INTERTIDAL BIVALVES OF NORTHERN MINAHASA, NORTH SULAWESI, INDONESIA

S.B. Pratasik, M. Ompi & M.Y. Sekeon
Universitas Sam Ratulangi, Fakultas Perikanan, Manado 95115, Indonesia

ABSTRACT

Intertidal bivalves were sampled within 5 quadrats placed at 20 m intervals along transect lines perpendicular to the shore. Six transect lines, 50 m apart, were sampled in each study site. A total of 13 bivalve species in 11 families were recorded. Densities were highly variable. Three species groupings were identified, diversity indices ranged from 1.17-1.65. Community similarity was 11.9-71.25 %.

INTRODUCTION

In terms of biodiversity, Indonesia is probably the richest region in the Indo-Pacific (Salvat 1967; Briggs 1974). Intertidal areas are rich in bivalves, but density and diversity are vulnerable to human exploitation since these animals are immobile (Krebs 1985). In the present study area, it is evident that many people utilise the low tide period to collect various kinds of bivalves. Shells are used for ornaments and production of lime. The meat is used for food.

Since most bivalves are immobile, their existence is highly influenced by exploitation (Krebs, 1985). Hence, man's activity has possibly changed the distribution and occurrence of many bivalve species.

The aim of this study is to examine if species diversity would be measurably influenced by the destruction of natural habitat, shell collection, and exploitation of the economic species.

MATERIAL AND METHODS

The study was conducted along the northern side of the main land, North Sulawesi (Fig. 1). Four sites were selected: Tongkaina, Tiwoho, Teep and Pondang. Bivalves were collected within 5 quadrats placed at 20 m intervals along transect lines perpendicular to the shore. A total of 6 transects (50 m apart) were studied at each site. Quadrat numbers and substratum types were recorded.

The animals were taken to the laboratory for identification according to Abbott & Dance (1970), Dharma (1972), Abbott (1972), and Dance (1977).

Species density and distribution patterns were calculated according to Elliot (1977), species diversity, Shannon-Wiener index, according to Krebs (1989), and community similarity according to Odum (1971) and Southwood (1992) using the Sørensen index:

$$S = \frac{2w}{a+b} \cdot 100; \; PV = mF^{1/2},$$

where S = coefficient of community similarity, w = number of PV at both stations compared with the lowest value, a = number of

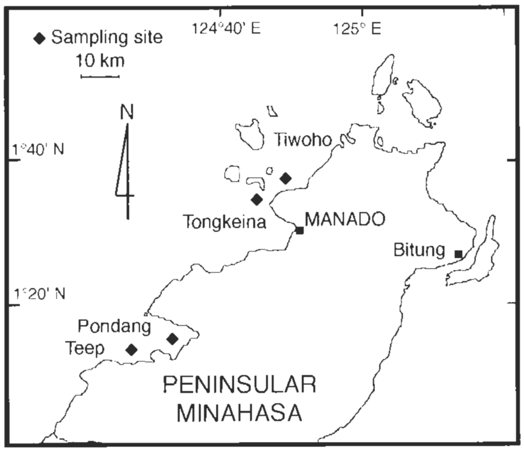

Figure 1. Map of Minahasa Peninsula. Four sampling stations in the northern and southern parts of Northern Minahasa are shown.

Table 1. Bivalve species at each sampling site and their density (ind. m^{-2}).

Family	Species	Density (ind. m^{-2}) Station			
		Tongkeina	Tiwoho	Teep	Pondang
Mytilidae	*Septifer bilocularis* (Linné, 1758)	0.76	0.66	0.90	0.13
Isognomonidae	*Isognomon isognomum* (Linné, 1758)	0.90	0.1	0.2	0.06
Chamidae	*Chama sinuosa* (Broderip, 1835)	0.23	-	0.13	-
Pteriidae	*Pinctada margaritifera* (Linné, 1758)	0.13	0.06	0.1	0.10
Spondylidae	*Spondylus squamosus* (Schreibers, 1793)	0.2	0.13	0.1	0.30
Tridacnidae	*Hippopus hippopus* (Linné, 1758)	0.03	-	-	-
Pinnidae	*Pinna bicolor* (Gmelin, 1791)	-	0.03	-	-
	Pinna muricata (Linné, 1758)	-	-	0.03	-
	Atrina vexillum (Born, 1778)	-	-	0.1	-
Cardiidae	*Acrosterigma subrugosa* (Sowerby, 1838)	-	0.03	-	0.03
Glycymeridae	*Glycymeris amboinnensis* (Gmelin, 1791)	-	-	-	0.06
Carditidae	*Cardita variegata* (Bruguiere, 1792)	-	-	0.03	-
Ostreidae	*Pycnodonta hyotis* (Waldheim, 1834)	-	-	-	0.03

PV at station I, b = number of PV at station II, m = predominance value and F = relative density of species i. Two communities are not different if the S value exceeds 50 %.

RESULTS AND DISCUSSION

Thirteen species in 11 families were found in the study. Total density varied with species and study site (0.71-2.25 ind. m^{-2}) (Tab. 1). The variability in species density might be related to at least two factors: Firstly, the environmental conditions at the site. Deterioration of habitat is caused by coral mining which eliminates the availability of hard substrata for settlement. Secondly, the impact from people living in the area. At low tide local people collect specimens for food.

Four species were found in all study sites, *Isognomon isognomum, Septifer bilocularis, Spondylus squamosus,* and *Pinctada margaritifera*.

