

Defecation behavior of the hairy urchin, *Tripneustes gratilla*

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Abstract

The hairy urchin, *Tripneustes gratilla* (Linnaeus 1758), is a common sea urchin in the shallow waters of Indo-West Pacific reefs. Its anus is centered on top of its body. During a windless period in August 2011, we photographed 26% (n=50) sea urchins lifting up their bodies 30-90 degrees in the Houbihu Lagoon, southern Taiwan (21°56'57"N, 120°44'53"E). Upon close examination of these animals, we saw feces dropping from the anus directly to the substrate. The feces content was subsequently identified in the laboratory as undigested algae and fine sand. During a windy period in December 2011, no sea urchins displayed this defecation behavior. It is postulated that the defecation behavior of these urchins ensures the deposition of feces directly on the substrate. Discharging feces this way could be more energetically efficient than removing feces with tube feet and spines as observed in other urchin species.

Key words: Sea urchin, *Tripneustes gratilla*, defecation behavior

Introduction

The Echinoidea include the regular urchins (sea urchins) and irregular urchins (heart urchins and sand dollars). The anus of regular urchins is centered on top of its body. While defecating, the undigested content is usually dropped around the anus

and subsequently removed by water currents and with the facilitations of numerous tube feet and spines (personal observation).

The hairy urchin, *Tripneustes gratilla* (Linnaeus 1758), is a common regular sea urchin in the shallow waters of Indo-West

Pacific reefs (Clark and Rowe 1971). This urchin is a rover on reef areas consuming a large amount of algae as food. Its anus is centered on top of its body.

As the hairy urchin is an edible sea urchin, aspects of its ecology and behavior are readily available (Lawrence and Agatsuma, 2001; Nojima and Mukai, 1985; Régis and Thomassin, 1982; Lison de Loma et al., 1999; Schumacher, 1974). Literature on defecation behavior, however, is limited for sea urchins. In this paper, we describe a defecation behavior of the hairy urchin photographed from a lagoon during a windless month in August 2011 in southern Taiwan.

Materials and Methods

Houbihu Lagoon (21°56'57"N, 120°44'53"E) is a landward reef lagoon in southern Taiwan. It is a small lagoon with an area of 0.33 km². Abundant hairy urchins live in the shallow water of 1-2 m depth.

In 2011, we examine the hairy urchins by skin diving in the lagoon every month from March to December. Photos and videos were taken to examine its defecation behavior.

In August (calm month) and December (windy month), three adults with diameter over 8 cm were captured each month. Gut contents of each individual were collected in test tube with sea water. The floating algae and precipitated materials were separated and

weighted.

In August and December 2011, 50 individuals undergoing defecation (i.e., with feces around anus) were filmed by digital camera. If the urchin decline exceeded 30 degrees, it was classified as "defecation behavior". The proportion of hairy urchins partaking in this behavior was calculated in August and December.

Results

Feces materials

Feces were composed of undigested macroalgae, crustose coralline algae, and sand. In August, sand and crustose coralline algae composed 73.7% total wet weight of the feces (35.7±2.1g) (M±SD, n=3), whereas macroalgae constituted 26.3%. In December, sand and crustose coralline algae composed 36.3%, whereas macroalgae made up 63.7 % of the total wet weight of feces (34.3±4.0g, M±SD, n=3).

Windless month

August 2011 was a windless month with slight wave action in the lagoon. Thirteen individuals among the 50 individuals photographed were observed with defecation behaviors (26%, n=50). This was the same summer that most of the macroalgae died, during which the hairy urchins ate large amounts of fine sand and calcareous red algae. In the lagoon, we typically observed urchins lifting up their bodies over 30 degrees,

even up to 90 degrees (Fig. 1a, b). While lifting up, hairy urchins always rest their oral surface against a small rock on the substrate or attach on the upright wall of large rocks. Upon close examination of these

urchins, we observed feces dropping from the anus directly to the substrate (Fig. 1c, d). This behavior has commonly been observed prior to the rise in tide rise while the water movement is low.

