96-026

ILLINOIS WILDLIFE PRESERVATION FUND

Small Project Proposal FY95 (July 1994 - June 1995)

1. Project Title: An exotic zooplankton in Illinois: its distribution and potential impacts.

2. Submitted by: Name (Dr., Mr., Mrs., Ms.) Ms. Cynthia Kolar and Dr. David H. Wahl

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City, State, Zip Kinmundy, IL 62854

3. Contact Person: (Dr., Mr., Mrs., Ms.) Ms. Cynthia Kolar 4. Phone Number: (618) 245 6348

5. I request $ 1,000 in funding from the Wildlife Preservation Fund.

6. PROPOSAL CATEGORY (*For Staff Use Only*)

Management Site Inventories Education

7. Project Justification:

Daphnia lumholtzi, a species of zooplankton native to Australia, southern Asia and eastern Africa, has recently been found in a number of southern reservoirs in the United States. In summer, 1993, Illinois Natural History Survey personnel discovered *D. lumholtzi* to be dominant large zooplankton in Lake Springfield by late summer. Our finding constitute the first siting in Illinois and represents the current northern boundary of this species. *Daphnia lumholtzi* has large head and tail spines to increase its size to better avoid predation and it is unknown whether North American fish predators will readily consume it. Populations of *D. lumholtzi* could potentially spread throughout the state, impacting native threatened and endangered species. Without determining the impact of this daphnid on the diets of native planktivores and examining its thermal preferences, we cannot accurately predict the impact of this exotic on the aquatic ecosystems of Illinois.

8. Project Objectives:

Our primary objective will be to develop a better understanding of the possible impact of *D. lumholtzi* on the aquatic ecosystems of Illinois. Our approach will include: monitoring the zooplankton community of Lake Springfield throughout the summer months of 1994, determining the impact of *D. lumholtzi* on the diets of larval and juvenile fish populations, testing the vulnerability of *D. lumholtzi* to predation by native fish, and developing a better understanding of the life history and ecology of *D. lumholtzi* in the current northern boundary of its distribution in North America.

9. Project Methodology:

We plan to sample the zooplankton community at various locations in Lake Springfield biweekly throughout the summer months of 1994. The larval and juvenile fish populations will be sampled concurrently with zooplankton sampling. Stomach contents will be analyzed to document whether or not larval and juvenile fish readily consume the exotic daphnid. As growth and reproductive potential of zooplankton species is related to environmental temperature, and D. lumholtzi is usually found in warmer clines, we plan to sample areas of Lake Springfield enhanced thermally from the City Water Light and Power plant. We will also sample selected surrounding waters from the same and adjacent watersheds for the presence of D. lumholtzi to establish its current range in central Illinois. Laboratory experiments will be performed to examine the vulnerability of the exotic daphnid to predation by larval and juvenile fish.

10. Project Location (city, county, etc.):

Lake Springfield, Springfield, Sangamon County

Budget:

11. Illinois Wildlife Preservation Funds Requested:

Labor and Fringe $909. - Technician & Research Biologist
Travel
Equipment
Commodities
Contractual
Other Indirect costs $90.00

SUBTOTAL $ 1,000

12. Funds You Will Provide: INHS equipment, travel, additional labor costs

SUBTOTAL $ 2,000

13. TOTAL COST OF PROJECT $ 3,000

15. Does your project involve endangered or threatened species ( ) yes (x) no collecting protected species ( ) ye (x) no a nature preserve ( ) yes (x) no Department of Conservation property(ies) ( ) yes (x) no If you answer ye to any of the above, complete the appropriate permit application.

15. You may wish to attach more detailed documents to assist the Committee in their decision making. Attached are the following:

Detailed Budget
Map of Project Area
Detailed Proposal
Professional Vitae
Relevant Publications
Other

16. Mail completed application form to: Natural Heritage Division Department of Conservation 524 South Secon Street Springfield, IL 62701-1787

