

## REPRODUCTIVE CYCLE OF *HALIOTIS OVINA* GMELIN, 1791 IN NHA TRANG BAY, SOUTH CENTRAL VIETNAM

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### ABSTRACT

Abalone *Haliotis ovina* spawned all year round in Nha Trang Bay, but intensively from March/April to July/August. The spawning periodicity was confirmed by regular examination of histological sections of gonad material. The female of *H. ovina* was sexually mature at a size of 42 mm shell length. Fecundity of the female varied from 106,100 to 382,200 eggs. *H. ovina* had a sex ratio of 1 male to 1.2 female.

### INTRODUCTION

Three species of abalone occur in Nha Trang Bay, South Central Vietnam: *Haliotis ovina* Gmelin, *H. varia* Linnaeus, and *H. asinina* Linnaeus (Nguyen & Le 1996). Among them *H. ovina* is abundant and commercially valuable, but its reproductive biology is not fully understood. The aim of this study is to describe the reproductive biology of *H. ovina* because such knowledge is important for managing natural stocks and establishing successful aquaculture.

### MATERIALS AND METHODS

The study was carried out along the coast of Lon Island in Nha Trang Bay, South Central Vietnam (Fig. 1). Inshore temperatures range seasonally between 24 °C and 29 °C. Animals were removed from the substrata (dead coral and rock) using a blunt knife and were immediately fixed in 10 % formalin.

Length and width were measured with sliding callipers to the nearest 1.0 mm. Weight was measured on an electronic balance to the nearest 0.01 g.

#### Histology

Monthly samples of both sexes of *H. ovina* were collected for gonad analyses. Ripe ovaries of *H. ovina* are blue or dark green. Testes are light yellowish.

The gonads were sectioned, stained with hematoxyline-fucine, and examined under a light microscope. In accordance with Tomita (1967, 1968), Lee (1973), and Nguyen

& Le (1996), four development stages were identified:

Stage 1: immature - gonad very small, no gametes.

Stage 2: maturing - gonad visible, small primary oocytes and the egg stalk of the oocytes attaching to the ovarian lobe.

Stage 3: mature and spawning - swollen and firm gonad, sperm very active. The egg round and covered by a gelatinous membrane.

Stage 4: spent - the gonad wrinkled up and flattened.

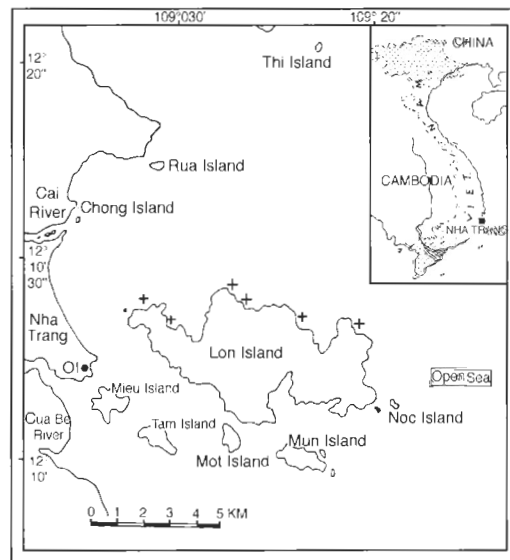


Figure 1. The study area.

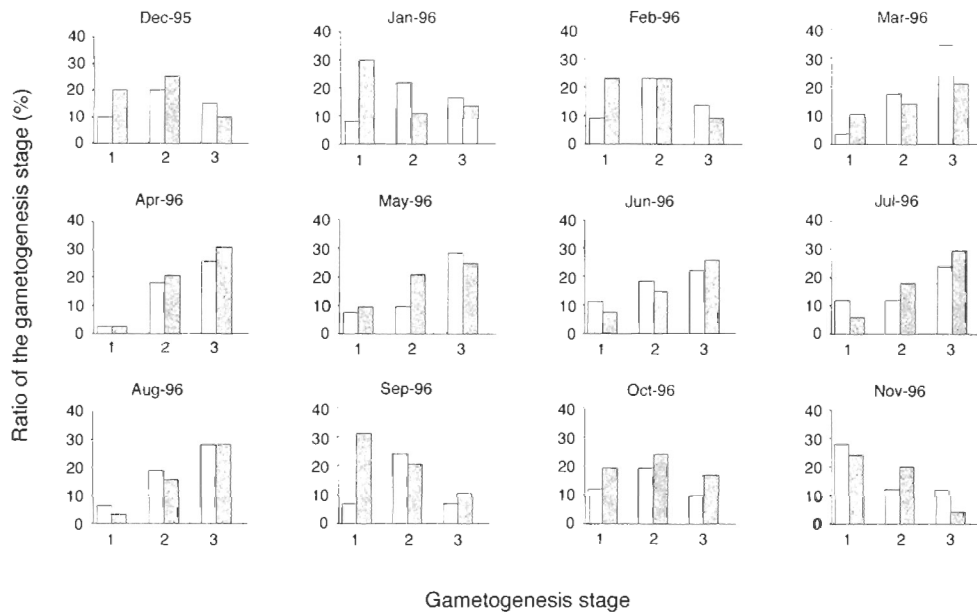


Figure 2. Percentage of individuals in the reproductive stages 1-3 of *Haliotis ovina* from December 1995 to November 1996. Male = white bar; female = grey bar.

