

SIZE DISTRIBUTION AND DENSITY OF ABALONE, *HALIOTIS VARIA*, NORTH SULAWESI, INDONESIA

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ABSTRACT

Haliotis varia were sampled at random within a 50 x 50 m area. Shell length and width were measured at low tide from May 1994 to April 1995. The animals were released back into the habitat. The number of individuals varied much among months (from 62 to 11 individuals). The minimum and maximum lengths were 16 mm (March 1995) and 51 mm (April 1995), respectively. Mean shell length was not significantly different between the first month of observation and the following months. This study is considered a contribution towards a better understanding of the area required to preserve populations of the abalone *H. varia*.

INTRODUCTION

Information on abalone populations in the North Sulawesi Province is scarce. So far research dealing with abalone has been limited to a preliminary study on distribution, abundance and sex ratios (Kaligis 1994). The abalone, *Haliotis varia*, is a tropical species distributed widely in coastal reef zones of Southeast Asia and the use of abalone for food shows good prospects. For many reasons, it is a worthwhile mollusc to consider for aquaculture (Fuze 1981). The meat is a good protein source, and it is highly prized by many nations as a delicacy. In 1966 - 67 the Australian export exceeded \$ 1 million, making it the third most valuable seafood product.

Although tropical abalones have a high market value, there has been very few reports on rearing of species, such as *Haliotis varia* and *H. asinina* (Singhagraiwan & Sasaki 1991). The main problem with culture of abalone is the long time needed by the animals to reach commercial size. For example, *H. rufens* takes 3-4 years (Bardach *et al.* 1972); *H. discus discus* 5 years (Lucien-Brun 1983 ref. Nateewathana & Hylleberg 1986); *H. diversicolor* 2 years (Chen 1984).

The present study was aimed at estimating

population growth of the abalone *H. varia*, in nature. The growth potential was studied by means of monthly measurements of length and width of the shell.

MATERIAL AND METHODS

Field Sampling. Transect lines were arbitrarily deployed on the intertidal coral reef flats at low tide. The substrata were mostly dead coral and rock. Animals found along the lines were collected within a 50 x 50 m area (Fig. 1). The animals were gently removed from the substratum using a thin-bladed knife. Length and width were measured with a pair of callipers to the nearest 1.0 mm. Collection was done at low tide, monthly during a year from May 1994-April 1995. After measurements the animals were released so the population could be studied again in the following months.

Data analysis. Size distributions for the shell length were calculated according to Sudjana (1988). Comparison between months were done by non-parametric Mann-Whitney test (Elliott 1977; Praptono 1986; Rice 1988; Fowler & Cohen 1990). Taxonomy and terminology of the species are based on Nateewathana & Hylleberg (1986), Fuze (1981), and Dance (1977).

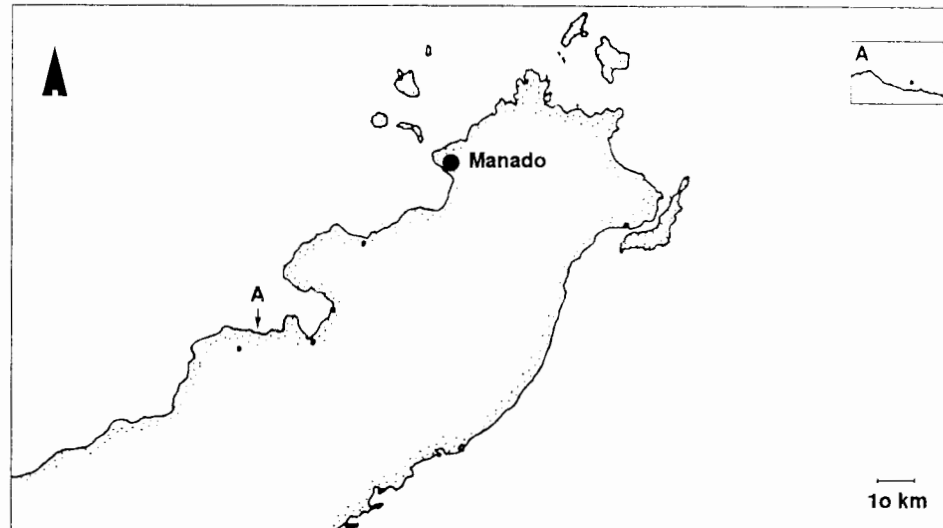


Figure 1. Sampling site. Northern part of Sulawesi.

