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ABSTRACT

Food-habits data were collected from 102 yellow perch, *Perca flavescens,* in West Long Lake, Nebraska, from April to October, 2001, to determine if food habits changed seasonally in this shallow, vegetated, natural lake. Based on percent by number and weight, yellow perch in all length groups and during all seasons primarily consumed macro-invertebrates. Yellow perch < 130 mm in total length fed primarily on amphipods and chironomids in all months except October. For perch between 130 and 199 mm, amphipods and chironomids composed greater than 60% of the diet by weight in all months except August. Yellow perch ≥ 200 mm primarily consumed macro-invertebrates with fish contributing less than 6% of the diet by weight during all months except June. Knowledge of the trophic ecology of yellow perch in these lentic systems should help biologists better understand the role of perch as both predator and prey.

† † †

The yellow perch, *Perca flavescens* (Fig.1), is a popular sport fish in Nebraska Sandhills lakes. While yellow perch can serve as a primary prey for predators (Paukert et al. 2002), they can also be a predator of bluegill, *Lepomis macrochirus* (Fullhart et al. 2002; Reed and Parsons 1996; Schneider and Breck 1997). Food habits of yellow perch have varied from zooplankton to macro-invertebrates to fish (Clady 1974; Laarman and Schneider 1972; Lott et al. 1996; Schneider 1972; Wolfgang and Mackay 1992). However, little information exists on the seasonal diets of yellow perch in Nebraska Sandhills lakes. Thus, the objective of this study was to describe food habits of small (< 130 mm), medium (130–199 mm), and large (≥ 200 mm) yellow perch in West Long Lake, Nebraska.

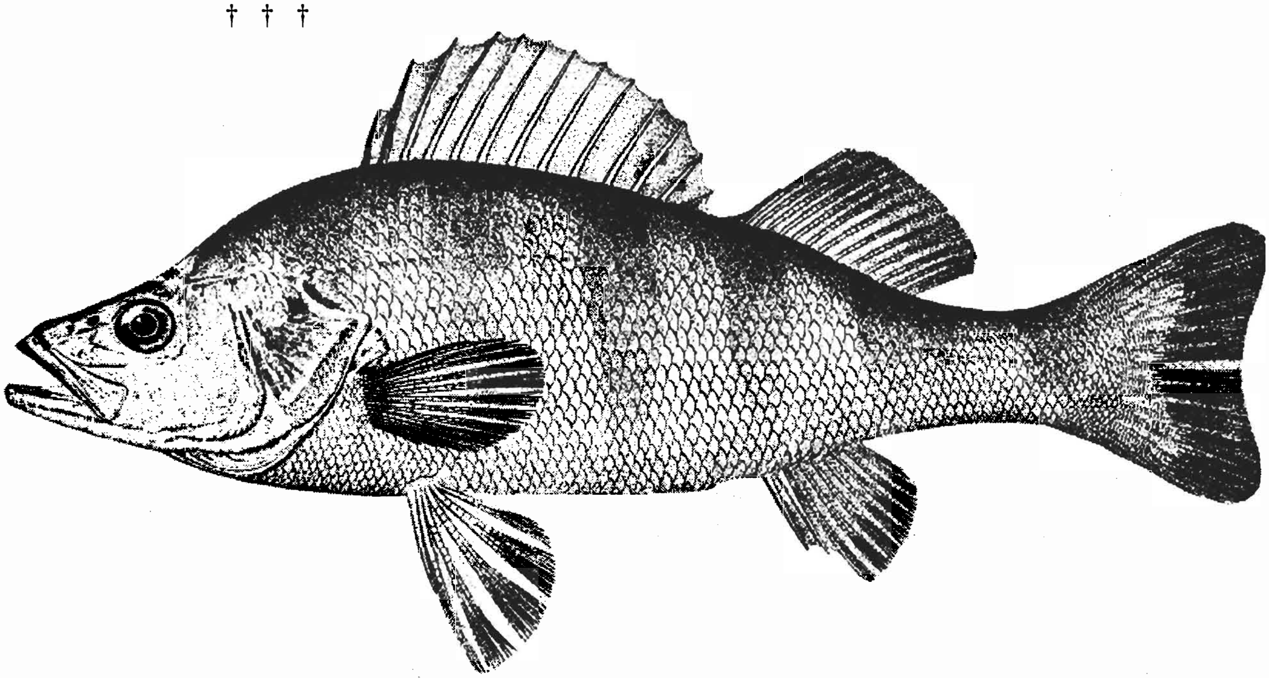

Figure 1. Yellow perch, *Perca flavescens*, about life size, after a drawing by H. L. Todd from Goode (1884-87) obtained from National Oceanic and Atmospheric Administration/Department of Commerce website.

