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INFLUENCES OF WAVE ACTION ON SHELL SHAPE OF MARINE SNAIL *NERITA PLICATA* AND OIL SPILL ON MARINE COASTAL ENVIRONMENTS

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Abstract

Influences of wave action on shell shape of marine intertidal snail *Nerita plicata* and oil spill on marine coastal environments were investigated in Ulithi Atoll, Yap State, Federation of States of Micronesia. Twenty species of marine snails were observed in the intertidal areas in Ulithi Atoll. Aperture mouth size of *N. plicata*, which was the most common snail in Ulithi Atoll was significantly different between smaller and larger snails but not between wave exposed area and sheltered area. However shell shape was significantly different between smaller and larger snails and between exposed area and sheltered area. These results suggested that shell shape and aperture size of *N. plicata* were affected by different factors.

Six Polycyclic Aromatic Hydrocarbons (PAHs) components (fluorine, phenanthrene, anthracene, fluoranthene, pyrene and chrysene) in surface seawater, sand and marine snails *N. plicata* in Ulithi Atoll where oil spill had happened from a sunken ship in August 2001 showed lower value. Although concentration of benzo (a) pyren in surface seawater and sand showed lower value, that of marine snails showed about six times higher concentration than snails in not-polluted area. I discussed the possibility of the influences by oil spill to the lives in coastal area.

Keywords: benzo (a) pyren, Micronesia, *Nerita plicata*, oil spill, Ulithi Atoll, wave action

Introduction

Many environmental conditions in intertidal area are rapidly changing in a short period. Therefore, this is one of harsh area for animals and plants to inhabit. However, many animals and plants adapted to these environmental conditions very much and much number of them inhabited in this area. Many researchers have studied the mechanisms and systems of their adaptation on these environment conditions such as wave action, predator, temperature, desiccation, light, etc (ex. LITTLE and KITCHING 1996; RAFFAELLI and HAWKINS 1996). Wave action was one of the important factors to influence on shell shape of the snails and shell shape was highly correlated to strength of wave force (ex. ETTER 1988).

Recently environmental pollution by oil spill became a big problem in the world (ex. PETERSON 1993). Oil spill has happened from a sunken oil tanker in August 2001 near Falalop Island, Ulithi Atoll, Micronesia (SALAS 2001). The ship was sunken by Japanese submarine "Kaiten" in World War Ⅱ. The leaking point of sunken ship was soon filled up but some amount of oil was leaking to Atoll. Two weeks later, most of the oil spill from the ship was gone through to open sea beside Asor and Falalop Islands. But there is not any research about influence of oil

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leaking on the animals.

There are three purposes on this paper: 1) to investigate species of marine snails in intertidal area in Ulithi Atoll, 2) to study the influence of wave action on the shell shape and aperture mouth of *N. plicata*, which is the most common species in the intertidal areas, and 3) to investigate the concentration of oil in the seawater, sand, and marine snail *N. plicata*.

Materials and Methods

The research was carried out in intertidal areas in Ulithi Atoll, Yap State, Federation of States of Micronesia from 18 October to 24 October 2001. To study sort of marine snails in the intertidal areas, I walked along seaside in Mogmog, Asor, Falalop, and Fassarai Islands, to record the species name of all kind of the observed snails and take unknown species into laboratory to know species name.

I decided that *Nerita plicata* was a target species to study, because this was the most common snail in these areas (see Result). Thirty smaller (shell length < 15 mm) and 30 larger (shell length > 15 mm) *N. plicata* were collected from wave exposed and sheltered areas of Mogmog, Asor, Falalop, and Fassarai Islands, respectively. I assumed that the open seaside of atoll was exposed area and inside of atoll was sheltered area. In the laboratory, I measured the shell length, shell width, aperture length, and aperture width of the all snails (Fig. 1) and calculate following 2 indices: 1) Relative Aperture Index (RAI) = (aperture length) × (aperture width) / (shell length)^2, and 2) Relative Shell Shape Index (RSSI) = (shell length) / (shell width). RAI is an index of size of aperture mouth and higher value of the index means that size of the aperture is bigger. RSSI is an index showing shell shape.

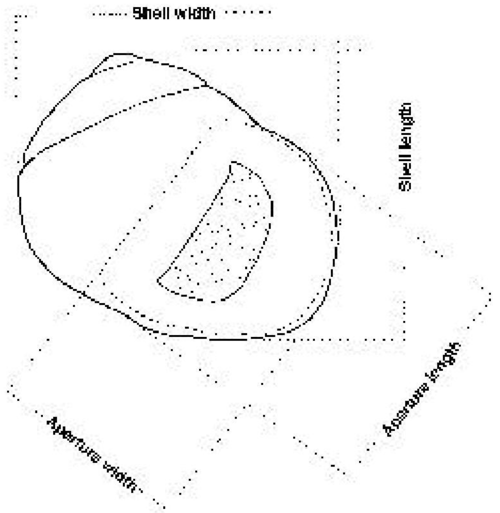

Fig. 1. Measuring method of two indices: 1) Relative Aperture Index (RAI) = (aperture length) x (aperture width) / (shell length)^2, and 2) Relative Shell Shape Index (RSSI) = (shell length) / (shell width).

To study state of the pollution, I studied 7 Polycyclic Aromatic Hydrocarbons (PAHs) components (fluorine, phenanthrene, anthracene, fluoranthene, pyrene, benzo (a) pyren and chrysene) in seawater, sand, and marine snail *N. plicata* in Asor Islands. Three litter of surface seawater was sampled near the shore. Two thousands and seven hundred cm^3 of sand was collected form 5 cm depth under the ground surface. Ten *N. plicata* were collected from sheltered shore. I commissioned Japan Frozen Foods Inspection Corporation to analysis these samples.

Results and Discussion

Shell Shape

Twenty species of marine snails were observed in the intertidal areas in Ulithi Atoll (Table 1). *Nerita plicata* and *Littorina undulata* were the two most common snails in this area. I adopted *N. plicata* as a target species of the study, because the density was higher than the other snails (personal observation).

Table 1. Species name which observed in intertidal area in Mogmog Island, Asor Island, Falalap Island, and Fassarai Island. ○ indicates that the snail was observed in the island.

Species	Mogmog	Asor	Falalap	Fassarai
Nerita plicata	○	○	○	○
Cerithium nodulosum	○			
Littoraria undulata	○	○	○	○
Cypraea tigris	○			
Cypraea moneta				○
Thais marginatra		○		
Thais savignyi	○			○
Drupa ricinus	○			
Drupa ebraeus				○
Drupa grossularia				○
Mancinella hippocastanus		○		
Coralliophila neritoides				○
Vasum ceramicum	○			○
Eugina mendicaria				○
Strigatella paupercula				○
Conus ebraeus				○
Muricidae A	○			
Muricidae B				○
Muricidae C				○
Mitridae A				○

Average RSSI of larger snails was significantly lower than that of smaller snails (two way ANOVA, $P < 0.001$) and average RSSI of snails in exposed area was significantly higher than that in sheltered area (two way ANOVA, $P < 0.001$) (Fig. 2, Table 2). There was an interaction effect between snail size and shore type on RSSI (two way ANOVA, $P < 0.05$). These suggested that there was significantly difference between exposed and sheltered area in smaller snail and no significant difference in larger snail. Larger and smaller snails inhabited in same area (personal observation), therefore both group received the same strength of wave force but shell shape showed different. There are two possible explanations on this. Firstly, sensitivity for selection force by wave force might be different between smaller and larger snails. Secondly, this was