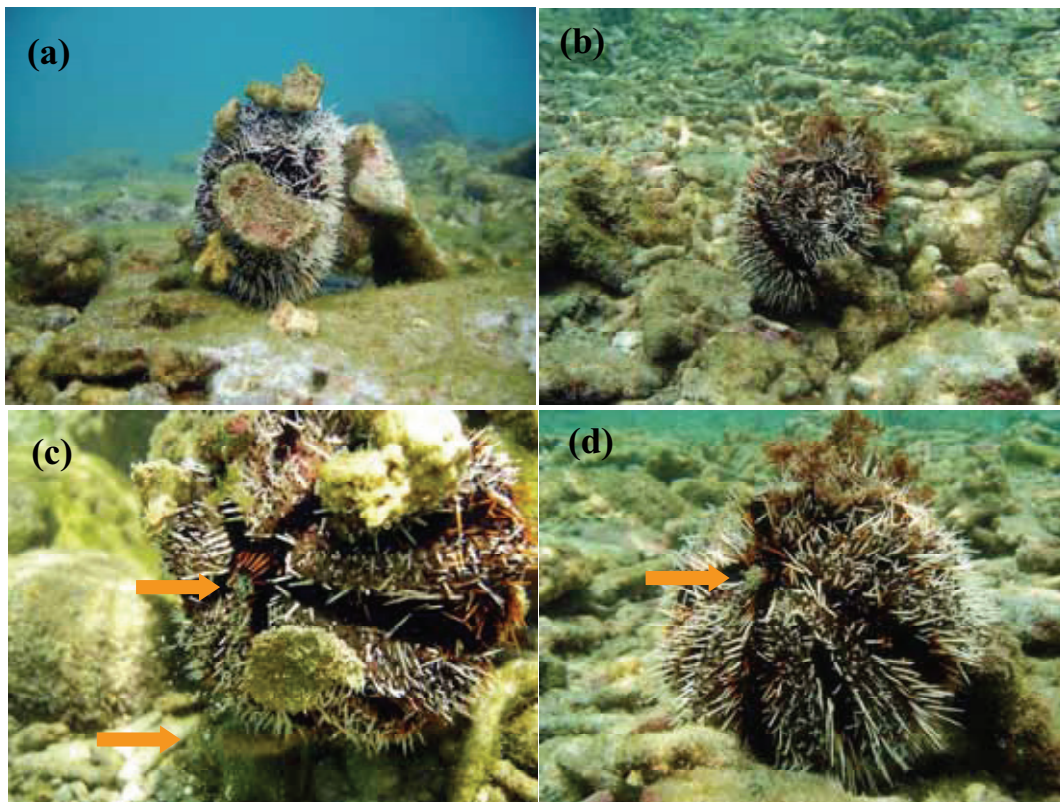


Fig. 1. *Tripneustes gratilla*. (a, b) Defecating posture. (c, d) Feces discharged from anus. Arrows indicate feces falling from anus. Anus is surrounded by several orange spines in fig. 1c.

Windy month

December 2011 was a typical cold windy month in southern Taiwan during which current and wave movements are strong in the lagoon. No hairy urchins were observed lifting up to defecate (n=50).

Feces were expelled around the anus that were removed by water current and by the numerous short spines and tube feet.

Discussion

Although its food varies with habitat,

the hairy urchin mainly eats macroalgae, crustose coralline algae and sand with macroflora (Ogden et al., 1989, Lawrence and Agatsuma, 2001). In the cold windy months, food (macroalgae) is abundant in the lagoon. The undigested materials are lighter, such that they could easily be flushed away by water movements and by the help of dense short spines. In addition, it may not be suitable for hairy urchins to lift their bodies to defecate as the wave action could cause them to turn upside-down. In windless months, however, undigested materials composed mainly by sands and undigested coralline algae are likely not as easy to move away via spines and water movement. We suspect that the hairy urchin lifts its body up to defecate during windless months to ensure that feces are discharged directly or easily to the substrate. Discharging feces this way could be more energetically efficient than removing feces with tube feet and spines.

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白棘三列海膽的排便行為

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摘 要

白棘三列海膽是印度洋到西太平洋珊瑚礁區很常見的海膽，主要以大型藻類、珊瑚紅藻及底沙中的有機物為食，牠的肛門位於身體上方正中央。大多數海膽排便時常會利用棘刺及管足將糞便緩緩移走，這種過程需要消耗一些能量。在2011年8月無風浪的月份，我們在台灣南端的後壁湖地區的潟湖中拍到26% (n=50)的白棘三列海膽將身體立起30~90度的特殊行為，糞便由肛門口排出，直接掉落海底。糞便的成份為細沙及未完全消化的藻類。12月風浪較強的月份，則沒有這種直立行為 (n=50)。這種直立排便行為的好處是糞便直接掉落，省去棘刺及管足的運送。

關鍵詞：海膽，白棘三列海膽，排便行為。