Food Preference of Striped Bass, *Morone saxatilis.*

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Question: Do striped bass have a food preference?

Background

Striped bass, *Morone saxatilis,* are opportunistic feeders eating fish such as alewives, flounder, sea herring, menhaden, mummichogs, sand lance, silver hake, tomcod, smelt, silversides, and eels, as well as lobsters, crabs, clams, small mussels, sea worms and squid (see Nelson et al., 2003, 2006; Walter et al., 2003 for a more extensive listing). To capture their prey, striped bass rely on their sensory systems including vision, hearing, lateral line, taste and olfaction to track their prey. The importance of each of these sensory systems for locating food depends on the time of day and other environmental conditions. For example, in shallow water striped bass will target bait dropped from above while it is in the air indicating that, under these conditions, they are using primarily vision. On the other hand, at night vision plays less of a role and the other senses like superficial neuromasts become more important (Sampson et al., 2013).

Fishers indicate that when striped bass are feeding on one food source it is most effective to use bait or a lure that matches this prey ("match the hatch"). Such fishing lore implies that striped bass have food preferences under certain conditions. Qualitative observations of striped bass in Eel Pond, Woods Hole, MA indicates that they prefer squid to other prey items such as scup. I chose to study the food preference of striped bass as a way to better understand their feeding habits. The results indicate that they do prefer one food source over another and provides the basis for understanding how the fish feed in the wild.

Hypothesis: *Morone saxatilis* will prefer one prey over others.

Variables

i. Independent- species of prey
ii. Dependent- time it takes the bass to eat the prey (time will start once prey hits the water)
iii. Constant- all prey or parts of prey will be same size, weight (in grams), dead and thrown at the same distance

Materials

--Equivalent-sized pieces of squid, scup, butterfish, flatfish
--plastic control shaped like a cross section of squid
--stop watch
--paper and pencil

--fishing line

Preparation-

1. Bait items: Squid were cut into cross sections and small scup were cut into pieces to roughly match the size of the squid cross sections (1" thickness and 1.75 inches in diameter). As a control, a white plastic tube was cut into one inch rings (1.75 inches in diameter) to match cross sections of the circular mantle of a squid (Fig. 1).

