# Preface

This book is the first dedicated entirely to *Sound Communication in Fishes*. The topic has frequently been included in other books such as 'How Animals Communicate' edited by Sebeok (1977), 'Hearing and Sound Communication in Fishes' edited by Tavolga et al. (1981), 'Behaviour of Teleost Fishes' edited by Pitcher (1993), 'Communication in Fishes' (first volume) edited by Ladich et al. (2006) and 'Fish Bioacoustics' edited by Webb et al. (2008). Except for 'Communication in Fishes' the number of chapters dealing with sound production and behaviour of fishes was limited to one or two chapters within these books.

What is meant by the term 'sound communication,' and what is the content of the present book? Communication per se is an information-transfer process during which a sender generates a signal perceived by a receiver and which results in a change in the behaviour of the receiver for the advantage of the sender (Myrberg 1981; Bradbury and Vehrencamp 1998, 2011). According to this definition communication is only demonstrated when a receiver (be it a conspecific or heterospecific such as a predator) alters its behaviour after detecting a signal. However, we must admit that in the majority of cases and species in which signals in general and sound signals in particular have been described changes in behaviour of receivers have not been reported although there have been several successful playback experiments. Alternatively, we could argue that signals and in particular sound emission per se is evidence for communication because the production of sounds and sound-generating mechanisms would not have evolved without an advantage for the signaler. Sound production can be costly and risky for senders because signals may be intercepted by predators, and the sender may end up in the stomach of the wrong receiver (Myrberg 1981; Tyack 2000). Thus, in the strict sense our knowledge of sound communication in fishes is limited and would never fill up an entire volume. Therefore, this book will deal not only with sounds having a proven signal function but with sounds assumed to have evolved for communication purposes. This is most likely the case with sounds produced by special sound-generating mechanisms and emitted in clearly defined intra- and interspecific behavioural contexts. These sounds are often termed vocalizations to indicate the behavioural context and importance. This definition excludes sounds

unintentionally produced during feeding, swimming or exchange of air (e.g. air gulping or air release from swimbladders).

The present book broadens the perspective dealt within the two-volume treatise 'Communication in Fishes' (2006) in which seven chapters were dedicated to sound communication. Chapter 3 by Fine and Parmentier provides an overview and update of our knowledge of sonic organs and their function by concentrating on newly studied taxa such ophidiiformes. It provides a cladogram showing known vocal fish taxa, confirming that sound production evolved independently multiple times in fishes.

Chapter 2 by Bass, Chagnaud and Feng reviews the literature on neuronal control of sound production in fishes. The chapter shows that the large diversity in sound-producing mechanisms is mirrored in the large diversity in sonic/vocal motor nuclei in the hindbrain and the spinal cord. However, the entire vocal pathways up to the mid or forebrain is only investigated in toadfishes, and therefore we need to be cautious when generalizing these data. Many more groups, including taxa lacking swim bladder muscles, need to be studied to determine if sound production is controlled similarly in all vocal fish taxa.

The other chapters review topics which have by my knowledge not previously been dealt with in a comprehensive fashion. Amorim, Fonseca and Vasconcelos analyse in Chap. 1 the degree to which fish sounds are used for choosing mates. So far only a few studies show that female fishes choose mates based on particular sound characteristics. This contrasts with the large number of successful playback studies in other taxa such as insects, frogs and birds.

Ladich reviews two neglected topics, namely sound production in juvenile and female fishes. Typically, investigators concentrate on male vocal behaviour because males are the vocal sex in the majority of reproducing fish species. Males defend territories and attract females to nest sites with vocalizations. Nevertheless, because of the male- and reproduction-centred scientific approach of the majority of studies we miss that females and juveniles also need access to resources such as food throughout the year and that access to limited resources necessarily results in aggressive behaviour and frequently acoustic signalling. Chapters 4 and 5 summarize gaps in our knowledge, attempt to close them and hopefully will stimulate research on juveniles and females.

