# Sponge size preference by the sponge-dwelling yellowline goby *Gobiosoma horsti*

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*Abstract:* The yellowline goby *Gobiosoma horsti* is commonly found in the yellow tube sponge, *Aplysina fistularis*. The gobies depend on the sponge for protection from predators, food, and nesting sites. Satellite individuals are also found on the outer walls of the sponge, presumably for similar reasons. We predicted that gobies would preferentially inhabit larger sponges where resources are greatest. As gobies are territorial, the larger, more dominant gobies were predicted to inhabit the more desirable, large sponges. We predicted that satellites also would be found in clusters of multiple large sponges. We found that gobies, satellites included, did prefer the larger sponges, and the larger, dominant individuals inhabited the preferred sponges.

*Key Words: habitat preference, mutualism*

## INTRODUCTION

Neon gobies, genus *Gobiosoma*, are brightly colored inhabitants of Caribbean coral reefs. Individuals in a subset of this group spend the majority of their lives in tubular sponges. The yellowline goby, *Gobiosoma horsti*, is most commonly found in the atria of the yellow tube sponge, *Aplysina fistularis*. In this mutualistic relationship, the gobies gain protection from predators, nesting sites, and a food resource, and in return, the gobies feed extensively upon polychaete worms parasitic to the sponge (Thresher 1980). The sponge-dwelling gobies pick up noxious toxins from the sponge tissues and become highly distasteful to predators (Thresher 1980). The males of the species guard eggs layed by the female deep in the atrium of the sponge. It has been observed by Brady and Levesque (1995) that small (~1.5 cm) individuals of the same species are often found clinging to the exterior wall of sponges within inhabited clusters. Little is known about these "satellite" individuals.

The parasitic polychaete worm that infests *A. fistularis* has been found to make up as much as 5% of the weight of some sponges (Thresher, 1980). Hence, a larger individual sponge (singular atrium) is likely to provide more food to its inhabitant than a smaller sponge within a cluster of sponges. If this is the case, then we predict that the larger sponges will provide a preferred habitat and thus will be more likely to contain a goby than a smaller sponge. Brady and Levesque (1995) showed that goby size increased as atrium volume increased, and that larger individuals of *G. horsti* have been found to be dominant over smaller gobies. Therefore, large gobies should inhabit sponges of greater height, osculum diameter, and atrium volume more often than smaller individuals.

Satellite individuals may forage upon sponge-infesting polychaete worms just as the larger sponge inhabitants do. Clusters with greater numbers of large sponges provide more surface area of sponge wall on which a satellite might feed. Thus, we predict that satellites will be more abundant in clusters with many large sponges. Additionally, if the satellite individuals are all small males, then moving within a large cluster may provide them with reproductive benefits. Females that visit the sponge of a male may be susceptible to a satellite attempting a "sneak mating" if the satellite adheres to a cluster with characteristics that attract fit males and females.

## METHODS

We surveyed transects for the yellow tube sponge, *Aplysina fistularis* , and its inhabitant, the yellowline goby, *Gobiosoma horsti*, at Discovery Bay, Jamaica. Surveys were conducted at four fore reef sites (LTS, Dancing Lady, Mooring 1, and Dairy Bull) along 50 m transects at depths of 8 – 17 m, from 6 Mar – 11 Mar 1999. All yellow tube sponges visible from the transect line (~18m to each side) were surveyed. The number of sponges within a cluster, and the height (cm) and osculum diameter (cm) of each sponge were recorded.





Diameter of the osculum and height of the sponge were used to calculate an estimate of atrium volume. The presence or absence of a goby (small or large size classes) within the sponge was also noted. On the exterior of inhabited sponge clusters, smaller "satellite" individuals of the same species were sometimes found. The number of satellite gobies was recorded for each sponge cluster.

Five sponge clusters with satellite gobies were haphazardly chosen for a 10 minute observational period. Sponge inhabitant and satellite movement and behavior were noted. We recorded the movement of a goby from one sponge atrium to another. Also, the number of aggressive interactions between sponge gobies was counted, and the size difference between the aggressor and the submissive goby was noted.

