeia hoyi* and *Chironomidae* larvae, with *Mollusca* and *Ephemeridae* nymphs ranking next in importance. The kinds of food materials and the proportions of the various constituents vary enormously due to the great range in depth at which the fish is taken, namely, from 2 to over 300 feet. The typical depth for the larger fish appears to be between 50 and 150 feet where occur larger quantities of *Pontoporeia* and *Chironomidae* larvae. At this depth they meet with little competition except from northern suckers. The common whitefish is the chief commercial fish of Lake Nipigon, the average annual catch for the years 1918-1923 being 1,146,904 lbs. dressed weight. The amount of food organisms on the bottom of the lake producing such an annual whitefish crop is thus enormous.

10. *Ciscoes:* Six species occur in Lake Nipigon, but no attempt has been made to determine any differences in their food. The ciscoes are pre-eminently animal plankton feeders. The smaller fish feeding inshore may take considerable quantities of insect larvae, but the larger fish of the open

water feed chiefly upon *Mysis relicta*. *Limnocalanus macrurus* is usually associated with *Mysis*, but in much smaller quantities. *Daphnia* and other plankton animals are eaten extensively when the ciscoes inhabit the shallower bays. Ciscoes thus enter into food competition with no other fish except to some extent with the ling, which, however, is not at the present time considered of value but rather of detriment. Of the ciscoes only the larger blackfins and tullibees are taken in the commercial gill nets ($4\frac{1}{2}$ inch mesh) and marketed, and the quantity is relatively small. However, they support a large population of lake trout, and thus are extremely valuable inhabitants of the lake.

11. *Pike:* Although a considerable number of stomachs were examined, only 23 of these contained food materials. It is quite evident that this fish is the most voracious species inhabiting the lake. Ten species of fish were found in the stomachs, a greater variety than was found in any of the other piscivorous species. One specimen had eaten a mole shrew. Relatively small numbers of pike are taken in the commercial gill nets and marketed, but the annual catch has been increasing due to the development of a market demand and this circumstance will no doubt tend to keep the numbers within reasonable limits.

12. *Sticklebacks:* There appears to be no fundamental difference in the food of the two species occurring in Lake Nipigon. Practically the same materials are taken, but some items that make up a large proportion of the food of one species appear to form a minor element in the food of the other, no doubt because of the difference in the habits of the two fish. On the other hand, such a staple food material as *Chironomidae* larvae bulks large in the food of both. Thus the food of the two species in the order of the importance of the different items would appear to be as follows:—nine-spined stickleback: *Bosmina*, *Chironomidae* larvae, *Cyclops*, *Epischura*, *Diaptomus*, *Eurycercus*, *Chydorus*, fish eggs, *Ephemeridae* nymphs, *Trichoptera* larvae, *Sida*, *Ostracoda*; brook stickleback: *Chironomidae* larvae, *Ostracoda*, *Eurycercus*, *Trichoptera* larvae, *Sida*, *Corixa*, *Epheme-*

ridae nymphs, *Cyclops*, *Chydorus*, *Bosmina*, *Diaptomus*, *Epischura*, fish eggs.

13. *Trout Perch:* The nine specimens here reported upon were taken in the lake proper, while the twenty-three reported on in 1923 were taken in a river near its mouth. The results are essentially the same in both cases, showing that the trout perch is a bottom-feeder taking chiefly insect larvae (*Chironomidae*, *Ephemeridae*, *Trichoptera*), and *Amphipoda* (both *Hyalella* and *Pontoporeia*). It is eaten to a slight extent by lake trout, brook trout, and sauger.

14. *Small-mouthed Black Bass:* Only small specimens have been taken and only nine individuals ranging in size from 2.6 to 3.4 cm. have been examined. The results show that they very early take to a piscivorous diet. Parent black bass were planted in Orient Bay in 1920 and some, at least, have maintained themselves and are reproducing, since young were taken in seine hauls in 1921 and 1923, and one or more adults have been caught by trolling. As regards the food supply, plankton animals are abundant, but enormous quantities are consumed by the very large numbers of small yellow perch, young suckers, darters, etc., occurring there. If the black bass feed upon the yellow perch and suckers and reduce their numbers somewhat, they should succeed in the locality, providing the physical conditions are suitable.

