J. Great Lakes Res. 16(2):330-333
Internat. Assoc. Great Lakes Res., 1990

NOTE

EVIDENCE FOR ALEWIFE (*ALOSA PSEUDOHARENGUS*) PREDATION ON THE EUROPEAN CLADOCERAN *BYTHOTREPHES CEDERSTROEMI* IN NORTHERN LAKE MICHIGAN

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ABSTRACT. Stomach contents of 10 alewife (Alosa pseudoharengus), *3 bloaters* (Coregonus hoyi), *1 rainbow smelt* (Osmerus mordax), 4 chinook salmon (Oncorhynchus tshawytscha), *and 1 lake trout* (Salvelinus namaycush) *were examined for the presence of the European cladoceran,* Bythotrephes cederstroemi. *Fish were collected commercially (by gillnetters and sport charters) in July and August of 1988 in the North Manitou Island area of Lake Michigan when* B. cederstroemi *were abundant. The zooplankter was found in all alewife examined and its remains normally filled the entire stomach cavity. The only other evidence for fish predation on* B. cederstroemi *was found in the stomach from a 0.5 kg chinook salmon. A few caudal spine fragments were found in the stomach of one bloater yet because the stomach was full of the benthic amphipod,* Pontoporeia hoyi, *it was hypothesized that the fish acquired the remains from the sediments. Stomachs of other fish were either empty or did not contain* B. cederstroemi. *Although limited, these data are the first conclusive evidence that the economically important alewife prey upon the exotic* B. cederstroemi *in the open waters of the Great Lakes.*
INDEX WORDS: Fish diets, zooplankton, Lake Michigan, fish food organisms, alewife.

INTRODUCTION

The presence of the large, predatory European cladoceran, *Bythotrephes cederstroemi*, has now been reported for all of the Great Lakes (Lakes Erie and Huron: Bur *et al.* 1986; Lake Ontario: Lange and Cap 1986; Lake Michigan: Lehman 1987; Lake Superior: Cullis and Johnson 1988). Its interaction with the resident biota, however, is just beginning to receive attention (Evans 1988).

Being a voracious zooplankton predator as well as possessing a long and barbed caudal spine to presumably deter its own predation, the species has the potential of significantly altering the dynamics of the planktonic food web (de Bernardi and Canali 1975, Lehman 1987, Scavia *et al.* 1988). The likelihood of alterations, such as reducing the preferred food of the planktivorous alewife, will greatly depend upon the ability of resident fishes to prey upon *B. cederstroemi*. In the Great Lakes, *B. cederstroemi* has been found in the stomach cavities of perch, walleye, and white bass (Bur *et al.* 1986) and deepwater sculpin (Evans 1988). However, no direct evidence for predation on *B. cederstroemi* by alewife, whitefish, and salmonids has been presented.

To investigate predation on *B. cederstroemi* by these fishes, stomach contents of fish provided by commercial and sport charters from northern Lake Michigan were examined. Emphasis was placed on the salmonid forage fish, *Alosa pseudoharengus*, because it is an abundant true planktonic feeder with good potential for affecting *B. cederstroemi* populations, and it has direct and indirect economic significance.

METHODS

All fish were collected between 29 July and 18 August 1988. Alewife, bloaters, and rainbow smelt were gillnetted by commercial fishermen in

TABLE 1. Summary of fish descriptive statistics (fish number, date collected, approximate depth fish retrieved from, length (cm), weight (g or kg where noted) and stomach analyses (percent fullness of stomach, percent **B. cederstroemi** *in stomach contents, and other contents).*

