Seasonal Changes in Male Oyster Toadfish's Response to Boatwhistle Playbacks

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Introduction

Throughout summer, the Oyster toadfish, *Opsanus tau*, utilize acoustic communication to engage in courtship behavior. Male toadfish produce a long, tonal call with banded harmonics called a "boatwhistle." Each boatwhistle has a unique form, duration and frequency that corresponds to individual fish (Putland *et al*. 2018). These calls begin in mid-May and continue through August; the fundamental frequencies of the calls are correlated with increasing water temperature(Van Wert *et al*. 2019). Calls are produced at any point during the day, but are most frequently produced between sunset and sunrise (Van Wert and Mensinger, 2019). Females localize the calls, and swim to males' nests to deposit eggs. Males use grunts to interrupt each other's calls (Mensinger, 2014). However, little is known about how males alter the timing of their own boatwhistle calls in response to other males. This experiment examined how males change the number and timing of their calls in response to extraneous boatwhistles produced using a speaker throughout the season.

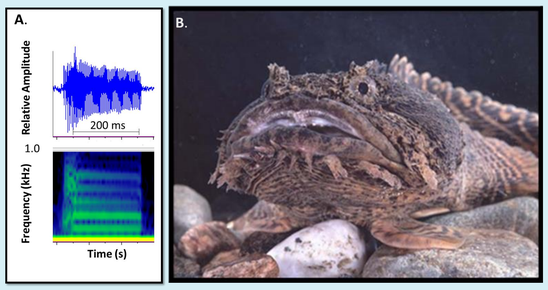

Figure 1 (A). Toadfish Boatwhistle. Top panel is the waveform. The bottom panel is the spectrogram.
(B). *Opsanus tau.*

Methods

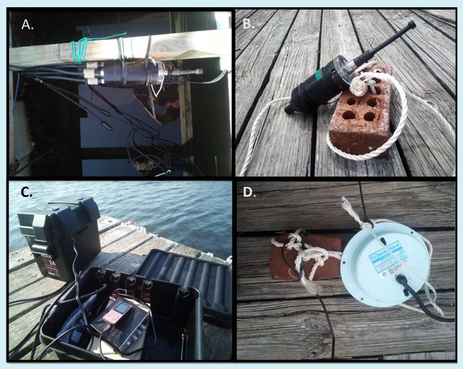

Figure 2. (A) SoundTrap Data Recorder. **(B)** Single Channel Hydrophone. **(C)** Battery, amp and mp3. **(D)** Underwater Speaker

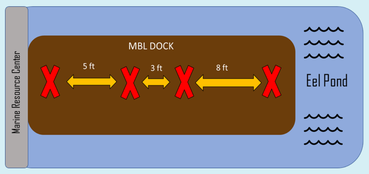

Figure 3. Layout of hydrophones on the MBL dock.

Figure 4. Order of playbacks and rest times throughout a single experiment.

Four HTI hydrophone were arranged in a linear array under the MBL dock in Eel Pond to passively record toadfish calls. The hydrophones were integrated into a four channel SoundTrap data recorder. Each hydrophone was 1 m from the bottom of Eel Pond and recorded continuously upon deployment with a sampling rate of 24 kHz.

Underwater sound was broadcast with UW-30 speaker suspended 1 m above the bottom of Eel Pond at the end of the dock. During experimental trials, an additional hydrophone was deployed 1 m from the speaker to monitor output. The speaker was connected to a Speco Technologies amplifier powered by a 12 V DC battery. An MP3 player connected to the amplifier generated sound. All experimental trials lasted 1 hour and were conducted at morning, afternoon, evening, and midnight. Playbacks consisted of five minute segments of pure tones or boatwhistle calls at 150 Hz, 175 Hz, 200 Hz, and 225 Hz. Each sound was presented for 0.5 seconds at ten second intervals.

The data was analyzed using RavenPro 1.5. Spectrograms and waveforms were used to determine when boatwhistles occurred. The calls were counted during intervals of: five minutes before the playback, during the playback, and five minutes after. Individual fish were identified and labeled; the timestamps of their calls were tracked during the before and during periods of the trial.

