

Short communication:

SPAWNING PERIODICITY OF SEA URCHIN *DIADEMA SETOSUM* IN THAILAND

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ABSTRACT

Changes in volume and maturity of gonads were examined in *Diadema setosum* through 6 weeks. Spawning had a semi-lunar periodicity in the Gulf of Thailand and the Andaman Sea. But maturation grades varied much during the period from February to March, indicating that the pattern of spawning may be complex.

INTRODUCTION

Lunar reproductive rhythms in sea urchins have been reviewed by Pearse and Cameron (1992). Most species with such rhythms are tropical diadematoid sea urchins. However, semi-lunar reproductive rhythms have been reported for several species of sea urchins near the Seto Marine Biological Laboratory located in Shirahama on the Kii Peninsula, Japan (Kobayashi, 1967, 1969, 1992; Kobayashi and Nakamura, 1967). The ques-

tion of whether spawning of *D. setosum* is related to the full lunar cycle, or whether it has a semi-lunar periodicity, has been addressed in Thailand by examination of gonad size, and changes of volume and degree of maturation of gonads during 6 weeks with new and full moons.

The sea urchin *Diadema setosum* (Leske) is widely distributed over the tropical and subtropical parts of the Indo-Pacific.

Table 1. Classification of maturation grades.

Grade of ripening	GT ratio	Color of gonad tissue	Texture of gonad	Gamete in smear	State of gonad
I	<9.9%	dark brownish yellow	very hard	empty	wholly spent
II	10.0-19.9%	brownish yellow	coarse	almost empty	spent
III	20.0-29.9%	yellow	soft	various stage of ripening	in ripening
IV	30.0-39.9%	light yellow	softer than III	mostly ripen	mature
V	40.0%<	same, transparent	very soft	full of ripe	fully matured

MATERIALS AND METHODS

Diadema setosum were collected in February and March 1991 near Sichang Marine Science Research and Training Station, Sichang Island, the Gulf of Thailand, and at Phuket Marine Biological Center, Phuket Island, the Andaman Sea. Only fully grown individuals were examined (4-6 cm diameter). About 10 specimens were collected each time from shallow water shortly before or after lowest water level. Sampling took place round full and new moons because this sea urchin is known to

spawn at spring tide (Kobayashi and Nakamura, 1967). The largest gonad volume may be seen at that time. The test (before dissection) and gonad (after dissection) volumes were measured. The maturation grade of each gonad was graded into five classes according to the GT ratio (Table 1). This ratio was calculated as the gonad volume divided by the total test volume, and expressed as a percentage (Kobayashi and Nakamura, 1967; Pearse and Cameron, 1991). Subsequently, fresh smear preparations of squashed gonad fragments were examined.

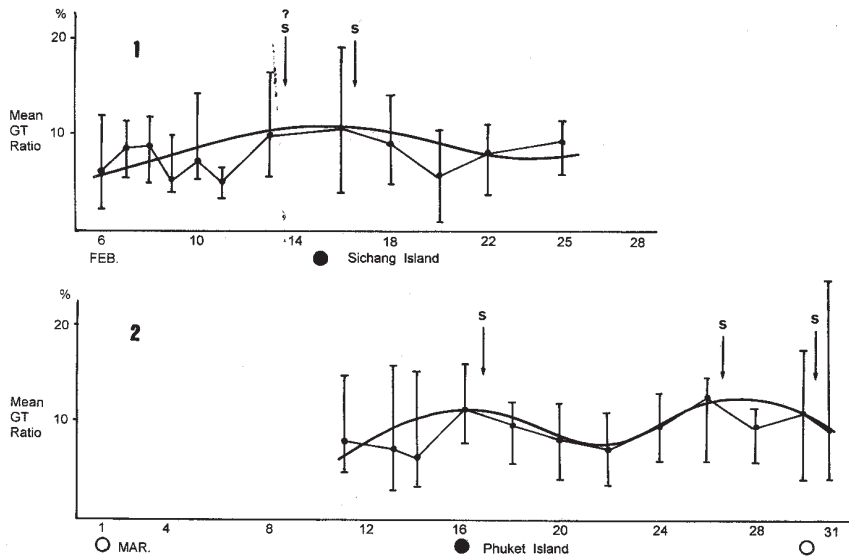


Figure 1. Successive changes of the GT ratios of *Diadema setosum* in 1991. Vertical lines indicate range of variation of GT ratios. Arrows indicate suggested times of spawning.

