Lacking the hard shell of other crustaceans, most hermit crabs must inhabit empty gastropod shells for protection. The factors influencing their decision of which shell to occupy have been the subject of many studies. It has been found that aspects such as competition, shell type, shell size, shell internal volume, and shell availability all play roles in the final decision. Ideally, a hermit crab would continue moving into larger shells as it grows. However, there is usually a shortage of suitable, available shells. Angel (1999) studied how living in smaller than ideal shells affected the growth rate and risk of predation in hermit crabs.

First the shell fit was determined by giving 50 *Pagurus longicapus* hermit crabs their choice between 300 various *Littorina littorea* periwinkle shells. After 48 hours the crabs were removed from their chosen shells and massed and the shell aperture sizes were measured. Using a best-fit line, the shell adequacy index was determined, with 1.0 representing the ideal shell, or “preferred fit”, and 0.5 representing a shell that is ideal for a crab half the mass of the actual inhabitant, or “tight fit”.

The growth rate was measured by pairing 28 hermit crabs by similar masses and randomly assigning half to be put in a “preferred fit” shell, with the others being placed in “tight fit” shells. Both groups were fed shrimp pellets every three days and massed after 89 days. Growth rate was calculated as the difference between initial and final masses divided by time.

The predation risk was measured by pairing 22 crabs by mass again and placing an equal number in “preferred fit” and “tight fit” shells. Each pair was then left in a tank
with one North Atlantic rock crab for two or three nights, with the damage or mortality being recorded afterwards. The rock crabs were fed, and ate, mussel immediately after the trials, indicating they weren’t full from eating just one of the hermit crabs.

Shell fit was found to significantly affect the growth rate, with eleven of the thirteen hermit crabs growing at a slower rate in the “tight fit” shells. Predation was also discovered to increase in the smaller shells. While all of the crabs in “tight fit” shells were eaten or fatally wounded, with the large majority being eaten, all but one of the “preferred fit” hermit crabs were unharmed. Thus, both decreased growth rate and increased risk of predation are possible reasons that hermit crabs would avoid undersized shells for habitation. The decreased growth rate may also be an adaptation to life in a small shell, in an attempt to decrease the risk of predation, instead of an actual effect of the smaller shell.

While the negative effects of settling in a smaller than ideal shell are obvious, they aren’t the only factors that weigh on the decision of the hermit crab. Pechenik (2000) investigated the bias of the same hermit crab species against shells with holes created by gastropod predators. Using the same relationship between crab weight and preferred shell size as Angel (2000), eighteen naked, or shell-less, hermit crabs were given a choice between an intact “tight fit” shell and a drilled “preferred fit” shell. Sixteen other naked hermit crabs were given a choice between an intact shell appropriate for a crab one quarter their weight and a drilled shell of the “preferred fit”.

Almost all the hermit crabs chose the “tight fit” shell over the drilled one. However, when the size of the shell was decreased to one quarter of the ideal, almost all of the crabs chose to settle in the larger, drilled shell. This extreme avoidance of drilled
shells indicates that there is strong selection against their use in the *P. longicarpus* population. More study is needed to learn whether other hermit crab populations, especially those that live in areas with less drilled shells present, have the same strong preference against drilled shells. Avoiding drilled shells could be a normal behavior used by all hermit crabs when choosing protection, or it could be a locally selected response due to the high number of drilled shells off the coast of Nahant, Massachusetts.

A later study done by Pechenik (2001) investigated what some of the costs of living in a drilled shell might be. Hermit crabs in drilled shells were found to be more susceptible to predation and eviction by conspecifics. Thus, both these factors likely play a role in giving the hermit crabs such a strong hesitancy to occupy punctured shells.

The results of Pechenik (2000) are somewhat surprising given the costs of small shells demonstrated by Angel (2000). Assuming the researchers discovered all the main factors influencing the hermit crabs’ choice between shells, one can make a comparison between the costs of inhabiting small and drilled shells: the risk of predation and decreased growth rate due to living in a shell half the ideal size must be less than the risk of predation and eviction from conspecifics due to having a hole in the shell. However, there could be other unknown factors that influence the decision of the hermit crab, making such a simple comparison invalid.

Further research on other species of hermit crabs living in different areas would be useful in determining whether these priorities are standard for all hermit crabs, or whether the local environment plays a major part in molding their behaviors.
Literature Cited