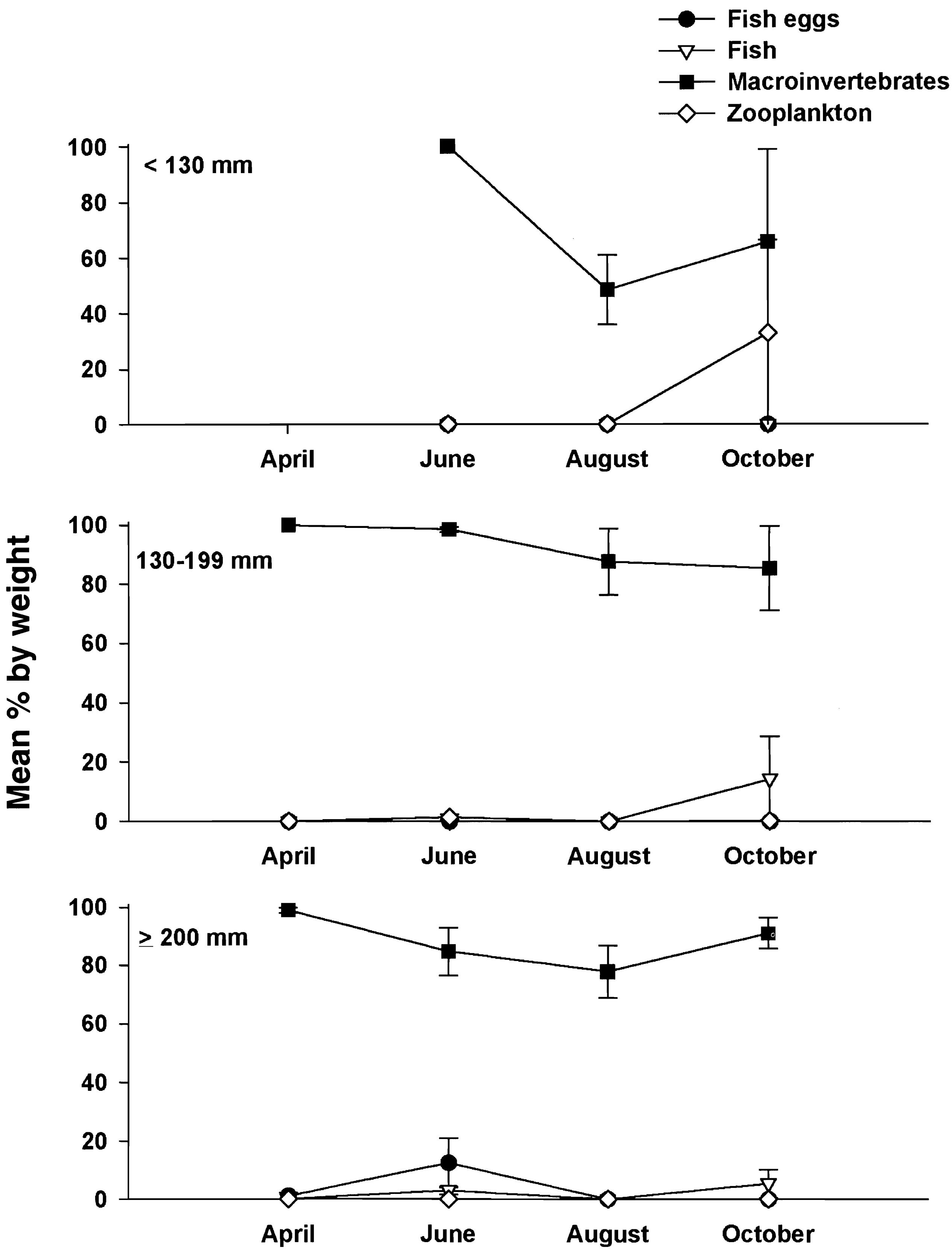

Figure 2. Food habits by season and length group for yellow perch sampled from West Long Lake, Nebraska, in 2001. Vertical bars represent ± 1 *SE*. Percentages do not always add to 100 because unidentifiable remains and plant material were excluded from these data.

STUDY SITE

West Long Lake is a 25-ha natural lake located on the Valentine National Wildlife Refuge in Cherry County, Nebraska. Mean depth of West Long Lake is 1.2 m, with a maximum depth of 1.8 m. Submergent vegetation covers approximately 80% of the lake surface during mid-summer. Grasslands completely surround the lake and there are no crops within its watershed (McCarraher 1977).