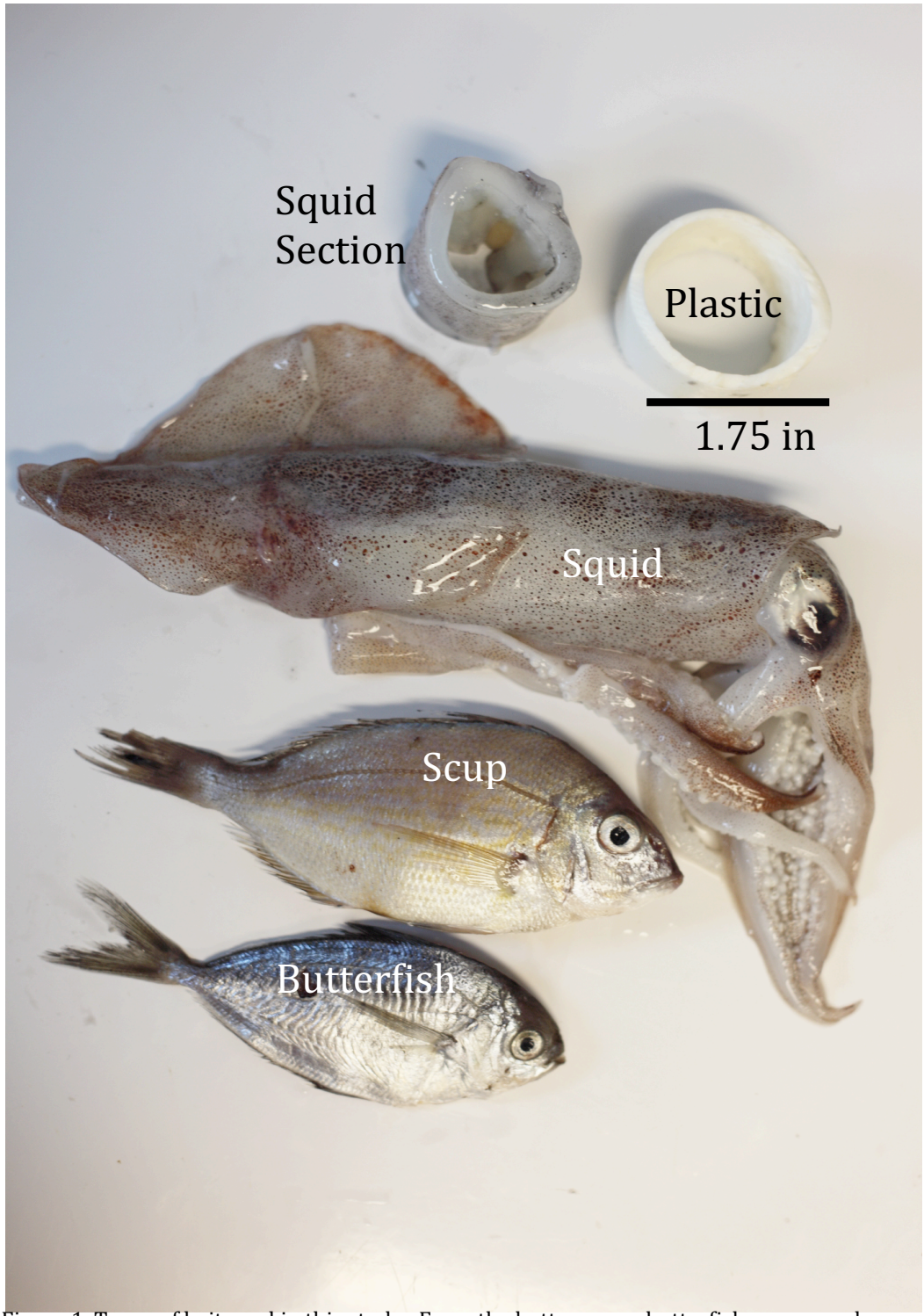


Figure 1. Types of bait used in this study. From the bottom up, a butterfish, a scup and a squid are shown. Each was cut into roughly equivalent sizes (1 x 1.75 inches). This is shown for a cross section of squid at the top left. A "control" piece of plastic is shown in the upper

2. Two lengths of fishing line the same length. One was tied to the control piece of plastic so that fish could not pull it off and consume the plastic.
   The other piece of line was loosely tied to hold the actual bait so the fish could pull it off and consume it.

Trials- The site for this study is shown in Fig. 2

1. Pieces of squid, scup or plastic were chosen in a random order.
2. Pieces of bait were thrown off the wall shown in Fig. 2. The experimenter stood in the same position and dropped the bait in approximately the same location from trial to trial.
3. A stop watch recorded the time from when the bait hit the water to when the entire bait was brought into the mouth (or in the case of the control, when the fish halted their approach or bumped the plastic)
4. Any rejection of bait by ejecting it from the mouth was noted.
5. 5-10 trials were run per bait item per day in order to limit food intake and prevent satiation. Squid, scup and control bait were presented 20 times over three days.

Figure 2. Top: Wall behind the Marine Resources Center at the Marine Biological Laboratory where experiments were conducted. Bottom: view from the wall of the population of striped bass used in this study.

