Gammarus lacustris - herbivore or predator?

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ILKKA KORTELAINEN. Gammarus lacustris - herbivore or predator? Rep. Kevo Subarctic Res. Stat. 21: 31-34. 1990. - The capability of *Gammarus lacustris* of feeding on crustacean zooplankters was tested in a subarctic pond. *Gammarus* reduced the numbers of cladoceran *Sida* and copepod *Eudiaptomus* in experiments, but had little effect on *Heterocope*. The finding indicates that the amphipod is not restricted to herbivorous or detrivorous feeding.

KEY WORDS: *Gammarus lacustris* - zooplankon - predation - feeding mode - subarctic pond

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Introduction

The amphipod *Gammarus lacustris* G.O. Sars inhabits various sized ponds and lakes in Siberia, North America, Northern Europe and the British Isles, as well as alpine lakes in Central Europe. In Scandinavia studies dealing with the species have focused on life cycle and reproduction (Bjerknes 1974), karyology (Salemaa 1984) and factors underlying distribution (Segerstråhle 1954, Ökland 1969, Ökland & Ökland 1985). In Norway the species is perhaps the most important food organism for trout (Ökland 1969), but it is also preyed upon by other fish, such as char and perch. Locally its density can reach several hundred or even thousand individuals per square meter (Bagge 1964, Anderson & Raasveldt 1974).

In spite of the abundance of *G. lacustris* in many lakes and its importance as a food for fish, the ecology of the species, especially its feeding habits, are still relatively unknown. Analysis of the gut content has led to an emphasis on feeding on planktonic algae and detritus (Ermolaeva 1962, Koslucher & Minshall 1973, Moore 1977). According to Anderson & Raasveldt (1974) and Anderson (1980), on the other hand, Canadian populations of *G. lacustris* can be predaceous and capable of altering the zooplankton community structure in lakes and ponds.

In research concerning subarctic populations in northern Finland, the species has been regarded as a herbivorous scavenger (Bagge 1968, Salemaa 1984). To find out whether northern Scandinavian *Gammarus* is able to feed on co-occuring zooplankton as well, in situ predation experiments were carried out.

Methods

The experiments were conducted in a fishless pond near Kevo Subarctic Research Station (69°45', 27°N) in August 1986. The maximum depth of the pond was 2.5 meters; the bottom was mainly gravel and sand, with some organic debris. Aquatic vegetation was sparse except for a *Carex* belt covering some parts of the shore. *Gammarus* has been reported to dominate the bottom fauna biomass of this pond (Ijäs 1976), but in addition to the benthos it occurs in free water, swimming limnetically even close to the surface.

The experiments were carried out in one litre glass jars covered with 100 m nylon netting, with a single *Gammarus lacustris* in each jar. Three zooplankton species, all numerous in net plankton, were offered as prey: the calanoid copepods *Eudiaptomus graciloides* and *Heterocope borealis,* and the cladoceran *Sida crystallina.* Only adult zooplankters were used (egg carrying females of *Eudiaptomus* and *Sida,* the largest individuals of *Heterocope).* Prey densities and other details are given in Table 1.

Table 1. Experimental conditions in trials conducted.

Trial	Prey	Initial density (ind./l)	Length of trial (hours)	Water temp. (°C)	Date
A	Eudiaptomus	40	21	14	10.8.
B	Sida	20	20	12	14.8.
C	Heterocope	20	22	12	16.8.
D	Sida + Heterocope	10 + 10	20	10	24.8.

Before each experiment an appropriate number of swimming amphipods were caught from shallow water with a ladle. While the jars were being prepared, the amphipods were kept in a plastic pail which contained pond water filtered through 40 m mesh. Zooplankters were collected by casting a plankton net from the shore. The glass jars were filled with filtered pond water, and the plankters were counted into them by pipetting. After that the jars were randomized into pairs. One jar from each pair was then randomly chosen as a control, and a single *Gammarus* was placed in the other. The jars were covered with 100 m netting fastened with rubber bands, and placed at the bottom of the pond at a depth of about 30 cm. To reduce the variation arising from the heterogeneity of the substrate, the light conditions, and *Gammarus* size (13-22 mm), the treatment and control jars were placed at the bottom in pairs. After 20-22 hours the jars were removed, the contents filtered through 40 m mesh, and the animals flushed into plastic bottles and preserved in alcohol. The zooplankters were counted in the laboratory under a stereo microscope.

The difference between the number of zooplankters in jars containing *Gammarus* and in the control jars was tested using Wilcoxon's matched-pairs signed-ranks test (Sokal & Rohlf 1981: 448-450).