Yellow perch are common in West Long Lake. Other species present include bluegill; largemouth bass, *Micropterus salmoides*; black bullhead, *Ameiurus melas*; and the recently established northern pike, *Esox lucius*, which was first documented in 1998 (Paukert and Willis 2000).

MATERIALS AND METHODS

West Long Lake was sampled by nighttime electrofishing (pulsed DC) in April, June, August, and October of 2001. We collected yellow perch throughout the lake, with a goal to collect seven yellow perch per total length group (< 130 mm, 130–199 mm, ≥ 200 mm) each month.

Yellow perch collected by electrofishing were weighed and measured, and food items were removed using an acrylic tube (White 1930). The tube was inserted through the esophagus to the posterior end of the stomach. Visual inspection was made by looking through the tube to see if all food items had been removed (Dubets 1954). Some yellow perch < 130 mm were preserved in 10% formalin and brought back to the laboratory for dissection and removal of the stomach.

In the field, stomach contents were stored in a plastic bag and preserved in 10% formalin. In the laboratory, stomach contents were retained by a 100-µm sieve while water was used to rinse off formalin. Stomach contents were then examined under a dissecting microscope. Stomachs from preserved yellow perch were separated from the digestive tract and the contents were flushed into a petri dish. Aquatic invertebrates were identified to family or order using keys by Merritt and Cummins (1984) and Pennak (1989). Fish were identified using keys developed by Cross and Collins (1995). Prey items that could be distinguished as fish or insects but could not be identified further were labeled as unidentifiable fish remains (UFR) and unidentifiable insect remains (UIR), respectively. Remains that could not be identified as fish, macro-invertebrate, or plant items, were labeled unidentified remains (UR). Frequency of occurrence (number of fish where a specific taxon was present in stomach divided by total number of fish in length group), percent by number (number of taxa divided by total number of food items present in each stomach), and percent by weight (weight of specific taxon divided by total weight of stomach contents in each stomach) were used to describe diets. Zooplankton weights were calculated using weight-length regressions obtained from Dumont et al. (1975). In the laboratory, macro-invertebrates and fish and were weighed to nearest 0.01 g using a digital scale.

RESULTS

Stomach contents were assessed for 102 yellow perch in West Long Lake from April to October of 2001. Based on percent by weight, yellow perch in all length groups primarily consumed macro-invertebrates during all seasons (Fig. 2). Zooplankton were a minor dietary component, while fishes were rarely consumed.

Macro-invertebrates composed the majority of the stomach contents for yellow perch < 130 mm, with cladocerans, unidentifiable remains, and plant material appearing in August and October (Table 1). Chironomids and amphipods dominated (% by number) the stomach contents of yellow perch in this length group, ranging from 64% of the diet in October to 93% in June. Unidentifiable remains (UR) made up the majority (% by weight) of stomach contents in August. Cladocerans composed approximately 33% (by number and by weight) of the stomach contents during October for yellow perch <130 mm.

Although amphipods dominated the diets of 130–199 mm yellow perch in three of the four samples (Table 2), a greater variety of prey taxa appeared in their diets compared to yellow perch < 130 mm. In April, only three prey taxa appeared in the diets of 130–199 mm yellow perch, with amphipods composing 84.6% of the diets by weight. In June, amphipods dominated the diets at nearly 89% by weight, with cladocerans composing 12% of the stomach contents by number but only 1.5% by weight. Chironomids and molluscs dominated the diets in similar proportions by weight during August. In October, amphipods composed greater than 50% by weight of the diet, with fish and chironomids making up an additional 23% by weight. The lone stomach containing fish involved a single bluegill weighing 1.9 g.

Macro-invertebrates again dominated the diets of yellow perch ≥ 200 mm in all seasons (Table 3), with a continuing trend of greater prey diversity with increasing perch length. Chironomids and amphipods were primary prey items in June and October. Amphipods composed greater than 85% of the diets by number and weight during April. In August, hemipterans, mol-

Table 1. Frequency of occurrence (FOC), mean percent by number, and mean percent by weight for prey items eaten by yellow perch < 130 mm total length during 2001 at West Long Lake. *N* represents number of fish sampled; *SE* = standard error of the mean; UR = unidentifiable remains; UIR = unidentifiable insect remains. No small (< 130 mm) yellow perch were collected during April, 2001.

