OBSERVATIONS ON THE SUSCEPTIBILITY OF SOME PROTISTS AND ROTIFERS TO PREDATION BY ASPLANCHNA GIRODI

John J. GILBERT

Department of Biological Sciences, Dartmouth College, Hanover, New Hampshire 03755 U.S.A.

Keywords: Asplanchna, predation, rotifers, behavior

Abstract

Direct observations of behavioral interactions show that the predator A. girodi: 1) easily ingested Synchaeta pectinata, two forms of Keratella cochlearis cochlearis, and individuals of Conochilus unicornis and C. dossarius enzymatically dissociated from their matrix; 2) rarely, if ever, captured Kellicottia bostoniensis and intact Conochilus; and 3) generally rejected the peritrich ciliate Rhabdostyla sp. and the dinoflagellate Peridinium sp. Coloniality and secretion of a gelatinous matrix in Conochilus can be viewed as adaptations to limit mortality from invertebrate predation. Intraspecific variability in the feeding responses of A. girodi is considered.

Introduction

Since Asplanchna can exhibit both functional and numerical responses to prey density, it may have an important regulatory effect in freshwater ecosystems. Some field correlations between the population density of A. priodontia and the death rate of Keratella cochlearis (Edmondson, 1960; Zimmerman, 1974) provide indirect evidence for such control.

We are initiating a study to determine the extent to which predation by A. girodi controls the population dynamics of a variety of potential prey in a small, eutrophic lake. We plan to look for correlations between the abundance and birth rate of A. girodi and the population dynamics of its prey and to conduct in situ experiments in which A. girodi is enclosed with or excluded from the zooplankton community. Before undertaking such studies, however, it seemed desirable to first identify those prey which were most susceptible to, and hence most likely to be regulated by, A. girodi predation. Attention could then be focused on interactions among these organisms. One such study has been completed (Gilbert & Williamson, 1978) and showed that Keratella cochlearis was readily captured and eaten while Polyarthra vulgaris almost always escaped capture. The purpose of this study was to observe behavioral interactions between A. girodi and other, previously untested, potential prey from its environment.

Material and methods

A. girodi were collected from Star Lake, Norwich, Vermont, U.S.A. or taken from a laboratory population, clone 5A1, originating from Tampa, Florida, U.S.A. and cultured on Paramecium aurelia as described elsewhere (Gilbert & Litton, 1978).

Procedures for analyzing behavioral interactions between A. girodi and its prey were similar to those described previously (Gilbert & Williamson, 1978). Predators were starved for 1-8 hours and then generally observed singly in the presence of first one and then another type of prey in lake water, the least preferred type usually being tested first so that the predator would be likely to encounter both types before eating a food item. Predators were usually discarded after ingesting a prey. The behavior of A. girodi was observed after it physically contacted a prey with the center of its corona, and the numbers of prey so encountered, attacked, captured, and ingested were recorded.

All of the following prey organisms were, at least at times, very common in the plankton of Star Lake and were collected from there during the spring and summer of 1979: the dinoflagellate Peridinium sp., a peritrich
Results and discussion

A. Susceptibility of Kellicottia, Keratella, Rhabdostyla, and Peridinium to predation by A. girodi, clone 5A1

Predator-prey interactions between A. girodi and several types of potential prey were observed and quantified in some detail. All of these prey were of a size that could be captured and ingested, approximate body lengths or diameters being 60 μm for Peridinium, 80 μm for the small form of K. cochlearis, 120 μm for both K. bostoniensis and the large form of K. cochlearis, and 140 μm for Rhabdostyla. The results are shown in Table 1. Although there was considerable variability among replicates, perhaps partly due to variation in starvation times, a number of points can be made.

K. bostoniensis was rarely attacked and, once attacked, was rarely captured and never ingested. The basis for the failure of this prey to elicit attacks is not known. However, attacked individuals were clearly well protected from capture by their long anterior and posterior spines. Some specimens of K. bostoniensis, however, are occasionally found in the stomachs of A. girodi collected from Star Lake (R. E. Magnien, unpublished). Thus, this species is not entirely unavailable to A. girodi. It is also interesting to note that specimens of K. longispina have been found in the stomachs of A. herricki and A. priodonta (Ghilarov, 1977).

Both large and small forms of K. cochlearis were readily attacked, and about 20% of those attacked were subsequently eaten. Experiment 3 showed that there was little difference between the two forms in their susceptibilities to attack, capture, and ingestion. These results are similar to those obtained previously for the large form and are consistent with the common occurrence of K. cochlearis in the stomachs of individuals from Star Lake and other natural systems (Gilbert & Williamson, 1978; Gilbert, unpublished; R. E. Magnien, unpublished).

The peritrich Rhabdostyla was rarely attacked and, once attacked, was very rarely captured. It was unquestionably distasteful to A. girodi, since every individual that was captured was subsequently rejected.

The dinoflagellate Peridinium was also distasteful to A. girodi. The attack probability was low, compared to that for K. cochlearis, and, although every individual attacked was captured, every captured individual was rejected.

B. Susceptibility of intact and dissociated Conochilus to predation by A. girodi, clone 5A1

When adult A. girodi, starved for 6 hours, were placed together with colonies of C. unicornis, they would frequently attack those individuals of the colony that they contacted with the centers of their coronae. During these attacks, the predator would open its mouth and attempt to engulf the anterior part of the individual extending from the colony matrix. Often the predator succeeded, but almost invariably it soon released its prey, apparently unharmed. In only two instances was an individual ever dislodged from the matrix and eaten. Sometimes individuals would slowly contract into the colony matrix when attacked.

C. unicornis was definitely well protected against attacking A. girodi. The colony itself was much too large (about 900 μm in diameter) to be captured, and the individuals within it were too firmly embedded in the matrix to be extracted.

Adult individuals in C. unicornis colonies were about 140 μm in length and, when enzymatically dissociated from the colony matrix, were extremely vulnerable to A. girodi predators which had been starved for only 1-2 hours. Eight predators attacked and then ate the first specimen encountered. A ninth predator attacked the first four specimens encountered and ate three of these.

Slightly different results were obtained with C. dossuarrius, a solitary species in which individuals and their developing young are surrounded by a gelatinous matrix. Extended individuals were attacked much less commonly than in C. unicornis. Attacks never led to captures, because C. dossuarrius, with its matrix, was too large (about 600 μm in length) and because individuals could not be dislodged from their matrix.

As with C. unicornis, individuals dissociated from their matrix were vulnerable to A. girodi. Of the 14 young individuals encountered were attacked and ingested. Of the 11 adult individuals contacted, 7 (64%) were attacked.