						Gut Analyses		
Species	Fish No.	Date Collected	Depth (m)	Length/wt (cm)	(g)	% fullness of stomach	% *B. ceder.*	other
Alewife	1	12/08/88	80	15	41	100	75	misc. zoop.
	2	12/08/88	80	15	44	100	100	
	3	12/08/88	80	17	50	100	50	misc. zoop.
	4	12/08/88	80	15	43	100	100	
	5	09/08/88	80	19	74	100	100	
	6	15/08/88	80	21	78	100	100	
	7	03/08/88	80	20	66	100	75	P. hoyi
	8	fr. salmon	2	12	35	100	100	
	9	fr. salmon	3	6	16	100	75	misc. zoop.
	10	fr. salmon	4	12	33	100	100	
Bloater	1	04/08/88	90	21	131	50	<1	P. hoyi
	2	04/08/88	90	21	133	100	0	P. hoyi
	3	04/08/88	90	23	135	100	0	P. hoyi
Rainbow Smelt	1	18/08/88	30	15	29	0	0	
Salmon	1	29/07/88	20	NA	0.4 kg	10	10	caddis lar
	2	02/08/88	20	NA	1.1 kg	75	0	2 alewife
	3	29/07/88	20	NA	3.2 kg	75	0	2 alewife
	4	29/07/88	20	NA	8.4 kg	50	0	2 alewife
Lake trout	1	03/08/88	30	NA	4.0 kg	10	0	un-ident.

approximately 30–100 m of water in North Manitou Island/Leland region of Lake Michigan (Fig. 1). Generally, nets were set about 2–3 m off of bottom. Fish were frozen whole until examination. Chinook salmon and lake trout were obtained from sport charters. Fish were caught approximately 20 m deep in 70 m of water. Fish were weighed, and then their stomachs removed and frozen until processing. All stomachs were cut open laterally and contents observed under a dissecting microscope. Stomach fullness (extent to which the stomach cavity was expanded with contents), percent *B. cederstroemi*, and the percent contribution of other food items to total contents were estimated when viewing.

Although quantitative lake zooplankton samples were not available at the time of fish collection, qualitative *B. cederstroemi* samples were collected as early as mid-July in the study area. Samples were removed from downrigger cables on a sport-fishing boat. *Bythotrephes* remained extremely abundant throughout the region at least through August.

RESULT AND DISCUSSION

Six of the 10 alewife stomachs examined were solidly packed with *B. cederstroemi* (Fig. 2). Three were 75 percent *B. cederstroemi*/25 percent other zooplankton, and one was 50/50. Bloaters appeared to be relying heavily on *Pontoporeia hoyi*, although some spine fragments were found in one stomach. There was no evidence that the larger salmon preyed directly on *B. cederstroemi*. However, stomachs from larger salmon did contain alewife, and the alewifes' stomachs were full of *B. cederstroemi*. The stomach from the smallest (0.5 kg) salmon examined contained one whole large *B. cederstroemi*, a few spine fragments, and three trichopteran larvae. The one rainbow smelt stomach examined was completely empty and the one lake trout stomach contained some unidentifiable minnow remains, but no sigh of *B. cederstroemi* (Table 1).

These preliminary data clearly show that the Great Lakes alewife will prey upon *B. cederstroemi*. Because sampled alewife ranged from 6-21 cm in length, it also appears that predation is not restricted to a specific fish size-class. However,

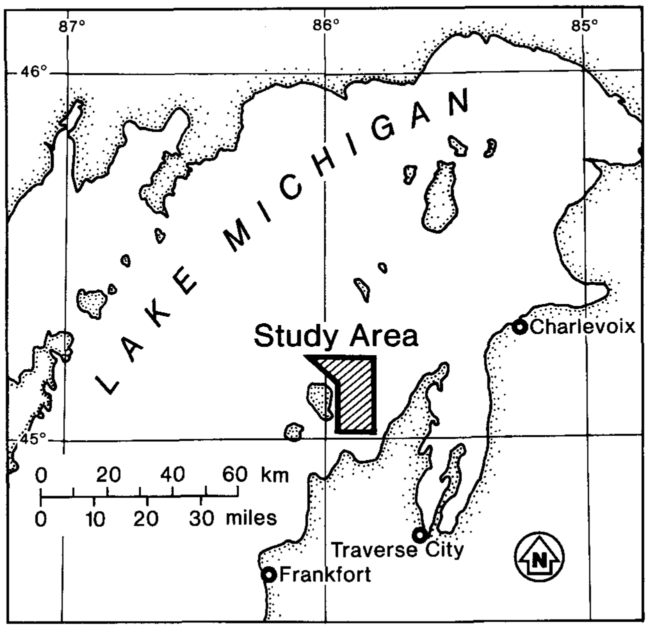

FIG. 1. Location of fish collections in northern Lake Michigan (shaded area).

