REFERENCES

BRUCE, A. J. 1965. *Zool. Meded. Leiden*, **40** (31) : 287-291.

CHAITIAMVONG, S. AND T. RATNA-ANANTA 1974. *Mar. Fish. Lab., Dept. Fish., Bangkok*, 38 pp.

HALL, D. N. F. 1962. *Fish. Publ. Colon. Off. London*, **17** : 1-229.

HOLTHUIS, L. B. 1980. *FAO Fish. Synop.*, **125** (1) : 1-162.

MIQUEL, J. C. 1984 a. *Crustaceana*, **46** (2) : 211-216.

———— 1984 b. *FAO species identification sheets for fishery purposes. Western Indian Ocean (Fishing Area* 51). Vol. V. FAO, Rome.

WEAR, R. G. AND H. P. STIRLING 1974. *Hong Kong Fish. Bull.*, **4** : 97-108.

LENGTH-WEIGHT RELATIONSHIP IN THE BIVALVE *ANADARA ANTIQUATA* (LINNAEUS 1758)

ABSTRACT

Investigations were conducted on the hinge length meat weight relationship in *Anadara antiquata* (Linnaeus 1758) collected from the mud flats of Zanzibar, between July 1987 and February 1988. A hinge length frequency distribution with a clear mode at 2.4 cm was observed in a total sample of 980 bivalves used in the investigation. The meat weight frequency distribution was positively skewed and had a peak at 2.2 g. Meat weight and hinge length had a correlation coefficient of 0.9852 and were related by the exponential curve equation : $W=0.23676\ L^{3.1691}$ where W=meat weight, L= hinge length. Meat weight was also found to vary with time.

THE BIVALVE *Anadara antiquata* occurs abunddantly in the sheltered coastal mud flats of Tanzania (Matthes, 1974 ; Mwaiseje, 1982 ; Kayombo and Mainoya, 1985), it is an important non-conventional fishery item, constituting over seventy per cent of the bivalves collected (Per. obser.) and has a high potential for aquaculture development (Panikkar, 1966 ; 1976).

In Tanzania, coastal dwellers especially women and children engage in *Anadara* collection particularly during spring low tides. Groups of up to 30 collectors can often be seen along the beaches at low ebb tide. The bivalve is collected mainly to meet family consumption, but occasionally some is sold either fresh or after boiling and sun drying the meat, usually pierced and arranged on wooden spokes.

Studies on *Anadara antiquata* in Tanzania have to-date concentrated on aspects of the ecology and reproduction of the species (Kayombo, 1985). Another study related to this species has been that by Kudoja (1987), who reported coliform bacteria counts in the meat of *Anadara* spp. from Dar es Salaam coastal waters. His studies revealed high coliform bacteria count to the extent that he was of the opinion that bivalves collected from Dar es Salaam beaches should be declared unfit for human consumption as they could easily be a source of diseases.

Yield related studies on the bivalves currently being collected have not been undertaken. Information regarding the sizes and meat content of the bivalves cropped is essential for the determination of current human predation pressure on the bivalve populations, as well

as for estimating the molluscan contribution to the annual yield of fish. Such information could indeed also help in the formulation of recommendations regarding appropriate harvestable cockle size for the realisation of optimum yeilds, especially when the fishery becomes conventional, in addition to serving as baseline data for future studies on the growth and sizes of the molluscs.

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for eight months (July 1987-February 1988). Effort was made to get the samples as random as possible by buying from a different collector and at a different place everytime, without the collectors having any prior information. This was an attempt to ensure that the samples represented what the collectors naturally collected.

