FISHERY MANAGEMENT AND BIOLOGY OF THE SCALLOP *CHLAMYS NOBILIS* (REEVE) IN SOUTHERN VIETNAM

Vo Si Tuan
Institute of Oceanography, Nhatrang, Vietnam

ABSTRACT

The scallop *Chlamys nobilis* is abundant in the coastal waters of Binhthuan province (south central Vietnam). Favourable substrata consist of coarse sand, gravel, dead corals, or pebbles at a depth of 7-20 m. Water temperature in this area is relatively low because of upwelling in the summer and cooler water currents in the winter. Main breeding seasons of the scallop are July-August and January-February when the temperature is lowest. The growth parameters of von Bertalanffy equation are L = 93,3 mm and K = 1,43. Scallop production changes considerably among years. It is suggested that this fluctuation depends mainly on the environmental conditions of primarily rainfall, wind regime, and water temperature. A management model is presented.

INTRODUCTION

The scallop *Chlamys nobilis* (Reeve) is a resource with a high export value for Vietnam. The species has been recorded in few places (Quangnam, Kiengiang provinces) but commercial fisheries have developed only in the coastal waters of the Binhthuan province (south central Vietnam). There is a need for base-line studies on the biology and ecology of scallops for proper management.

MATERIALS AND METHODS

Studies on *Chlamys nobilis* started in 1989 with preliminary surveys at 20 stations in Binhthuan coastal waters in depths of 5-20 m. Data on temperature, sediment, and nutrients were collected at the same time. Samples for estimates of reproduction were collected from March 1992 to May 1993. The parameters of von Bertalanffy growth equations were calculated according to the Gulland & Holt plot method (Sparre & Venema 1992) (capture/recapture, size frequency). The gonad index was calculated using the formula GI = gonad wet weight · 10^{-5} · shell height^{-3} (Devauchelle & Mingant 1991). The minimum square analysis was used to estimate relations between fluctuations of scallop stocks and variance of the physical environment.

RESULTS AND DISCUSSION

Distribution

The scallop *Chlamys nobilis* occur on coarse sand, gravel, dead corals, or pebbles at 7-20 m depth. The distribution zones change with time but scallops have always been recorded in large patches (Fig. 1). Substrata and depths favourable for scallops are very common in the south central region (Institute of Oceanography, pers. com.). The scallop, however, has only been recorded in commercial quantities along a stretch of about 100 km in the Binhthuan province. This area has lower temperatures in the winter (December-February) and in the summer (June-August). Lower temperatures are caused by a northern current during the north-east monsoon and by upwelling during the south-west monsoon with a centre in the south central region (La & Vo 1997). The recorded favourable temperature range for this species in south Vietnam corresponds to findings in Japan for the same species (Shokita 1977).

Upwelling provides nutrients for development of phytoplankton supplying adequate food for a great biomass of scallop. The patchy distribution could be explained by oceanic circulation near to the shore, trapping nutrients, and thereby influencing scallop distribution (Bui & Vo in press).

