Experiment: Shell selection behaviour of hermit crabs in areas of low shell availability

Introduction

Hermit crabs rely on occupying empty gastropod shells to protect them from predation, desiccation, other hermit crabs and other environmental factors (Conover 1978). The selection of shells by hermit crabs is not random, instead they employ a selection process to find the optimal shell and thus, the optimal habitat (Conover 1978). Factors such as size, colour, shape, weight, condition, aperture size, internal configuration and species of shell are all taken into consideration by the hermit crab when selection a shell (Billock 2008; Reese 1962; 1963). In environments where shells are abundant, hermit crabs can spend their time searching for an optimal shell in inhabit. However, environmental pressures such as a low shell availability and competition will prevent the hermit crabs from occupying optimal shells and instead will force them into shells that are sub-optimal, which will result in increased predation and lower growth rates (Billock 2008; Conover 1978). Shell availability occurs naturally with seasonal changes; low shell abundance causes bottle necks in the population which results in disproportionate numbers of adult and juvenile hermit crabs (Billock 2008).

Aim: To see if there is a correlation between body size and shell size when hermit crabs are placed in an environment of very low shell abundance.

Hypothesis: It is hypothesised that the hermit crabs will be forced to utilise shells of a sub-optimal standard and that shell size will not necessarily reflect body size. Thus, there will be little to no correlation between shell and body size due to a lack of shells available to the hermit crabs.

Methods

Hermit crabs were submerged in ice water for 20mins to ensure death. The hermit crabs were taken out of the water and dried out. Measurements including length and width of shells, and weight of hermit crabs were recorded. The hermit crabs were extracted by cracking their shells, being careful not to inflict damage on the body. A length measurement was taken, by extending the body, from the tips of the chelae to the end of the abdomen. The bodies of the hermit crabs were weighed, from this the weight of the shell was calculated. A correlation analysis was carried out on the data.

Results

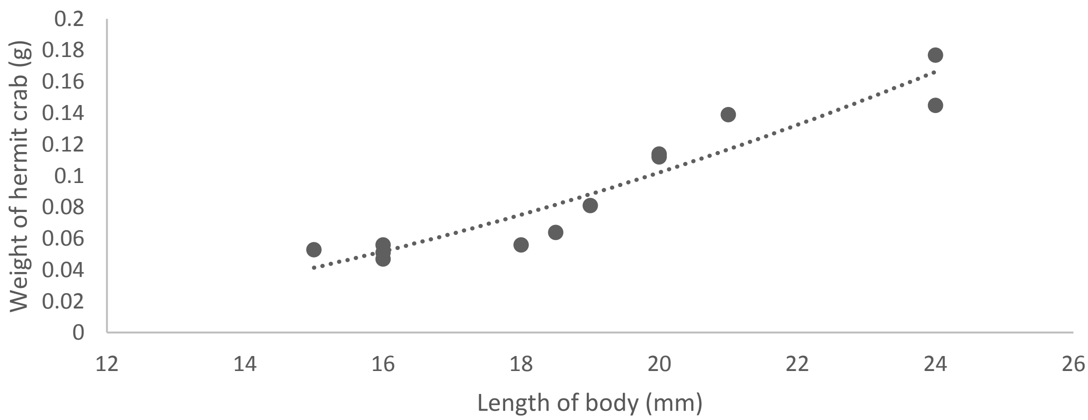

Figure 1 Correlation between the length of the body and the weight of the body R^2=0.90.

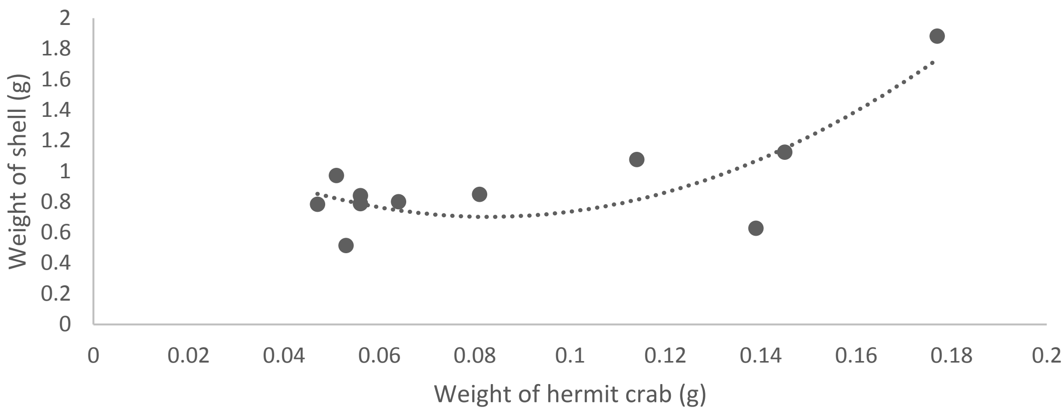

Figure 2 Correlation between the weight of the hermit crab and the weight of the shell chosen R^2=0.67