An exotic zooplankton in Illinois: its distribution and potential impacts

Cynthia S. Kolar and David H. Wahl

Daphnia lumholtzi, a species of zooplankton native to Australia, southern Asia and eastern Africa, has recently appeared in a number of reservoirs in the southern and midwestern United States in the following states: Alabama, Arizona, Arkansas, Florida, Kansas, Missouri, North and South Carolina, Oklahoma, Tennessee and Texas (J. E. Havel, personal communication). In late summer, 1993, we found D. lumholtzi to be the dominant daphnid in Lake Springfield, central Illinois. Re-analysis of earlier zooplankton samples revealed small numbers of the exotic daphnid present in 1992 (Fig. 1). This species has distinct morphology with a large spike-like helmet (up to 2/3 of total length), a long tail spine and smaller spines to deter predators (Benzie 1988; Fig. 2). In short, it looks very different from any zooplankton native to Illinois. Sampling on one date during time of peak abundance revealed additional populations in Lake Shelbyville, Lake Kincaid, Lake Taylorville, Lake Decatur, Clinton Lake and Sangchris Lake (all within central and southern Illinois). Since this zooplankton is exotic and thus lacks natural biological controls found in its native waters, and this zooplankton has unique morphological adaptations that presumably deter predation, the introduction of D. lumholtzi may have profound effects on the waters of Illinois.

Zooplankton is a major food source for larval (Dettmers and Stein 1992), juvenile (Noble 1975) and adult fishes (Mills et al. 1992). Selective predation, competition and changes in water temperature can lead to structural changes in the zooplankton community (Hall et al. 1976; Ware 1977). These changes in zooplankton assemblages can influence the growth and survival of larval and juvenile fishes (Miller et al. 1990; Bur and Klarer 1991).

We compared peak zooplankton in Lake Springfield to that of two reference impoundments in 1992 and 1993 and found that total zooplankton abundance in 1993 was lower in 1992 for only Lake Springfield (Fig. 3). All taxa of zooplankton in Lake Springfield decreased from 1992 to 1993 except the exotic zooplankter. This early evidence suggests that D. lumholtzi may impact native zooplankton, and thus, native fish populations. Since many fish are size-selective predators, D. lumholtzi may be selected because of its large size or it may be selected against because of its extreme anti-predator morphological adaptations. The effect of exotic zooplankton cannot always be predicted. Bythotrephes cederstroemi is an exotic zooplankton established in the Great Lakes that also has obvious predator-deterring morphology (a long caudal process, which can measure up to 12 mm). It was believed by some that B. cederstroemi would

negatively effect plankton assemblages because it would be too difficult for fish to ingest readily. In fact, colonization by B. cederstroemi led to a shift in the feeding ecology of yellow perch and alewives as they quickly added it to their diet (Bur and Klarer 1991; Mills et al. 1992).

We plan to examine the impact of D. lumholtzi on native ecosystems both in the field and in the laboratory. In the field we can assess the changes in the zooplankton population through the summer to monitor trends in the relative abundances of plankton species. We can also determine the impact of the exotic daphnid on the diets of larval and juvenile fish. Field sampling will be largely financed through an on-going study evaluating the walleye stocking program funded through the Department of Conservation. In bag experiments, we will assess the effect of adding D. lumholtzi to native zooplankton populations by stocking exotic zooplankton into half of the bags in addition to native zooplankton communities. In the bags, we will also examine whether or not the presence of fish predators change the competitive outcome between the exotic and native zooplankters. We are developing a grant proposal for the Natural Science Foundation to fund this portion of the project. In the laboratory, we propose to examine the vulnerability of D. lumholtzi to predation by larval and juvenile bluegill, estimate handling time and energetic return relative to that of native daphnids and to determine larval and juvenile bluegill prey preference (native vs. exotic). It is this portion of our project which we are proposing be funded for this proposal.

Laboratory research will be conducted in mid-late summer at Sam Parr Biological Station, Kinmundy, Illinois. We will first establish cultures of exotic and native daphnids. Zooplankton will be collected from Lake Springfield using a 0.5 m diameter, 63 μm mesh zooplankton net towed vertically through the water column. Zooplankton will be transported to Sam Parr Biological Station in coolers and will be cultured in the laboratory. D. lumholtzi and native daphnid cultures will be started by passing lake water through graded sieves to separate the species, if possible (otherwise, daphnids will be hand-picked). From our preliminary work, we have found that the exotic daphnid cultures easily in the laboratory. We will use D. pulex in pair-wise tests as a native zooplankton as it also cultures easily and is common in our area. We currently have laboratory cultures of this species. Daphnid cultures will be fed algal cultures also maintained on-site. After culture establishment, we will conduct behavioral feeding studies with larval and juvenile bluegill.