15. *Pike Perch (Yellow Pickerel):* This species ranks third in commercial importance, being greatly exceeded by whitefish and lake trout in poundage taken. As with all young fish studied, it is first planktonivorous. Later it becomes piscivorous and insectivorous. Individuals living inshore feed upon sticklebacks, cottids, and *Ephemeridae* nymphs, while those from the deeper water feed largely upon ciscoes.

16. *Sauger:* This fish is of rare occurrence in the southern end of the lake, but is very abundant in the northern portion. The specimens examined were taken during two trips to the northern end of the lake, so that the record does not cover an extended area or period of time. The period July 26-28 was marked by the emergence of large numbers of *Ephemeridae*

and the saugers were feeding extensively upon the mature nymphs. Further data would probably show that the food of the sauger is much the same as that of the pike perch.

17. *Yellow Perch:* A special study has been made of the food of the yellow perch in connection with the study of shallow water plankton. It was early evident in this study of the food of fish that the plankton of the open water was of direct importance only to the ciscoes and ling, and possibly to some extent to the young of lake trout, which have not been located as yet in the lake. On the other hand, plankton of the shallow water forms the food of the young of practically all the other species of fish. A special study has been made of this shallow water plankton, and in conjunction with it collections of small yellow perch have been made in order that the plankton collections of the fish might be compared with the net collections.

An examination of the fish stomach data shows that up to a length of 4.0 cm. the yellow perch is largely a plankton feeder, although some individuals as small as 2.5 cm. sometimes feed upon fish. Between the lengths of 4 and 8 cm. the percentages of fish and insects in the diet increase rapidly and beyond 8 cm. plankton organisms become negligible. In the lower end of Orient bay small yellow perch occur in large numbers, but the largest taken was only 13.5 cm. ($6\frac{1}{2}$ in.). It is probably a case of overpopulation in relation to food supply.

18. *Darters:* Both species of darters are bottom-feeders. It would appear that the tessellated darter shows a definite preference for *Chironomidae* larvae, whereas the Iowa darter consumes less amounts of *Chironomidae* larvae, but greater quantities of *Hyalella*, *Ephemeridae*, *Trichoptera*, and *Mollusca*. The difference is possibly correlated with difference in habitats. Both feed to a considerable extent upon small bottom organisms.

19. *Log Perch:* The few specimens of log perch examined had obtained their food from the bottom. The food is largely *Chironomidae*, *Ephemeridae*, and bottom plankton organisms.

20. *Cottids:* The data for these fish are very limited,

but it is quite apparent that they are bottom-feeders. The specimens of *Triglopsis* were all obtained from the stomachs of ling taken in commercial gill nets.

21. *Ling:* No specimens less than 12 inches in length were examined, so that the statements following apply to fish above that length. The two outstanding elements in the food are ciscoes and *Mysis relicta*, and these generally occur together in the stomachs. *Mysis* forms the bulk of the food for the fish from 12 to 22 inches; thereafter ciscoes become the dominant element, although individuals up to a length of 26½ inches may feed entirely upon *Mysis*. The Lake Sculpin (*Triglopsis thompsoni*) is commonly found in the stomachs of specimens of all sizes. It is interesting to note that the ling obtains a small proportion of its food from the bottom of the lake in the form of *Pontoporeia*, *Ephemeridae* nymphs, *Chironomidae* larvae and *Mollusca*

The ling is thus a competitor of the cisco for food as well as being predaceous upon it, and is a competitor of the lake trout, directly and indirectly. It is also a competitor of the pike perch. In view of the large numbers of ling in the lake, there is little doubt that this competition is serious and that reduction in numbers of ling would mean increase in numbers of lake trout.

The diagram on page 161 is an attempt to express the inter-food relationships as they occur in Lake Nipigon, based upon the studies carried out during the summer months only, of three successive years. The basis of the food supply is the plant materials consisting of microscopic floating plants, especially diatoms, higher filamentous *algae* such as *Ulothrix*, *Cladophora*, *Spirogyra*, *Mougeotia*, *Chara*, etc., and higher aquatic vegetation as *Potamogeton*, *Myriophyllum*, *Ceratophyllum*, *Elodea*.

