# NICHE SEGREGATION OF ARCTIC CHARR AND BROWN TROUT – A RESULT OF DIFFERENT THERMO-REGULATORY BEHAVIOUR?

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## Introduction

If food is not limiting, fish grow at their maximum rate a species-specific temperature, defined as the optimum temperature for growth. It varies considerably between species (Brett, 1979) and it is generally correlated to their geographical distribution, with high latitude fish species at one end and tropical fishes at the other. Similar, under conditions of unrestricted food availability, fish has been shown to prefer a species-specific temperature, defined as the final preferendum temperature. In general, there is a good correlation between the optimum temperature for growth and the final preferendum temperature in fish (Jobling, 1981). Thus, it seems like fish actively select the temperature at which their growth rate is maximised.

The growth of Arctic charr (*Salvelinus alpinus* L.) and brown trout (*Salmo trutta* L.) at different temperatures have been reasonably well studied and their optimum temperatures for growth have been shown to be around 15°C (Larsson and Berglund, 1998) and 16°C (Forseth and Jonsson, 1994), respectively. The preferred temperatures of the two species have not however, been thoroughly examined. Since the optimum temperature for growth of charr and trout has been proposed to be one aspect in the niche segregation of the two species (Langeland et al., 1991), knowledge of the correlation between the final preferendum temperatures and the optimum temperature for growth are vital. Accordingly, the aim of this study was to estimate the final preferendum temperature of Arctic charr and brown trout, and to discuss the result in context of interspecific competition and niche segregation.

## Material and methods

The temperature preference of charr and trout were tested in aquaria, each divided in to two chambers that were connected via a tube. During the experiment, pelleted food was provided in excess at both chambers. A temperature difference of 1°C was created between the chambers and thus, fish were forced to choose between two temperatures. By a simultaneous stepwise increase (or decrease) by 1°C in both chambers every second day, the temperature at which the fish switched preference for one chamber to the other could be estimated. This temperature was regarded as the final preferendum temperature. The position of the fish (in the colder or warmer chamber) was recorded by applying PIT-tag antennas at the entrance between the chambers or by videotaping the fish at regular intervals during the experiment. In total, 20 charr and 11 trout were individually tested.

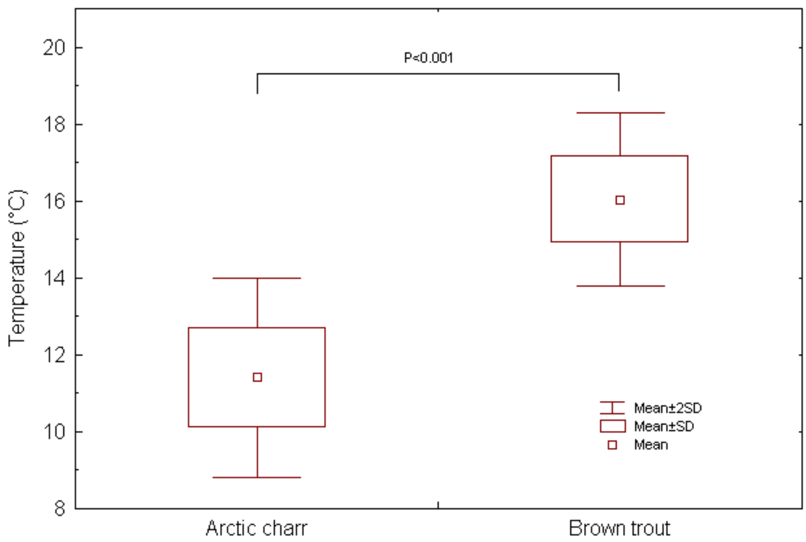
## Result and Discussion

Charr and trout preferred significantly different temperatures. Whilst the mean preferred temperature of charr was found to be 11.4°, the mean preferred temperature of trout was found to be 16.0°C (Fig. 1). The preferred temperature of charr is substantially lower than the temperature of about 15°C at which growth has been shown to be maximised. Thus, the thermo-regulatory behaviour of charr contradicts the general view of good correlation between optimum temperature for growth and the preferred temperature in fish. On the other hand, trout in this study preferred a temperature close to the optimum temperature for growth (16-17°C) and thus, trout thermo-regulated in accordance with the expectation.

The reason why charr has a seemingly “maladapted” thermo-regulatory behaviour remains to be explored. In general, the optimum temperature for food conversion efficiency is found at a lower temperature than at which the growth is maximised. For instance, in a recent study of growth and food intake of charr, the conversion efficiency was found to be highest at 9°C (Larsson and Berglund, 1998). Since charr mostly occupy cold and low productive lakes it is reasonable to assume that individuals that converts the sparse food in the most efficient way might be favoured by natural selection. Thus, it might be that charr thermo-regulate in order to optimise food conversion and not to maximise growth.

The thermal performance has in some studies been put forward as a factor involved in the frequently observed niche segregation of sympatric charr and trout in Scandinavia. In allopatry, charr and trout are both reported to utilise mainly near shore and littoral areas, whilst in sympatry charr is excluded from these areas by the more aggressive trout. The niche segregation pattern disappears in autumn when the temperature drops. Alloptaric charr populations in Scandinavia are mainly found in the mountain area at high altitudes. Available temperature records from a large number of lakes indicate that lakes above about 800 m a.s.l. may never exceed temperatures of 12°C during summer. Lakes inhabited by sympatric charr and trout populations are generally found at lower altitudes, where the summer temperature in near shore areas often exceeds 12°C, i.e. the preferred temperature of charr. Consequently, the observed niche segregation of charr and trout might merely be a result of differences in thermo-regulatory behaviour rather than the outcome of interference competition between the two species.

Figure 1. Boxplots of preferred temperatures of individually tested Arctic charr (N=20) and brown trout (N=11).

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