# Recordings and Mechanisms of Sound in three Carapidae Fishes

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## Introduction

In 1970, Courtenay and McKittrick described otophysic features in different Carapidae fishes. However no sound recordings were realised and minor attention was given to the swimbladder structure and its fine associations. In Moorea (French Polynesia), *Carapus boraborensis*, *Carapus homei* and *Encheliophis gracilis* are usually found in the same species of sea cucumber (*Bohadschia argus*).

In this study, main features for the « sonic mechanism » are presented for *Carapus boraborensis* and sound recordings are presented for each of the three studied species.

## Materials and Methods

For each experiment, a specimen of *Bohadschia argus* was first placed in a small thank (80cm x 30cm x 40cm)in which Carapidae specimens were secondarily released. Fish directly attempted to introduce within the host cloaca. Sounds were emitted only during the introduction or when the fish was just inside the sea cucumber. However, this sound producing behaviour was not present systematically.

Recordings were realised with an hydrophone (10Hz/23,8kHz, -3dB) coupled with a preamplificator (-186dB re 1V for a sound pressure of 1µPa, 2H/20kHz, -3dB) and a CAG card. Recordings were digitalised by an « analog to digital converter » and processed by a computer hardware.

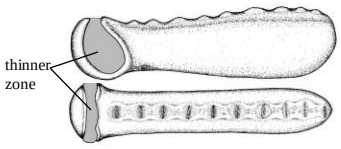



Fig.2 Lateral and dorsal view of the swimbladder

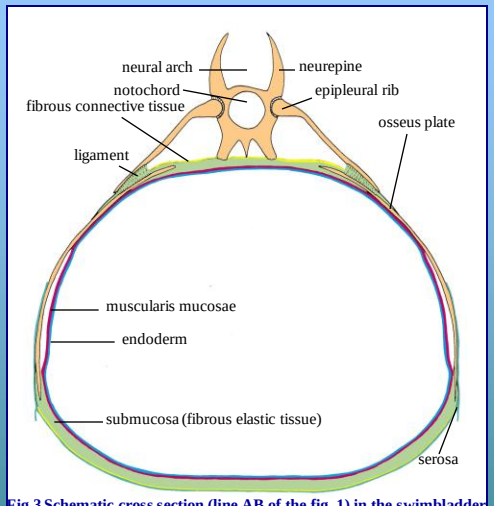



**Fig.3 Schematic cross section (line AB of the fig. 1) in the swimbladder**

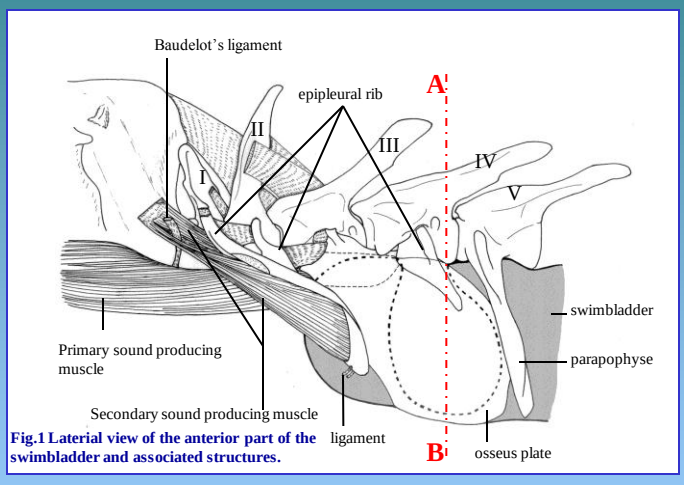



**Fig.1 Laterial view of the anterior part of the swimbladder and associated structures.**

## Main morphological features

-2 primary sound producing muscles (orbit roof ➞ anterior part of the swimbladder), fig.1

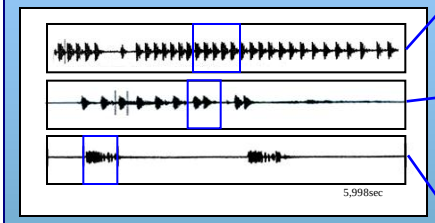
-2 secondary sound producing muscles (posterior part of the otic region ➞ distal part of the 2 first ribs), fig.1

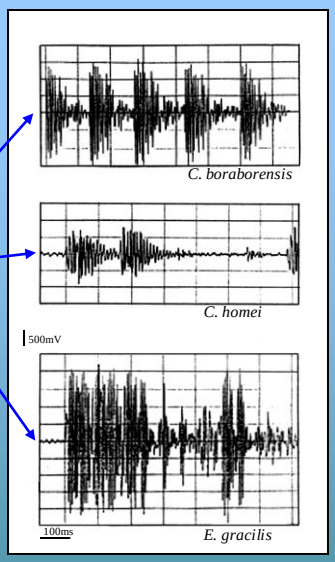
-2 osseus plates around the anterior part of the swimbladder (fig. 1). Their sizes vary among the three species

- Ligaments between the 2 first ribs and the antero-lateral part of the swimbladder (fig.1).

-Presence of a thinner zone in the anterior part of the swimbladder (below the osseus plates), figs 2,3)

Histological section (fig. 3) reveals that the thinner zone is due to the absence of the submucosa in its fibrous elastic layer form. The swimbladder osseus plate seems to derived either from the submucosa, eihter from the somatopleura (or both).




## Sounds

*Carapus boraborensis* and *Encheliophis gracilis* display a grunt-like sound. The different pulses are more long in *E. gracilis* (pulse length =359±69ms, n=6) whereas each pulse is shorter (138 ±14ms, n=49) *C. boraborensis* but is a part of a more important wavetrain. *C. homei* (pulse length = 306±38ms, n=8) presents a metallic sound because of the highest frequencies situated between 5kHz and 10kHz.

## Discussion and Conclusion

1. The contraction of the primary sound producing muscles could pull forward the anterior part of the swimbladder. This action stretchs then the swimbladder thinner zone. The resulting tension in this layer could be the main generator of sounds. In this hypothesis, the osseus plate and the swimbladder features of each Carapidae could act as two amplificators. On the other hand, they also could be in part responsible of the species-specific signatures.

2. The secondary sound producing muscles act in deforming the anterior part of the swimbladder and in this manner could play a rule in the sound variations or in adjusting the sonic emission it in relation with the depth.

3. At this stade of the experiments, it is difficult to interpret the significance of the sounds. As they were emitted only in the host and in the presence of other fishes, it could correspond to a territoriality (aggressiveness ?) message.