

sheets to mimic fronds of algae and pipework to act as hides. The RSPCA Assured Certification Scheme for farmed salmon already contains welfare standards for cleaner fish, which includes environmental enrichment considerations. This is also true of the Code of Good Practice that most salmon farmers follow.

Chapter 10 covers cleaner fish nutrition, whilst genetics is the focus of Chapters 11 and 12. Suggestions of Quantitative Trait Loci (QTL) for lice grazing in lump fish might seem somewhat premature, but major differences in grazing activity between lumpfish have been observed, so there are perhaps grounds for further research. Other chapters include transportation of cleaner fish (16) and cleaner fish fisheries (17).

Part III of the book is a practitioner's view of the state of the art on the use of cleaner fish in the different salmon-producing countries, with Chapters 18–23 summarising current practice in Norway, the UK, the Republic of Ireland, Iceland, the Faroes and Canada. The book concludes with Treasurer's thoughts on the future of cleaner fish. There is a degree of repetition, particularly in chapter introductions, but this is perhaps to be expected with so many contributing authors. Notwithstanding, it serves as an excellent source of information on both the biology of the main species of cleaner fish and current commercial practice for their use in aquaculture.

For an industry that often attracts negative attention, media coverage of the cleaner fish story has mostly been positive, and they are generally viewed as a more sustainable and environmentally friendly solution to sea lice control, compared with chemotherapeutic treatments. However, questions remain as to their welfare under farmed conditions, their fate at the end of their working life, and the wider ethics around use of one animal to support the commercial production of another. Some of the examples presented, where cleaner fish deployment eliminated or greatly reduced the use of chemical treatments, suggest that cleaner fish will continue to play a role in the integrated management of sea lice for the foreseeable future.

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### **Personality in Nonhuman Animals, First Edition**

Edited by J Vonk, A Weiss and SA Kuczaj (2017). Published by Springer, Tiergartenstrasse 15-17, Heidelberg, Germany. 340 pages Hardback (ISBN: 978-3-319-59299-2). Price £129.99.

The study of non-human animal personality has been subject to a considerable growth in interest across a number of academic fields over the last two decades yet, despite plenty of discussion, it has been rarely measured within the comparative psychology literature. Whilst there were considerable challenges in the assessment of human personality, such as the debates around whether the person or the context was more influential in determining a person's behaviour (the so-called person-situation debate, eg

Kenrick & Funder 1988), the difficulties in understanding and measuring (non-human) animal personality were even greater. The history of animal personality research is a disjointed, stop-start tale of lone scientists persisting in the face of adversity. From early acknowledgements of animals as 'individuals', descriptions of characteristics displayed in comparative ethological works (eg Hobhouse 1915), and Pavlov's 'constitutional differences'—broad classifications of animals on what he understood to be nervous system traits—which, although noted, were never formally incorporated into his research (Pavlov 1966).

In the field of ethology, individual differences in behaviour were more traditionally considered as noise, not requiring further investigation, but it is this field in particular that has witnessed a pronounced growth in interest, with personality becoming a key target of research in recent years (Réale *et al* 2010). This gear change appears to have been triggered by two key findings: the first being that behavioural differences have structure, tending to be stable over time and across different situations and contexts (Sih *et al* 2004a; Bell *et al* 2009); and the second that this temporal-context structure is a commonly occurring feature of many diverse animal populations (Gosling 2001; Sih *et al* 2004b; Réale *et al* 2007). Such structured behavioural differences in humans are termed 'personalities' and, hence, the term 'animal personalities' has been adopted into the animal behaviour literature (Gosling 2001).

Within animal welfare, the study of personality and individual differences is a very new area of research, benefitting greatly from the earlier advances made in animal behaviour, behavioural ecology and the comparative psychology literature. Early debates in the behavioural ecology literature helped to question and sharpen the terminology and definitions for terms such as coping style, behavioural syndrome and personality, all of which are common terms within the animal welfare lexicon. Furthermore, the interface between personality research and ecological research has provided evidence that individual variation influences both life history and population level traits, such as foraging (Ioannou & Dall 2016), disease transmission patterns (Keiser *et al* 2016), and population stability and extinction risk (Pruitt 2013). Many of these approaches offer intriguing insights for animal welfare research, such as ways of investigating the social transmission of emotions (Briefer 2018), and the factors that influence the dynamics of stray dog or cat populations (Smith *et al* 2019).

In Vonk, Weiss and Kuczaj's (2017) edited volume, *Personality in Nonhuman Animals*, we find a collection of 16 chapters on a highly diverse range of topics relating to the subject matter at hand. In a fast-paced, popular field of research as animal personality has become, there is always the possibility that science moves on before the printing press has finished its work, but in the case of this volume, the content is likely to continue to be valuable for many years to come. The book is divided into four themed sections: a detailed and engrossing history of personality research in non-human animals; different methodological

approaches and models; reviews of personality in different taxonomic groups (dogs, cats, pigs and zebrafish, plus a few less-expected but very interesting groups, such as sharks and reptiles); and the potential applications of animal personality research. Whilst all the chapters in this text are interesting and educational, providing a vast array of excellent examples that can — and inevitably will — be used to explain key points in future personality-focused lectures, these final chapters saw a considerable change in tone, moving into the realm of the largely hypothetical. This raises some exciting ideas, juxtapositions of concepts, and possibilities, many of which were largely or wholly unobserved and untested. Included within this is the potential application of personality research to animal boredom and curiosity, to conservation research, foraging ecology and the choices animals make in relation to food, and individual differences in response to environmental enrichment. Each of these subject areas offers a tantalising glimpse of some of the possible future avenues that await animal welfare research. Some of these avenues are better lit, with underpinning evidence that can help to guide the next steps. Others, such as those relating to animal curiosity, are very much uncharted, requiring exploration and testing of first principals in the first instance.

Overall, this volume offers an outstanding insight into the subject of non-human animal personality. It is well-written and consistent in tone and pitch across the multiple contributors, with minimal overlap in content between chapters covering similar ground. The level of detail makes the text perhaps better suited to a post-graduate and beyond audience, rather than an undergraduate one though the text is accessible so could be used by later stage undergraduates with appropriate guidance.

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