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Assessing the effects of a chronic stressor, stocking density, on welfare indicators of juvenile African catfish, *Clarias gariepinus* Burchell

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Abstract

Fish welfare is an area of increasing interest and stocking densities used in commercial aquaculture have been highlighted as a subject of specific welfare concern. The present study assessed how stocking density affects growth performance (final body weight, SGR, FCR), physiological (plasma cortisol, glucose, lactate) and behavioural (swimming activity, stereotypes, escapes, aggression, airbreathing) responses of farmed African catfish (*Clarias gariepinus*). We stocked African catfish (10 g) in triplicate in 120 l tanks at densities of 500, 1125, 1750, 2375, and 3000 animals/m^3. After exposure to stocking density, responses (plasma cortisol, glucose, lactate, number of lesions) to an acute stress challenge were studied. Growth performance, physiological and behavioural data showed little indications of impaired African catfish welfare within the range of densities examined in this study. However, the acute stress challenge gave indications that African catfish were in fact stressed. Catfish housed at densities of 500 and 3000 fish/m^3 showed signs of chronic stress, reflected by the absence of a cortisol response after an acute net stressor. Furthermore, fish housed at high densities (2375 and 3000 fish/m^3) showed a strong increase in the amount of skin lesions after the 1-h group housing after net-stress. In conclusion, an interaction effect between stocking density and additional stress was shown. Since additional stressors (e.g. handling, grading) are not uncommon in a farming situation, this means that the total farming situation may influence the effect of stocking density. Welfare of African catfish seemed impaired at both the lowest and highest density. Due to opposing data, the situation of fish housed at densities between 1125 and 2375 fish/m^3 is less

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clear. The higher aggression at the low end of this density range and increased escape attempts at the high end of this density range seem to be balancing each other. Which stocking density within this range should be regarded optimal depends on the relative weight assigned to the different parameters.

Keywords: Stocking density; Welfare; Stress response; Behaviour; African catfish; *Clarias gariepinus*

1. Introduction

In recent years fish welfare has been a much debated topic. Many animal rights associations have publically expressed their concerns on the welfare of farmed fish. Because of this, public, commercial, and governmental concern on the subject has grown (Anonymous, 1996; FSBI, 2002; Lymbery, 1992, 2002). Stocking densities used in commercial aquaculture have been highlighted as an area of specific welfare concern. Fish farmers are keen to rear fish at high densities, partly because operating at higher stocking densities can reduce production costs. However, stocking density has been demonstrated to affect various aspects of the welfare of farmed fish, although differences between species are distinct. High densities may impair the welfare of some fish species (e.g. trout, Ellis et al., 2002; salmon, Ewing and Ewing, 1995; seabream, Montero et al., 1999, while for instance Arctic charr grow more rapidly at high density, Jørgensen et al., 1993).

Published data on the effect of stocking density on growth performance of African catfish is contradictory. Several studies find decreasing growth performance with increasing density (Haylor, 1991, 1993; Hecht and Appelbaum, 1988; Hossain et al., 1998). Other studies show increasing growth performance with increasing density (Almazán Rueda, 2004; Hecht and Uys, 1997) or no effect of density (Hengsawat et al., 1998). Data on the effect of stocking density on behaviour show a positive effect of high densities on the behaviour of African catfish. Increasing densities reduce the occurrence of agonistic behaviour in African catfish larvae and juveniles (Almazán Rueda, 2004; Hecht and Appelbaum, 1988; Hecht and Uys, 1997; Kaiser et al., 1995a,b).

Information on the effect of stocking density on later life stages of African catfish is scarcely available. Furthermore, the stocking densities under investigation are generally low, making them hardly comparable to situations in modern aquaculture. Moreover, most studies focus on only 2–3 different stocking densities, making it difficult to come to a proper dose–response curve for the effect of stocking density on African catfish.

Therefore, the purpose of this study was to assess the influence of stocking density on possible welfare indicators of juvenile African catfish. A range of five stocking densities, comparable to densities applied in modern aquaculture, will be studied. Stocking density is often considered a chronic stressor, potentially leading to a suppression of stress responses. Therefore, a acute stress challenge (netting stress) was applied to reveal such a chronic stress situation. Such an acute stress challenge has been shown to give valuable, additional information on the effects of stocking density in fish (Di Marco et al., 2008) A range of dose–response relationships will be established for the effects of stocking density on growth performance, physiology, and behaviour with the ultimate goal to come to an optimal stocking density for this fish species at a weight range of 10–100 g.