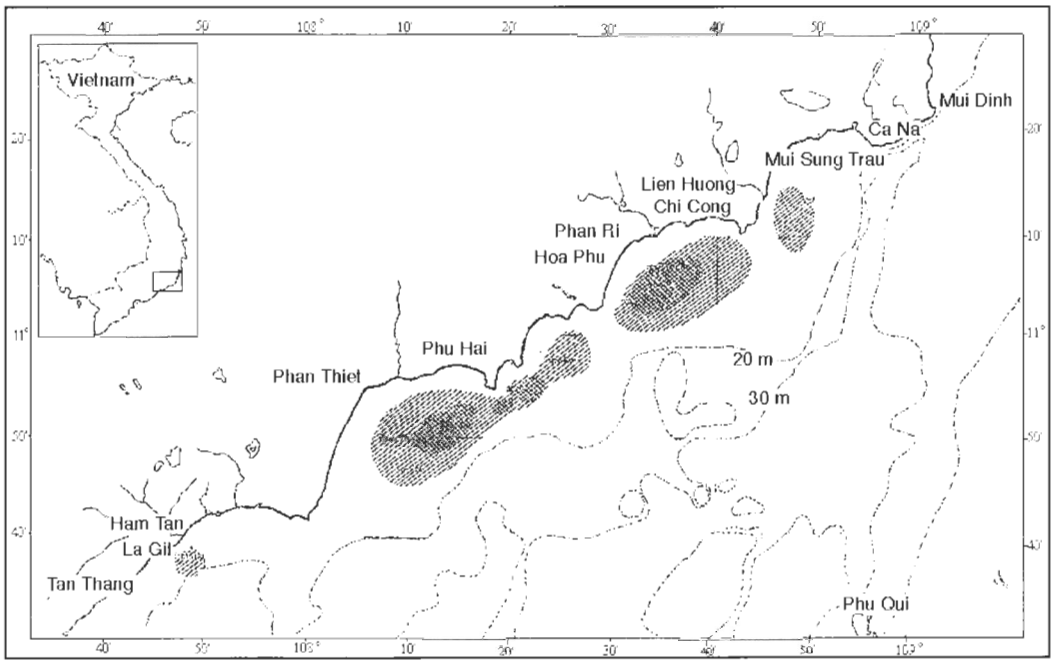

Figure 1. Distribution of scallop *Chlamys nobilis*, Binhthuan province, Vietnam. Hatching: patch with high density of scallop.

Reproduction

Based on direct observations of the outside of gonads and analysis of gametogenesis, Vo (1994) concluded that scallops measuring 61-65 mm in height had mature gonads. The sex ratio was not found to be stable between months and study sites (Fig. 2), but there was a relationship between sex ratio and height of shells. When the height increased, the male frequency decreased and female frequency increased (Fig. 3).

The variation of gonad index showed that scallops in the south central area have two main breeding seasons: July-August and January-February (Fig. 4). These periods correspond to the months with the lowest temperatures. The period with upwelling plays an important role in July-August with high fecundity (high gonad index).

Growth

Broom (1985) found that the growth of the blood clam, *Anadara granosa,* in Malaysia was related to conditions in the physical

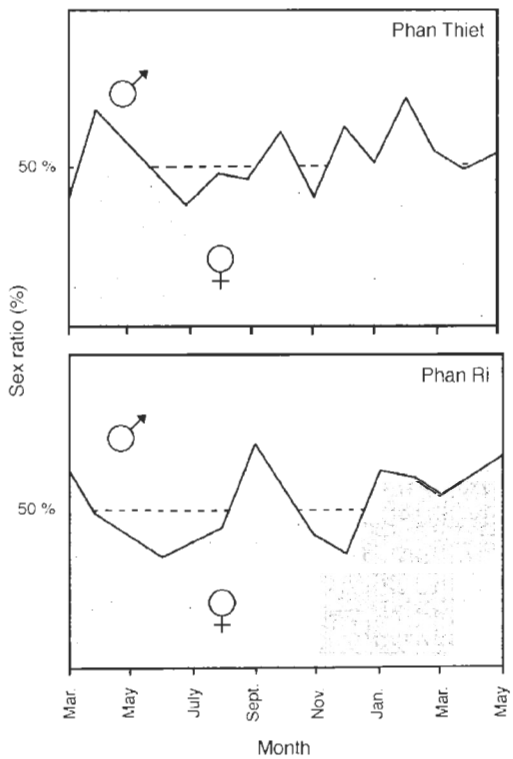

Figure 2. Monthly variation in sex ratio of the scallop *Chlamys nobilis*.

Table 1. The growth parameters of the scallop *Chlamys nobilis* in Binhthuan province.

Parameters	Recapture mark method	Size frequency method
Study months	May 1991 - September 1991	December 1991 - August 1992
Size range (mm)	55 - 78	47 - 73
Results:		
-Maximum theoretical size (L_∞, mm)	103.4	93.3
-Growth coefficient (K)	1.67	1.43

environment. The present growth studies (Tab. 1) also indicate that conditions were optimal during a period of the year, in this case the period of upwelling from July-August.

The condition coefficients computed by the formula $K = Wsp \cdot 10^{-4} \cdot H^{-3}$ (in which Wsp = soft part weight, H = height in mm) reflect favourable environmental conditions for the scallop. These values reach highest levels from July-September (Fig. 5).

Resource fluctuations

Based on available landing statistics, the fluctuations of scallop production have been extreme (Tab. 2). This has caused many problems for policy makers in the planning of how to exploit, process, and export the resource. Examination of the annual catch in relation to environmental parameters suggested that the problem should be studied in greater detail (Vo 1997).