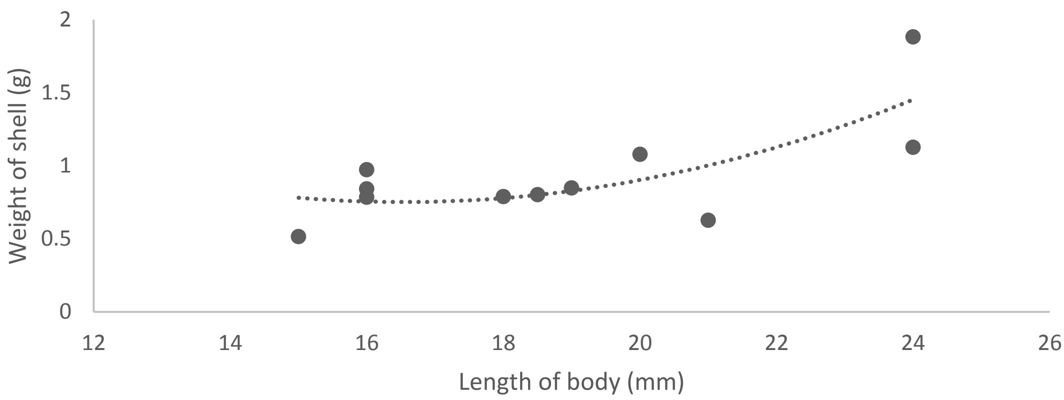

Figure 3 Correlation between the length of the body and the weight of the shell R^2=0.55

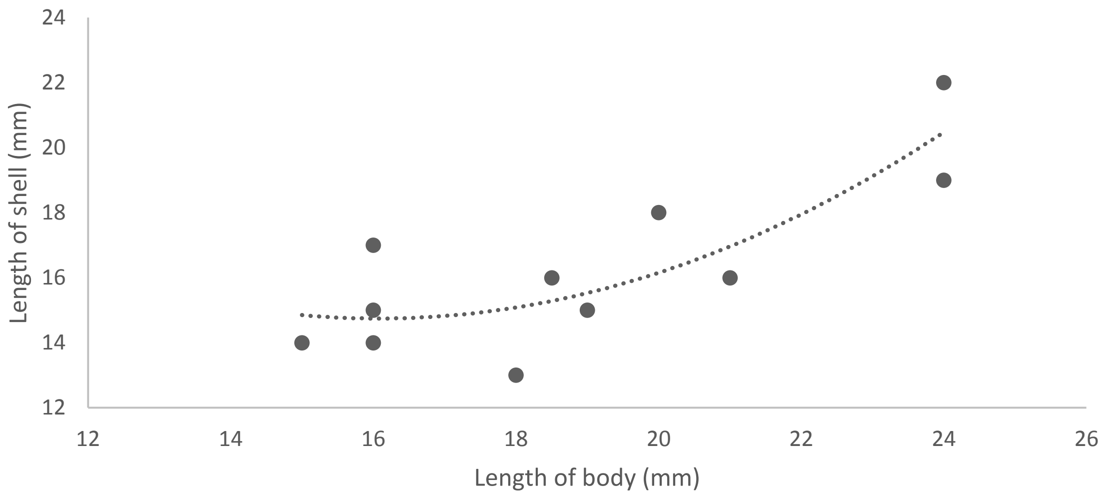

Figure 4 Correlation between the length of the body and the length of the shell R^2=0.70

Each graph shows the level of correlation between sizes and weights of the hermit crabs and shells. A trendline was added to show the exact level of correlation between the two factors. A polynomial trendline was selected as it best showed the correlation. As expected there is a strong correlation between the body size of the hermit crabs and the length of the hermit crabs (Fig 1) R^2=0.9; As the hermit crab increases in size so will his body weight. Figure 2 shows a slight correlation between the weight of the hermit crab without the shell and the weight of the shell chosen by the hermit crab, R^2=0.67. Figure 3 shows the correlation between the length of the body and the weight of the shell, however the correlation is quite weak, have an R^2 value of 0.55. Figure 4 has an R^2 value of 0.70, this shows a slight correlation between the length of the hermit crabs body and the length of the shell chosen.

Discussion

The shell selection process of hermit crabs is a complex one that relies upon many factors. One major factor of shell selection is the size and the weight of the shell (Conover 1978). It has been recorded in the literature that hermit crabs tend to select shells of a particular species, yet all hermit crabs pick a shell by comparing the weight of the shell to that of their own (Conover 1978).

Shells become a limiting factor when unoccupied shells are scarce. In this scenario hermit crabs are forced to occupy shells that are too small for the. This can result in an increase of predation and a decrease in growth rate (Conover 1978). Figure 2 shows only a slight correlation between hermit crab size and shell weight, however this was expected to happen as the hermits crabs were put in an environment where shells were very scarce. This could cause an increase in predation, as hermit crabs in a small shell cannot fully retreat when is senses danger, this leaves the legs and the chelae exposed to predators that specialise in pulling the hermit crabs out of their shells (Conover 1978). Having a small shell and large body increase the weight index of the hermit crab, and so when predators drop them from a height they break open easier compared to hermit crabs in larger shells and smaller body weight (Conover 1978). There was some correlation found between the size of the shell and the size of the hermit crab (Fig 3 & 4), however in an environment of little to no shell availability it was expected to see a much lower correlation. This could possibly be explained by a decrease in growth rate caused by occupying a small shell. Smaller shells have a smaller internal volume compared to larger shell and so the hermit crabs are restricted in their shell until one of a more suitable size can be found (Conover 1978; Reese 1962). Thus, it is likely that the hermit crabs growth rate was decreased and the body size of the hermit crab matched that of the shell it occupied.

It can be concluded that low shell availability will force hermit crabs to occupy shells that are sub-optimal in order to avoid predation and environmental factors. It is far safer to occupy a too small or too big shell than to be exposed to predators and environmental factors.

References

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