mistakes with common names of at least one species and some of the references to the value of EEG for detecting loss of consciousness do not match with the experience of my co-workers who find it a complex tool to use and certainly not an easy off-the-shelf answer.

So, to conclude, did we need another review of fish welfare? After reading the book from cover-to-cover, I would say we did and there is a great deal of value in this book.

I would certainly advise all students or early career scientists working in the field of fish welfare to read *The Welfare of Fish*. For those longer in the tooth (or the field), you will also find value, novelty and some beautifully written text.

Reference

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Understanding the Behaviour and Improving the Welfare of Chickens

Edited by C Nicol (2020). Published by Burleigh Dodds Science Publishing, 82 High Street, Sawston, Cambridge CB22 3HJ, UK. 688 pages Hardback (ISBN: 978-1786764225). Price £170.00.

Written by scientists throughout the western world, *Understanding the Behaviour and Improving the Welfare of Chickens* is an easily interpretable book encompassing multiple facets of chicken behaviour (genetics, sensory and pain perception, cognition and sociality), providing a coherent overview of current welfare challenges (related to breeding, management and housing) and offering abundant suggestions and tools to monitor and improve welfare in poultry. Targeting all professionals in the field, not to mention researchers, students, producers, breeders and all other poultry-related professions, the book expertly outlines both scientific and commercial advancements. Directions for future research and development are given, while considering their feasibility as regards finance, practicality and commercial demands within the industry.

At the start of the book, a concise introduction outlines the chapters and their content. Each chapter provides an overview of current knowledge on the topic in question, accompanied by an outline of advances in both scientific and applied fields. The chapters are written by twenty-five authors, all scientific experts in the subjects discussed. Each chapter states separately what knowledge or potential solutions to improving welfare are missing from their field. Some authors also detail hypotheses for further investigations.

Instances in which no unequivocal answer to a question exists or a clear understanding is lacking, sees various views and arguments presented by different authors. This illustrates gaps in knowledge and how much research is still required. However, explicit references to other chapters in the book stating different perspectives are often lacking, which makes the book less coherent overall and challenges the reader to formulate their own judgements. Also, chapter order is, at times, unhelpful as issues relating to different breeds, namely broilers and laying hens, do not always follow consecutively.

The book is divided into parts one and two, organised into eight and ten chapters, respectively. The first part, entitled 'Behaviour', offers a broad explanation of chicken behaviour (in terms of genetics, physiology and ethology) as well as providing scientific tools to monitor and enhance their welfare (by sensor technology and welfare assessment protocols). The second part, 'Welfare issues in breeding, management and housing', focuses on the applied part of the poultry industry, including specific welfare compromises and ways of improving the farming environment to meet the behavioural needs of specific poultry breeds.

What stands out in the opening chapters is the emphasis on the importance of studying sensory capabilities (Chapter 2), pain perception (Chapter 3), cognition (Chapter 4) and social behaviour (Chapter 5), from the chickens' point of view. What may intuitively seem natural or painful to humans may not be perceived similarly in poultry. Guarding oneself against anthropomorphism is imperative when working with animals, especially when focusing on their well-being.

From genetics (Chapter 1) to sensory perception (Chapter 2), the first part of this book covers a wide range of disciplines. Moreover, it introduces a variety of tools to monitor welfare, by observing behaviour (Chapter 5), applying sensor technology (Chapters 6 and 7) and using welfare assessment protocols (Chapter 8). Each considers the feasibility in practice when it comes to offering advice to professionals in the field, in terms of finances, practicality, efficacy and acceptance by the industry. This is an important aspect, since most of the presented outcomes are from more fundamental research investigations, performed in experimental settings — a potential hindrance for translation of the results into practical implementation.

More specifically, Chapter 1 (entitled 'Advances in understanding the genetics of poultry behaviour') gives an expert introduction to Quantitative Trait Loci mapping and related methodologies, which are used to unravel the genetics behind poultry behaviour. Because of the high level of information provided and the use of many field-specific abbreviations, the general impression is that this chapter is not written for laymen. In contrast, Chapter 3 ('Understanding states of suffering with implications for improved management of poultry') discusses discomfort, suffering, and pain perception in chickens in an easily understandable style. Undeniably, this is an important topic due to its obvious and direct link to welfare. This chapter offers a broad overview of states of suffering and related factors in farmed poultry, and it's a subject all professionals in the field should become acquainted with. Lacking, unfortunately, is a discussion of positive emotional states in poultry and mention of future possibilities to investigate emotions further.

