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PART 8

IMPACT OF ANTHROPOGENIC SOUNDS ON FISH AND TURTLES

DOES BOAT NOISE AFFECT SPAWNING SOUND PRODUCTION OF SONIFEROUS FISH IN SHALLOW ESTUARINE SYSTEMS?

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INTRODUCTION

Soniferous fish in the Sciaenidae family spawn in shallow (<10 m) estuaries and along the coasts worldwide. Low-frequency sounds produced nocturnally by male red drum (*Sciaenops ocellatus*), weakfish (*Cynoscion regalis*), spotted seatrout (*C. nebulosus*), and silver perch (*Bairdiella chrysoura)* are used to attract females to spawning sites. We monitored sound and egg production simultaneously to document spawning areas of these fishes in Pamlico Sound, North Carolina, using passive acoustic methods (Luczkovich & Sprague 2002; Luczkovich et al. 1999, 2000). Because sound plays an important role in the reproductive communication of these fish, we examined the potential for masking of fish spawning by vessel noise and determined whether these fishes respond in any way to the vessel sounds.

METHODS

We deployed a long-term acoustic recording system (LARS) with a HTI 96-min hydrophone at on a bottom-mounted tripod in 4-m depth at a site near the Intracoastal Waterway in Pamlico Sound from April to November 2006. The LARS recorded fish and vessel sounds at 22- to 50-Hz sampling rate in 10-s digital wave files at 900-s intervals during the deployment period and stored them to a flash memory card. We recovered and redeployed the LARS at regular (monthly) intervals to obtain data and recharge battery power. We analyzed the data using MATLAB and Extensible Bioacoustics Tool (www.xbat.org) and by listening to the recordings.

RESULTS

Dominant frequencies of the fishes were 100-200 Hz for red drum, 300-400 Hz for the *Cynoscion* species, 900-1200 Hz for silver perch. Outboard motors were loudest in the 2,000- 8,000-Hz range, but larger

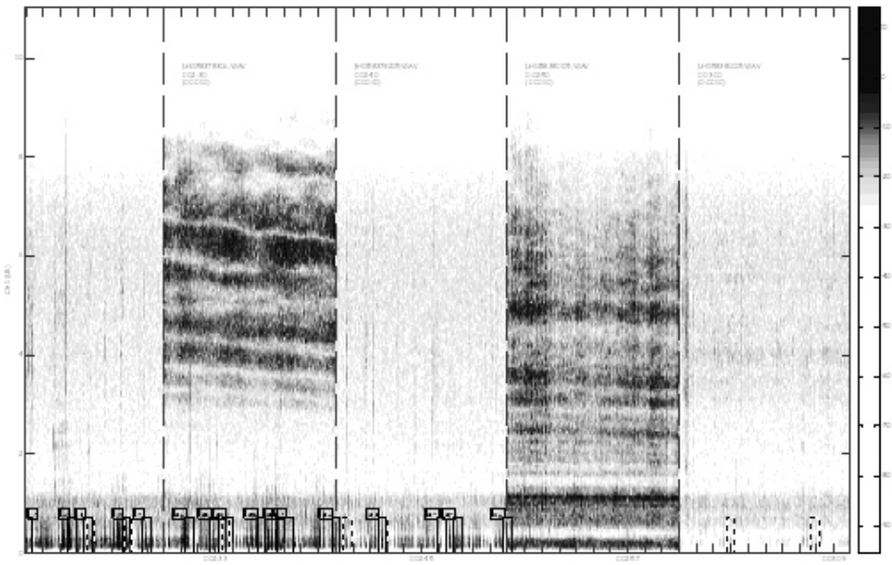

Figure 1. Spectrogram (0-10 kHz) of vessel and fish noises in successive recordings made on 16 September 2006 from 0230-0330 EDT. Outboard motor and red drum sounds (boxes are XBAT detections) (LH158378306.wav), red drum sounds (LH1158379205.wav), larger vessel and no red drum sounds (LH115838105.wav), and reduced calling sounds of red drum (LH1158381005.wav).

boats had the broadest range, with dominant frequency peaks at 200 and 1,000 Hz and a series of harmonic peaks at 2,000, 4,000, and 6,000 Hz (Figure 1). Large-boat noises were louder than the ambient fish sounds at the same frequencies. Fish sounds appeared to decline during and after large vessels passed the site.

DISCUSSION

There is the potential for masking of the reproductive sounds of fishes in the Sciaenidae due to boat noise, especially in the range < 1,000 Hz because of the large amount of overlap in frequencies and greater sound pressure levels.

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EXPERIMENTS AND OBSERVATIONS OF FISH EXPOSED TO SEISMIC SURVEY PULSES

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INTRODUCTION

McCauley et al. (2003a) reported auditory damage in caged pink snapper exposed to multiple air gun passes. This damage occurred over a long time frame, with the more serious damage evident 58 days after initial exposure, just before the same batch of fish were exposed a second time. Correlating behavioural information was collected from these two and previous experiments. The general behaviour of caged fish to an approaching air gun and the behaviour of fish held in the McCauley et al. (2003a) trials is briefly discussed here.

METHODS

Ten experiments were conducted in Jervoise Bay, Western Australia, where caged fish were exposed to air gun noise. McCauley et al. (2003b) described in detail the experimental methods and results. Briefly, fish were captured or purchased from commercial aquaculture facilities, acclimated for 10-14 days, and exposed to a fixed or approaching-departing Bolt 600B air gun with 20 cui chamber operating at 10-s repetition rate and 12 MPa pressure. The 10-m (length) × 6-m