FIG. 2. Photograph of B. cederstroemi *in stomach of alewife no. 2.*

due to the small sample size, caution should be excercised in interpretation of the data. Future studies should incorporate quantitative zooplankton samples before, during, and after peak emergence of *B. cederstroemi* both in surrounding waters and alewife stomachs.

Although bloaters are considered planktivorous and have been shown to preferentially consume *Bythotrephes* in Lake Maggiore in Italy (Giussani 1974), it may be that the Great Lakes bloaters are exploiting the oil-laden, annually abundant benthic amphipod, *Pontoporeia hoyi*. Based on the few spine remains intermingled with some 30 *P. hoyi* in the stomach of chub no. 1, it is likely that the fragments were ingested with bottom sediments. Even if this were not the case, it was clear that *P. hoyi* was the prey of choice. Evans (1988) reported finding spine remains in the stomach contents of Lake Michigan deepwater sculpin, yet it is unclear as to whether the fish were consuming live *B. cederstroemi*.

Smelt have been shown to consume *B. cederstroemi* in Lake Vanern in Sweden (Nilsson 1979), however rainbow smelt predation on this cladoceran has yet to be reported for the Great lakes.

Because the stomach from the smallest salmon sampled contained *B. cederstroemi*, it is possible that young fish may be able to exploit this resource. Larger fish did not appear to be directly consuming *B. cederstroemi*, however they were ingesting *B. cederstroemi*-engorged alewife. The latter may ultimately prove to be beneficial to the sport fishing industry.

ACKNOWLEDGMENTS

I am indebted to many associates for providing assistance, particularly Kim Crowley of Carlson's Fish Market in Leland, for coordinating the fish collections. Ross Lang is also thanked for his cooperation in this regard. Hank Vanderploeg and Mike Quigley are thanked for review of the manuscript. Contribution No. 663 from the Great Lakes Environmental Research Laboratory.

REFERENCES

Bur, M. T., Klarer, D. M., and Krieger, K. A. 1986. First records of a European cladoceran, *Bythotrephes cederstroemi*, in Lakes Erie and Huron. *J. Great Lakes Res.* 12:144-146.

Cullis, K. I., and Johnson, G. E. 1988. First evidence of the cladoceran *Bythotrephes cederstroemi* Schoedler in Lake Superior. *J. Great Lakes Res.* 14:524-525.

de Bernardi, R., and Canali, S. 1975. Population dynamics of pelagic cladocerans in Lake Maggiore. *Mem. Ist. Ital. Idrobiol.* 32:365-392.

Evans, M. S. 1988. *Bythotrephes cederstroemi*: its new appearance in Lake Michigan. *J. Great Lakes Res.* 14:234-240.

Giussani, G. 1974. Planctofagia selettiva del coregone "Bondella" (*Coregonus* sp.) del Lago Maggiore. *Mem. Ist. Ital. Idrobiol.* 31:181-203.

Lange, C., and Cap, R. 1986. *Bythotrephes cederstroemi* (Schödler). (Cercopagidae: Cladocera): a new record for Lake Ontario. *J. Great Lakes Res.* 12:142-143.

Lehman, J. T. 1987. Paleartic predator invades North American Great Lakes. *Oecologia* 74:478-480.

Nilsson, N. A. 1979. Food and habitat of the fish community of the offshore region of Lake Vanern, Sweden. *Inst. Freshw. Res. Drottningholm Rept.* 58:126-139.

Scavia, D., Lang, G. A., and Kitchell, J. F. 1988. Dynamics of Lake Michigan plankton: a model evaluation of nutrient loading, competition, and predation. *Can. J. Fish. Aquat. Sci.* 45:165-177.