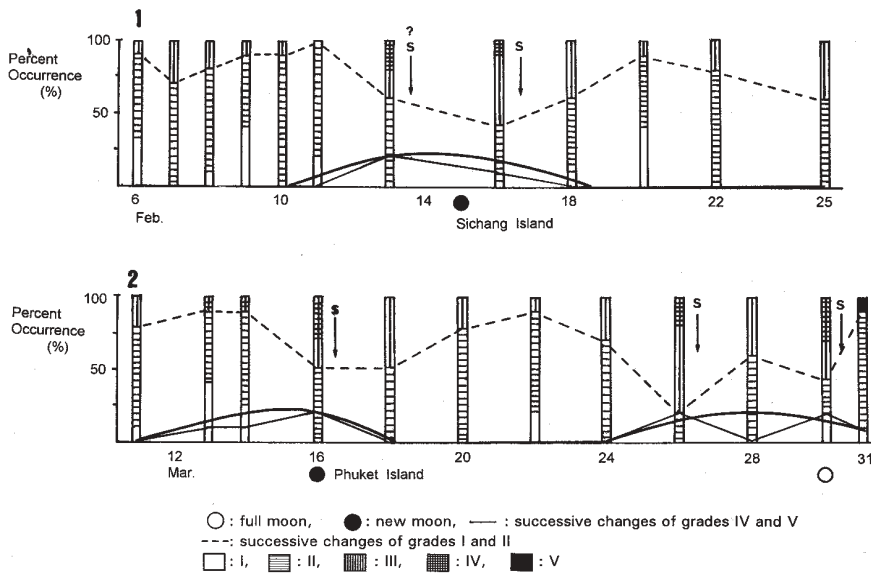


Figure 2. Percent occurrences of respective maturation grades in 1991 during the spawning season. Smooth curve lines indicate suggested fluctuation of mean GT ratios.

RESULTS

Variations of the mean GT ratio

Successive changes of the mean GT ratios for February to March are shown in Fig. 1, periods 1-2. The mean GT ratios ranged from 5-12%. The means demonstrate a general tendency. Peak values generally occurred round full and/or new moons, but considerable variation was encountered.

The first period. (February 6-25, New moon: 15)

Mean GT ratio was highest (about 10%) on the first day after new moon. The smallest GT ratios (about 5%) appeared 6-4 days before the day of new moon (Fig. 1, period 1). Grade IV was found 1-2 days after the day of new moon. Grades I and/or II indicated that maturation and spawning had begun (Fig. 2, period 1, dotted line).

The second period. (March 11-31, New moon: 16; full moon: 30).

Mean GT ratios were highest (11-12%) at new moon and four days before the full moon. The smallest mean GT ratios (6-9 %) appeared on day 4, 12, and 21 (Fig. 1, period 2). Grades V and IV were found a few days before the new moon, and a few days before and after the full moon (Fig. 2, period 2). Grades I and/or II indicated that maturation and spawning had begun (Fig. 2, period 2, dotted line).

DISCUSSION

Reproduction is correlated with the lunar cycle in many species of sea urchins. Mature individuals of both sexes discharge genital products in a period round the full or new moons during the breeding season (reviews by Kobayashi, 1967; Pearse and Cameron, 1991). Lunar rhythms are particularly prominent in diadematoids. Semi-lunar spawning rhythms have been reported at Seto for *Mespilia globulus* (Kobayashi, 1967), *Diadema setosum* (Kobayashi and Nakamura, 1967), *Anthocidaris crassispina*, *Echinometra mathaei*, *Echinostrephus aciculatus* and *Tripneustes gratilla* (Kobayashi, 1969) and *Hemicentrotus pulcherrimus* (Kobayashi, 1992). *Diadema setosum* of the present study apparently also displayed a semi-lunar rhythm with peaks of spawning round full and new moons.

Based on this finding, a smooth curve has been drawn to fit the mean GT ratios (Fig. 1). However, more data are needed to give proof of enhanced reproductive activity during full and new moons as observed at Seto (Kobayashi and Nakamura, 1967). Maturation grades varied much during the period from February to March, indicating that the pattern of spawning may be more complex in the present study areas.

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