Adult bluegill will be collected locally and allowed to spawn in ponds to produce experimental larval fish, juvenile bluegill will be collected from Forbes Lake. All fish will be held in the laboratory prior to use. We will use three size-classes of bluegill for these experiments: larval, 50 mm and 100 mm. We will have three forage treatments: all D. pulex, all D.

lumholtzi, and an equal number of each (daphnid density for all experiments will be kept constant at 75/L). Daphnids will be sorted using graduated sieves to ensure equal body size. Bluegill will be allowed to acclimate 24 hr in 20 L plastic buckets filled with 2-4 L water, depending on fish size. Then daphnids will be added. The bluegill will be allowed to feed for one hour. After an hour, remaining zooplankton will be removed and enumerated. We will block by fish, thus each bluegill will be exposed to each foraging treatment, in random order. After which time, bluegill will be preserved to later obtain lengths and weights--and to verify stomach contents. We will run 20 bluegill of each size-class through the selection experiments. Preference will be measured using a selectivity index such as Chesson's alpha (Chesson 1983).

We will also run separate observational experiments with bluegill of the same size-classes as above to look at handling time and feeding behavior of bluegill feeding on native and exotic daphnids. For these experiments, we will randomly offer exotic or native daphnids to bluegill and observe feeding behavior. We will re-test the same bluegill until no further learning is observed for either daphnid species. Again 20 bluegill of each size-class will be run in these experiments. Energetic values for both exotic and native daphnids will be obtained from the literature or will be determined from microbomb calorimetry.

Our combination of field and laboratory investigations are designed to better understand the possible impact of the exotic D. lumholtzi in Lake Springfield and other waters of Illinois.

Literature Cited

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Bur, M.T. and D. M. Klarer. 1991. Prey selection for the exotic cladoceran Bythotrephes cederstroemi by selected Lake Erie fishes. J. Great Lks. Res. 17(1):85-93.

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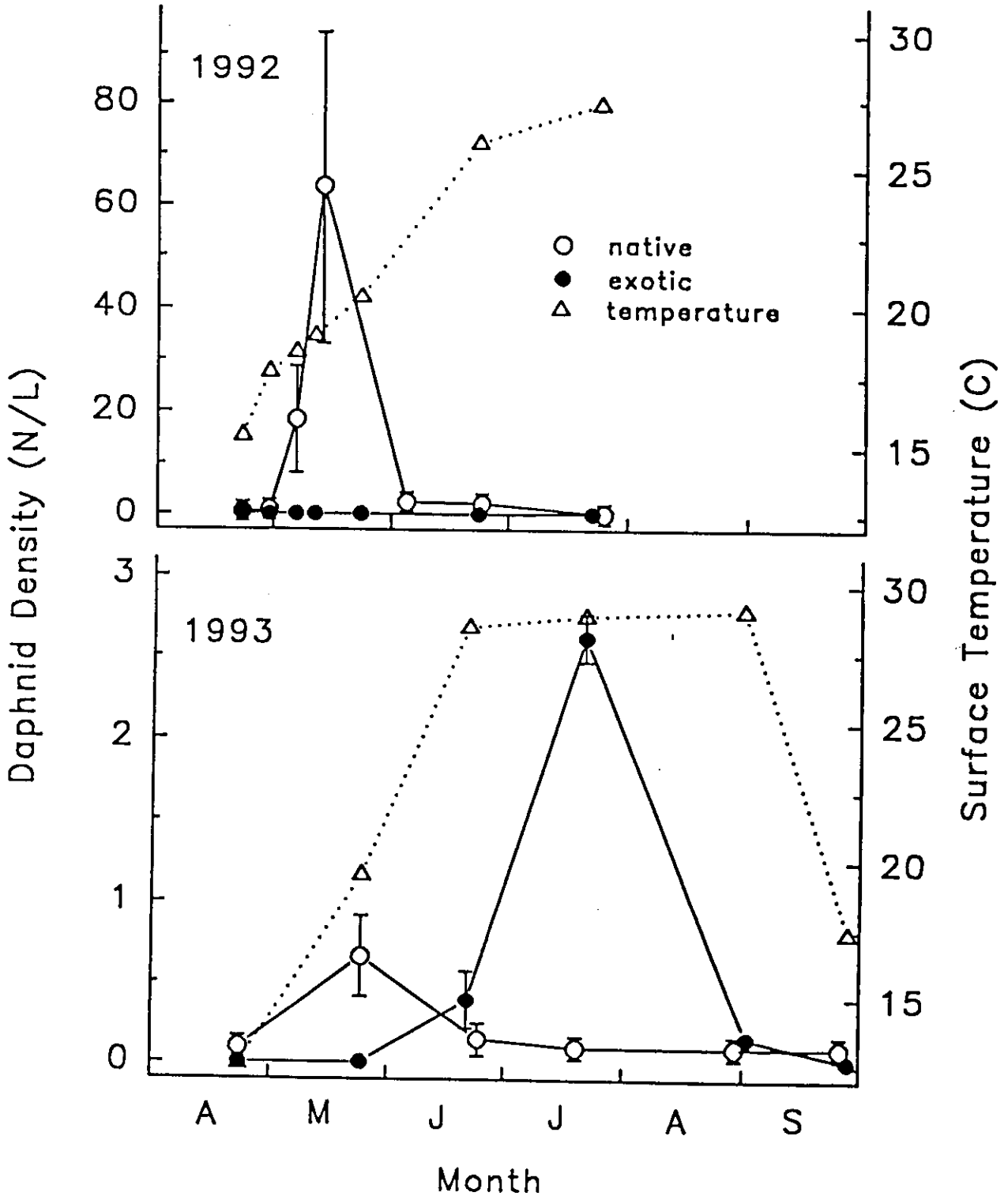