Sex ratio was determined from individuals collected throughout the year. Samples of all available size classes of *H. ovina* were collected to determine the minimum size at sexual maturity. Fecundity was determined by counting the total number of ripe eggs in ovaries.

## RESULTS

### Breeding season

The histology of the ovary of *H. ovina* is similar to that of other species described by Tomita (1967, 1968) and Lee (1973). Changes of the testes are closely timed with the reproductive cycle of the female.

Fig. 2 shows that *H. ovina* with ripe spermatozoa and eggs appeared in all months, from December 1995 to November 1996. However, the highest proportion of the third stage was found in both sexes from March to August indicating a main spawning season during this period.

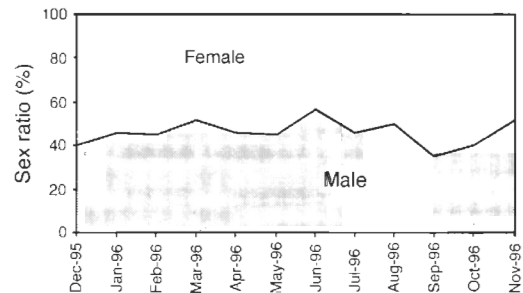


Figure 3. *Haliotis ovina*. Percentage of male and female.

### Size at sexual maturity

The minimum size for the beginning of sexual maturity was 42.1 mm shell length (SL) for the female, and 41.3 for the male. The proportion of individuals with gametes and sperm increased at sizes over 60 mm SL and 70 mm SL (Tab. 1).

### Sex ratio and fertility

On average, the sex ratio of *H. ovina* in Nha

Table 1. *Haliotis ovina*. Reproductive stages as a function of shell length.

Shell length (mm)	N	Stages of maturity (%)					
		I		II		III	
		Male	Female	Male	Female	Male	Female
31-40	30	10.00	16.67	33.33	40.00		
41-50	63	19.05	14.28	25.40	22.22	11.11	7.93
51-60	110	6.36	10.91	24.54	26.36	20.00	11.82
61-70	109	2.75	5.50	17.43	15.60	26.60	32.11
71-80	52	1.92	7.69	5.77	28.85	21.15	34.61

Table 2. *Haliotis ovina*. The absolute fecundity as a function of shell length.

Size (mm)		Weight (g)		Absolute fecundity
Length	Width	Total	Body	
46	34	27.6	14.4	259,200
48	37.7	13.5	6.4	106,100
48.4	40	15.4	9.2	187,000
49.4	39.7	19.7	10.9	257,200
52	39	18.4	9.0	135,000
53.4	41	19.2	10.8	252,400
57.4	43.5	25.2	13.8	268,400
58	45	28.2	15.2	309,760
59	39	37.9	23.1	382,200
59.1	44.5	24.8	11.2	264,414
60.5	46.6	27.1	15.8	347,000
62	48	28.0	12.6	230,000
65.4	50.3	41.9	23.8	310,000
65.7	51.3	39.8	19.8	287,500
65.8	52	37.6	19.7	310,200
66	51	37.6	21.0	256,500
68	53	39.0	22.0	381,400
78	57	54.5	17.7	331,800
				264,414 ± 77,665

Trang Bay was 1 male: 1.2 female.

Females tended to be more numerous in all months except March, June, and November (Fig. 3). Female fecundity increased with size. The mean number of eggs per female was 264,414 ± 77,665 (Tab. 2).

#### DISCUSSION

There is great variability in the spawning season of haliotids around the world (Boooloatian 1962). In Nha Trang Bay, *H. ovina* spawned all year round, but intensively from March to August, indicating that the reproductive season is longer for tropical abalones than for species occurring in higher latitudes. It may be related to a constant high temperature and abundance of food in the tropics.

The minimum size at sexual maturity provides necessary information for manage-

ment schemes which lay down the minimum size for harvesting. Generally, commercial species should have a chance to spawn at least once before they are harvested. In our study the size at maturity of *H. ovina* was 42.1 mm SL for the female and 41.3 for the male. It means that male *H. ovina* mature at a smaller size than female *H. ovina*. In comparison, female and male *H. varia* mature at the sizes of 30 mm SL and 31 mm respectively (Le, unpublished data).

The larger proportion of females found at Nha Trang Bay seems uncommon when compared with other populations around the world. Nevertheless, the results for this species agree in part with those of Fretter & Graham (1964); that females tend to be more numerous in older populations.

The average fecundity of *H. ovina* was 264,414 eggs which places it between the

other two species of abalone in Nha Trang Bay. The average fecundity of *H. varia* and *H. asinina* was 100,001 and 1,270,286 eggs respectively (Le, unpublished data).

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