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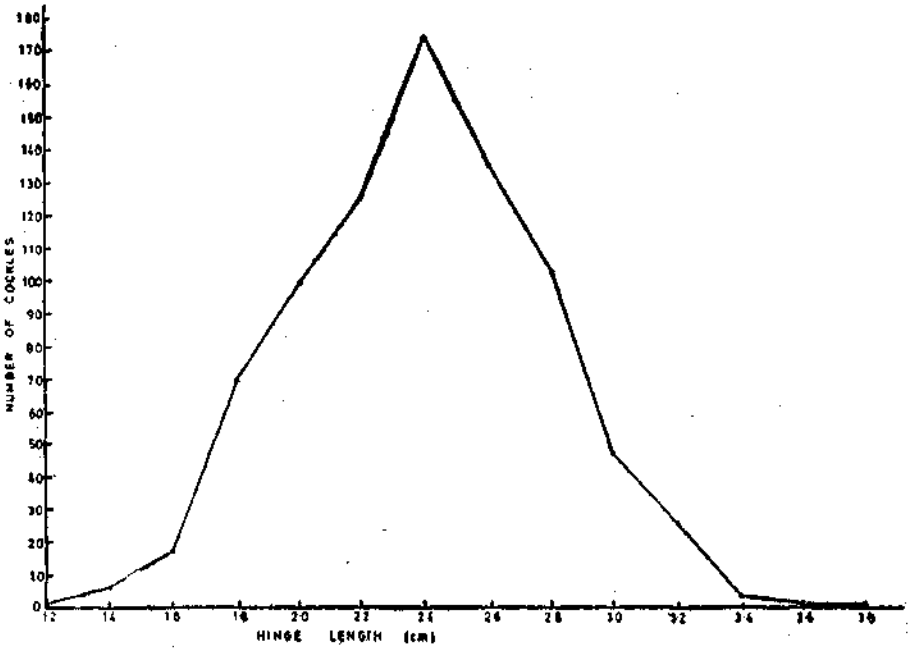

Fig. 1. Size distribution of the cockles.

Material and methods

Samples of *Anadara antiquata* were bought from collectors operating on the beach extending from Zanzibar town southwards to Mbweni village. Samples were taken twice per month

total wet weight (including the shells) ; weight of meat (after removing it from the shells and blot drying it) ; hinge length (the hinge length being the length of the straight edge of the shells on one side of the Umbo).

All the weights were in grams and recorded to one decimal place and were taken using a sensitive electronic balance (Sartorius model). The hinge lengths, taken by means of a vernier caliper were recorded in centimetres to one decimal place. A total of 980 bivalves were examined. From these data, hinge length, meat weight frequency and the length weight relationship were determined.

Results

The hinge length frequency distribution curve was unimodal and more or less normal. The meat weight frequency curve was unimodal, but was also positively skewed. The correlation coefficient between meat weight and hinge length was very significant at 0.9852. Meat weight increased exponentially with hinge length. A time related variation in the weight of meat was also revealed (Fig. 1-4).

Discussion

It can be seen from the results of this investigation that the majority of the *Anadara* collected from this beach have a shell hinge length of 2.4 cm each and it appears (Fig. 1) that exploitation of these bivalves on this beach is not biased with regard to size.

From the meat weight frequency distribution curve it is seen that the majority of the cockles collected have a meat weight of 2.2 g each. This is a small amount of meat compared to the maximum amount of 12.7 g which was observed in few animals (Fig. 2). The positive skew of the curve (Fig. 2) reflects the influence on the mean meat weight of the few large meat weight values observed in the samples. As is shown in Fig. 3, bigger meat weights are obtained by collecting bivalves with a hinge length exceeding 2.4 cm. It can