These species prefer hard bottom substrata which were observed in all study sites. Other species encountered were as shown in Tab. 1; *Hippopus hippopus* and *Chama sinuosa* at station I, *Pinna bicolor* at station II, *Pinna muricata* and *Cardita variegata* at station III, and *Glycymeris amboinensis* and *Pycnodonta hyotis* at station IV. *C. sinuosa* was found at stations I and III, and *Acrosterigma subrugosa* at stations II and IV.

Members of the families Pinnidae, Spondylidae, Tridacnidae, and Pteriidae are economically important species in Indonesia. But many economic species (*eg Anadara* spp.) were not seen in the study area. This might be related to the sampling sites which covered only few habitat types. This study has been limited to hard bottom substrata with sand and very sparse seagrass. Mangroves have not been studied. This data might also reflect the fishing activity of the local people who take advantage of the low tide to collect specimens for food. Shells of some bivalves are also collected for sale in tourist areas, such as Bunaken Island.

The distribution pattern indicates that *I. isognomum, P. margaritifera,* and *S. squamosus* have random and clumped patterns of distribution, but the other species are randomly distributed. The importance of behaviour in creating distribution patterns has been described by many people (Bertness and Grosholz 1985; Okamura 1986; Lin 1989), and it is part of a survival strategy of the animals. Competent larvae of intertidal bivalves settle in habitats fit for their structural and physiological adaptations (Newell 1976). Moreover, the effect of a patchy distribution of substrata would be patchiness of the individuals.

Diversity indexes ranged from 1.17-1.40 (Fig. 2). These values do not show any difference among stations. Based on the equitability index, Tiwoho and Teep were the highest (71.25 %) followed by Tongkeina and Teep (70.40 %), Tongkeina and Tiwoho (62.11

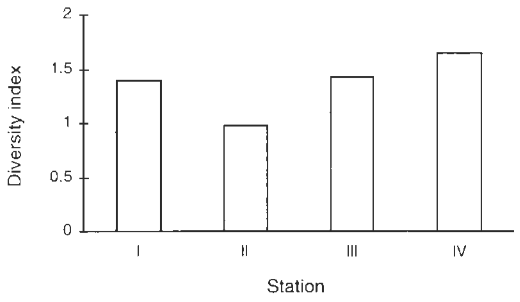

Figure 2. Shannon-Wiener's diversity index at each sampling station. Number I-IV represent Tongkeina, Tiwoho, Teep, and Pondang respectively.

%), Tiwoho and Pondang (16.19 %), Teep and Pondang (13.39 %) and Tongkeina and Pondang (11.93 %). This indicates that Tongkeina, Teep and Tiwoho have similar communities, but they are different from Pondang.

We have not been able to demonstrate that low species diversity in the study area could be related to the destruction of nature or shell collection by local people. We have to conclude that more habitat types should be examined, and a detailed study needs to be done on substratum classification in order to get a better understanding of the relationship between habitat type and bivalve species.

ACKNOWLEDGEMENTS

We thank the Eastern Indonesian Development Project and the Tropical Marine Mollusc Programme sponsored by DANIDA for their support to this paper to be presented at the Eighth Congress/Workshop of Tropical Marine Mollusc Programme in Phuket, Thailand.

REFERENCES

Abbot, R.T. & S.P. Dance. 1970. A color compendium of seashells. A color guide to more than 4,200 of world marine shells. American Malacologist Inc., Melbourne, Florida, 411 pp.

Abbot, R.T. 1972. Seashells of Southeast Asia. Graham Brash, Singapore, 145 pp.

Bertness, M.D. & E. Grosholz. 1985. Population dynamics of the Ribbed Mussels, *Geukensi demissa*: the cost and benefits of an aggregated distribution. - Oecologia **67**: 192-204.

Briggs, J.C. 1974. Marine zoogeography. McGraw-Hill, New York, London, 475 pp.

Dance, S.P. 1977. The encyclopedia of shells. Blandford Press Ltd., London, 288 pp.

Dharma, B. 1988. Siput dan kerang Indonesia (Indonesian shells). PT Sarana Graha Jakarta, Indonesia, 111 pp.

Elliot, J.M. 1977. Some methods for the statistical analyses of samples of benthic invertebrates. Biological Association Scientific Publication no. 25, 159 pp.

Krebs, C.J. 1985. Ecology. The experimental analysis of distribution and abundance. Harper & Row Publ., New York, 800 pp.

Krebs, C.J. 1989. Ecological methodology. Harper & Row Publ., New York, 654 pp.

Lin, J.L. 1989. Importance of location in the salt marsh and clump size on growth of ribbed mussels. Elsevier Science Publ. B.V. pp. 49-65.

Newell, R.C. 1976. Adaptations to intertidal life. Pages 1-82 *in*: Newell, R.C. (ed.). Adaptations to Environment, Essays on the Physiology of Marine Animals. Butterworths, London.

Odum, E.P. 1971. Fundamentals of ecology. W.B. Saunders, Philidelphia, London, Toronto, 574 pp.

Okamura, B. 1986. Group living and the effect of spatial position in aggregation of *Mytilus edulis*. - Oecologia **69**: 341-347.

Roberts, D., S. Soemodihardjo & W. Kastoro. 1982. Shallow water marine molluscs of North West Java. - Lemabaga Oseanologi Nasional, LIPI, Jakarta, Indonesia, 143 pp.

Salvat, B. 1967. Importance de la fauna malacologique dans les atolls polynesiens. Cah. Pacific II: 7-9.

Southwood, T.R.E. 1992. Ecological methods: with particular reference to the study of insect populations. Second edition. Chapman & Hall, 524 pp.