Goldfish in a tank: the effect of substrate on foraging behaviour in aquarium fish

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Abstract

The welfare of captive animals is influenced by their ability to express natural behaviours. Foraging is one behaviour that may be particularly important in this respect; many species will continue to work for food even when it is freely available. The role of substrate, and in particular particle size, on the foraging behaviour of goldfish (Carassius auratus) was examined through three repeated measures experiments. In the first, tanks were set up with five uniform substrates: plastic grid, coarse sand, fine gravel, pebbles, and cobbles. In the second, fish were provided with a choice between coarse sand and fine gravel, fine gravel and pebbles, and pebbles and cobbles. In the third, they were provided with two choices between coarse sand and cobbles, one where the sand contained more food and one where the cobbles did. Our results show that particle size significantly affected the amount of time goldfish spent foraging, and that goldfish exhibited foraging behaviour even in the absence of a substrate they can manipulate. Goldfish foraged longest when provided with coarse sand. Fish foraged significantly longer over smaller particle size substrates when given a choice, although they did not distinguish between the two finest substrates, coarse sand and gravel. Increases in total time spent foraging were achieved through more, rather than longer, bouts. Food density did not significantly alter preference for smaller particle substrates. In general, coarse sand (1.5 mm) was found to be the most appropriate substrate in terms of facilitating natural foraging behaviours. These findings are discussed with respect to the welfare and husbandry of goldfish and aquarium fish in general.

Keywords: animal welfare, aquarium fish, foraging, goldfish, husbandry, substrate

Introduction

The majority of animal welfare standards and legislation pertain to mammals and birds. The welfare of species that are perceived as being either less valuable or more dissimilar to us, such as fish and invertebrates, has historically received disproportionately little attention (Broom 2007). There is a growing interest in the welfare of fish which are kept in ever greater numbers for aquaculture, research and as pets (eg Lund et al 2007; Algers et al 2009). Increasingly, fish are being recognised as being on a par with mammals and birds in aspects of their behavioural abilities and responses; there is mounting evidence that they have the capacity to feel pain and to suffer (for reviews, see Huntingford et al 2006; Broom 2007; Volpato et al 2007). Whilst Rose (2007) cautions against anthropomorphism in considering fish welfare, arguing against their capacity to feel pain as we know it or to experience boredom and other emotions, Volpato et al (2007) suggest a precautionary ethical position that, in the absence of conclusive contrary evidence, assumes fish to be sentient and thus capable of suffering.

The need for a greater understanding of the behavioural needs of fish has been highlighted by Huntingford et al (2006). Fish have been shown to be capable of complex feats of learning in a wide range of contexts (eg Brown & Laland 2002; Brown et al 2003); from this, we may expect them to suffer in much the same way as other vertebrates if kept in barren or otherwise unstimulating environments (Huntingford 2004). Volpato et al (2007) argue that physiological standards of assessing fish welfare are problematic and propose a preference-based definition. Preference tests, where an animal is given a choice of two or more resources, can provide a useful tool for gathering information on their priorities (Dawkins 1998, 2004). They have been used successfully with fish (eg Anthouard et al 1994), and may provide means to identify conditions that may promote better welfare (Huntingford et al 2006). They can be used to probe many aspects of fish husbandry, such as stocking density, water depth and flow rates, and lighting and feeding regimes (Volpato et al 2007). However, caution should be used in interpreting the results of such tests as animals may not always choose what is best for them. Preferences are only expressed between choices presented, and the most preferred option may be one that is not provided (Brydges & Braithwaite 2008). Here, we use preference tests to examine the effect of substrate particle size on foraging behaviour in goldfish (Carassius auratus).