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DENSITY DEPENDENT GROWTH IN DOVER SOLE (*SOLEA SOLEA*)

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Introduction

Sole is considered one the most promising new species for aquaculture in Europe due to its high market volume and value. The economic feasibility of sole culture in land based systems will strongly depend on the productivity of sole in these systems. In order to accurately predict this productivity it is essential to establish the relationships between key factors determining productivity: stocking density and growth rate. For sole its known that stocking density affects both growth rate and growth dispersion (Howell, 1998). However, for sole over 15g of body weight and stocking densities that are likely to be applied on commercial farms, data are lacking.

Materials and Methods

Dover soles with an initial weight of 40g were stocked in a recirculation system in duplicate sets of stocking densities of 0.5, 1, 5, 7.5, 10 and 12kg.m^{-2} (8 till 195% bottom cover). The square tanks used, had a bottom surface area of 0.49m^2. Temperature was kept at 21°C. The fish were daily fed to satiation with a commercial extruded feed, which was administered by belt feeder for 20 hours per day. The experiment lasted for 55 days. The initial and final individual weights of all fish in the experiment were determined. From this the individual specific growth rates (SGR), the average SGR per treatment and the initial and final coefficients of variation (CV) per treatment were calculated.

Results

Mortality in the experiment was high (0-17%) and increased with increasing stocking density. Due to the mortality duplicates needed to be treated as individual treatments. Previous feeding trials at RIVO with Dover sole resulted in approximately 10% higher SGR for comparable stocking densities (Schram, unpublished data). In the current experiment the SGR was found to be significantly negatively related to stocking density (Figure 1). The difference between final and initial CV (ΔCV) was found to increase significantly with increasing stocking density. Howell (1998) found a similar trend for both the SGR and the CV for Dover sole of 1.5 till 13g at stocking densities ranging from 0.07 till 3.3kg.m^{-2}.

The total number of individual SGR in the experiment was divided into four equally sized parts, resulting in four SGR categories (see legend Figure 3). For each treatment the frequency per SGR category was determined (Figure 3). The proportion of fast growing fish per treatment was found to decrease with increasing stocking density.

Apparently the growth depression can be attributed to an increasing proportion of slow growing fish at increasing stocking density, rather than to equal growth depression for all fish in the population. The increased diversity in frequency of SGR categories at higher stocking densities explains the increase of ΔCV. According to Jobling (1995) poor disparate growth coupled to poor feed utilisation reflects a poor social environment. Therefore improvement of the social environment, e.g. a better feeding strategy, may very well result in improvement of the current growth results.

Based on the growth results the productivity was calculated for the different experimental stocking densities (Figure 4). An exponential relationship between productivity and stocking density was established. According to this relationship a stocking density of $12.5 kg.m^{-2}$ results in a productivity of $16.5 kg.m^{-2}.year^{-1}$. It was found that despite the decreasing growth rate at increasing stocking density, within the range of stocking densities in the current experiment, an increase in stocking density did not result in a decrease in productivity.

Figure 1: SGR vs. stocking density

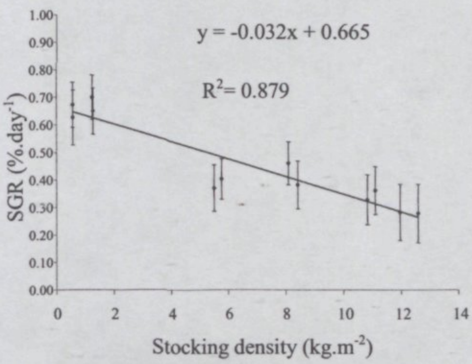


Figure 2: ΔCV vs. stocking density

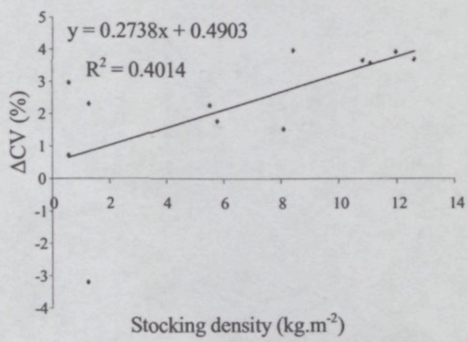


Figure 3:Frequency distribution of SGR categories

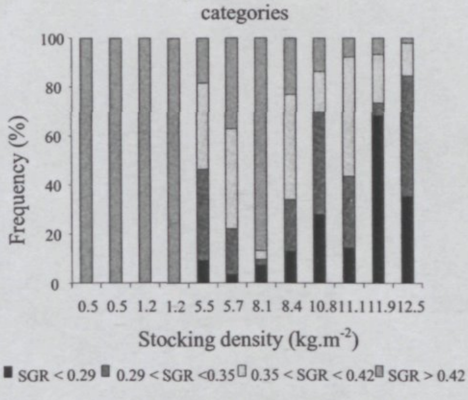
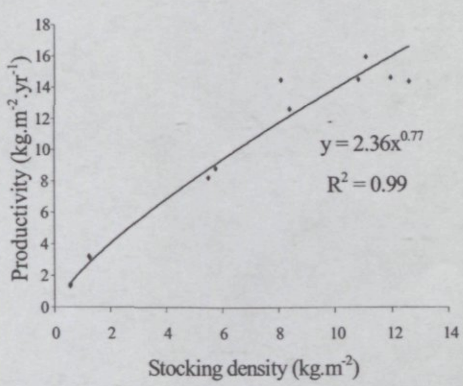


Figure 4: Productivty vs. stocking density



References

Howell, B.R. 1998. The effect of stocking density on growth and size variation in cultured turbot and sole. ICES cm 1998/L:10.

Jobling, M. 1995. Simple indices for the assessment of the influences of social environment on growth performance, exemplified by studies on Artic charr. Aquaculture International. 3: 60-65.