Book Reviews

Cleaner Fish Biology and Aquaculture Applications

Edited by J Treasurer (2018). Published by 5M Publishing Ltd, Benchmark House, 8 Smithy Wood Drive, Sheffield S35 1QN, UK. 515 pages Hardback (ISBN 9781912158218). Price £150.00.

This book perhaps requires some context for readers unfamiliar with the concept of cleaner fish, or indeed much background knowledge of the salmon farming industry. Salmon farming is now an established global industry, with 2.5 million tonnes of Atlantic salmon produced in 2016. Where there are farmed salmon, there are usually sea lice, which are ectoparasitic copepods that complete part of their lifecycle on certain species of salmonids. These sea lice pose a major challenge in all the major salmon-producing countries (ie Norway, Chile, Scotland, Canada, the Faroes and the Republic of Ireland). If left unchecked, sea lice can pose a serious threat to fish welfare, causing scale loss, lesions and increased susceptibility to other infectious diseases. There is also a concern that sea lice from farmed salmon may infect wild salmonids, which is one of the major indictments of the salmon farming industry, constraining its expansion.

Traditional control of sea lice in aquaculture has been through use of a small number of therapeutants to which lice have been able to develop varying degrees of resistance. This has led to a recent proliferation of novel, non-medicinal sea lice control measures, which includes the deployment of so-called 'cleaner fish'. Cleaner fish species include lump fish and various species of wrasse, which are stocked in net pens alongside the farmed salmon, where they actively graze on the lice attached to the surface of infested salmon.

Chapter 1, which is written by the book's editor, Dr Jim Treasurer, provides an overview of the sea lice challenge and the use of cleaner fish from the first efforts in the early 1990s, through to current practice where tens of millions of these animals are used each year. Treasurer, one of the pioneers of modern aquaculture, has had a long and distinguished career focused on optimising husbandry practices for a variety of the less mainstream marine aquaculture species. The book is divided into three parts, focusing on: (i) biology and rearing of wrasse and lumpfish; (ii) advances in cleaner fish science (thematic); and (iii) cleaner fish developments in various countries, before concluding with the editor's thoughts on the future for cleaner fish. More than 60 authors have contributed to the book, including fish farmers, academics, fish health biologists and veterinarians, reflecting the scale and degree of effort currently focused on cleaner fish.

The book is aimed at fish farmers and aquaculture researchers, as a practical guide providing a snapshot of our collective understanding of the biology, rearing and deployment of cleaner fish. It is also relevant for those with wider involvement in the Atlantic salmon value chain, providing insight into the increasingly important role cleaner fish are playing in salmon farming together with costs and implications.

Chapters 2–5 are dedicated to wrasse, with chapters 2 and 5 focusing on their reproductive physiology. The practicalities of optimal rearing and rearing and stocking are covered in Chapters 3 and 4 from the perspective of salmon farm biologists. There is currently a reliance on wild-caught wrasse for use as cleaner fish and millions of these long-lived animals are captured each year and deployed on salmon farms. This trend is reflected in the book which focuses, understandably, on how to increase the output of wrasse that are farmed for purpose to reduce pressure on the fisheries.

Chapters 6–8 describe lump fish biology, reproductive physiology and effective hatchery management as well as their deployment on salmon farms. Compared to wrasse, hatchery production is easier in lump fish as their eggs are easy to access and their hatchlings can be quickly weaned on artificial diet. This is more complicated with wrasse due to their spawning behaviour and sensitive larval stages, which require live feeds. Chapter 9 summarises findings from the commercial deployment of lump fish, with some encouraging trials presented that showed significant growth, feed conversion and lice reduction benefits when lumpfish were stocked with large (> 2 kg) Atlantic salmon.

Although lump fish may be the easier species when it comes to rearing, they share similar challenges to wrasse when it comes to health and welfare, which is the subject of Chapters 13–15. It's clear from these chapters that both wrasse and lump fish are highly susceptible to diseases under farmed conditions, with high mortality rates and a plethora of newly identified diseases listed. There is obvious concern surrounding potential transmission of diseases from the cleaner fish to cohabiting farmed salmon. This is particularly true of notifiable diseases, such as Viral Haemorrhagic Septicaemia (VHS) that have been isolated from lump fish, although the authors report no recorded cases of transmission across species. Salmon farmers are strong advocates of a preventative approach to fish health management and a commercial vaccine for some of the major diseases for lump fish is already in use and mentioned at several points in the book, whilst autogenous vaccines appear to be used for wrasse.

For those with an interest in animal welfare research, Chapter 15 will be the highlight of this book. It begins with a good introduction to fish welfare, before going on to discuss a range of operational welfare indicators (OWIs) for wrasse and lumpfish, which include fin, jaw and eye damage. Behavioural welfare indicators, such as swimming behaviour, aggression and ventilation rate are also described, although the authors acknowledge the need for greater research in this field. Recommendations are made, here and elsewhere in the book, for environmental enrichment for the benefit of the cleaner fish, using plastic

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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

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