SELECTIVITY OF COVERING MATERIAL IN TWO SEA URCHINS, *TRIPNEUSTES VENTRICOSUS* AND *LYTECHINUS VARIEGATUS*

SARAH E. B. FIERCE AND HEATHER E. LAPIN

Abstract: Many sea urchin species exhibit covering behavior, and several explanations for this behavior have been posed. One hypothesis is that urchins cover to protect themselves from harmful UV radiation. If this is true, then urchins should select covering materials that block light using photoreceptors on their aboral epidermis. To test this, we gave two species of urchins (*Tripneustes ventricosus* and *Lytechinus variegatus*) grass strips, clear plastic strips, and black plastic strips and recorded the percentage of strips they held on to after 30 seconds. While *Tripneustes* did prefer black covering strips to clear, *Lytechinus* made no distinction between the two. This suggests that the two species have different mechanisms for covering, and that *Tripneustes* requires covering material that blocks sunlight. *Lytechinus* may prefer grass to unnatural plastic strips, which suggests that covering is a cryptic behavior.

Key words: black plastic, clear plastic, light, *Thalassia testudinum*

INTRODUCTION

Many sea urchin species exhibit covering behavior, where shells, algae, leaves, or other debris are heaped on the aboral surface of the body. Several explanations for this behavior have been posed and tested. Covering may provide camouflage from predators, protection from toppling in heavy surge (Lees and Carter, 1972), shielding from suspended sediment (Richner and Milinski 2000), or protection from UV light (Lees and Carter 1972, Adams 2001, Butcher et al. 2002). While none of these has been shown definitively to be the explanation for covering, light has been shown to be a cue that induces urchins to cover, such that urchins cover more in full sunlight than partial sunlight or darkness (Kehas and Theoharides 2003).

In this study, we examined the selectivity of urchins for covering material. If urchins display a preference for covering materials that block light, this would suggest a mechanism where urchins use photoreceptors on their aboral epidermis to select covering materials. If this is the case, then urchins may select covering material to shield sunlight. Alternatively, urchins may display no preference for light-blocking materials, picking up any material that they can move onto their aboral surface. This would suggest a mechanism where urchins detect and select covering material using only tactile sensors. The lack of preference for light blocking material would suggest that other explanations for covering behavior are more probable than shielding from sunlight. We tested this on the urchins *Tripneustes ventricosus* and *Lytechinus variegatus* by comparing covering behavior when urchins were presented with opaque and translucent covering materials.

METHODS

On 25 - 26 February 2004, we collected ten *T. ventricosus* and seven *L. variegatus* urchins from the West Back Reef at Discovery Bay, Jamaica. Between 1330 and 1630, we placed each urchin in an individual tub with running seawater in full sunlight. Each urchin was presented with three kinds of covering material, one at a time: 2 x 4 cm strips of black plastic, clear plastic, and turtle grass (*Thalassia testudinum*; to serve as a control for the effects of using

plastic). Plastic strips were scored with a sharp probe to make a rougher surface to which tube feet could attach. While translucent covering materials are not normally available to urchins in nature, they allow examination of the mechanism behind this behavior. However, it is of some interest to note that *Tripneustes* will cover with opaque plastic in nature; one individual on the East Back Reef had most of its aboral surface covered with green plastic (R. Quinn Thomas, pers. obs.).

We offered each strip to the urchin using forceps and allowed the urchin to hold and feel the strip with its tube feet. After 30 seconds, we recorded whether the urchin had accepted the strip by continuing to hold it with its tube feet, or whether the urchin had rejected the strip by pushing it aside or allowing it to float away. We repeated this procedure on each urchin using five strips of each kind of covering material, for a total of 15 strips per urchin, presented in a random order. We calculated the proportion of strips accepted by each urchin for each kind of covering material and arcsine-transformed these values for statistical analysis.