Figure 1. Densities of native and exotic daphnids in 1992 and 1993 in Lake Springfield, IL. While the density of Daphnia lumholtzi increased from 1992 to 1993, native daphnids declined dramatically. Note the y-axis scale in 1993 is different than that of 1992 and that D. lumholtzi densities reflect surface temperature in 1993.

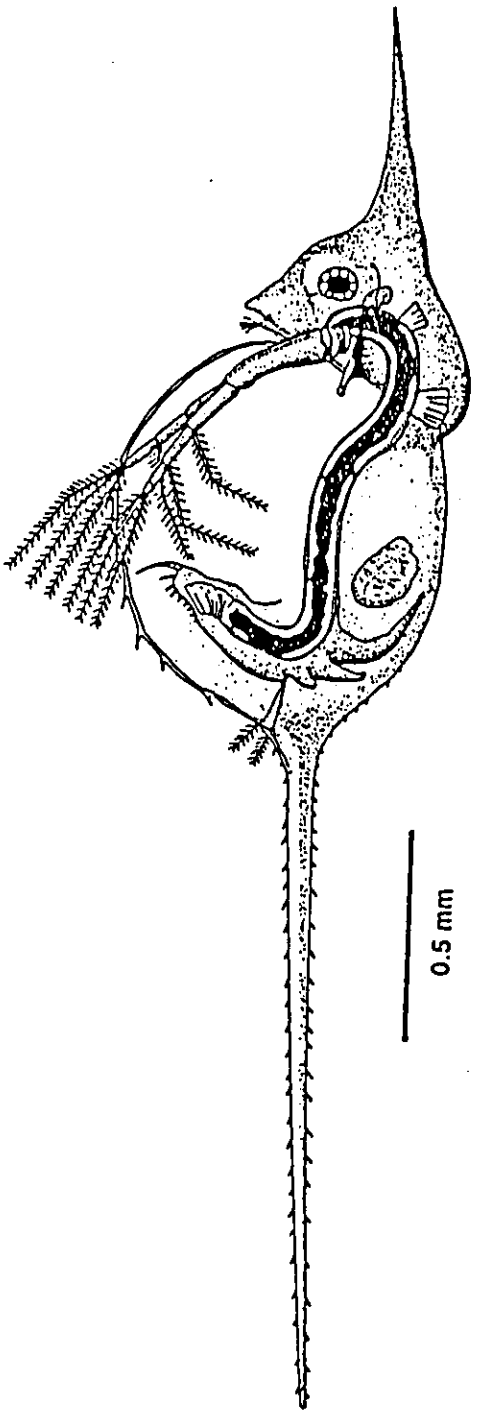

Figure 2. Morphology of Daphnia lumholtzi showing long helmet and tail spines (taken from Havel and Hebert 1993).