Six sponge inhabiting gobies, and 5 satellites were collected using a 1:9 mix of quinaldine and ethyl alcohol. The gobies were examined under a dissecting microscope in an effort to determine the sex of the specimens.

Wilcoxon/Kruskal-Wallis Tests were used to analyze the means and variances. Only the sponge height data were distributed normally.

## RESULTS

### *Quantitative*

Gobies were found significantly more often in taller and wider sponges, although cluster size had no affect on goby presence or absence (Table 1). Large gobies were found in sponges with significantly larger osculum diameter and height than small gobies (Table 1). There was a trend for large gobies to be found in sponges with greater atrium volume (Table 1). While there was no relationship between inhabitant goby size and number of sponges in a cluster, satellite gobies were found significantly more often in clusters with greater numbers of sponges (Fig. 1), and in sponges with greater height, osculum diameter, and atrium volume (Table 2). Satellites were also more prevalent when clusters were inhabited by greater numbers of goby individuals (Table 2). In only one case were satellites found on a sponge cluster that did not appear to be inhabited by a larger goby. In this case, five satellites were seen on a single large sponge.

Table 1. Characteristics of *Aplysina fistularis* sponges in relation to the presence/absence (yes/no) and size class of the yellowline goby *Gobisoma horsti* at Discovery Bay, Jamaica. Values indicate mean (± SE).

| | Goby (Yes) | Goby (No) | Kruskal-Wallis Results | Goby (Large) | Goby (Small) | Kruskal-Wallis Results |
|---|---|---|---|---|---|---|
| Height (cm) | 20.2 ± 0.80 | 12.8 ± 0.68 | $X^2 = 53.1$, df = 1, P < 0.0001 | 22.7 ± 0.95 | 16.8 ± 1.07 | $X^2 = 14.9$, df = 1, P > 0.0001 |
| Osculum Diameter (cm) | 3.22 ± 0.12 | 2.03 ± 0.10 | $X^2 = 53.1$, df = 1, P < 0.0001 | 3.5 ± 0.17 | 2.86 ± 0.20 | $X^2 = 10.6$, df = 1, P > 0.0011 |
| Atrium Volume ($cm^3$) | 250.3 ± 21.8 | 99.6 ± 18.5 | $X^2 = 57.0$, df = 1, P < 0.0001 | 295.3 ± 36.7 | 192.3 ± 41.7 | $X^2 = 1.85$, df = 124, P = 0.066 |
| # Sponges in Cluster | 3.89 ± 0.19 | 3.93 ± 0.16 | $X^2 = 0.0$, df = 1, P > 0.995 | 4.10 ± 0.24 | 3.62 ± 0.27 | $X^2 = 0.98$, df = 1, P > 0.322 |

Table 2. Characteristics of *Aplysina fistularis* sponges in relation to the presence/absence (yes/no) of satellite individuals of the yellowline goby *Gobisoma horsti* at Discovery Bay, Jamaica. Values indicate mean (± SE).

| | Satellite (Yes) | Satellite (No) | Kruskal-Wallis Results |
|---|---|---|---|
| Height (cm) | 19.6 ± 1.58 | 13.7 ± 0.86 | $X^2 = 11.01$, df = 1, P = 0.0009 |
| Osculum Diameter (cm) | 3.30 ± 0.32 | 2.25 ± 0.13 | $X^2 = 11.5$, df = 1, P = 0.0007 |
| Atrium Volume ($cm^3$) | 274.7 ± 73.4 | 114.1 ± 23.5 | $X^2 = 14.29$, df = 1, P = 0.0002 |
| # Sponges in Cluster | 3.65 ± 0.36 | 2.57 ± 0.19 | $X^2 = 7.88$, df = 1, P = 0.005 |
| # Gobies in Cluster | 2.00 ± 0.31 | 0.92 ± 0.12 | $X^2 = 13.3$, df = 1, P = 0.0003 |

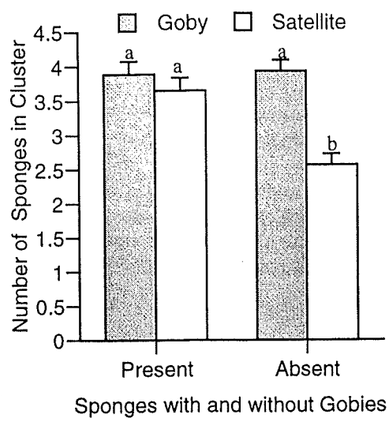


Fig 1. The occurrence (presence / absence) of goby sponge inhabitants and satellite individuals with number of sponges in a cluster (mean ± SE) in four fore reef sites at Discovery Bay, Jamaica. Different letters indicate significant differences (P = 0.005).

