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# *Daphnia lumholtzi*: Appearance and Likely Impacts of an Exotic Cladoceran in the Ohio River

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Abstract

Exotic species can have a profound impact on the ecosystems they invade. Over the period 1992–1994, the exotic cladoceran *Daphnia lumholtzi* has become increasingly common in the Ohio River. This cladoceran has prominent helmet and caudal spines which may protect it against invertebrate and some vertebrate predators. This well-defended cladoceran may eventually dominate the Ohio River plankton during the warm months of the year, potentially altering the composition of the potamoplankton assemblage and the trophic processes within the river.

## Introduction

The Ohio River and its tributaries have been invaded by several exotic species in recent history. Species with obvious direct economic impacts such the zebra mussel (*Dreissena polymorpha*) have been the object of intense research attention, but there are new arrivals in the plankton community of the Ohio that may have less direct but equally serious effects. Among these is the exotic water flea, *Daphnia lumholtzi* Sars [Crustacea: Branchipoda] which may have been accidentally introduced from its native habitat in Africa, Asia, or Australia to the southern United States in association with either fish-stocking efforts or the release of exotic aquarium fish into the environment (1). It is distinguished from other cladocerans in the Ohio River by its relatively large size (adults average about 1.1 mm long, [2]) and the prominent spines on the head (helmet) and caudal regions. The plankton community in the McAlpine pool of the Ohio has been dominated for the past 4 years by small cladocera, such as *Bosmina longirostris*, which have no obvious spines (3).

The presence of spines in cladocera is often considered an anti-predator mechanism to reduce success by vertebrate and invertebrate predators in capturing and ingesting these organisms. The recent invasion of Lake Michigan by the predatory cladoceran *Bythotrephes cederstroemii* shows the impact that such well-defended zooplankton can have. This northern cladoceran also has a prominent caudal spine, which makes capture and ingestion by small fish such as juvenile yellow perch (*Perca flavescens*) difficult. Apparently these fish learn to avoid attacking *B. cederstroemii* (4). Such aversive behavior by the fish may prevent them from wasting pursuit and handling energy attempting to capture *B. cederstroemii*, but it also allows this cladoceran to compete with these small fish for other, less well-defended zooplankton prey.

To determine the seasonal occurrence, densities and distribution of *D. lumholtzi* at sites in the lower McAlpine and upper Cannelton pools of the Ohio River, we collected numerous plankton samples from spring through fall of 1992–1994. If the densities of *D. lumholtzi* are increasing in the Ohio, it is likely this cladoceran will have a negative impact on the native zooplankton and on the fish that rely on these zooplankton for food.

## METHODS

We took plankton samples every 10 days from April to November at 2 sites in the Ohio River in 1992–1994. Two shore (within about 10 m of the shoreline) and one midchannel sample were taken at Cox's Park (Ohio River Mile [ORM] 600) near Louisville, KY and the Gallagher Power Station in New Albany, IN (ORM 610). Fifty liter samples were retrieved using a battery-operated water pump (rate ≈ 26 liters min.$^{-1}$) from 1.0 m depths through a 63 μm-mesh plankton net. The samples were concentrated through a dolphin bucket (also with 63 μm mesh) at the cod-end, placed in 75 ml Nalgene screw-top containers transported back to the laboratory on ice. The samples were counted and identified within 4 hours of their collection. The zooplankton samples were enumerated at 45× using a Nikon SMZ-10 or a Nikon SMZU stereomicroscope. *Daphnia lumholtzi* was identified using the drawings of Havel and Herbert (1).

In 1994, various physical data were also taken in the river at the Cox's Park site. Temperature and conductivity data at the river surface were collected using a YSI Model 57 oxygen meter. Water samples (75 ml) were taken from the river surface, stored in acid-washed plastic containers and later analyzed for turbidity in nephelometric turbidity units (NTUs) using a Hach model 2100P turbidity meter.

## RESULTS AND DISCUSSION

We collected no physical data from the Ohio with our plankton samples during 1992–1993, but in 1994 the conditions in the river varied seasonally. Turbidity was highest in April (mean ≈ 8.2 NTUs) and dropped through the year until the final sample in November (≈3.9 NTUs). Temperature varied from 17°C (April) to a high of 28°C in late August. Temperatures had dropped to about 15°C in November when the sampling ended. Conductivity did not vary much through the sampling period, remaining between 320 and 490 μmohs.

*Daphnia lumholtzi* was present in low densities in the summers (June through August) of 1992 and 1993 (5), but the occurrence and densities were too sporadic and low to distinguish any meaningful trends. In 1994, *D. lumholtzi* appeared suddenly in our samples in late July (see Fig. 1) at significant densities in the river. Through most of August, *D. lumholtzi* was a significant component (about >50% numerically) in our samples of the crustacean zooplankton in the Ohio River. Its population levels dropped soon afterward to undetectable levels in late August, although it reappeared briefly at lower densities in October (see Fig. 1).

