



**Baldisserotto B., Urbinati E.C.  
& Cyrino J.E.P. (Eds.) 2020.  
Biology and Physiology of Freshwater  
Neotropical Fish.  
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South and Central American tropical freshwater fishes are among the most diverse fish groups. They account for about 20–25% of the World's fish diversity. According to ALBERT et al. (2020), more than 6,200 fish species have been reported in Neotropical freshwaters and this number is still increasing. Most Neotropical fish species belong to five orders: Siluriformes, Characiformes, Cyprinodontiformes, Cichliformes and Gymnotiformes (DAGOSTA & DE PINNA 2019). The study of biological and physiological features of fish species is one of the most important

and necessary parts in ichthyological research that has attracted the attention of many researchers (e.g. RADKHAH & EAGDERI 2019, 2020). Due to the exceptional diversity of Neotropical fish species, the present review is devoted to the book *Biology and Physiology of Freshwater Neotropical Fish* edited by B. Baldisserotto, E.C. Urbinati and J.E.P. Cyrino. In the following text, we briefly review each of the 14 chapters of this book.

The first chapter focuses on the phylogeny and systematics of Neotropical fishes. The phylogenetic relationships between modern and extinct fish groups are examined. The diversity and classification of Neotropical clade Otophysa that includes the orders Siluriformes, Gymnotiformes and Characiformes are examined. A review on the modern developments in understanding the diversification of the Neotropical clade Euteleostei (including Cichliformes and Cyprinodontiformes) is presented. The authors conclude that further changes in the classification of Neotropical fishes can be expected due to the current extensive investigations, especially in orders belonging to the Euteleostei as well as in the family Characidae. Chapter 2 studies the anatomy of bony and elasmobranch fish. The general features of the external features and internal anatomy are reviewed, including scales, fins and tegument. The physiological characteristics of bony fishes and elasmobranchs are discussed. The authors represent the nutritional, respiratory, buccal, Weberian apparatus, excretory, reproductive, nervous and endocrine systems. At the end of this chapter, the general anatomy of Neotropical characins, siluriforms and cichlids is reviewed. Chapter 3 discusses the genetic basis of the physiology. The role of environmental factors and genetic traits in reproductive physiology are discussed. It is emphasised that genetics provides essential tools for ecotoxicological studies. In the concluding sections, the authors address important concepts such as triploidy and transgenic approach in the physiological studies.

In Chapter 4, the authors discuss the structure of fish behaviour and welfare. They describe various behaviours, including territoriality, aggression and reflex behaviour. Chapter 5 is focused on stress and the immune system; responses to stress are examined, including primary, secondary and tertiary responses. Innate and acquired immune systems in bony fish are discussed. The authors also point to the relationship between the immune system and humoral compounds. Humoral immunity is an aspect of immunity triggered by macromolecules in extracellular fluids such as antibodies, complement proteins and some antimicrobial peptides (JANEWAY et al. 2001). Chapter 5 is devoted to strategies modulating the immune system. They include catecholamines, cortisol, immune stimulants and cytokines. Strategies improving the immune system are further discussed; these include the use of micronutrients, probiotics and prebiotics. Immunostimulants such as lactoferrin, levamisole and  $\beta$ -glucans can play an important role in improving the fish immune system. Among the immune stimulants,  $\beta$ -glucan is the best known and most widely used. It should be noted that  $\beta$ -glucan, being an immune stimulant, is also known as a prebiotic.

Chapter 6 deals with the evolution and physiology of electroreceptors and electrical organs. In this chapter, the evolutionary aspects of electroreceptors and electrical organs are first discussed. Electroreception occurs in various groups such as lampreys (Petromyzontiformes), cartilaginous fish (Chondrichthyes), lungfish (Lepidosireniformes), South-American electric fish (Gymnotiformes) and catfish (Siluriformes). Chapter 7 is focused on colour and physiology of pigmentation. Pigment cells and pigment system of fishes are examined. In addition, the authors refer to

the mechanisms of transport of pigment granules. They also look at colour (chromatic) adaptations in fish and explain the adjustments of these adaptations. Chapter 7 discuss the changes of the colour pattern in response to environmental stimuli. In the final part of this chapter, the authors state that melanocyte-stimulating hormone, melanin-concentrating hormone, catecholamines, melatonin and endothelins are involved in the regulation of pigment cells.