Results

Passive Acoustic Monitoring

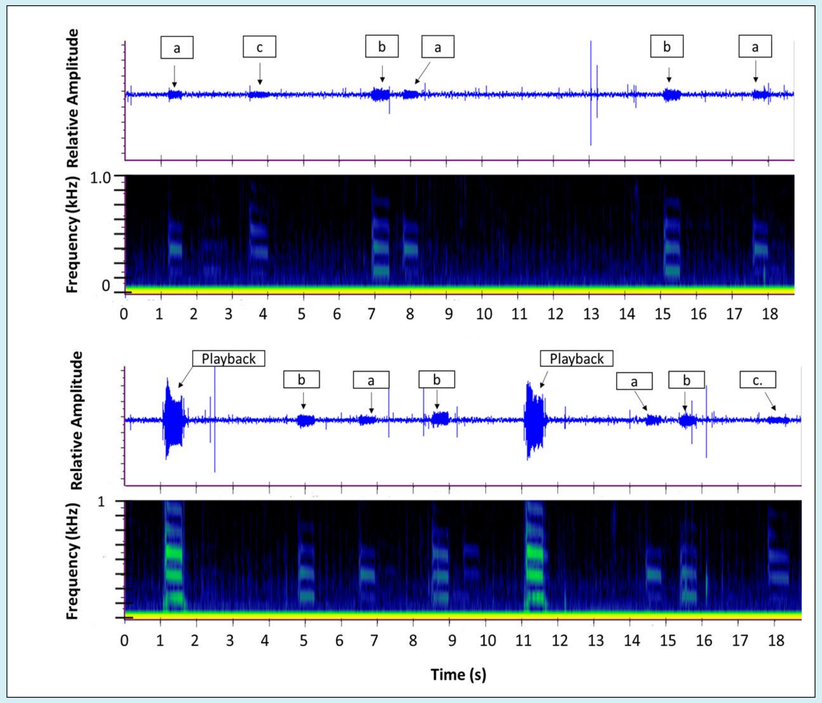

Figure 5. Each panel shows a 19 second recording from a hydrophone in the linear array. Panels include the waveform (top) and spectrogram (bottom). Individual toadfish boatwhistles are indicated by letters. Panel A is spontaneous calling, and panel B shows calling during playbacks.

Seasonal Calling

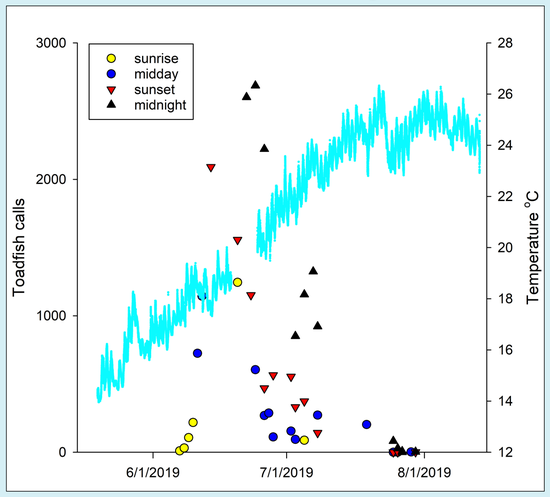

Figure 6. Total Calls in each experimental hour plotted against date. Temperature plotted by date.

Playbacks

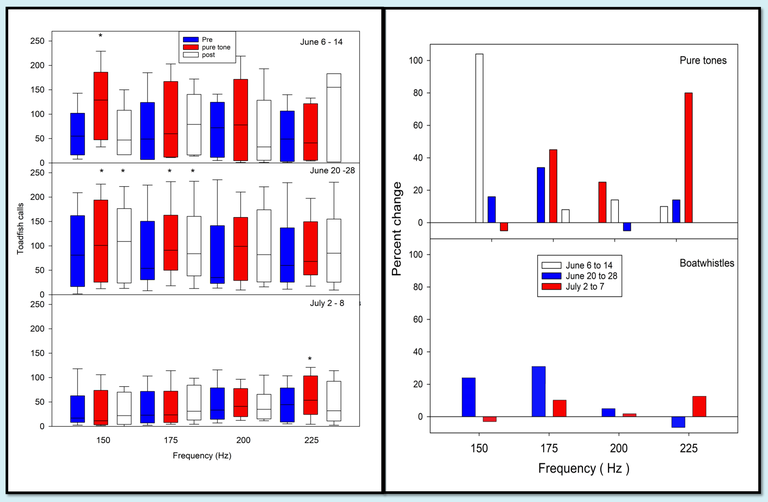

Figure 7. (A) The average number of calls recorded before, during, and after playbacks grouped by date. Calls were counted in five minute segments. **(B)** The percent difference in number off calls before and during playbacks throughout the season.

Conclusions

- The number of boatwhistle calls produced by the Oyster Toadfish increased after the broadcast of both pure tone and boatwhistle playbacks with pure tone playbacks eliciting a higher response.
- Toadfish responded more to lower frequencies such as 150 Hz playbacks during the month of June and responded more to higher frequencies such as 200 Hz and 225 Hz during the month of July. This corresponds to a similar increase in the fundamental frequency of their calls which is correlated with increases in water temperature.
- The timing of boatwhistles from individual fish changes in response to both playbacks and other toadfish.
- The toadfish decreased their natural calling late in the season, (after 07/19/19) and stopped responding to the playbacks.

Future Plans

- Track and label the calls of individual fish throughout experiments and complete statistical analysis on trials where individual calls have been tracked and labeled.
- Continue pure tone and boatwhistle playbacks with an even distribution of sunrise, afternoon, sunset and midnight experiments.
- Examine effects of boatwhistle playbacks earlier in the season.
- Change the time interval between playbacks to see if longer or shorter intervals affect calling responses

Acknowledgements

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