

# Accepted Manuscript

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PII: S1558-7878(17)30176-4

DOI: [10.1016/j.jveb.2017.09.009](https://doi.org/10.1016/j.jveb.2017.09.009)

Reference: JVEB 1084

To appear in: *Journal of Veterinary Behavior*

Received Date: 5 September 2017

Accepted Date: 12 September 2017

Please cite this article as: Cooke, G., Stereotypic behaviour is not limited to terrestrial taxa: A response to Rose et al, *Journal of Veterinary Behavior* (2017), doi: 10.1016/j.jveb.2017.09.009.

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Abstract:

This comment is in response to a recent review of stereotypical behavior in captive exotic animals (Rose et al., 2017). Negative stereotypical behavior occurs across most if not all taxa, including notable aquatic invertebrates. A useful discussion of animal suffering cannot occur if we continue to ignore phylogenetically distant animals, especially when relevant information is becoming more easily available. Those interested in animal welfare and suffering must devise a plan and means to ensure all taxa are represented in such surveys and in the literature, and that their behaviors are assessed in ways meaningful to the species.

Keywords: abnormal repetitive behaviours; aquarium; zoo; invertebrates; fish;

## Abstract:

This comment is in response to a recent review of stereotypical behavior in captive exotic animals (Rose et al., 2017). Negative stereotypical behavior occurs across most if not all taxa, including notable aquatic invertebrates. A useful discussion of animal suffering cannot occur if we continue to ignore phylogenetically distant animals, especially when relevant information is becoming more easily available. Those interested in animal welfare and suffering must devise a plan and means to ensure all taxa are represented in such surveys and in the literature, and that their behaviors are assessed in ways meaningful to the species.

## Discussion commentary:

I am writing about what I consider the omission of vital information in a recent review of ARB (abnormal repetitive behaviors) in zoo animals (Rose et al., 2017).

The paper attempts to review stereotypic behaviors in captive zoo animals, including those found in aquariums which includes fish and invertebrates. Invertebrates are absent in the review.

My issue is that, despite mentioning that such taxa are underrepresented, the authors fail to cite the important papers that do have a focus on these taxa. How do we create momentum in aquatic animal welfare if highly relevant studies are ignored in review papers?

First, the authors state there is little evidence of ARBs in fish. The authors searched the literature broadly with respect to terrestrial animals (e.g., Broom and Frazer, 2007), but did not do so with respect to fish. In fact, the aquaculture literature contains papers dealing with stereotypic behavior in fish found in aquaculture (Schjolden et al., 2005; van de Nieuwegiessen et al., 2008), providing evidence that teleost fish respond with the same coping mechanisms as mammals.

Many captive non-domesticated zoo/aquarium animals have been studied extensively and could provide valuable information as they are often closely related to their cousins on display. Seeking out this information would benefit the field.

Second, two papers the authors do cite involve elasmobranchs (Scott et al., 1998a, b). These two papers attempt to address only one of the many known stereotypic behaviors in captive rays (*Raja* spp.) Scott et al. attributed the ARB 'surface breaking' to feeding or foraging in captive circumstances, but ignored the other ARBs (e.g., spiralling; Greenway et al., 2016). This ARB is observed no matter where the food is placed (Cooke pers. Obs.) and is likely exacerbated by the commonly seen touch pools, where visitors are encouraged to 'stroke' the animals, which the animals may view as interference. Greenway et al., (2016) provide information on the various other stereotypic behaviors (e.g., spiralling, bobbing) and show that stocking density and substrate type has a significant role in reducing ARBs in taxa that are commonly seen in public aquariums.

Another paper, not cited in this review, described how pacing may be contributing to spinal deformities in sand tiger sharks (*Carcharias taurus*) (Prezios et al., 2005). This species, too,

is a common public aquarium animal. These reports of stereotypic behavior suggest that the statement by Rose et al. "Behavioral divergence of captive animals from wild counterparts...appears to manifest itself as an absence of a normal behavior in ectothermic vertebrate, rather than in ARBs" may not reflect what the animals are actually doing once one looks.

The complete lack of discussion regarding invertebrates is distressing. Cephalopods are incredibly sophisticated, matching the abilities of many mammals. A wide variety are found across the world in public aquariums and zoos with aquatic facilities. National zoo bodies (e.g. ,BIAZA, AZA) state that octopuses exhibit stereotypical behavior (Slater and Buttlig, 2012; AZA 2014 respectively) and provide information on how reduce it (also see Cooke and Tonkins, 2015 for advice on cuttlefish). It is frustrating when zoo bodies, themselves, produce progressive advice on invertebrate suffering, which is then ignored by zoo researchers who are trying to inform both the academic and public readership.

Rose et al., have made some important points in their review paper. It is refreshing to see active members of the zoo community admitting stereotypic behavior cannot be cured in some individuals/taxa while others may always develop ARBs in captivity (see Rose et al., 2017 abstract), and therefore should not be kept as display animals.

However, complaining that taxa are underrepresented, and then ignoring data when they are available, helps no one appreciate current knowledge regarding poor welfare in captive aquatic animals. A discussion on how we can catalog and compare such data, and a plan for systematic collection and analysis of relevant behavioral data on all captive species would be welcome.

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