Estate Agency Recommendations for *Coenobita violascens*

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Introduction

Terrestrial hermit crabs rely upon empty gastropod shells to protect themselves from predation, desiccation and environmental stress (Orno *et al*., 1998). A study on Isabel island, Mexico found that *Coenobita compressus* significantly preferred the shell *Nerita scabricosta* to 11 other species (Guillen & Osorno, 1993). This was attributed to the shell's high internal volume to weight ratio, which enabled mobility (Osorno *et al*., 1998). This study on Aride island set out to discover which shell species *C. violascens* prefers and why.

Methods

The three shell species were beachcombed, numbered using permanent black marker and then varnished. Their aperture length and width were recorded, as were their weight, internal volume and body whorl length, which is a measure of internal volume. A scale of wear was applied as follows:

1 – near perfect condition, no holes in shell
2 – slightly worn, no holes, possible chipped aperture
3 – worn, no holes, shell may have broken aperture
4 – very worn, holes present but not in the body whorl
5 – extremely worn, hole in body whorl

The closest wandering crab to a feeding station was selected and a free access experiment was conducted. As shell use may be influenced by shell availability (Turra & Leite, 2001), equal numbers of shells of each species were used. Crabs were placed in an experimental arena with two larger shells and two smaller shells of each species, comparative to their current shell. If the crab tried to flee within the first five minutes it was replaced in the arena, otherwise the experiment continued until the crab made its escape. Crabs were checked periodically for shell-seeking behaviours. If a change of shell occurred: the old shell was measured as with the beachcombed shells, the crab's weight was deduced, and the crab was replaced in the arena. All data were tested for normality using Anderson-Darling and the appropriate test was then performed using MINITAB.

Results

Of the 146 crabs used in the experiment, 3% were in a *Pleuroploca trapezium* shell, 40% in *Turbo argyrostomus* and 57% in *Turbo setosus*. 25 *Pleuroploca trapezium* shells, 99 *Turbo argyrostomus* and 67 *Turbo setosus* shells were beachcombed at Aride over two months and were measured (Table 1).

Shell Species	Weight (g) / 1st whorl (cm)	Weight (g) / Internal Volume (mm)
Pleuroploca trapezium	0.59	27.48
Turbo argyrostomus	0.55	**28.82**
Turbo setosus	**0.71**	27.71

Table 1: Shell weight to length of the body whorl and shell weight to internal volume relationships are displayed for the three shell species that *Coenobita violascens* is most commonly found in on Aride.

All crabs were observed to display shell-acquisition behaviours of touching empty shells in an exploratory manner. However, there was a low satisfaction rate, with only 22 (15%) crabs acquiring a new shell. In addition 17 other crabs did change shell but later returned to their original shell. The mean number of shells changed into before these crabs returned to their original shell was 1.5 ± 0.9 (n = 17).

50% of the crabs that acquired a new shell were in a *T. argyrostomus* shell and 50% in a *T. setosus* shell. Seven crabs (32%) then changed into a *T. argyrostomus* shell and 15 (68%) to *T. setosus*. Changes were observed from one shell species to the other and to the same shell species, however no crabs acquired a *P. trapezium* shell. The new and old shells did not differ significantly from each other in shell weight to body whorl length (T = -0.95, n = 22, p > 0.05) or shell weight to internal volume (T = 0.38, n = 22, p > 0.05). Aperture length (T = -0.98, n = 22, p > 0.05) did not differ significantly between the old and newly acquired shell. However, aperture width was greater in the newly acquired shell than the old shell (T = -2.17, n = 22, p > 0.05; Figure 1).

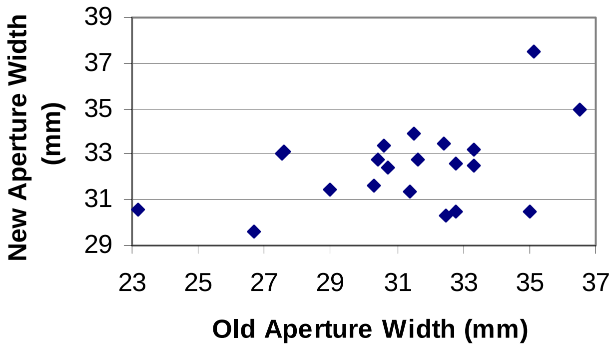

Figure 1: Old shell aperture width plotted against the aperture width of the shell that the hermit crab then acquired during the experiment.

Old shell aperture length increased significantly with crab claw length (r = 0.68, n = 22, p < 0.01), as did shell aperture width with crab claw width (r = 0.78, n = 22, p < 0.01). However the newly acquired shell's aperture length (r = 0.17, n = 22, p > 0.05) and width (r = 0.33, n = 22, p > 0.05) were not significantly related to crab claw length and width respectively. The mean scale of wear did not differ between old (2 ± 1, n = 17) and new shells (2 ± 1, n = 17). No crabs selected a shell with a hole in the body whorl.

Discussion

The hermit crab C*. violascens* was found predominately in *T. setosus*. This is not due to the shell's abundance as *T. argyrostomus* was the commonest shell that C*. violascens* was found in. A low percentage of C*. violascens* were found in *P. trapezium* shells, yet no crabs acquired one of these shells in the experiment. The *T. setosus* preference may be attributed to its high weight to body whorl length ratio in comparison to the other two species.

The increase in shell aperture width between the old and newly acquired shells was in contrast to other experiments where hermit crab shell preference was strongly associated with shell weight and internal volume (Garcia & Mantelatto, 2001). Shell internal volume was more important as a choice factor than weight for *Calcinus tibicen* and *Clibanarius antillensis* (Floeter *et al*., 2000). High internal volume/weight ratio is required by hermit crabs when high mobility is needed and predation pressures are low (Guillen & Osorno, 1993). It is possible that the small sample sizes in this experiment did not allow a similar trend to be revealed, especially as shell internal volume was measured with the rain gauge preventing precise measurements.

No shells with holes were acquired during this experiment. Shells with holes increase the vulnerability of the hermit crabs to decapod predators, in part by allowing predators to enlarge the hole and also by reducing the force needed for predators to crack the shells open. In addition, living in shells with holes may make hermit crabs more vulnerable to eviction by conspecifics and low-salinity stress (Pechenik *et al*., 2001). Hermit crabs apparently discriminated between shells that were intact and shells with holes based on tactile cues.

It was noted that some crabs switched shells only to return to their old shell. The mean number of shells changed into was 1.5 but this figure is likely to be higher as crabs were not constantly observed, to prevent disruption. Switching shells then returning to the old shell suggests that *C. violascens* cannot always assess the suitability of shells solely through tactile stimulation. Additionally the shells provided in the experiment may not have been sufficiently different to the inhabited shell, reflected by the low satisfaction rate. The *C. violascens* hermit crabs found around the feeding station tended to inhabit large turban shells and discernibly larger turban shells could not be found. One crab, not used in the experiment, inhabited a coconut shell suggesting that past a certain size *C. violascens* seek alternative large, light objects for housing. Large *P. trapezium* shells were available, yet no crabs selected these, possibly because of their low weight to internal volume ratio.

Further Experiments

It is suggested that the hermit crabs *C. rugosus* and *C. pseudorugosus* be used in further experiments as they are more abundant and show greater size variation than *C. violascens*. Use of volume gauges and callipers that record to a higher degree of precision are advised.

References

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