Management model

Based on the fluctuation of scallop production and variation of physical conditions over eleven years, the factors rainfall, temperature, and wind regime seemed to determine the potential catch of scallop (Vo 1997). An analysis of ecological conditions during planktonic and benthic stages of the scallop shows that the stock of a given year (N_j) not only relates to physical conditions of this year but also those of the previous year (N_{j-1}). The stock (S) of the year also depends on the population size of the previous year as the replacement source of broodstock. In this survey, the environmental factors influencing the planktonic stage were examined for the duration of the main breeding season (July-August) and some months later of the previous year. These data were analysed in relation to rainfall of the year N_j (Q_{1j}); rainfall of the months July-October N_{j-1} (Q_{2j}, mm), July-August average temperature of

Table 2. Landing statistics 1982-92 (tonnes per year) of scallop *Chlamys nobilis* in southern Vietnam.

Year	Production (tonnes)
1982	126
1983	200
1984	500
1985	800
1986	15,000
1987	1,600
1988	100
1989	100
1990	100
1991	10,000
1992	1,600

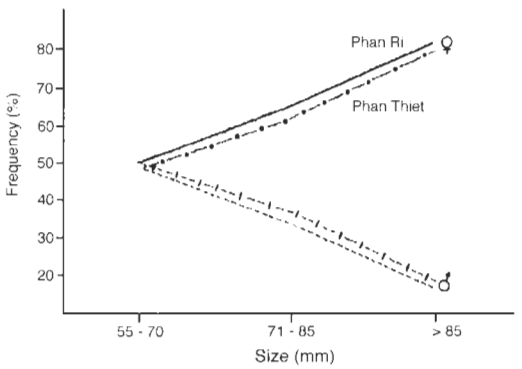

Figure 3. Size variation of female and male frequency of the scallop *Chlamys nobilis*.

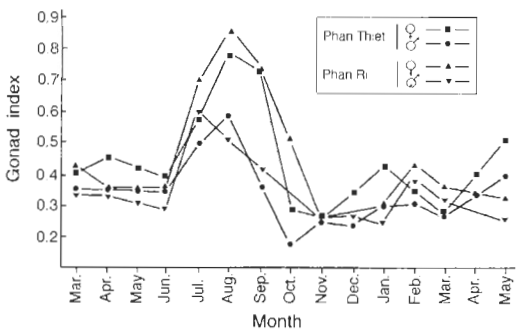

Figure 4. Varation of gonad index (G) indicating two main breeding seasons of *Chlamys nobilis*.

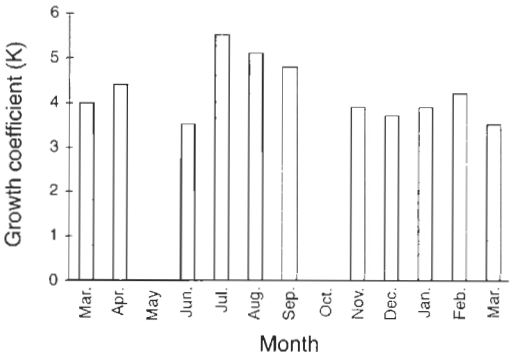

Figure 5. Variation of condition coefficients (K) of the scallop *Chlamys nobilis*.

the months N_j (Q_{3j}, °C); average temperature of the months July-August N_{j-1} (Q_{4j}, °C); replacement source of broodstock from the year N_{j-1} (Q_{5j}, tonnes); wind velocity in August N_{j-1} (Q_{6j}, m s^{-1}), and common wind direction in August N_{j-1} (Q_{7j}, degree).

A multivariable correlation was calculated using the following equation:

$$y_j = L_n S = a_o + a_1X_{1j} + a_2X_{2j} + a_3X_{3j} + a_4X_{4j} + a_5X_{5j} + a_6X_{6j} + a_7X_{7j}$$

in which:

$X_{1j} = Q_{1j}$, $X_{2j} = Q_2$, $X_{3j} = Q_{3j}$, $X_{4j} = Q_{4j}$, $X_{5j} = Q_{5j}$, $X_{6j} = Q_{6j}\sin(Q_{7j})$, $X_{7j} = Q_{6j}\cos(Q_{7j})$ with $j = 1...m$ (m; observed numbers m = 11)

The coefficients a_i ($i = 0...7$) were calculated as follows:

$a_0 = 174.67$
$a_1 = 0.0054$
$a_2 = 0.0014$
$a_3 = -3.2387$
$a_4 = -3.1588$
$a_5 = 0.6946$
$a_6 = 0.2973$
$a_7 = 0.1837$

The correlation coefficient between field observations and the model is 0.7947.

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