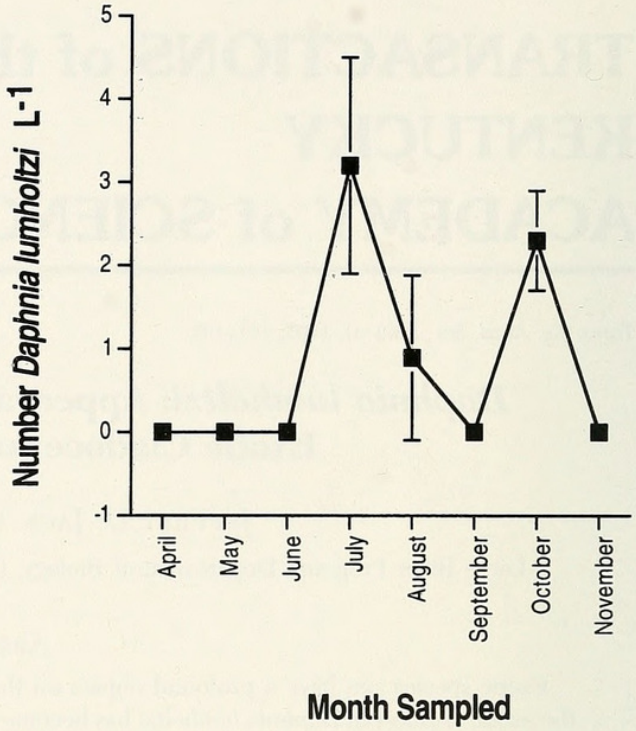


FIG. 1. Abundance of *Daphnia lumholtzi* in the Ohio River in 1994. Means are the result of at least three samples within the month; error bars indicate standard deviations. See text for comparison to densities in 1992–1993.

The appearance of this exotic zooplankter is cause for concern both in terms of the trophic relationships in the Ohio River plankton community and its resultant impact on fisheries. Since its first confirmed report in 1991, *D. lumholtzi* has been found in reservoirs throughout much of the Southeast and Midwest regions of the United States (1); its rapid dispersal would indicate it could potentially colonize much of the Ohio River within the next few years.

While *D. lumholtzi* may not prey directly on other cladocerans as *B. cederstroemii* does, it is still likely to have a negative impact on lotic and lentic systems in this country. The presence of the spines on its helmet and caudal regions may provide some protection against invertebrate and small vertebrate predators.

Such structures have been shown to be effective against invertebrate predators in rotifers (6) and daphniids (7), as well as against fish (4). As *D. lumholtzi* continues its colonization of the Ohio River and tributaries, its defenses may result in it becoming a dominant member of the zooplankton during the warmer portions of the year. It seems likely that invertebrate predators such as the phantom midge larva, *Chaoborus* (especially early instars), may not be able to feed efficiently on this well-protected cladoceran, which may result in more predation pressure on co-occurring but less well-defended cladocera such as *Bosmina*. Increased feeding on *Bosmina* would further drive the plankton community toward dominance by *D. lumholtzi*, although *Bosmina* may be able to compensate for its losses through increased reproduction.

We will be performing both in situ and large tank experiments this spring and summer, investigating the impact of this new cladoceran on the pelagic communities in the river. Our experiments will enable us to understand better the probable impact of this new member of the Ohio River plankton community on trophic processes in the Ohio River.

## Summary

In systems dominated by *D. lumholtzi*, a new population bottleneck for large invertebrates and small vertebrates may emerge. Densities of small zooplanktivorous fish and the macroinvertebrate predators such as *Chaoborus*, which can be important food for the larger fish in a community, may drop due to poor success with the new dominant cladoceran. Decreases in their densities would probably have an impact on higher trophic levels, including the larger fish popular with sport fishermen.

## Acknowledgments

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## Literature Cited

1. Havel, J. E. and P. D. N. Herbert. 1993. *Daphnia lumholtzi* in North America: another exotic zooplankter. Limnol. Oceanogr. 38:1823–1827.

2. Thorp, J. H., A. R. Black, K. H. Haag, and J. D. Wehr. 1994. Zooplankton assemblages in the Ohio river: seasonal, tributary and navigation dam effects. Canadian J. Fisheries and Aquatic Sci. 51:1634–1643.

3. Jack, J. D. unpublished data.

4. Barnhisel, D. R. 1991. The caudal appendage of the cladoceran *Bythotrephes cederstroemii* as a defense against young fish. J. Plankton Res. 13:529–537.

5. Black, A. R. personal communication.

6. Stemberger, R. S. and J. J. Gilbert. 1987. Multiple species induction of morphological defenses in the rotifer *Keratella testudo*. Ecology 68:370–378.

7. Havel, J. E. and S. A. Dodson. 1984. *Chaoborus* predation on typical and spined forms of *Daphnia pulex*: behavioral observations. Limnol. Oceanogr. 29:487–494.