Month	*N*	Prey item	FOC	% by number	*SE*	% by weight	*SE*
June	1	Chironomidae	100.0	6.7	6.7	4.3	4.3
		Ephemeroptera	100.0	6.7	6.7	2.9	2.9
		Amphipoda	100.0	86.7	86.7	92.8	92.8
August	5	Chironomidae	100.0	25.4	11.4	7.6	5.4
		Zygoptera	40.0	9.0	6.7	3.0	2.6
		Trichoptera	20.0	0.6	0.6	0.6	0.6
		Ephemeroptera	80.0	7.4	3.9	3.4	2.8
		Mollusca	20.0	2.8	2.8	6.6	6.6
		Amphipoda	100.0	54.6	7.7	27.3	10.1
		Cladocera	20.0	0.3	0.3	0.01	0.01
		UR	100.0	.	.	51.4	51.4
October	3	Chironomidae	33.3	28.0	28.0	31.6	31.6
		Trichoptera	33.3	1.3	1.3	0.2	0.2
		Amphipoda	66.7	36.0	32.1	34.1	33.0
		Cladocera	33.3	33.3	33.3	33.3	33.3
		UIR	33.3	1.3	1.3	0.2	0.2
		Plant material	33.3	.	.	0.5	0.5

luscs, chironomids, and ephemeropterans together composed 69% of the stomach contents by weight. Molluscs were the dominant diet item by weight, followed by plant material that likely was ingested as yellow perch fed on gastropods.

DISCUSSION

Yellow perch apparently exhibit differential roles in various fish communities. For example, yellow perch predation on small bluegills may positively influence bluegill growth and size structure in Minnesota lakes with complex fish communities (Anderson and Schupp 1986; Fullhart et al. 2002; Reed and Parsons 1996). In contrast, yellow perch in eastern South Dakota lakes fed almost exclusively on zooplankton and macro-invertebrates rather than on fishes, even when perch exceeded 200 mm in length (Lott et al. 1996). In our study, yellow perch in West Long Lake primarily fed on macro-invertebrates. We found few fishes in yellow perch stomachs, which confirms speculation by Paukert et al. (2002), who found no evidence of an inverse relationship between abundance of bluegill and yellow perch in a study of 30 Nebraska Sandhills lakes. In fact, they reported that bluegill abundance, size structure, and condition were all positively related to yellow perch abundance, size, and condition. Thus, production of high quality yellow perch populations for angling in Nebraska Sandhills lakes apparently is not dependent on bluegill predation to reduce abundance of small perch. Paukert et al. (2002) suggested that largemouth bass predation may be the most influential factor on yellow perch size structure in Sandhill lakes.

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Table 2. Frequency of occurrence (FOC), mean percent by number, and mean percent by weight for prey items eaten by yellow perch 130—199 mm total length during 2001 at West Long Lake. *N* represents number of fish sampled; *SE* = standard error of the mean; UR = unidentifiable remains; UIR = unidentifiable insect remains.

Month	*N*	Prey item	FOC	% by number	*SE*	% by weight	*SE*
April	3	Chironomidae	33.3	13.3	13.3	2.0	2.0
		Zygoptera	33.3	11.1	11.1	13.3	13.3
		Amphipoda	100.0	75.6	12.4	84.6	12.4
June	4	Chironomidae	50.0	8.2	4.8	3.5	2.4
		Trichoptera	25.0	0.7	0.7	3.4	3.4
		Ephemeroptera	50.0	1.8	1.1	1.6	1.5
		Hemiptera	25.0	1.1	1.1	1.1	1.1
		Amphipoda	100.0	76.2	9.9	88.9	5.6
		Cladocera	50.0	11.9	7.7	1.5	.9
August	7	Chironomidae	71.4	29.3	11.7	27.3	12.1
		Zygoptera	14.3	0.5	0.5	0.7	0.7
		Trichoptera	28.6	1.1	0.9	1.1	1.0
		Ephemeroptera	57.1	15.1	14.2	3.2	2.9
		Nematomorpha	28.6	0.4	0.3	0.05	0.03
		Lepidoptera	14.3	0.2	0.2	0.05	0.05
		Hemiptera	71.4	20.2	13.6	15.2	14.1
		Mollusca	71.4	15.1	9.9	26.7	14.1
		Amphipoda	42.9	17.7	9.0	11.9	8.3
		UIR	28.6	0.4	0.2	1.4	0.9
		UR	28.6	.	.	12.2	11.2
		Plant material	14.3	.	.	0.2	0.2
October	7	Chironomidae	85.7	15.5	5.8	8.7	4.7
		Zygoptera	85.7	8.7	4.6	5.7	3.8
		Anisoptera	28.6	0.3	0.2	3.7	3.6
		Trichoptera	28.6	0.1	0.07	0.1	0.07
		Ephemeroptera	28.6	0.3	0.2	0.1	0.06
		Hirudinea	14.3	0.04	0.04	0.2	0.2
		Mollusca	28.6	2.5	2.4	0.4	0.3
		Amphipoda	71.4	52.2	14.0	52.6	15.6
		Cladocera	28.6	3.0	2.9	0.3	0.29
		Fish	14.3	14.3	14.3	14.3	14.3
		UIR	28.6	3.1	2.4	13.8	13.7
		Plant material	42.9	.	.	0.2	0.1