Chapter 8 is relatively short, focusing on the cellular and molecular properties of skeletal muscles. The morphology of skeletal muscles is first discussed. Embryonic growth (myogenesis) and postembryonic skeletal musculature growth are examined. An important part of Chapter 8 deals with muscle anabolism and catabolism. Interestingly, the authors are looking at skeletal muscle growth genetically and using MicroRNA analysis. At the end of the chapter, the authors refer to primary myoblast cell culture and its use as a tool to study myogenesis *in vitro*. Chapter 9 is focused on the cardiovascular system. The authors first explain the anatomy of the heart and then discuss its physiology. They also refer to the function of atrial and ventricular muscle cells. At the end of the chapter, the authors focus on controlling cardiac functions, including effects of temperature, hypoxia and pollutants on cardiac function.

Chapter 10 examines the relationship between oxygen consumption and fish metabolic rate. The respiratory function is considered in relation to environmental factors such as hyperoxia, hypoxia, temperature and pollution. Here, we need to explain an important point. Although the environmental factors mentioned are very important, it would be important to examine the role of salinity and pH in the respiratory function, which is lacking in the text. Chapter 11 discusses the nutritional aspects. This chapter refers to the macronutrients, such as proteins, carbohydrates and lipids, and micronutrients (vitamins, minerals and dietary supplements). The nutritional and digestive system is described and its various parts are mentioned, including the mouth and pharynx, oesophagus, stomach, intestines, liver and pancreas. In Chapter 11, the authors focus on nutrition ecology and feeding habits and adaptations. An important part is the introduction of digestive enzymes (proteases, lipases, cellulase, amylase, carbohydrases, disaccharidases, chitinase, pepsin, trypsin and chymotrypsin). Chapter 12 is focused on osmotic and ionic regulation. The organs and tissues involved in osmotic regulation are reviewed. These include the epithelium, gills, gastrointestinal tract and renal system. The authors discuss the effects of hypoxia, water hardness, pH, and dissolved organic matter on the osmotic regulation.

Chapter 13 examines reproduction and embryogenesis. It is one of the most important and practical chapters. The authors first describe the structure of gonads and their stages of maturation. They also comment on the reproductive period, spawning season and fish fecundity. The embryonic development is also considered. In Chapter 14, in addition to gametogenesis, the brain-pituitary-gonadal axis is investigated. The authors describe the hypothalamus and pituitary gland. In Chapter 14, oogenesis and spermatogenesis are reviewed. In the oogenesis section, oocyte development is considered; most importantly, vitellogenesis and hormonal control of oogenesis are explained. In spermatogenesis, the authors first describe the morphology of the testis and then focus on the reproductive cycle of males. In addition, they address the structure of spermatozoa and hormonal control of spermatogenesis.

The present book has obvious positive points that need to be mentioned. From our point of view, these are the most important positive features: (a) The use of appropriate colour images to teach the physiology of fish. It should be noted that in this book, in addition to colour images, schematic figures have been used to show physiological processes. Certainly, using schematic illustrations can make it easier for readers to understand the physiology of fish. (b) The book has been written by many researchers and experts who have worked in the field of fish biology and physiology. In this regard, it can be acknowledged that the present book can be a valid reference for researchers around the world. (c) Use valid and up-to-date references – given that the present book was published in 2020, it can be used as a new and authoritative source by the academic community.

However, we have observed some disadvantages and shortcomings: (a) It would be useful to provide an abstract at the beginning or end of each chapter. Certainly, providing a summary of each chapter can be helpful in better understanding the topic. (b) The main shortcoming of the book is the lack of a comprehensive explanation of the knowledge gaps and unresolved questions about the biology and physiology of Neotropical fish. This information could be added as a chapter at the end of the book. It should be noted that articulating challenges and gaps ahead in the biology and physiology of Neotropical fish could pave the way for future ichthyological research.

This book, in spite of its small shortcomings, has interestingly studied Neotropical fish from biological and physiological aspects. In this regard, it can be acknowledged that the book is a good guide for researchers, especially for physiological aspects. We believe that this book, because of its extensive coverage of fish physiology, can answer many questions from students and researchers around the world.

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