*Observations*

In our 10 min observations, goby inhabitants moved from one sponge to another within a cluster, usually to sponges uninhabited at that time, for a total of 13 inter-sponge movements. If the sponge was already occupied, the larger of the two gobies acted aggressively toward the smaller one and chased it out of the atrium (4 of the 13). Satellites generally had no interaction with the sponge inhabitants, although in one observational period, a large satellite individual was chased away by the inhabitants of two different sponges when it tried to enter the atria. Satellites moved among the periphery of sponges within a cluster, and were not specific to a single sponge. The satellites never left their specific cluster within the 10 min of observation. However, satellites did swim through short distances of open water to get to another sponge within the cluster.

As an interesting side note, two glasseye snapper (*Priacanthus cruentatus*) were seen wedged deeply into two large atria of a four sponge cluster of *A. fistularis*. during a recreational night dive to Dairy Bull.

*Goby Sexing*

While our ability to sex the gobies was limited, we were able to distinguish a difference in genitalia among the larger size class sponge inhabitants. From these differences, we can infer that both sexes were found as inhabitants of the same cluster.

We were not able to determine sexes among the collected satellites. Either the genitalia were too small for us to distinguish, or the individuals were juveniles with undifferentiated genitalia.

## DISCUSSION

As predicted, large sponges were more likely to be inhabited by gobies, and moreover, by larger individuals, as there is a greater food resource at these sites. Larger gobies demonstrated their ability to chase away smaller individuals and exclude them from sponges during our observational periods. Our observations of the territoriality of the gobies support the findings of Brady and Levesque (1995); however, the boundaries of their territoriality within the sponge cluster are unknown. It is unclear if they are territorial over one particular atrium, multiple atria, or only the atrium they happen to be in at that moment. With such extensive movement of the gobies between sponges within a cluster, the large gobies may be exerting their dominance, or foraging in the other sponges for polychaete worms.

Satellites also preferentially existed on larger sponges where there were more goby inhabitants. As we were unable to determine the sex of these satellites, we cannot be sure if this aggregation results in a reproductive advantage through "sneak-matings." In fact, satellites may be juveniles incapable of reproduction. The greater exterior surface area of the large sponges where satellites are found probably provides them with the toxins for predator defense and a more abundant food resource than they might find in smaller sponges or in smaller clusters of sponges. As the infauna of a sponge are largely found inside the tissues and atrium of a sponge, a large cluster with atria that are only inhabited part of the time may also provide satellites with more





oppurtunities to feed. Many of the sponges are also covered, in part, by mats of filamentous algae. These patches of algae may be fruitful foraging grounds for satellites.

The function of the satellite goby is very unclear; we found that large clusters with satellites often had uninhabited atria, and yet they did not attempt to utilize the atrium as the other gobies. Perhaps the threat of aggression from the large gobies in the cluster keeps them on the periphery of the sponge. Also, the interior of the sponge does not seem to offer more protection from predation. First, the satellites have access to the noxious toxins that makes them unpalatable to predators, and in addition, the satellites' small size allows them to utilize the small nooks and crevices of the outer sponge wall as physical protection. It seems that the availability of a greater food resource seems to determine their preference of sponge cluster association.

## LITERATURE CITED

Brady, J. H. and V. R. Levesque. 1995. Territoriality of the yellowline goby (*Gobiosoma horsti*) in yellow tube sponges (*Aplysina fistularis*). Pp. 187-190 *in* eds. Dartmouth Studies in Tropical Ecology. Dartmouth College: Hanover, New Hampshire.

Thresher, R. E. 1980. Reef Fish. The Palmetto Publishing Co., St. Petersburg, Florida, USA