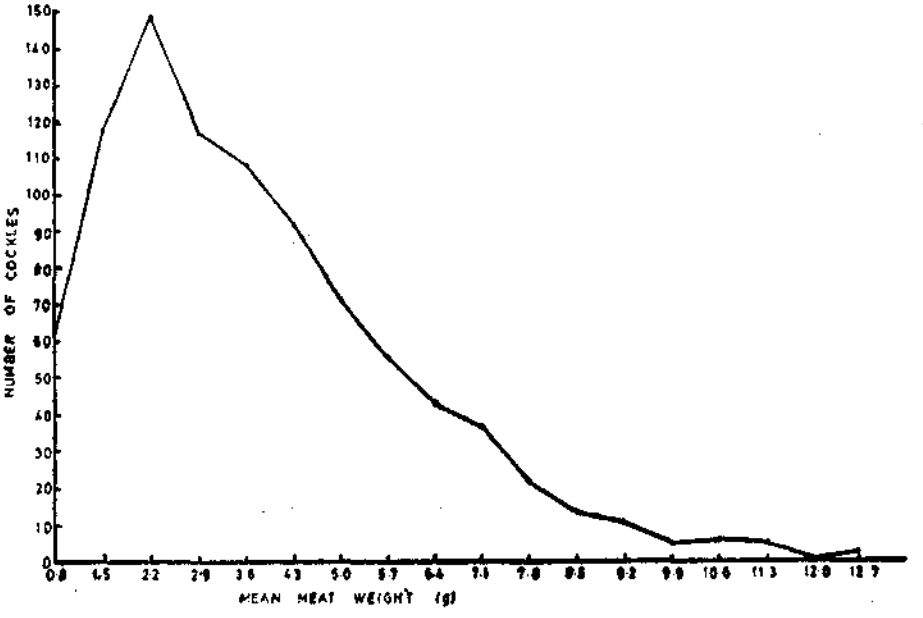

Fig. 2. Mean meat weight of cockles.

be said however that there were few animals with large meat weights on this beach. Since collectors would naturally not leave large sized cockles, hence bigger meat weights, in preference for small ones, the present collection of cockles with an average hinge length of 2.4 cm (Fig. 1) appears to represent the exploitation of the best available size from the beach. This can also be taken to indicate the low availability of cockles with hinge lengths exceeding 2.4 cm.

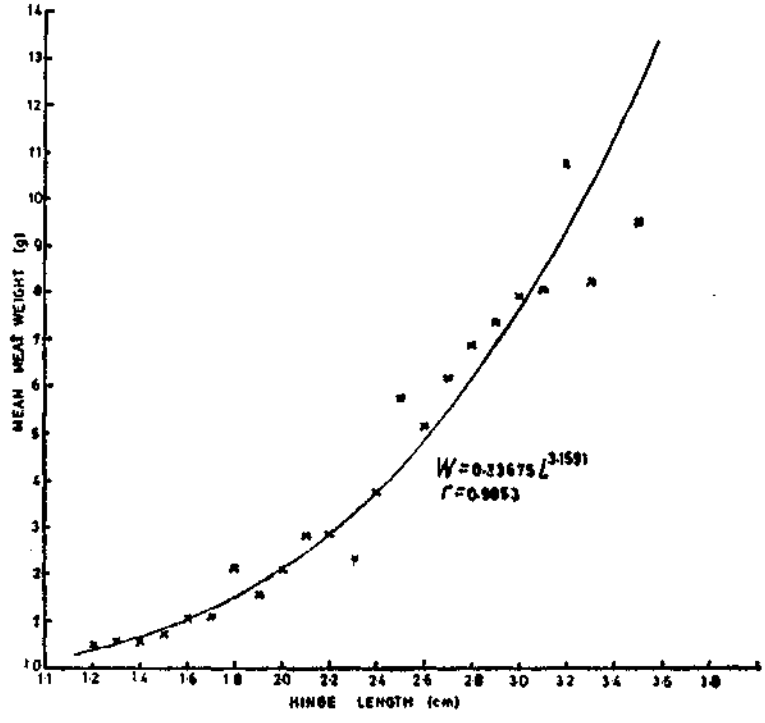

Fig. 3. Length-weight relationship in *Anadara antiquata*.