Results

Tripneustes favored black strips over clear strips (paired-t = -4.58, df = 9, P = 0.001), grass over clear strips (paired-t = -3.36, df = 9, P= 0.008) and did not distinguish between grass and black strips (paired-t = -0.48, df = 9, P = 0.64; Fig 1). *Lytechinus* showed no preference between clear strips and black strips (paired-t = 0.76, df = 6, P = 0.76), tended to prefer grass over clear strips (paired-t = -2.27, df = 6, P = 0.06), and had no strong preference for grass over black strips (paired-t = -1.92, df = 6, P = 0.10; Fig 1).

For each treatment, the two urchin species did not differ significantly from one another in their preference for grass strips (t = 0.14, df = 15, P = 0.89), black strips (t = -1.01, df = 15, P = 0.33), or clear strips (t = 0.21, df = 15, P = 0.83).

Discussion

While *Tripneustes* did prefer the black strips to clear strips, *Lytechinus* made no distinction between the two. It is possible that the species have different mechanisms for selecting covering material, or that the purpose of covering differs for the two species. For *Tripneustes*, it may not be sufficient to simply cover; the covering material must block light. This provides evidence that photoreceptors are used in the selection of covering material in *Tripneustes*. Furthermore, this is consistent with the hypothesis that *Tripneustes* covers itself to shield sunlight, possibly protecting itself from harmful UV rays.

Lytechinus appeared to be less discriminating in its choice of covering material. However, we did see a trend where *Lytechinus* preferred grass material over black or clear plastic. *Lytechinus* may have rejected the plastic material

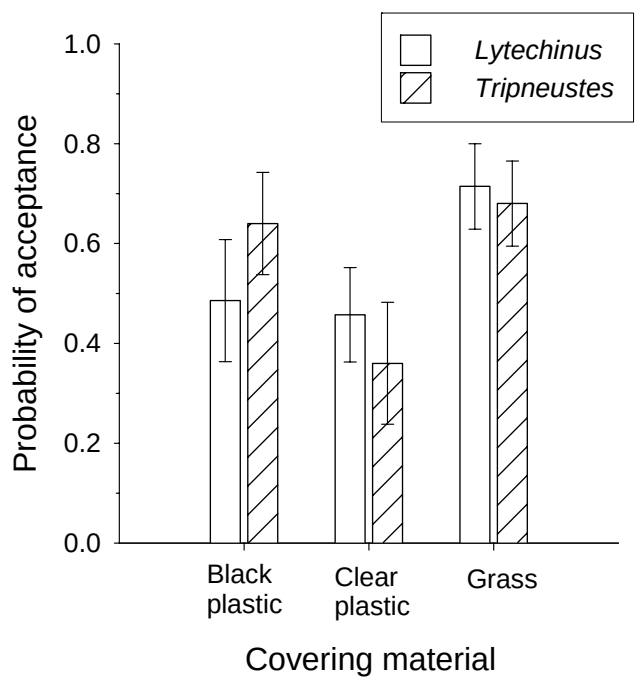

Figure 1. Mean (± SE) probability of acceptance (number of strips accepted out of five) of three types of covering material for ten *Tripneustes ventricosus* and seven *Lytechinus variegatus* urchins.

simply because it was a foreign, introduced material. Another possibility is that *Lytechinus* chooses material that allows it to blend in to its natural substrate (turtle grass). This idea should be tested in the field.

The different preferences for covering material shown by *Lytechinus* and *Tripneustes* may be linked to a difference in the cost and benefits of covering between the two species. For example, urchin tube feet that hold on to covering material are also used for respiration. Therefore, interference with respiration may be a cost of covering. Future studies should examine the costs of covering, and how they vary among species.

Overall, it appears that light is an important factor in the covering behavior of some sea urchins. *Tripneustes* covers more in full than reduced sunlight (Kehas and Theoharides 2003) and, as shown here, selects covering material that reduces sunlight on its aboral surface. There may be other benefits to covering, like protection from surge, and future studies could determine whether covering for these reasons affects the selection of covering material.

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