Getting fat with a little help from your friends: The effect of schooling on feeding behavior of bluehead wrasse

Christina L. Glastris and Melissa R. Kang

Abstract: Past studies have shown that schooling fish enjoy benefits such as higher feeding rate. We hypothesized that bluehead wrasse (*Thalassoma bifasciatum*) feeding rates would differ according to feeding mode. We predicted that juveniles in schools would have higher feeding rates in damselfish territories than those feeding as solitary individuals, but that the feeding rate would not differ outside of territories. We also predicted that solitary juveniles would have higher feeding rates outside of damselfish territories than within territories. By observing bluehead wrasse, we determined that the feeding rate was higher for the schooling individuals than individuals feeding alone; however, there was no difference in feeding rates between single and mixed species schools, perhaps due to similar group sizes between the modes. The feeding rate in damselfish territories increased with school size. Solitary individuals were found to feed more outside of damselfish territories than within territories. Schooling provides a significant feeding advantage for juvenile bluehead wrasse, most likely by decreasing the likelihood of a particular individual being chased out of territories and thus allowing more feeding.

Key Words: feeding, schools

Introduction

Schooling is a behavior exhibited by many species of fish. Studies have shown that aggregating in schools of conspecifics or mixed species may allow individuals to feed more efficiently and gain access to otherwise unavailable food resources in damselfish territories (Robertson et al. 1976, Reinthal and Lewis 1986, Foster 1987, Baptista et al. 1998). This paper aims to determine whether the schooling behavior of the bluehead wrasse, *Thalassoma bifasciatum*, leads to this feeding enhancement.

The bluehead wrasse is a common fish species in the Caribbean, and initial phase juveniles forage in schools on reefs, rubble beds, and in the water column (Deloach 1999). We observed three different foraging modes for juvenile wrasse in the back reefs of Discovery Bay, Jamaica. Juveniles were found feeding either 1) alone or with a few conspecifics, 2) in a school of conspecific juveniles, or 3) in a school of several herbivorous species. We hypothesized that these different feeding modes would result in different feeding rates for individuals, through varied access to resources in damselfish territories. We predicted that within damselfish territories, juveniles feeding in schools would have higher feeding rates than those feeding alone, because the individual would experience fewer attacks by the damselfish. In contrast, we predicted that feeding rate outside of damselfish territories would not differ between solitary and schooling individuals. We also predicted that solitary juveniles would have higher feeding rates outside of damselfish territories than within territories, since they would be chased out of territories rapidly. Additionally, if mixed species schools are larger in size than schools of conspecific juvenile wrasse, we predicted that feeding rates of individuals within mixed species schools invading a territory would be lower. This may be because although one species feeds on benthic invertebrates on the algae and the other on algae itself, both compete to feed in the algae.

Methods

On 3-5 and 7-9 March 2001, we observed bluehead wrasse on both the east and west back reefs, Discovery Bay, Jamaica. We located juvenile bluehead wrasse for observa

tion by swimming over the reef until an individual was sighted; if more than one fish was present, a focal individual was chosen haphazardly. Group size was noted, and feeding mode was classified as solitary (three wrasse or less), schooling (four or more wrasse), or mixed species school (four or more wrasse as well as other species). We followed the focal individual for four minutes, noting the number of bites taken from algae and water column both within and outside damselfish territories. We classified feeding as algal when the individual nipped at algae, and as planktivorous when the individual nipped above algae or in the water column. It was difficult to determine if feeding was planktivorous or not, due to the fact that the wrasse did not exhibit clear lunges or mouth openings.

Overall feeding rate data were normalized using a log transform. We then used an ANOVA to analyze effects of foraging mode, and damselfish territory on feeding rate.

Results

Group size did not differ between bluehead wrasse schools and mixed species schools ($t = 1.53$, $df = 28$, $P = 0.14$). An average (± 1 SE) bluehead wrasse school included 9.9 ± 2.2 individuals while a mixed species school included 20.6 ± 7.1 individuals. Rates of feeding in damselfish territories were also significantly different among the foraging modes (ANOVA, $F = 7.77$, $df = 2$, $P = 0.0034$; Fig. 1); the solitary mode fed at the lowest rate (Tukey-Kramer HSD, $P < 0.05$), while bluehead wrasse schools and mixed species schools did not differ (Tukey-Kramer HSD, $P > 0.05$). The feeding rate in damselfish territories did not increase with school size ($r^2 = 0.004$, $df = 1, 68$, $P = 0.26$). However, this relationship was strongly affected by an outlier, an unusually large school with 70 individuals compared with 40 or less in the other schools. When we removed the outlier, the increase in feeding rate in a damselfish territory with school size was significant though relatively small ($r^2 = 0.14$, $df = 1, 67$, $P = 0.0008$; Fig. 2). Bluehead wrasse feeding rates did not differ significantly among foraging modes when individuals were feeding outside damselfish territories (ANOVA, $F = 0.24$, $df = 2$, P

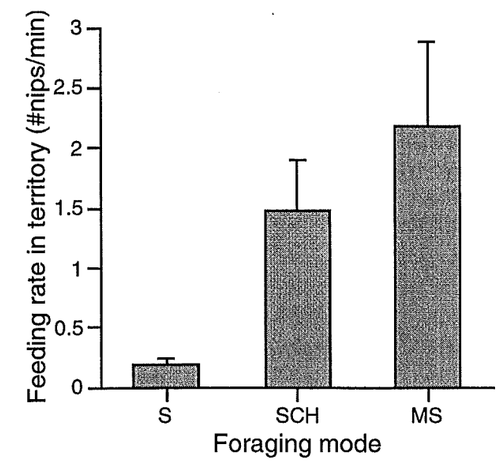

Fig. 1. Mean feeding rate (± 1 SE) of juvenile bluehead wrasse in damselfish territories across different foraging modes in Discovery Bay, Jamaica: single species of 3 or less (S), in groups greater than 3 (SCH), or greater than 3 wrasse in mixed species school (MS) (S: n = 40; SCH: n = 16; MS: n = 14).

