

Conditioning Striped Bass, *Morone saxatilis*, to a Sound Source.

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Question: Can striped bass be conditioned to respond to sound?

Background

Classical conditioning is a process of learning that pairs a neutral stimulus with a stimulus known to give a response. For example, food (unconditioned stimulus) presented to a dog will result in salivation (unconditioned response). When a sound is presented to the dog, there is no reaction since it is a neutral stimulus. When the sound is paired with the food, a conditioned response develops where the sound (now a conditioned stimulus) alone will elicit salivation. Ivan Pavlov was one of the first scientists to describe this so-called classical conditioning (Pavlov, 1928).

In 2012 a group from MBL elicited a conditioned response from black sea bass by pairing sound with feeding (Lindell et al., 2012). Their goal was to release small, conditioned fish into the environment, let them grow and recapture them by presenting the sound at a later time. Thus, they would be able to raise fish in the wild avoiding problems associated with fish farming (Pulkkinen et al., 2010; Assefa and Abunna, 2018). They concluded that black sea bass are readily adaptable to acoustic training but the application of such technology in the ocean was not so practical with the presence of predators such as bluefish. Although the black sea bass were classically conditioned, they did not provide information on whether the conditioning would last over long periods of time.

Based on the ability to classically condition black sea bass, I hypothesized that striped bass could be successfully conditioned to associate food with a sound. This experiment is a first step to possibly use conditioning as a way to attract fish to “safe” environments and conserve small populations.

Hypothesis- Striped bass can be conditioned to a sound source.

Gemma, the collecting boat at the Marine Biological Laboratory, feeds a population of striped bass with squid when it returns from collecting organisms for scientists. We speculate that these striped bass are conditioned to associate the sight and sound of the *Gemma* with food.

Variables

- a. Independent Variable: “Squawk Box” Same sound and look of box.

- b. Dependent Variable: If the fish show up when sound is played at a new location.
- c. Control: Running same procedure without sound. If they come in the absence of sound, then they are conditioned to the sight of the device and/or the experimenter. If they don't come in the absence of sound, then they are not conditioned to the sight and/or presence of the experimenter.

Materials

Squawk Box

- Sound Generator
- Speaker
- Plastic Container
- Battery Power

Fishing Line

Squid

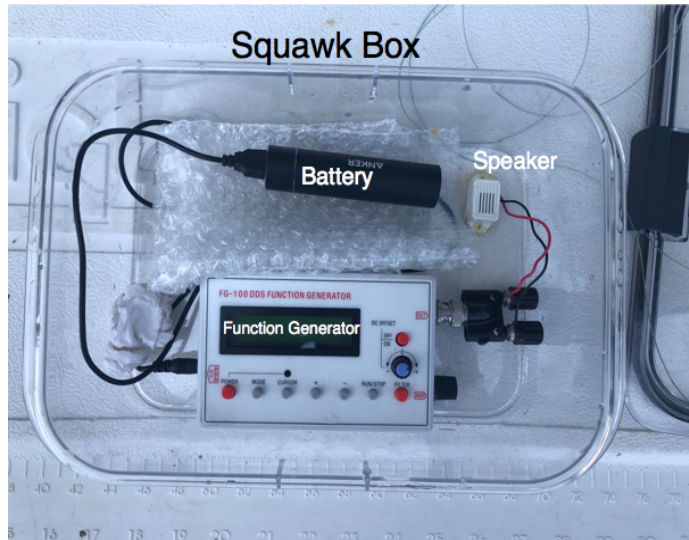


Figure 1. The sound or "Squawk" box

Procedure and Results

Site 1, conditioning trials

For conditioning trials I activated the sound, closed the container and then floated the container (Squawk box, Fig. 1) in the area behind the *Gemma* where the fish tend to



Figure 2. Study site behind the Marine Resources Center. Site 1 is located behind the *Gemma* and was used for conditioning the fish to sound. Site 2, which is about 80 feet from Site 1 is a location where

congregate (Site 1 Fig. 2). Once fish were noticed near the floating container with the sound on, I dropped pieces of squid within six inches of the container. Fish came to the surface near the container to feed and fish were fed in this way for five minutes. Eight conditioning trials over a number of days were run as listed below. Approximately fifteen fish were observed feeding on each day.

Sequence of Conditioning Trials		
Date	Time	Notes
7/24/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.
7/25/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.
7/26/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.
7/27/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.
7/28/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.
7/29/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.
7/30/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.
7/31/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.
8/1/18	2:30pm	Wait for fish. Lower box in with sound on and begin feeding. Continue feeding for 5 mins.

