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Contrasting top down effects of amphibians and stocked fish in Austrian alpine lakes

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Abstract

Stocking fishless alpine lakes dates back to medieval times, but with the use of helicopters stocking activities have increased in the past decades. We present several cases of subalpine and alpine lakes in the Austrian Alps with contrasting impacts of amphibian and fish predators. Introduced fish eradicated natural plankton and amphibian communities. Once the stocked fish started to reproduce, the metazoan plankton communities changed from large, pigmented crustacean species to a dominance of rotifers. Fish preyed heavily on eggs and larvae of natural amphibian species.

Keywords

Alien species, amphibians, alpine lakes, fish stocking, plankton, top down

Results

Case Study 1

Fish stocking in Lake Dreibrüdersee (1643 m a.s.l.) in the Totes Gebirge massif failed in the 18th century and Alpine newts (*Ichthyosaura alpestris*) are still free to exploit the habitat. The calanoid copepod *Arctodiaptomus alpinus* was an important prey item for adults and larvae. The feeding pressure of the alpine newt population was estimated and found to be low compared to introduced fish. Gastric evacuation rates and daily food consumption of adults and larvae are considerably lower than in salmonids. Additionally, adult newts only exploit the habitat during summer at the lake bottom, have lower body mass than fish, and comparatively low fecundity (SCHABETSBERGER 1993; SCHABETSBERGER & JERSABEK 1995; JERSABEK & SCHABETSBERGER 1996; SCHABETSBERGER et al. 1996).

Case Study 2

Two pairs of neighboring alpine lakes located in the Northern Calcareous Alps of Austria were investigated: Großer Feichtauersee (1387 m) and Kleiner Feichtauersee (1394 m) in the National Park Kalkalpen and Schwarzsee (1414 m) and Karsee (1434 m) in the Dachstein massif. Each pair comprised a deeper lake containing European minnows (*Phoxinus phoxinus*), and a corresponding shallower lake harboring Alpine newts as top predators. Plankton successions within fish and amphibian lakes differed markedly from each other. Throughout the year rotifers numerically dominated within the stocked lakes, while pigmented copepods (Genera *Heterocope, Acanthodiaptomus*, *Arctodiaptomus*, *Mixodiaptomus*) and *Daphnia* were predominant in the amphibian lakes. We argue that size-selective predation by minnows was the ultimate reason for this predominance of smaller zooplankton (SCHABETSBERGER et al. 1995, 2006).

Case Study 3

The zooplankton community of Alpine lake Seehornsee (1,779 m) was studied over a period of 13 years. In 1994, a typical high-altitude zooplankton community, consisting of two calanoid copepods (*Mixodiaptomus laciniatus, Arctodiaptomus alpinus*), one cladoceran (*Daphnia rosea*), and two rotifers (*Keratella quadrata*, *Synchaeta pectinata*) coexisted with infertile charr hybrids, which had been introduced in 1969 and again in 1974. When the aged fish were removed by intensive gill netting, they had fed predominantly on aquatic insects. After a fish-free period of 4 years, 2000 fertile juvenile Alpine charr (*Salvelinus umbla*) were stocked in 1998 and again in 1999. They preyed on benthic (chydorids, ostracods, cyclopoid copepods, chironomid larvae and pupae) and planktonic prey (diaptomid copepods, Daphnia). Between 2004 and 2006 charr successfully reproduced. Nine years after stocking of fertile charr, the two calanoids had virtually disappeared, and *Daphnia rosea* had notably declined in abundance. In concordance with the size efficiency hypothesis, the newly appearing and smaller cladoceran *Ceriodaphnia pulchella*, together with the two resident, and two emerging species of rotifers (*Polyarthra luminosa*, *Gastropus stylifer*) dominated the zooplankton community (LUGER et al. 2000; SCHABETSBERGER et al. 2009).

Case study 4

During ten years of research in the Austrian Alps we characterized the zooplankton communities of 101 alpine lakes and ponds. Forty-eight of the water bodies could be classified as lakes. Of these 48 lakes 24 contained fish. Of the 24 fishless lakes 15 were inhabited by one, two or three large crustacean zooplankton species. The remaining 9 fishless lakes were not populated by diaptomid copepods or daphnid cladocerans. However, these ultraoligotrophic lakes were situated on granite bedrock at an altitude above 2200 m and did not support a diverse zooplankton fauna. Twenty-two of the stocked lakes contained only small-bodied cyclopid copepods and chydorid cladocerans, and the zooplankton community was dominated by rotifers (JERSABEK et al. 2001).

Case Study 5

Lake Sulzkarsee (1450 m) in the National Park Gesäuse has been stocked with salmonids (*Salvelinus fontinalis*, *Oncorhynchus mykiss*) and minnows (*Phoxinus phoxinus*) in the 1970s. After piscivorous salmonids were removed by intensive gill netting in 2005, *Daphnia longispina* was driven to extinction by the minnows. Accordingly, the proportion of phytoplankton to zooplankton biomass changed from 0.5 in 2005 to 4.7 in 2015. In an ongoing project we are trying to eliminate minnows from the ecosystem by draining the entire lake through siphoning. Intensive fishing on minnows in 2016 resulted in successful spawning of numerous common toads (*Bufo bufo*).

References

JERSABEK, C.D. & R. SCHABETSBERGER 1996. Limnological aspects of an alpine karst lake with extreme changes in water level. Limnologica 26: 1-13.

JERSABEK, C.D., A. BRANCELJ, F. STOCH & R. SCHABETSBERGER 2001. Distribution and ecology of copepods in mountainous regions of the Eastern Alps. Hydrobiologia, 453/454: 309-324.

LUGER, M. S., R. SCHABETSBERGER, C.D. JERSABEK & A. GOLDSCHMID 2000. Life cycles, size and reproduction of the two coexisting calanoid copepods *Arctodiaptomus alpinus* (IMHOF, 1885) and *Mixodiaptomus laciniatus* (LILLJEBORG, 1889) in a small high-altitude lake. Archiv für Hydrobiologie 148: 161-185.

SCHABETSBERGER, R. 1993. Gastric evacuation rates of adult and larval alpine newts (*Triturus alpestris*) under laboratory and field conditions. Freshwater Biology 31: 143-151.

SCHABETSBERGER, R. & C.D. JERSABEK 1995. Alpine newts (*Triturus alpestris*) as top predators in a high-altitude karst lake: daily food consumption and impact on the copepod *Arctodiaptomus alpinus*. Freshwater Biology 33: 47-61.

SCHABETSBERGER, R., C.D. JERSABEK & S. BROZEK 1995. The impact of Alpine newts (*Triturus alpestris*) and minnows (*Phoxinus phoxinus*) on the microcrustacean communities of two high altitude karst lakes. Alytes 12: 183-189.

SCHABETSBERGER, R., S. GRILL, G. HAUSER & P. WUKITS 2006. Zooplankton successions in neighboring lakes with contrasting impacts of amphibian and fish predators. International Review of Hydrobiology 91: 197-221.

SCHABETSBERGER, R., M. LUGER, G. DROZDOWSKI & A. JAGSCH 2009. Only the small survive - Monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions 11: 1335-1345.

SCHABETSBERGER R., S. BROZEK, K. ENTACHER, C.D. JERSABEK & A. GOLDSCHMID 1996. Effects of temperature and body weight on gastric evacuation rates of alpine newt (*Triturus alpestris*) larvae. Herpetological Journal 6/3: 75-81.

Conclusion

Fish introduction has detrimental effects on the natural communities in high-altitude lakes. Action should be taken to remove alien fish from lakes within protected areas.

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