RESULTS AND DISCUSSION

Half of the size-frequency distributions were in the size class interval 2.4-2.9 cm, 3.0-3.4 cm, and 3.5-3.9 cm, except in the months of September, October, December, 1994, January, March, and April 1995. A special case occurred in March 1995 where no animals were found in the class interval of 2.5-2.9 cm (Fig. 2, pages 266-267). The number of collected abalones varied considerably between sampling occasions. The sample size collected the first and the last month were significantly different ($p = 0.005$ - $p = 0.5860$, Mann-Whitney test). But, the monthly mean shell lengths did not differ significantly during the study period (Table 1). Shell lengths of about 4 cm were found every month during this study.

According to Fuze (1981) *H. varia* is fully mature at a shell length of 2.7 cm. At this shell length individuals have been observed to release what is believed to be spawn (a mucoid, milky fluid, emitted from the second and third open holes that dissipated in the water). It is suspected that *H. varia* may have the ability to change sex from male to female as observed by Fuze (1981) on two

Table 1. *H. varia*. Monthly sample size, shell lengths, and standard deviations.

Date	Number of individuals	Mean length (mm)	± SD
May 27 '94	62	31.80	6.03
Jun 24 '94	62	35.54	5.52
Jul 25 '94	47	32.41	6.36
Aug 22 '94	49	32.94	6.56
Sep 21 '94	19	36.01	6.52
Oct 20 '94	24	31.10	6.82
Nov 20 '94	41	33.16	7.10
Dec 20 '94	27	34.52	6.52
Jan 24 '95	11	34.62	5.52
Feb 18 '95	20	34.71	4.70
Mar 20 '95	21	33.81	6.21
Apr 18 '95	21	36.34	5.93

tagged individuals, of shell sizes 42 mm and 43 mm, that were identified as males with white gonads. Later they appeared as females with dark green gonads (within a period of 41 days in captivity). It has been found also that there is no size differences related to the sex of the individuals.

The monthly population size was affected by migration and mortality, including pre-

dation and collection by local fishermen. Regarding migration, it is possible that the present specimens collected in a given month were different from those obtained in another month, due to migration of the abalones. This possibility could have been studied if the animals had been marked individually. An attempt was made to mark the animals with paint but it did not last long. The numbers were hard to read after two weeks. Fuze (1981) tried various tagging techniques: etching of the underside of the shells, or tying a short piece of monofilament through the last open hole. The nylon line was provided with a certain number of knots, or plastic tags for identification. But problems were encountered with both methods. The first one proved ineffective as the animals were sometimes injured by the saw blade used for etching, and the etchings were hard to read. An unknown drawback of the second method may be that the nylon lines through the holes may interfere with the animal's respiration and/or feeding habits.

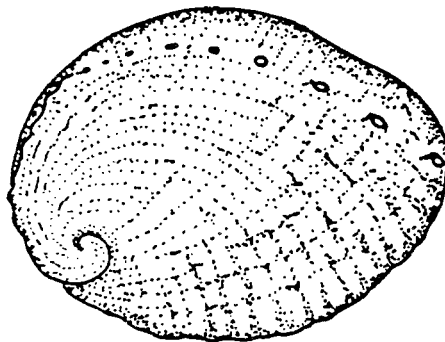
Regarding mortality, it is possible that local fishermen have removed some of animals.

The population of abalone was studied *in situ*, so the study area could not be controlled efficiently. Environmental conditions were not measured. However, there is no indication that factors such as temperature and salinity influenced the mortality of the population during the study period.

Along the lines stated by Shaffer (1981), the present study is considered a contribution towards a better understanding of the area required to preserve populations of the abalone *H. varia*.

