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USING PASSIVE ACOUSTICS TO MONITOR ESTUARINE FISH POPULATIONS

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INTRODUCTION

The goal of this study was to develop a passive acoustic survey protocol to identify spawning habitats of sciaenid fishes. Based on comparisons of captive fish and field recordings of species-specific courtship sounds, we have identified the spawning areas of red drum *Sciaenops ocellatus*, weakfish *Cynoscion regalis*, spotted seatrout *Cynoscion nebulosus*, and silver perch *Bairdiella chrysoura* (Family Sciaenidae) in Pamlico Sound (NC).

CAPTIVE FISH RECORDINGS

Individuals in each species were caught using hook-and-line and recorded in captivity. Sonograms, average power spectra, and oscillograms were used to characterise recordings following Sprague et al. (2000).

PASSIVE ACOUSTIC SURVEYS

Previous work suggested that all spawning and sound production by sciaenids occurred during the crepuscular period and after dark from May-October. We used two types of listening systems: a portable hydrophone deployed from a boat (Luczkovich et al. 1999), and ten timer-operated sonobuoys (Luczkovich et al. 2000). The portable hydrophone was deployed and a plankton tow was taken in order to estimate pelagic egg abundance at 15 fixed stations at night each month in 1997 and 1998. Sonobuoys were deployed at 32 random locations in two grid systems, one on the eastern side (Ocracoke Inlet) and one on the western side (Bay River Mouth) of Pamlico Sound each month from May-October 1998. Loudness of mating choruses of weakfish and silver perch was strongly correlated with the abundance of pelagic sciaenid-type eggs (Luczkovich et al. 1999), suggesting that these areas are used for spawning. Sonobuoy recordings (2-min recordings spaced at 0.5-hour intervals during a 12-h nocturnal period) were scored using a "drumming index" (0 = no fish heard, 1 = individuals, 2 = aggregations, 3 = chorus) of sound intensity; indexes for each location were summed for each day. A map of the summed sonobuoy drumming indexes showed that weakfish used predominantly the high-salinity habitats near the inlets on the eastern side of Pamlico Sound for spawning. Spotted seatrout used predominantly the low-salinity areas near the river mouths on the western side. Silver perch and red drum used both high and low salinity areas, but with silver perch much more widespread at the inlets. Red drum were the rarest of all species surveyed, occurring most abundantly in the mouth of the Neuse and Bay Rivers.

ACOUSTICAL AVOIDANCE

The loudness of mating choruses of silver perch was diminished when vocalising bottlenose dolphins *Tursiops truncatus* were present in the area around the sonobuoys. On at least seven sonobuoy recordings, when dolphin were present and vocalising, the sound pressure levels were lower in the 950-1200 Hz range, the dominant frequency produced by silver perch during mating choruses. Experimental playback of bottlenose dolphin sounds (signature whistles 3-6 kHz, played at 145 dB re 1 μPa) caused a reduction in loudness of male silver perch calls by an average of 9 dB (Luczkovich et al. 2000). Such "acoustical avoidance" behaviour causes variation in sound pressure levels and could lead to lower estimates of abundance of spawning adults when conducting passive acoustic surveys.

CONCLUSIONS

Seasonal mating patterns and predator-prey interactions of fishes may be studied remotely without interfering with their behaviour. The sonobuoys were used to sample sound production at random locations without observer influence. This method relies on adequate recordings of mating sounds from captive fish, which if lacking, may result in the misidentification of the sound producers, e.g. striped cusk-eels were mistakenly called weakfish "chatters"; see Sprague and Luczkovich (2001). An archive of reference sounds for known species should be established for future investigators to decrease the chance that sounds might be misidentified.

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