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PART 4

HEARING, MASKING AND ORIENTATION TO SOUND

their shells. Threshold levels for frequency and amplitude were thus determined.

This was a preliminary study. It is not yet known for how long the cockles would have kept their siphons retracted if the vibrations had continued for a longer period.

Similar studies should be conducted with other bivalve molluscs to learn if this phenomenon occurs in all species and if the effect occurs at similar frequencies and amplitudes.

REFERENCES

Campbell, A. C. (1980). *The Larousse Guide to Seashores & Shallow Seas of Britain and Europe,* p. 178. New York: Larousse.

Richardson, W. J., Greene, C. R., Malme, C. I., and Thomson, D. H. (1995). *Marine Mammals and Noise.* San Diego: Academic.

CAN LONGSPINE SQUIRRELFISH HEAR BOTTLENOSE DOLPHIN?

JOSEPH J. LUCZKOVICH[1] AND MARK A. KEUSENKOTHEN[2]

[1]*Department of Biology and Institute for Coastal and Marine Resources, East Carolina University, Greenville, NC 27858, USA. luczkovichj@ecu.edu*

[2]*Coastal Resources Management Program, East Carolina University, Greenville, NC 27858, USA. keusenkothenm@ecu.edu*

INTRODUCTION

Longspine squirrelfish *Holocentrus rufus* are sound-producing fish that inhabit shallow coral reefs throughout the Caribbean Sea. They produce low-frequency vocalizations at a dominant frequency of 75-600 Hz. These low-frequency sounds are produced during both day and night but appear to increase after sunset, with peaks at dawn and dusk. Longspine squirrelfish typically produce either single grunts or a series of grunts (staccatos) when fish predators and conspecifics are introduced. The fish maintain territories adjacent to other longspine squirrelfish (Winn et al. 1964).

Bottlenose dolphins *Tursiops truncatus* produce low- and high-frequency sound for communication and echolocation. Bottlenose dolphins also listen passively for low-frequency sounds made by soniferous fish (Gannon et al. 2005). Recent studies have suggested that some species of fish are capable of hearing and reacting to dolphin vocalizations (Luczkovich et al. 2000; Remage-Healey et al. 2006).

We examined the behaviour and sound production of free-ranging longspine squirrelfish to playbacks of vocalizations made by conspecifics and by bottlenose dolphins.

METHODS

Playback studies were conducted using an underwater speaker (Clark AC339) mounted on the bottom in 8 m of water on the Calabash Caye, Belize, at dusk (1700-1900 local time in June 2005). Longspine squirrelfish behaviour and sound production were recorded by divers using closed-circuit rebreathers, which produce minimal bubbles and sounds. Behaviour was monitored during a series of playback treatments: (1) preplayback period with no sounds, (2) pure 700-Hz tone, (3) longspine squirrelfish grunts, (4) bottlenose dolphin echolocation "pops" (1-8 kHz), (5) bottlenose dolphin signature whistle (6-15 kHz), and (6) a postplayback period with no sounds. Both the longspine squirrelfish and bottlenose dolphin sounds were previously recorded in coral reef areas near Calabash Caye.

RESULTS

Longspine squirrelfish did not spend less time in view during the conspecific and dolphin sound playbacks nor did they exhibit different duration of visual displays such as dorsal fin erection. Sound production by longspine squirrelfish did not appear to vary under the pure-tone and conspecific playback treatments; however, vocalizations became less frequent during dolphin echolocation playback. Vocalizations that had been recorded at median rate of 3.15 and 4.25 per minute during the control and 700-Hz tone periods, respectively, dropped to 2.45 per minute during the longspine squirrelfish playbacks and 0.25 per minute during the dolphin echolocation playbacks. The greatest reduction in sound production was observed with dolphin playbacks that were low frequency, i.e., the echolocation "pops" <6-8 kHz. During the postplayback period, the vocalization rates increased again to a median of 3.15 per minute. This suggests that the vocalization rate was not declining as a simple function of time as might be expected because ambient light levels declined at dusk. Indeed, the opposite pattern would be expected to occur because vocalizations should have increased as darkness increased.

DISCUSSION

The apparent suppression of longspine squirrelfish vocalizations during playback of bottlenose dolphin sounds is similar to the observed behaviour of other species of fish such as Gulf toadfish (Remage-Healey et al. 2006) and silver perch (Luczkovich et al. 2000). Both of these species suppressed vocalizations in apparent response to low-frequency sounds made by bottlenose dolphin. Similarly, Mann et al. (1998) observed that American shad (*Alosa sapidissima*) are able to detect simulated dolphin echolocations, although at much higher frequencies (100-180 kHz) than we used here.

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REFERENCES

Gannon, D. P., Barros, N. B., Nowacek, D. P., Read, A. J., Waples, D. M., & Wells, R. S. (2005). Prey location by bottlenose dolphins, *Tursiops truncatus*: an experimental test of the passive listening hypothesis. *Anim. Behav.* **69**, 709-720.

Luczkovich, J. J., Daniel, H. J. III, Hutchinson, M., Jenkins, T., Johnson, S. E., Pullinger, R. C., & Sprague, M. W. (2000). Sounds of sex and death in the sea: bottlenose dolphin whistles suppress mating choruses of silver perch. *Bioacoustics* **10**, 323-334.

Mann, D. A., Lu, Z., Hastings, M. C., & Popper, A. N. (1998). Detection of ultrasonic tones and simulated dolphin echolocation clicks by a teleost fish, the American shad (*Alosa sapidissima*). J. *Acoust. Soc. Am.* **104**, 562-568.

Remage-Healey, L., Nowacek, D. P., & Bass, A. H. (2006). Dolphin sounds suppress calling and elevate stress hormone levels in a prey species, the Gulf toadfish. *J. Exp. Biol.* **209**, 4444-4451.

Winn, H. E., Marshall, J.A., & Hazlett, B. (1964). Diel activities, and stimuli that elicit sound production and reactions to sounds in the longspine squirrelfish. *Copeia* **1964**, 413-425.

PREDICTING CETACEAN AUDIOGRAMS

DAVID C. MOUNTAIN[1], ALEKS ZOSULS[2], SETH NEWBURG[3],
AND DARLENE R. KETTEN[4]

[1-3]Boston University Hearing Research Center, Boston, MA 02215, USA. [1]dcm@bu.edu2azosuls@bu.edu 3setho@bu.edu [4] Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA. dketten@whoi.edu

INTRODUCTION

Our ability to predict the impact of sound on marine mammals is