These plants, however, are not fed upon directly to any extent by the species of fish occurring in Lake Nipigon, except in the case of young suckers, which have been found to eat considerable quantities of diatoms and *Ulothrix*, but they are turned over into animal material by being eaten by small animals which in turn are fed upon by fish. Several

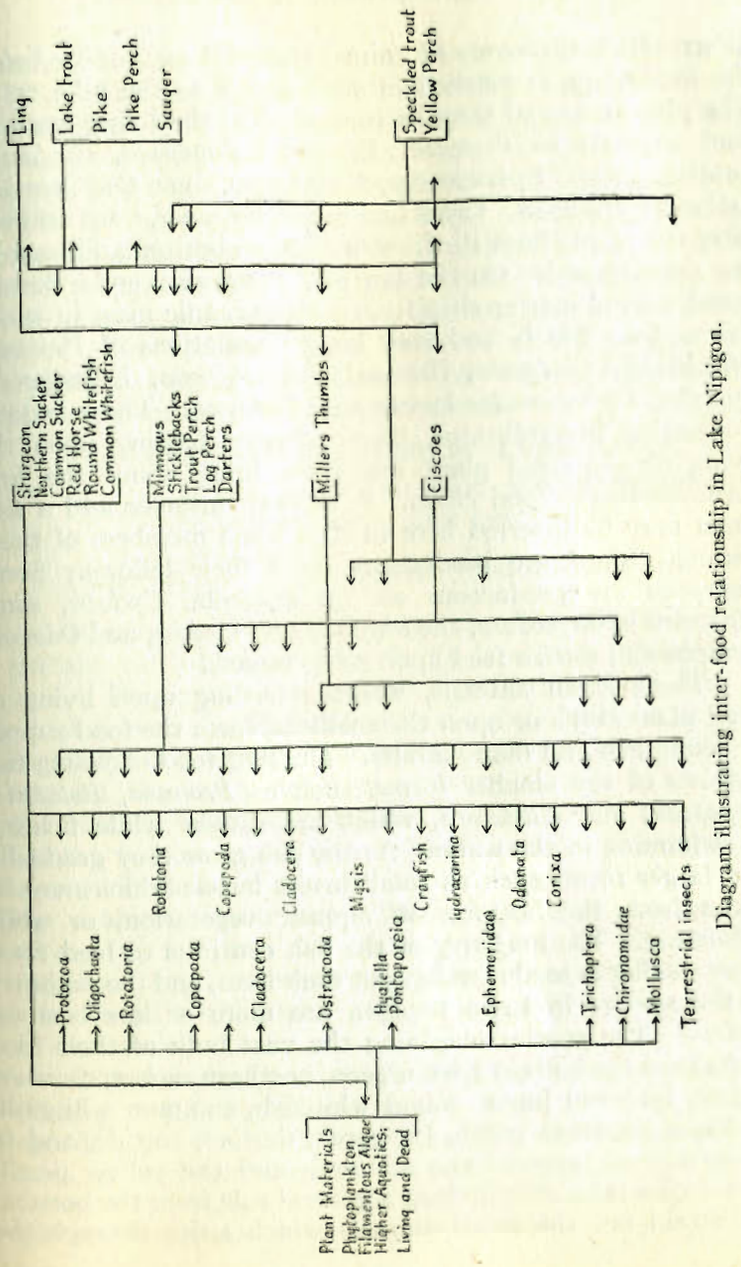

Diagram illustrating inter-food relationship in Lake Nipigon.

intermediate turnovers of animal material may occur before the final stage is reached in such a fish as the lake trout. The plant material may be consumed in the living state by such animals as *Protozoa*, *Rotatoria*, *Copepoda*, *Cladocera*, *Ostracoda*, some *Ephemeridae*, *Trichoptera*, some *Chironomidae* and some *Mollusca*. Great quantities, however, are consumed after the plants have died, settled to the bottom and more or less decomposed. On the bottom, along with some decomposed animal matter they form a rich organic mass in which live and on which feed very large populations of *Protozoa*, *Oligochaeta*, *Cladocera*, *Ostracoda*, *Amphipoda*, *Ephemeridae* nymphs, *Chironomidae* larvae and *Mollusca*. These vegetation-eating invertebrates, then, whether feeding upon the living or the dead plant materials, bring about the first turnover in the food chain. A second turnover and a side chain may be inserted here in that some members of these various groups are predaceous upon their fellows. Some *Copepoda* are predaceous as, for example, *Cyclops*, some *Cladocera* as *Leptodora*, the crayfish eats insects, and *Odonata* nymphs and *Corixa* feed upon other insects.

