

The Resettlement of Brown Trout in Alpine Streams of the National Park Hohe Tauern

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Introduction

During the last ice-age the European river systems have been formed. After glacier retreat the emerging rivers have been colonised by brown trout, *Salmo trutta*. Nowadays at least five genetically distinct lineages of brown trout are found (BERNATCHEZ 2001). The major part of Austrian waters belongs to the Danubian drainage system and it can be assumed that most autochthonous populations of brown trout belong to the Danubian clade (WEISS et al., 2001). Trout from the Rhine river system belong to the Atlantic clade. In the medieval age man started to stock brown trout from the rivers in fishless lakes and brooks. Thus, trout can be found in almost any mountain water body.

Beginning in the late 19th century trout populations began to decline due to the destruction of natural habitats by human activities and overfishing. As a consequence intensive stocking activities were initiated. However, most of the stocked brown trout in Austria belonged and still belong to domesticated strains of the Atlantic lineage. Furthermore, American species, namely the rainbow trout, *Oncorhynchus mykiss*, and brook trout, *Salvelinus fontinalis*, have been introduced. This introduction of allochthonous material led to altered population structures in most Austrian waters (LARGIADÈR & SCHOLL, 1996; OSIMOV & BERNATCHEZ, 1996; HANSEN. et al., 2000; WEISS, 2000, 2001; DUFTNER et al., 2003). Only in a few remote lakes and brooks descendants of the ancient populations survived until today.

Trout populations isolated from managed water bodies were sampled and the sequence of the mitochondrial control region was determined. This allowed for a separation between allochthonous Atlantic type and presumably autochthonous Danubian type trout. The fish populations from Anraser See and from Gossenköllesee were among the first being identified as homogeneous Danube clade brown trout (DUFTNER et al., 2003). Up to now at least 10 different homogeneous populations have been found in Austria. Microsatellite analyses of these populations indicate a very high homogeneity of these populations while overlapping alleles between populations are almost absent.

Field Experiments

The brown trout populations from the high mountain lakes Gossenköllesee and Anraser See were the first which were reproduced successfully and for which sufficient offspring was available to conduct stocking experiments in the field. Before stocking the brooks were electrofished to remove or to reduce the previous populations consisting of brook trout (*Salvelinus fontinalis*).

In all cases the reproduced Danube clade trout showed good survival and growth. Moreover, they stuck remarkably to the location where they were released and survived even high waters accompanied by massive gravel transport. Some data from Windbach are shown in Fig. 1.

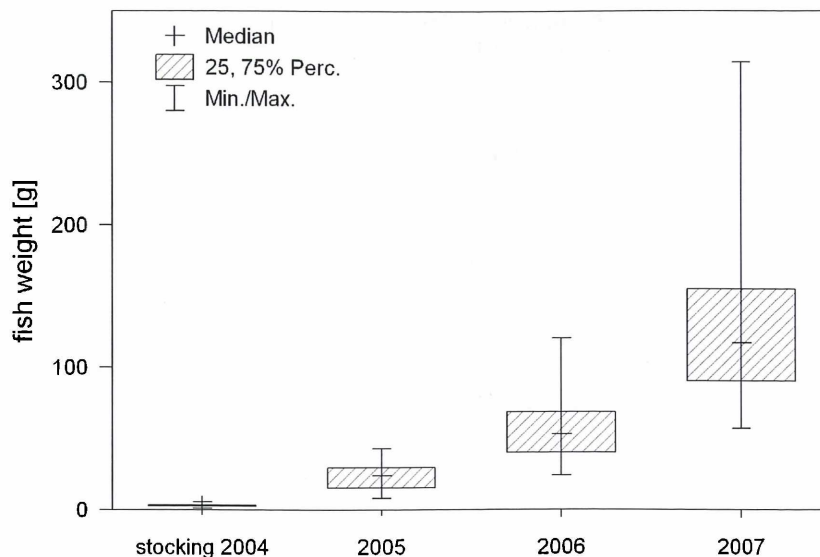


Figure 1: Growth of brown trout of the Anraser See clade in the Windbach (NP Hohe Tauern, Salzburg).

Laboratory Experiments

The growth rates of the reproduced fish fry were determined in the laboratory at 7 and 12°C offering commercial fish food *ad libitum*. Fig. 2 shows an example where the growth of commercially available fish fry (Atlantic clade) is compared with the growth of Danubian clade fry from the Anraser See population. Note that at the lower temperature growth rates for both are essentially equal as demonstrated by equal slopes of the regression lines. In this experiment the Atlantic fry was bigger at the start of experiment. This difference persisted during the whole experiment.

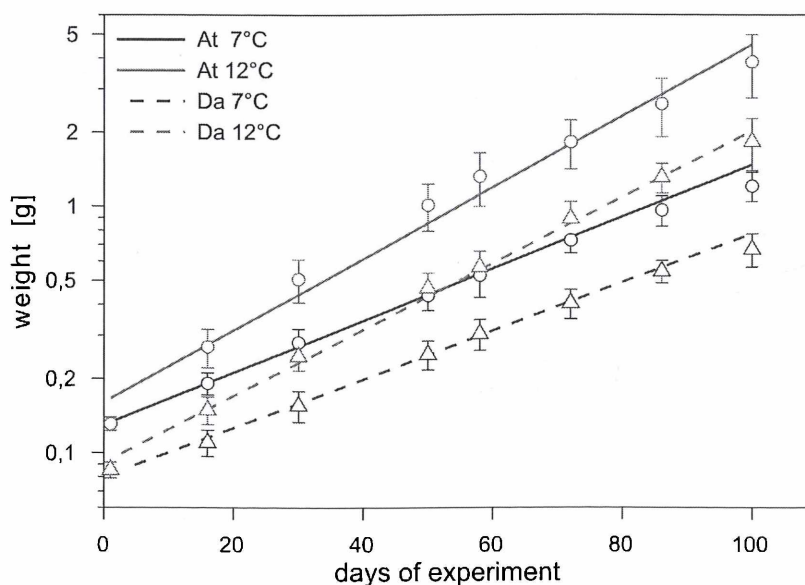


Figure 2: Growth of commercial (Atlantic clade, At) trout fry (circles and solid lines) and from the Danubian clade, Da, (triangles and dashed line) at 7 and 12 °C \pm S.D.

Discussion

Our data suggest that reproduced brown trout from relic populations are ideal for stocking in Alpine high mountain brooks. Most of these relic trout populations are small and have undergone some bottleneck selection. Although some of these populations survived for centuries in small mountain lakes (like in Gossenköllesee and in Anraser See) they still have the ability to settle and thrive in a brook. This advantages makes them the ideal fish for stocking the harsh and cold environments of the Alps.

Additional advantages include:

They are a native strain.

They are more resistant against high waters than hatchery raised domesticated trout.

They stay close to the stocking point.

Recapture efficiency is high.

Possible disadvantages:

Females gain full sexual maturity after 4 years only.

They may loose competition for food and space against allochthonous species, but presumably only in low land waters.

Most field experiments were done in the National Park Hohe Tauern. Only this shielded environment guarantees undisturbed development of fish populations.

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