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Table 3. Frequency of occurrence (FOC), mean percent by number, and mean percent by weight for prey items eaten by yellow perch ≥ 200 mm total length during 2001 at West Long Lake. *N* represents number of fish sampled; *SE* = standard error of the mean; UR = unidentifiable remains; UIR = unidentifiable insect remains.

Month	*N*	Prey item	FOC	% by number	*SE*	% by weight	*SE*
April	26	Chironomidae	23.1	3.6	3.1	0.7	0.4
		Zygoptera	7.7	0.1	0.1	0.1	0.1
		Trichoptera	7.7	0.2	0.2	0.1	0.1
		Ephemeroptera	7.7	0.1	0.1	0.1	0.1
		Hirudinea	3.8	0.3	0.3	2.6	2.6
		Mollusca	7.7	0.1	0.1	0.1	0.1
		Amphipoda	92.3	86.7	5.9	87.5	5.8
		Cladocera	23.1	0.5	0.2	0.003	0.001
		Fish egg	7.7	0.6	0.5	1.1	1.0
		UIR	7.7	7.7	5.3	7.7	5.3
June	15	Chironomidae	80.0	47.7	10.4	43.8	11.0
		Zygoptera	20.0	1.3	.9	2.7	1.9
		Trichoptera	73.7	10.0	4.6	11.1	5.4
		Ephemeroptera	33.3	0.9	0.4	0.6	0.3
		Nematomorpha	6.7	0.1	0.1	0.05	0.05
		Lepidoptera	6.7	0.7	0.7	0.8	0.8
		Hirudinea	20.0	0.6	0.4	5.9	4.7
		Mollusca	20.0	3.8	3.0	6.9	4.6
		Amphipoda	86.7	20.0	7.0	12.8	6.0
		Cladocera	13.3	0.8	0.6	0.01	0.01
		Fish egg	13.3	13.0	8.9	12.4	8.5
		Fish	66.7	1.2	0.3	3.0	1.3
August	16	Chironomidae	62.5	17.4	7.2	12.9	7.2
		Trichoptera	31.3	5.8	3.1	5.3	3.5
		Ephemeroptera	50.0	11.3	6.7	10.5	6.7
		Nematomorpha	12.5	0.1	0.06	0.02	0.01
		Lepidoptera	18.8	0.4	0.3	2.1	2.0
		Hirudinea	6.3	0.03	0.03	0.05	0.05
		Hemiptera	68.7	30.4	8.4	16.9	7.5
		Mollusca	37.5	22.3	8.0	28.8	8.9
		Amphipoda	37.5	3.7	2.0	0.4	0.2
		Cladocera	6.3	5.0	5.0	0.01	0.01
		Copepoda	6.3	0.1	0.1	0.004	0.004
		Fish	6.3	3.1	3.1	.	.
		UIR	12.5	0.3	0.2	0.6	0.5
		UR	12.5	.	.	0.1	0.1
		Plant material	56.3	.	.	22.1	8.9
October	16	Chironomidae	81.3	22.7	7.6	19.3	7.6
		Zygoptera	31.3	2.8	2.5	5.8	5.4
		Anisoptera	6.3	0.1	0.1	2.1	2.1
		Trichoptera	25.0	0.6	0.4	0.4	0.3
		Ephemeroptera	18.8	0.2	0.1	0.2	0.1
		Hirudinea	11.5	3.2	3.1	5.9	5.8
		Mollusca	6.3	0.03	0.03	0.01	0.01
		Amphipoda	87.5	64.5	8.8	56.8	9.6
		Cladocera	12.5	0.2	0.1	0.014	0.013
		Copepoda	6.3	0.03	0.03	0.01	0.01
		Fish	12.5	4.4	3.3	5.3	4.8
		UIR	6.3	1.3	1.3	0.3	0.3
		Plant material	62.5	.	.	3.8	1.3

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