These small animals, whether feeding upon living or dead plant stuffs or upon their fellows, form the food supply of young fish and many adults. The first food of young fish consists of the smaller forms, such as *Protozoa*, *Rotatoria*, *Copepoda*, and *Cladocera*, which are caught while floating or swimming in the water. As the fish grow they gradually add larger forms such as small insect larvae which may be taken from the bottom, off aquatic vegetation, or while swimming. The majority of the fish continue to feed upon these smaller animals throughout their lives, and the majority of the species in Lake Nipigon are more or less bottom-feeders. The species obtaining the vast bulk of their food stuffs from the bottom are sturgeon, northern sucker, common sucker, lake red horse, round whitefish, common whitefish, sticklebacks, trout perch, log perch, darters, cottids, and to a less extent some of the minnows and the yellow perch. The ciscoes take very little as a general rule from the bottom, but strain out the small animals which swim through the

water, such as *Copepoda*, some *Cladocera*, and *Mysis relicta*. The ciscoes remain plankton-feeders throughout their lives. A number of fish become piscivorous or partly so, such as pike, pike perch, saugers, lake trout, speckled trout, yellow perch, and ling. Of these the pike and the lake trout appear to be the most predaceous, the former capturing practically any fish that happens to come its way, while the latter feeds chiefly upon ciscoes. Pike perch, saugers, and yellow perch add considerable amounts of bottom insects to their fish diets. The speckled trout feeds to a large extent upon aquatic and terrestrial insects. The ling is peculiar in being planktonivorous as well as piscivorous.

The following are two examples of food chains:

Plants—{*Ephemeridae* / *Chironomidae*} — Nine-spined stickleback — pike perch—pike.

Plants—{*Copepoda* / *Cladocera*}—*Mysis*—ciscoes—lake trout.

It may be pointed out here that the lake receives important contributions towards its food resources from the land. The streams carry down materials from the land which add to the fertility of the marginal lake soil as well as enriching the supply of dissolved mineral salts, etc. The streams also carry down plant materials which are spread out over the bottom of the lake and ultimately become food for the bottom organisms. Finally terrestrial insects form a very decided addition to the food supply of fish. During the summer season large numbers of bugs, beetles, flies, ants, etc., fall into the water and are readily eaten by speckled trout, common whitefish, ciscoes, minnows, and nine-spined sticklebacks, and occasionally by a number of other species.

The complexity of the food chain makes the problems relating to production and control of the food supply correspondingly difficult. The results of this study should at least serve to emphasize the importance of paying greater attention to the crops of food stuffs for fish and the necessity for their protection and conservation.

There is little likelihood of destructive or killing pollutions being poured into Lake Nipigon in the near future, but there is a danger that wastes from sawmills, particularly sawdust, may be introduced. Fishermen and others interested in the fishing industry should see that any such introduction be prohibited in view of the fact that the sawdust may smother the bottom food stuffs.

From the monetary standpoint there are some species of fish in Lake Nipigon which at the present time at least are of little value directly or in the general economy of the lake, to judge from the data at hand. These are northern sucker, common sucker, lake red horse, round whitefish, ling, sauger, yellow perch. The northern sucker, the common sucker, and the ling are the most serious in view of their occurrence in large numbers. The first two consume very large quantities of bottom food stuffs and thus enter into direct competition with two of the most important commercial fish in the lake, namely, sturgeon and whitefish, while the ling competes with the lake trout for food, directly and indirectly. A great reduction in the numbers of these fish in the lake would seem to be desirable in the interests of the conservation of the staple food materials of species of commercial importance.

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