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Chapter 4 ('Understanding chicken learning and cognition and implications for improved management') provides readers with a comprehensive overview of chicken cognitive abilities. The — incorrect — general assumption that poultry are not very bright highlights the importance of this chapter.

The following ten chapters (part 2: 'Welfare issues in breeding, management and housing'), focus more on the applied part of the poultry farming industry. It covers diverse welfare and health challenges related to different breeds and types of chickens, including broilers (Chapters 11 and 18), broiler breeders (Chapter 9), laying hens (Chapters 12, 16 and 17) and young layer chicks (Chapter 10). In addition, all chapters discuss current management and housing topics related to poultry welfare in detail, such as the role of perches (Chapter 13), catching and transport practices (Chapter 14) and slaughter procedures (Chapter 15). These chapters provide a relevant and well-written overview for a wide audience, making it possible for many to better understand and improve chicken welfare.

Chapter 10 is entitled 'Opportunities to improve the welfare of young chickens' and offers a thorough examination of the indirect effects of parental genetics and environment and of incubation conditions on young chick development and welfare. The role of neurobiology in chicken welfare is also described. This chapter manages to skilfully link several complex fields (including ontogeny, stress regulation, brain lateralisation, immunity and the external environment), while discussing current welfare issues and innovative solutions. Although the neuroendocrine mechanisms of chicken physiology and their relation to welfare are sparsely mentioned throughout the book, Chapter 16 ('Cause and prevention of injurious pecking in chickens') further relates these mechanisms and early life experiences to the development of feather pecking. This is a major welfare issue for laying hens and additionally stresses the importance of understanding chicken neurobiology to improve health and welfare.

Chapter 11 ('Welfare issues in poultry housing and management: broilers') starts with a clear introduction and outline of housing systems and management in broiler production. The information that over a period of fifty years, broiler growth has increased by 400%, while feed conversion has improved by 50%, brings into focus the rapid genetic alterations in broilers which may now have surpassed our knowledge on how to safeguard the health and well-being of these animals. This chapter also provides an in-depth discussion on pressing broiler welfare issues and presents clear avenues to pursue for future research, including studies focused on slow-growing breeds.

Chapter 15 ('Improving welfare in poultry slaughter') begins with an expert description of the unique avian respiratory system, highlighting how it differs physiologically from mammals, whilst also underlining the impact of these differences on gas slaughter techniques. The chapter also highlights the general lack of sufficiently humane slaughter methods and the urgent need for research and development of improved slaughter procedures for poultry.

In conclusion, *Understanding the Behaviour and Improving the Welfare of Chickens* is an expertly written, widely accessible book for all professionals in the field, which should provide increased understanding of chicken behaviour and welfare. The book offers valuable guidance, including future research focus to close substantial knowledge gaps, practical up-to-date management improvements and the development of novel housing systems and farming methods, all contributing to the improvement of welfare in poultry.

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The Slaughter of Farmed Animals: Practical Ways of Enhancing Animal Welfare

Edited by T Grandin and M Cockram (2020). Published by CABI Publishing, Wallingford, Oxon, UK. 336 pages Paperback (ISBN: 9781789240573). Price: £49.99, €60.00, US$70.00.

This detailed and comprehensive guide to the complex field of welfare at slaughter is an extremely useful practical reference text and resource of evidence-based opinion, edited by two leading figures and with contributions by a number of key experts from across the globe.

The book is usefully divided into chapters which deal with a distinct area of the science or ethics of welfare at slaughter; beginning with generalised concepts of animal welfare, progressing through the various stages of transport, handling, restraint, stunning, slaughter, meat quality and auditing. The book concludes with several chapters which examine the ethical issues of slaughter from various standpoints. The book also objectively discusses the concept of welfare trade-offs and the practice of religious slaughter; often considered to be areas of sensitivity. Each chapter begins with a brief summary of key points and learning objectives, finishing with a concluding statement and expansive reference list. In this format, with its stated intention of acting as a resource for commercial abattoirs and for those conducting detailed scientific reviews, it should be considered an essential supporting text to any self-directed or structured programme of study. The international contributions authored by experts in both livestock and poultry slaughter from the UK and Europe ensure that the text is balanced in its coverage of red and white meat systems and avoids a North America-centric viewpoint.

The intended readership is listed to include anyone involved with or interested in the operation of a commercial slaughter facility, from students to animal welfare officers and factory managers. The level of detail and depth of discussion offers any reader the opportunity to expand their understanding of the practicalities and considerations in achieving high standards of welfare at slaughter. However, in this approach, there is inevitably an expectation of a baseline level of understanding of scientific principles, biochemistry, physiology and of commercial slaughter. Consequently, readers without a working knowledge of these prerequisites may