Results

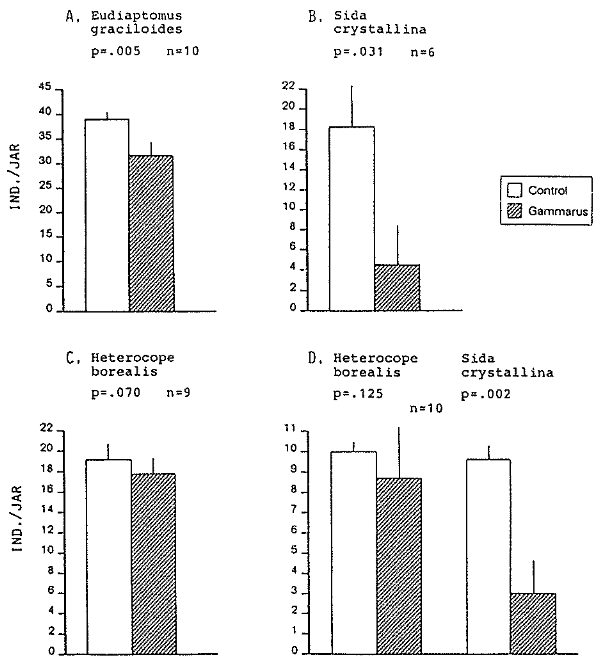

Fig. 1. Results of predation experiments A-D. Numbers of zooplankton in control jars and jars with a single *Gammarus* (mean, SD.), numbers of paired observations and p values for differences (Wilcoxon's signed-ranks test).

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The presence of *Gammarus* reduced significantly the number of *Eudiaptomus* and *Sida* in the experiments (Fig. 1). The effect on *Heterocope* was nonsignificant, although it was below the 10 % probability level. In the experiment where both *Sida* and *Heterocope* were present simultaneously (Fig. 1-D), the effect when tested separately was significant only on the number of *Sida*. In this case it was also tested whether there was a difference between the species in the response (H_0: difference between control and treatment for *Heterocope* - difference between control and treatment for *Sida* = 0). The result was significant (Wilcoxon, $p < 0.01$), confirming that *Gammarus* preyed selectively on *Sida* in this experiment. Slight differences from the expected numbers of zooplankton in the control jars were probably due to counting errors during the pipetting of the plankters under field conditions. However, on account of the randomization process this does not bias the results.

Discussion

Gammarus readily preyed on two of the three zooplankton species offered in these simple short term experiments. It was capable of catching small copepods (*Eudiaptomus*) as well as considerably larger cladocerans (*Sida*). Compared with *Sida*, *Heterocope* was successful in evading the amphipod, which is consistent with the results of Anderson and Raasveldt (1974). In their laboratory experiments *Gammarus* preyed on *Daphnia* and small calanoid copepods, but large calanoids were rarely eaten, evidently due to their better ability to escape. They also reported that *Chaoborus* larvae and the anostracan *Brachinecta paludosa* were consumed. Apparently *Gammarus* is not restricted to small prey species, but can catch available invertebrates of various size. At the pond I made two observations of swimming *Gammarus* carrying a plecopteran larva, comparable in size to the amphipods themselves. It was unclear, however, whether these had been captured alive or dead.

In these experiments zooplankton was the only food source available for the amphipods, except for algae and microzooplankton small enough to pass through the 100 m netting. The glass jars separated the amphipods from the benthos, and no alternative detrital or plant material was offered as a choice. Thus only the animals' capability for a predaceous mode of feeding was tested, not their actual feeding mode in the nature. The previously published results of other studies, based on gut content analysis, unfortunately do not shed light on this point either. Ermolaeva (1962) and Moore (1977) have compared the amounts and species composition of algae ingested with those available in the environment, but they give little information as to the rest of the material found in the guts (more than 86 % by volume of the contents according to Moore). Koslucher and Minshall (1973), however, detected only detritus and diatoms in the guts of specimens collected from a cool-desert stream.

In conclusion, there is no basis for classifying *Gammarus lacustris* as either a pure herbivore or a predator. Apparently the ingested food items can be variable, ranging from decaying material with associated micro-organisms to algae, zooplankton and other invertebrates. A predaceous mode of feeding may be advantageous especially in fishless ponds, as there the amphipods can safely swim actively in free water. If zooplankters or other aquatic invertebrates are present in adequate densities, *Gammarus* may profit from feeding on them, as live organisms may provide energetically and nutritionally better quality food than debris.

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