Protein Growth Efficiency in 210 families of Rainbow trout assessed by x-radiography

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Introduction

Less than 10% of the world's farmed fish populations are under selective breeding (Gjedrem, 1992). Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*) are the most studied species with respect to their genetic characteristics. The traits under selection in fish species typically include growth rate, age at maturity and traits related to meat quality and disease resistance. Growth efficiency (defined as a ratio of standard growth rate to weight specific food consumption) is difficult to measure in fish and therefore is not usually included in selection programmes. This study examined feed intake and growth efficiency in farmed rainbow trout which were fed two experimental diets differing in protein content. It was important to measure individual feed efficiency if genetic parameters were to be estimated accurately during subsequent analysis. Therefore, X-ray techniques (reviewed by Jobling et al., 2001) were employed on a large scale. The overall goal was to establish a sufficient knowledge base for selection programmes aimed at improving growth.

Materials and methods

One-year-old rainbow trout (n=2931) bred from an ongoing Finnish selection programme were individually weighed, measured and tagged. The fish originated from 210 full-sib families of which pedigree was known since 1989. All fish were fed with commercial rainbow trout dry food (Royal Response, Rehuraisio Inc., Finland) for three months. In May 2002, two dietary treatments were started by feeding four tanks with normal protein (NP) diet (45%) and four tanks with high protein (HP) diet (55%).

Feed Intake

Length and weight data was collected for all individuals. Individual food consumption was recorded six times during two 3-week sessions by X-radiography as described by Talbot & Higgins (1983) and McCarthy et al. (1993). Prior to X-ray, fish were fed as normal but the pellets were labelled with 0.5% and 0.2% per weight radio-opaque ballotini glass beads for May and September respectively (Figure 1)

Growth

Specific growth rate (SGR, % of body weight increase per day, Ricker, 1979) and growth efficiency (GE per weight specific consumption) were determined for each fish based on feed intake data.

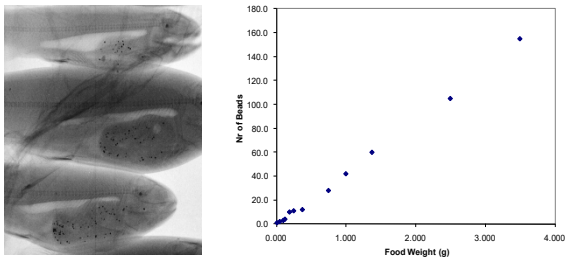


Figure 1. X-ray image demonstrating ballotini glass beads in *O.mykiss* and subsequent calibration curve based on bead count

Results

Total food consumption was significantly greater (P<0.001, two-sample t-test) for fish fed high protein diet than fish fed normal protein diet for each of the six X-ray weeks (Figure 2). However, there were no significant differences in specific growth rate between either group (HP/NP) for May or September X-ray sessions (Figure 3).

Figure 2. *O. mykiss* food intake for both normal protein (NP) and high protein (HP) diets (% body weight)

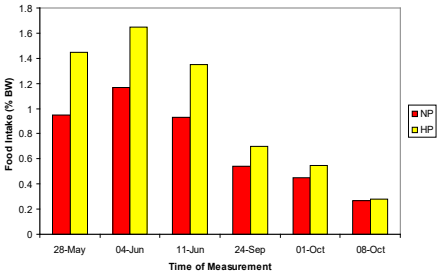
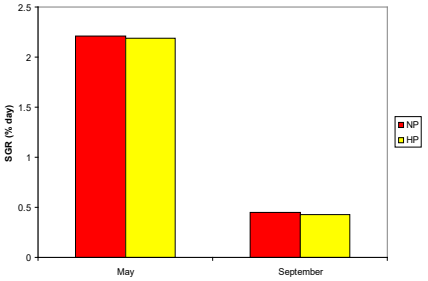


Figure 3. Mean specific growth rate (% day^{-1}) of *O. mykiss* individuals fed both normal protein (NP) and high protein (HP) diets for both X-ray sessions



Discussion

These findings show that rainbow trout are less efficient at converting high protein feed (55%) into net growth than normal protein feed (45%). Successive decreases or increases in food consumption evident for both diets across both X-ray sessions are most likely linked to temperature fluctuation. The inefficiency of the high protein diet is exhibited in Table 1 where growth efficiency for both X-ray sessions is greater for NP than HP.

Ultimately, the aim of examining the physiological traits analysed above for both diets across 210 families will be to establish the heritability of such traits. Also, it is hoped to uncover the influence of each trait on one another through correlation of random effect components.

Table 1. *O. mykiss* growth efficiency values for both normal protein (NP) and high protein (HP) diet regimes for both X-ray sessions

	Growth efficiency	
Diet	May 2002	September 2002
NP	2.20	1.31
HP	1.51	1.22

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