Lugli directs our attention to the need to study the ecoacoustical conditions in fish habitats (see also Ladich 2013, 2014) in order to understand evolutionary constraints on sound production and communication. In his Chap. 6 he illustrates that fishes communicate acoustically under conditions far from optimal. The majority of vocalizing taxa such as toadfishes, gobies, sculpins, gouramies, holocentrids and damselfishes are substrate breeders and live between rocks, stones, roots, coral reefs and close to hard or soft sandy bottoms, all of which can affect sound spectra and propagation. Many of these substrate breeders inhabit shallow waters, e.g. tidal zones or creeks, which are noisy and quite unsuitable for propagating low-frequency sounds generated via various swim bladder mechanisms. These acoustical conditions subsequently limit acoustic communication to a few metres or even centimetres. Currently, there is no evidence that fishes communicate

(respond to sound by showing either positive or negative phonotactic behaviour) beyond 10 m in the field (Mann 2006). Distance restrictions separate fishes from many other vocal animals such as insects, frogs, songbirds and mammals and point to the need for more well-designed playback studies in the field (McGregor 1992).

Finally, in their Chap. 7 Maruska and Sisneros summarize our knowledge of the influence of hormones on acoustic signaling and sound detection in fishes. They report on the hormone-dependent auditory plasticity and vocal production particularly in toadfishes and cichlids and indirectly indicate that our knowledge of endocrinological influences on sound communication is quite limited.

We hope this book will be a useful compendium for professionals as well as students working on animal communication, fish biology, neurobiology and animal behaviour. It should help to stimulate research in this field to close gaps frequently pointed out in the course of this preface.

Friedrich Ladich

## References

Bradbury JW, Vehrencamp SL (1998, 2011) Principles of animal communication. Sinauer Associates Inc, Sunderland

Ladich F (2013) Effects of noise on sound detection and acoustic communication in fishes. In: Brumm H (ed) Animal communication and noise. Springer-Verlag, Berlin, Heidelberg, pp 65–90

Ladich F (2014) Diversity in hearing in fishes: Ecoacoustical, communicative, and developmental constraints. In: Koeppl C, Manley GA, Popper AN, Fay RR (eds) Insights from Comparative Hearing. Springer, New York, pp 289–321

Ladich F, Collin SP, Moller P, Kapoor BG (eds) (2006) Communication in fishes. Science Publishers, Enfield

Ladich F, Fine ML (2006) Sound-generating mechanisms in fishes: a unique diversity in vertebrates. In: Ladich F, Collin SP, Moller P, Kapoor BG (eds) Communication in fishes. Science Publishers, Enfield, pp 3–43

Mann DA (2006) Propagation of fish sounds. In: Ladich F, Collin SP, Moller P, Kapoor BG (eds) Communication in fishes. Science Publishers, Enfield, pp 107–120

McGregor PK (1992) Playback and studies of animal communication. Plenum Press, New York

Myrberg AA (1981) Sound communication and interception in fishes. In: Tavolga WN, Popper AN, Fay RR (eds) Hearing and sound communication in fishes. Springer, New York, pp 395–426

Pitcher TJ (ed) (1993) Behaviour of teleost fishes. Chapman and Hall, London

Sebeok TA (ed) (1977) How animals communicate. Indiana University Press, Bloomington

Tavolga WN, Popper AN, Fay RR (eds) (1981) Hearing and sound communication in fishes. Springer, New York

Tyack PJ (2000) Functional aspects of cetacean communication. In: Mann J, Connor RO, Tyack PL, Whitehead H (eds) Cetacean Societies. The University of Chicago Press, Chicago and London, pp 270–307

Webb JF, Fay RR, Popper AN (eds) (2008) Fish bioacoustics. Springer, New York

http://www.springer.com/978-3-7091-1845-0

Sound Communication in Fishes
Ladich, F. (Ed.)
2015, IX, 244 p. 59 illus., 42 illus. in color., Hardcover
ISBN: 978-3-7091-1845-0