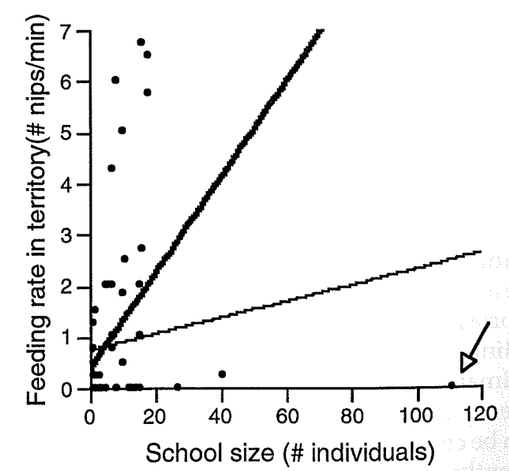

Fig. 2. Feeding rate in damselfish territories by school size at Discovery Bay, Jamaica (n = 70). The thin line is a regression of a complete data set, and the thick line is a regression with an outlier removed (outlier highlighted by an arrow).

= 0.79). Solitary individuals had a significantly greater feeding rate outside of damselfish territories than within damselfish territories (Welch's ANOVA, F = 49.1, df = 1, P < 0.0001; Fig. 3). Feeding rates of individuals in schools did not differ within and outside of damselfish territories (Welch's ANOVA, F = 1.32, df = 1, P = 0.25). The proportion of feeding on algae or on zooplankton did not differ significantly across foraging modes (ANOVA, F = 0.69, df = 2, 51, P = 0.51).

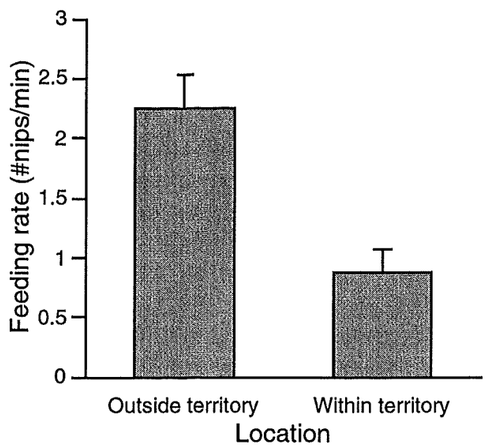

Fig. 3. Mean feeding rate (± 1 SE) for solitary juvenile bluehead wrasse outside and within damselfish territories in Discovery Bay, Jamaica (n = 70 for each location).

Discussion

Our data support our hypothesis that juvenile bluehead wrasse in schools have higher feeding rates than solitary individuals within damselfish territories, but not outside these territories. The feeding rate within territories also increased with group size, providing support for feeding enhancement as an ultimate benefit of schooling. A solitary fish attempting to feed in a damselfish territory can be chased out rapidly, as we observed frequently. When a larger group invades, the damselfish may attack with the same frequency. Thus, increasing numbers of fish in a school decreases the per capita number of attacks from damselfish, increasing individual foraging success. However, once a school reaches a certain size, the competition for resources may outweigh the feeding enhancement benefits of schooling.

We did not see the expected difference between feeding rates in mixed species schools and bluehead wrasse schools, perhaps due to the fact that school sizes were similar between the two modes. If mixed species schools do not form larger groups, there is no reason for focal individuals within them to experience greater competition for food during a territory invasion than they would in a school with bluehead wrasse only. The overall population size or predator density on the reef may be a determinant of school size.

Schooling behavior seems to provide a substantial feeding advantage for juvenile bluehead wrasse. The algal gardens in damselfish territories may be a nutrient rich resource, and those without access to it are restricted to resources outside territories. Further studies might examine the resources used by solitary foraging individuals and their tendency to remain solitary as well as the effect of habitat type. Additionally, to further understand schooling behavior, future studies might compare individual wrasse fidelity to conspecific versus mixed species schools, and the area covered by different schooling modes.

Literature Cited

Baptista, A.I., D. L. Poulin, and R. C. Yale. 1998. Interactions between blue chromis and herbivorous mixed species schools. Pp. 149-151 *in* E. S. Berg and R. F. Douzinas, editors. Dartmouth Studies in Tropical Ecology 1998. Dartmouth College, Hanover, NH, USA.

Deloach, N. 1999. Reef Fish Behavior. P. 326 *in* F. Connaughey, editor. New World Publications, Inc., Verona, Italy.

Foster, S. A. 1987. Acquisition of a defended resource: a benefit of group foraging for the neotropical wrasse, *Thalassoma lucasanum*. Environmental Biology of Fishes 19: 215-222.

Reinthal, P. N. and S. M. Lewis. 1986. Social behaviour, foraging efficiency and habitat utilization in a group of tropical herbivorous fish. Animal Behavior 34: 1687-1693.

Robertson, D. R., H. P. A. Sweatman, E. A. Fletcher, and M. G. Cleland. 1976. Schooling as a mechanism for circumventing the territoriality of competitiors. Ecology 57: 1208-1220.