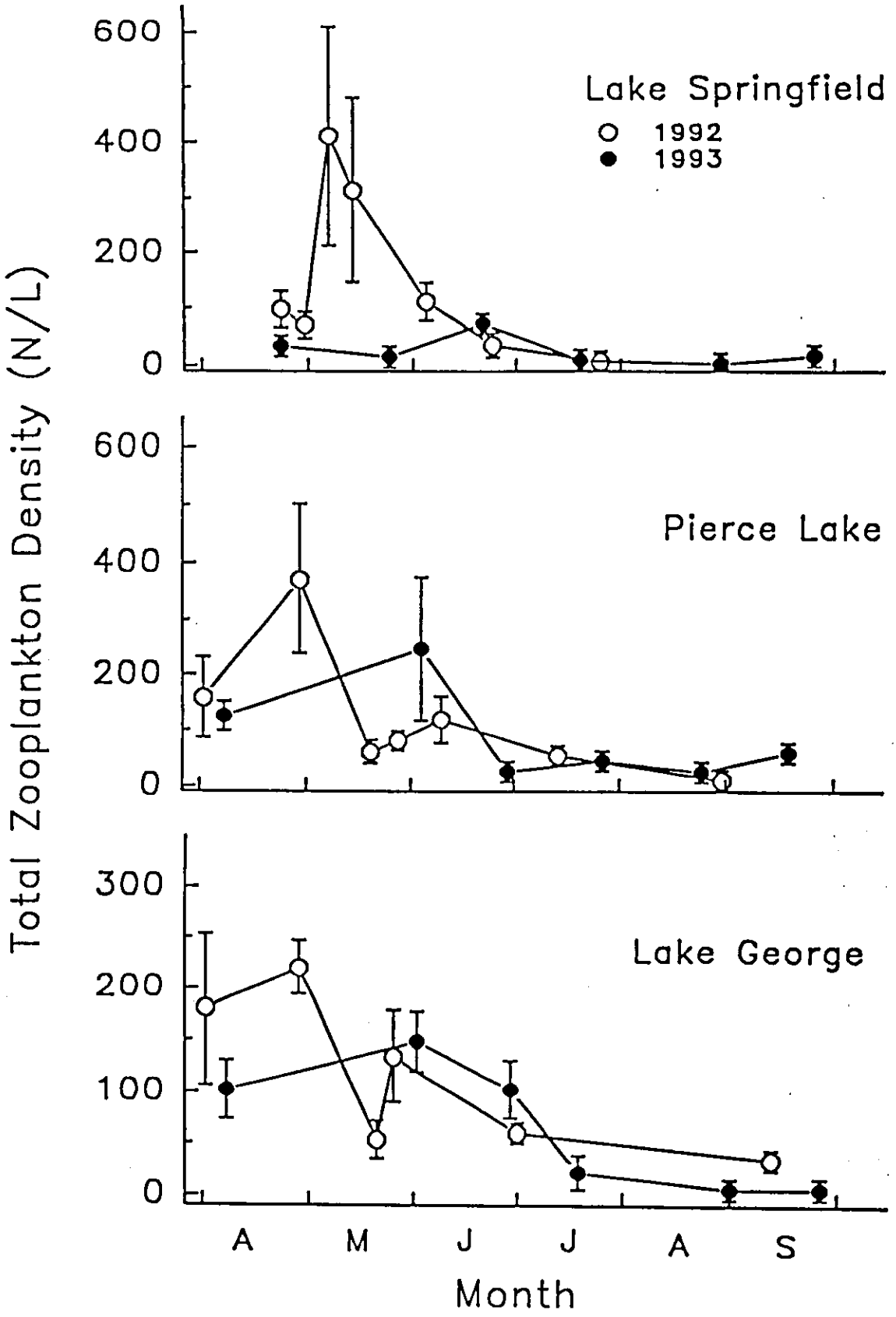

Figure 3. Total zooplankton density (exploiting rotifers) in three Illinois reservoirs: Daphnia lumholtzi became abundant in Lake Springfield in 1993. Values are means of three replicate vertical tows; vertical bars represent standard errors.

Lake Springfield, Sangamon County, central Illinois. Surface area is 4234 acres, maximum depth is 50 feet, average depth is 13 feet. Proposed sampling sites are indicated with asterisks.