Results

a. Quantitative measurements (see Tables below):

Time was measured from when the bait hit the water to when it was taken in the mouth. Time was averaged across all trials for a particular bait:

- Squid- 1.16 seconds
- Scup- 8.59 seconds
- Flatfish- 3.50 seconds
- Butterfish- 9.69 seconds
- Control- 7.08 seconds from the time the plastic hit the water until fish bumped the plastic or stopped their approach.

b. Qualitative observations:

- The scup were taken into the mouth but then rejected by ejecting the bait out of the mouth 36 times. During two separate trials the scup was spit out nine times by a large fish before a smaller one ate it off the bottom. In one trial a piece of scup was never eaten by any fish and was left on the bottom for a total of 42 seconds until a crab started eating it. On average most of the fish that ate scup pieces were small fish around the outside of the school. The squid was never spit out; it was eaten by the first fish to get to it every time. The flatfish was spit out twice but overall was eaten fairly quickly.
- The consumption of butterfish pieces was highly variable. Sometimes it was eaten in a few seconds on the first try but other times it was spit out with a long delay before it was eaten. The butterfish during day two trial 5 was spit out 9 times and took 42 seconds to be completely consumed.
- The fish approached the control bait frequently but did not attack it the same way as other bait items. Most of the fish bumped the control plastic with their nose and then turned away but there were a couple instances where the fish bit it and immediately spit it out.

Tables: Time in seconds from when the bait hit the water until it was taken into the mouth.

Day One (seconds)

	1	2	3	4	5
Squid	0.56 secs	1.20 secs	0.62 secs	2.30 secs	2.00 secs
Scup	6.00 secs	1.47 secs	47.00 secs	7.10 secs	5.60 secs
Control	4.00 secs	8.00 secs	9.00 secs	7.00 secs	5.00 secs

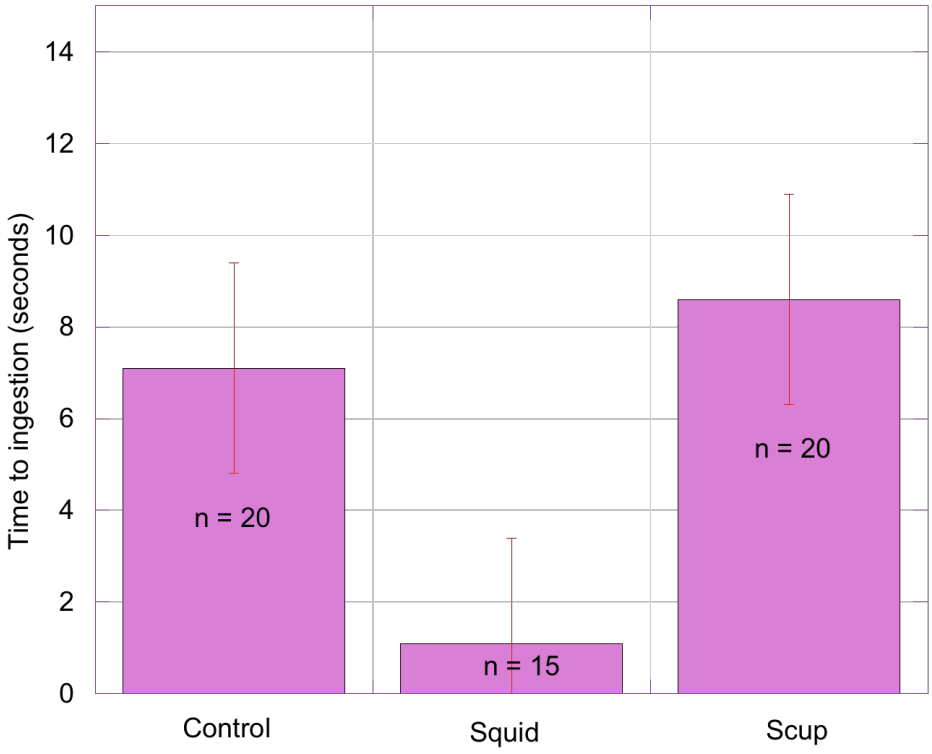
Day Two (seconds)

	1	2	3	4	5
Squid	0.20	0.70	1.00	0.70	0.80
Scup	1.2	12.00	3.50	6.00	8.70
Flatfish	2.30	8.00	2.90	2.10	2.20
Butterfish	4.30	2.00	3.80	24.00	42.00
Control	8.00	7.00	3.00	6.00	5.00

