

**INTRODUCTION**

Larval settlement in reef fish communities is analogous to seed dispersal in terrestrial plant communities. Like seed dispersal, patterns of larval settlement can impact community structure. However, the relative importance of larval settlement versus competitive interactions in structuring reef fish communities remains controversial. Settlement is generally viewed as a process that establishes initial variation in a community that may subsequently be reshaped by competitive interactions. In our previous research we have identified four labrid species likely to be engaged in competition based on indices of habitat use and ecomorphology; the sixbar wrasse (*Thalassoma hardwicke*), the fivestripe wrasse (*Thalassoma quinquevittatum*), the bird wrasse (*Gomphosus varius*) and the sixstripe wrasse (*Pseudocheilinus hexataenia*). Here we employ a field assay and replicated field experiment to evaluate the potential importance of competitive interactions between sixbar wrasse settlers and established individuals of the three likely competitor species, and how these interactions affect success of sixbar wrasse settlement.

**METHODS**

**FIELD ASSAY**

- For each of 32 patch reefs resident benthic fish were surveyed and habitat was characterized
- Resident sixbar wrasse were removed to avoid density dependent effects
- Settlement was simulated by introducing 3 individually tagged sixbar wrasse settlers (12-18mm) to each reef
- Surviving individuals and heterospecific wrasse species were surveyed daily for seven days, on experimental and neighboring non-experimental reefs (to check for migration)
- Time-to-disappearance (assumed to represent mortality) was examined via a Cox proportional regression to determine if survival varied among reefs according to the presence of each of the competitor species
- For competitor species found to influence survival a repeated measures ANOVA was run to test the effect over time.

**REPLICATED FIELD EXPERIMENT**

- Consisting of four treatments: presence or absence of the fivestripe wrasse crossed with presence or absence of the macroalgae *Turbinaria* (an hypothesized refuge habitat); five replicates of each treatment were randomly assigned to 20 patch reefs
- Resident sixbar wrasse were removed, and settlement was simulated as per the assay
- Surveying was conducted daily for three days, and results examined as per the field assay to determine if survival varied among treatments.

**TAGGING CONTROLS**

- There was no significant effect of tagging on laboratory controls.



# THE EFFECTS OF COMPETITIVE INTERACTIONS ON COMMUNITY STRUCTURE IN A GUILD OF CORAL REEF FISH

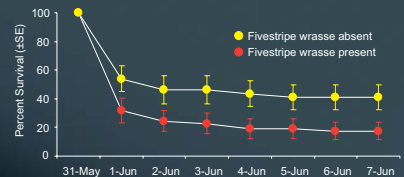


Inset top to bottom: Juvenile sixbar wrasse with elastomer tag, fivestripe wrasse, bird wrasse, sixstripe wrasse. Main image: Adult sixbar wrasse



**Table 1** Coefficients and results from the Cox proportional regression hazard assessment for the field assay. With non-significant interactions removed only presence of the fivestripe wrasse was found to significantly effect survivorship of sixbar wrasse settlers ( $p = 0.027$ ).

	Coef	exp(coef)	se(coef)	z	p
Fivestripe	0.611	1.842	0.276	2.212	<b>0.027</b>
Sixstripe	-0.211	0.810	0.270	-0.781	0.430
Bird	-0.167	0.847	0.315	-0.528	0.600



**Fig.1** Repeated measures ANOVA with a quadratic fit for the field assay examining the presence and absence of the fivestripe wrasse indicated that survival of sixbar settlers varied significantly over both time ( $p < 0.000$ ), and according to the presence (red) or absence (yellow) of the fivestripe wrasse ( $p = 0.027$ ).

**RESULTS**

**FIELD ASSAY**

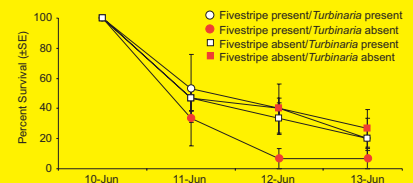
- Survival analysis indicated that of the three wrasse species examined only the presence of resident fivestripe wrasse significantly ( $p = 0.027$ ) affected post-settlement survival of sixbar wrasse (Table.1)
- Repeated measures ANOVA (Fig.1) indicated that survivorship of sixbar wrasse varied over time ( $p < 0.000$ ), and in the presence of the fivestripe wrasse ( $p = 0.027$ )
- Patterns of survivorship for sixbar wrasse settlers were established in the first two days (Fig.1).

**REPLICATED FIELD EXPERIMENT**

- Survival analysis indicated that treatment did not significantly affect the survivorship of sixbar wrasse settlers ( $p = 0.776$ )
- Repeated measures ANOVA showed that time ( $p = 0.000$ ) but not treatment ( $p = 0.525$ ) affected survival of sixbar wrasse (Fig.2). Despite this there was a non-significant trend for the survival of sixbar wrasse settlers to be lower in the presence of fivestripe wrasse when the macroalgae *Turbinaria* was not present
- Power analysis showed that a minimum of 18 reefs per treatment would be required to detect significant differences. Logistic constraints were therefore likely to have affected the ability to detect effects.

**CONCLUSIONS**

- Our field assay demonstrates that survivorship of sixbar wrasse is reduced by the presence of resident fivestripe wrasse, but not by the other species tested
- Despite limited power, our results showed a trend for presence of the macroalgae *Turbinaria* to mitigate the mortality experienced by sixbar settlers in the presence of resident fivestripe wrasse
- Our results suggest that the presence of heterospecific wrasse may restructure patterns established during settlement, possibly due to competitive interactions, and that this may be mediated via the availability of refuge habitat
- More research into the interactive effects of competitive species and refuge availability in restructuring settlement patterns is warranted.



**Fig.2** Repeated measures ANOVA for the replicated field experiment indicated that survival significantly varied over time ( $p=0.014$ ) for sixbar settlers, and although survival varied between treatments, this was non-significant ( $p=0.525$ ).



Experimental patch reef

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