The Pace of Life of Juvenile Brown Trout

Inter- and Intra-individual Variation in Growth and Behaviour

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Gothenburg 2015

Akademisk avhandling för filosofie doktorsexamen i naturvetenskap, inriktning biologi, som med tillstånd från Naturvetenskapliga fakulteten kommer att offentligt försvaras fredagen den 30 oktober 2015 kl. 10:00 i Föreläsningssalen, Institutionen för biologi och miljövetenskap, Medicinaregatan 18A (Zoologihuset), Göteborg

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ISBN 978-91-628-9606-5 (PDF)
ISBN 978-91-628-9605-8 (Print)
Elektronisk version: http://hdl.handle.net/2077/40167

Abstract

The pace-of-life (POL) syndrome hypothesis is the prevailing model used for explaining the differences in how animals live their lives. The POL syndrome is a framework connecting life-history traits (traits describing the characteristics of the life cycle of an organism) with behavioural and physiological traits, which can be used to describe differences between species, individuals and even within single individuals at different energetic states. A fast POL reflects attributes such as increased risk-taking, high metabolism, fast growth, low cellular maintenance, proactive stress handling and shorter life expectancy, whereas a slow POL is attributed with the opposite traits. This thesis investigates both inter- and intra-individual differences in a range of POL traits in juvenile brown trout (*Salmo trutta*).

In a stream experiment, one-year-old (1+) trout were shown to elicit faster than normal growth rates (i.e. increasing their pace-of-life) following starvation. This phenomenon, commonly known as compensatory growth (CG), was observed over summer and autumn before diminishing in winter. Despite CG, a hypothesised decrease in cellular maintenance was not detected and survival was not significantly affected.

A subsequent stream experiment investigating the effects of food-restriction on trout in late autumn also showed that CG was not elicited in the winter. Nevertheless, food-restricted fish performed equally well in terms of survival and condition (length-mass relationship), when compared to well-fed fish in the following spring. However, seaward migration in spring appeared to be delayed as a consequence of this achievement.

Given that 1+ trout could elicit CG, the focus of the study switched towards trout fry (0+). Fry normally grow much faster than 1+ trout, which may affect their scope to further increase growth rates. The experiments showed that CG in fry could occur in the laboratory environment but not in the wild, suggesting that fry growth rates are environmentally constrained in nature. Investigation of the behaviour in fry following different food treatments indicated that their behaviour was not influenced by CG, which may be adaptive if higher than normal growth is impossible to achieve in nature at this life-stage.

Behavioural syndromes (associations between different behavioural POL traits) were found, generally reflecting different activity levels. More active 0+ fish had higher survival rates than less active ones, however no such difference was observed in 1+ fish. Instead, the more active 1+ fish appeared to grow better in high-quality habitats whilst in habitats of lower quality a more passive strategy was more beneficial. Thus, different behavioural strategies appear to be advantageous in different environments.

This thesis presents several results contradictory to the general POLS hypothesis, which may be attributed to the territorial life-style of trout. This highlights the importance of not assuming trait correlations or ecological consequences of single traits only because the POLS hypothesis predicts such associations.

Keywords: Behavioural syndrome, Compensatory growth, Growth rate, Mortality, *Salmo trutta*, Pace-of-life syndrome, State-dependent behaviour, Trade-off