ACKNOWLEDGEMENTS

Considerable appreciation is extended to Programme Director of the Tropical Marine Mollusc Programme (TMMP): Prof. Jorgen Hylleberg, University of Aarhus. A large number of people have assisted during the 12 months field work conducted at Teep village, Amurang Bay, North Sulawesi, Indonesia. I am very grateful. Finally, I thank the Danish International Development Agency (Danida) for financial support.



Haliotis varia (L., 1758).
Drawing by Jorgen Hylleberg.

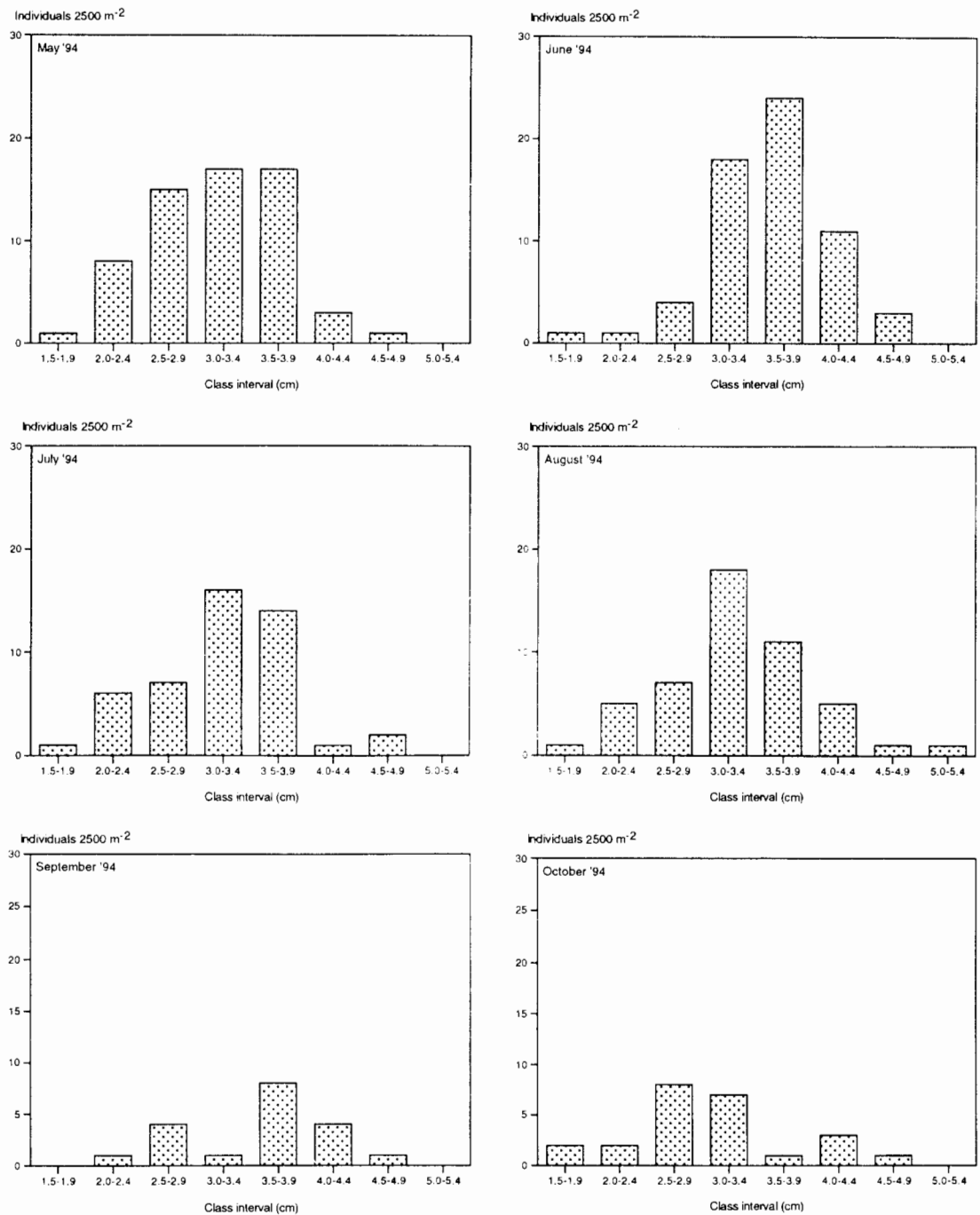
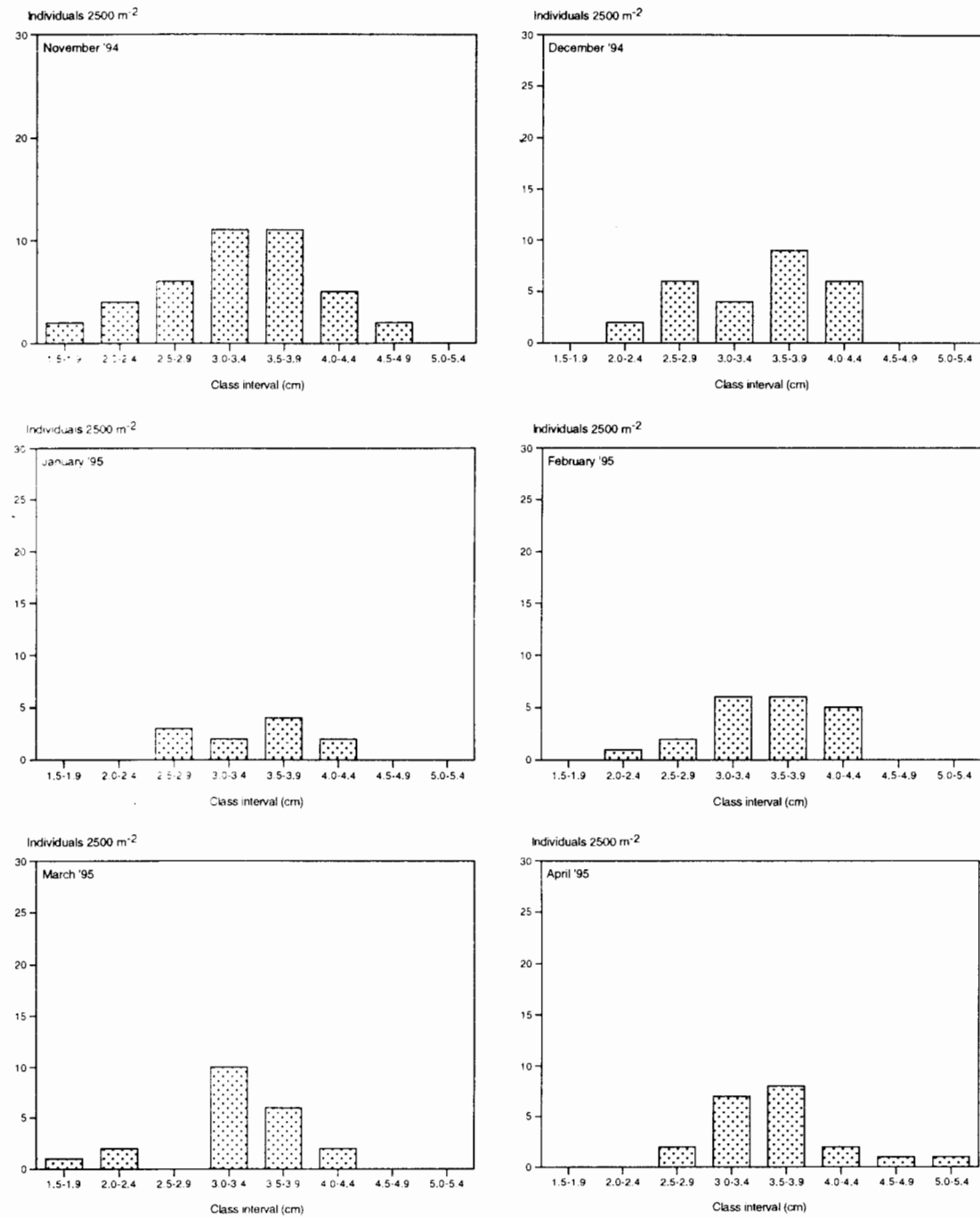


Figure 2. Monthly size (shell length) distributions of *H. varia* at Teep.

Figure 2 continues next page.

Figure 2 continued



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