Day Three (seconds)

	1	2	3	4	5	6	7	8	9	10
Squid	2.34	1.43	2.12	1.08	0.30	0.80	2.74	1.69	0.33	.46
Scup	7.93	4.92	8.36	3.25	9.00	7.42	5.34	14.26	5.49	7.02
Butterfish	13.03	6.13	8.42	3.43	5.22	9.00	6.00	4.36	6.67	7.06
Control	5.00	6.00	6.89	10.60	5.00	8.75	7.05	10.23	11.33	8.90

Graph 1
Average time from contact of bait with the water to the ingestion of the bait (Mean ± Standard Error for control, squid and scup pieces).



Time to ingestion of three bait types are plotted above. These baits were chosen for statistical analysis due to the large number of trials and the similarity of the bait pieces. A One-Way ANOVA indicated significance ($p = .002$). Bonferroni post hoc testing showed

significant differences between the control and squid ($p = .02$) and the squid and scup ($p = .002$) but not between the control and scup ($p = 1$).

Discussion

The MBL collecting boat catches organisms that are used by scientists for research study. The greatest scientific demand is for squid. Dead squid and other by-catch are fed to the striped bass when the boat docks and as nets are cleaned. In addition dead squid from the boat and tanks in the Marine Resources Center are occasionally dropped in the water and can act as a food source. As a result, the striped bass that are congregated in the proximity of the MBL have squid as one food source. I hypothesized that the striped bass will prefer squid over other food types.

Striped bass approached and ate squid more quickly than control plastic or scup pieces. In addition squid was never rejected after entering the mouth while both control and scup pieces were. Thus there appears to be a preference of the striped bass congregated in Eel Pond for squid which supports my hypothesis. Control values were difficult to determine after the first exposure of the fish to the plastic rings. That is, fish would quickly go to the control plastic on first exposure and then not react to the control as rapidly on subsequent exposures. This result implies that striped bass can identify the plastic with vision/sound and "ignore" it. I assigned times from the start of the initial movement of fish when the control plastic hit the water to when fish stopped movement towards the object. Such measurements are subject to my judgment and thus are a source of error.

Bigger fish appeared more competitive and tended to get to a bait first but consistently spit out all baits except squid. The smaller fish on the outside of the school would eventually eat the scup perhaps due to their less competitive nature and increased hunger. Some fish showed no interest at all in the baitfish but reacted quickly once the squid hit the water. Squid were also the only bait to be eaten in under one second and on multiple trials and days. The consistency of incredibly quick consumption times for the squid provides additional results that support the hypothesis.

Environmental conditions varied from day to day. Differences in water depth (tide), water temperature, weather and water clarity could have affected the timing to capture of bait. The biggest challenge was the delivery of the bait and the accuracy of timing, both of which can be refined with future studies. For example, delivery of bait through tubes and the use of an electronic timing system could address these challenges. The use of a clear vs. an opaque delivery tube might allow the limitation of vision as a sensory modality used in feeding.

Conclusion

The hypothesis that *Morone saxatilis* would prefer one prey over others was supported by the data. Squid was preferred over all other baits tested. In addition the squid was never rejected once in the mouth which was not the case for either control or scup pieces.

Applications and Recommendations for Further Study

The results of this study supports fisher's claim that if one can "match the hatch" there is a higher probability of catching striped bass. If striped bass are feeding on one bait (e.g., sand eels or menhaden or squid or eels), fishers can match lures and/or bait to the prey item for greater success in catching striped bass. Since striped bass are opportunistic, one might predict that their prey preference will change with the availability of a particular food source. Perhaps squid is preferred to any other food source. Such a concept could be tested by providing squid to striped bass while they are feeding on another food source.

Striped bass in Eel Pond have other sources of food including food thrown to them by customers at local restaurants and bait within the pond. Future experiments are needed to characterize these food sources and get a more complete picture of feeding behavior of the striped bass.

References

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