Site 2, control and test trials

Site 2 was about 80 feet away from Site 1 (Fig. 2 and Fig. 3). The squawk box was placed on the water surface as shown in Fig. 3 with no sound to control for visual identification by fish. No fish were seen in the vicinity of the box for 5 minutes after which the conditioning sound was turned on for 5 minutes. If fish appeared after the sound was played, they were fed squid within 6 inches of the box for 5 minutes.

Sequence of TESTING TRIALS at Site 2

1. 8/2/18 @ 11:00 am—3 mins after the sound initiation,, 3 striped bass observed. After feeding them for 2 mins more striped bass were observed (possibly because of the noises associated with feeding).



2. 8/2/18 @ 12:00 pm--2.35 minutes after sound was initiated, 3 fish observed.
3. 8/2/18 @ 12:30 pm--1.54 min after sound initiation 3 fish observed.
4. 8/6/18 @ 11:00 am--3.28 mins after sound initiation 4 fish observed.
5. 8/6/18 @ 11:35 am--4.34 mins after sound initiation 3 fish observed.
6. 8/6/18 @ 12:05 pm--2.08 mins after sound initiation 3 fish observed.

Figure 3. Site 2 in Fig. 1. Conditioning Test Location: This location is on small dock attached to the larger dock to the left. The small dock is about 80 feet away from where fish normally congregate.

Site 3, control and test trials

Site 3 was about 80 feet away from site 2 (Fig. 4). The squawk box was placed on the water surface with no sound to control for visual identification by fish. After 5 minutes with no sound, the conditioning sound was turned on for 5 minutes. No fish were seen within the control interval or the test interval.

1. 8/2/18 @ 11:30 am No fish were observed after 10 mins of sound initiation.
2. 8/6/18 @ 12:35 pm No fish were observed after 10 mins of sound initiation.



Figure 4. Third test site. Site 1 and 2 correspond to those shown in Fig. 1. Site 3, located about 80 feet from Site 2.

Discussion

After conditioning fish to associate food with a sound at Site 1, I was able to attract three striped bass to the sound of the Squawk box played at Site 2 where the bass do not normally congregate. Since no fish appeared when the box was floated on the water with no sound (control interval) at Site 2, I conclude that fish were not using vision of the squawk box or experimenter to associate with food. However, fish could not be attracted with the sound stimulus to the Site 3 location. I speculate that either the sound was not perceived by the fish or the fish were inhibited from traveling to shallow water near the dock where they might be exposed to predation..

A number of reports of striped bass following fishing boats implies that the fish might know the sound signature of the boat and associate it with food. For example striped bass have been observed to follow lobster boats and eat undersized lobsters thrown back in the water (<https://www.onthewater.com/secret-life-stripers>). The association of sound and food might also attract fish to fishing trawlers. If fish know the sound signature of a fishing trawler, they might follow it both during fishing to eat by-catch thrown overboard and later at the unloading site in a harbor when nets are cleaned.

The striped bass population has undergone a series of declines because of overfishing, the most recent being in the 1970s and 1980s (<https://www.pewtrusts.org/en/about/newsroom/opinion/2015/01/15/whats-happened-to-all-the-striped-bass>). Regulations have helped with the recovery of this fish population. Currently in MA a fish must be at least 28" to keep recreationally and only one can be taken each day per person. The continued conservation is critical to the long-term survival of the species (<http://www.asmf.org/species/atlantic-striped-bass>).

Conditioning striped bass to sound might be used in fish farming without the need for nets (Lindell et al., 2012). That is, the fish conditioned to sound will be attracted to the stimulus for the purpose of feeding and harvesting but will otherwise will be free to move in their natural environment reducing the possibility of infection associated with high concentrations of fish (Pulkkinen et al., 2010; Assefa and Abunna, 2018).

There are small populations of striped bass in harbors/estuaries up and down the Atlantic coast. These pockets provide a protected environment for these fish from predation by seals and sharks. Studies of why fish occupy these niches in relation to food sources and possible conditioning stimuli should be pursued. Perhaps conditioning could be used as a way to attract and provide a safehaven for striped bass especially during periods when their population is declining.

Applications and Recommendations for Further Study

During conditioning trials, fish were fed regularly but I did not standardize the amount of food provided in the 5 min feeding time window. In addition the 15 or so fish that were present did not all consume bait. These variables may have contributed to the low number of striped bass that were conditioned to come to the sound source at Site 2.

I did not characterize the sound used to condition the striped bass. In the future the sound should be matched to the sensitivity of receptors in fish ears (e.g., Coombs, 1982).

Although I controlled for vision, Site 2 was relatively close to Site 1. A louder conditioning stimulus coupled with trials at Site 3 or an equivalent site would be worth pursuing.

Optimally, sound sources could be placed permanently at a number of sites and activated from a distance..

References:

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