The scarcity of large cockles was also reflected by the fact that in the whole sample of 980 animals collected and examined during the eight month period of investigation, only about forty cockles had a hinge length of 3.0 cm. The frequency of cockles with a higher hinge length was even lower. It is difficult to explain or point out the reasons for this paucity for large cockles in the area. It is likely that there are factors other than man that operate selectively on the cockles such that certain size groups are removed from the populations. However, neither direct evidence for this was found nor was the search for such evidence part of the current work.

The present work has also revealed that the meat weight of the cockles fluctuates with time. It was seen for instance that bivalve within one hinge length category had low meat weight values during November, but had higher meat weights in January (Fig. 4). It is further seen from Fig. 4, that the months of July to September and December to January represent periods of high average meat weight per cockle. These observations tally with those by Kayombo and aiMnoya (1986), who suggested

the periods December, February and May to September as ideal for cockle harvesting, because then the condition index, C.I. (which also reflects the weight of meat per animal) is high.

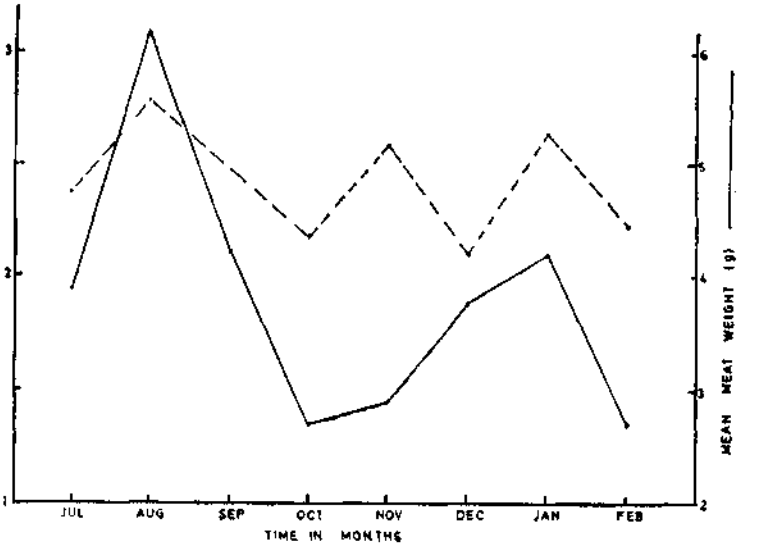

Fig. 4. Relationship between mean meat weight and mean hinge length during different months.

The low meat weight values observed are probably associated with spawning. Mainoya and Kayombo (1986) observed low C.I. in the same species during November and March and which they associated with spawning. Algarswami (1966) suggested that spawning was responsible for marked decreases in percentage edibility in clams and Gonor (1972) also reported losses in body weight of up to 15 g at spawning in marine invertebrates.

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REFERENCES

ALAGARSWAMI, K. 1966. *J. mar. biol. Ass. India,* 8 (1) : 56-76.

GONOR, J. J. 1972. *J. exp. mar. biol. Ecol.,* 10 : 89-103.

GRAHAM, M. 1956. *Sea fisheries. Their Investigation in the United Kingdom.* Edwars Arnold (Publishers), London. 487 pp.

KAYOMBO, N. A. 1985. Growth and reproductive activities in a bivalve *Anadara antiquata* (Linnaeus 1758) on the Dar es Salaam Coast. *M.Sc. dissertation, University of Dar es Salaam.*

——— AND J. R. MAINOYA 1986. Cockle harvesting on the Dar es Salaam Coast. *Proceedings of a workshop on 'Save the Mangrove ecosystems in Tanzania' 21-22nd February.* p. 71-79.

KUDOJA, W. M. 1987. Studies on Marine Chemistry done in the Indian Ocean and future prospects. *IOCINCWIO-II/Inf.* 8 *IOPP.*

MATTHES, H. 1974. Coastal and esturine aquaculture. In : A. S. Msangi and J. J. Griffin (Ed.) *International Conference on Marine Resources Development in Eastern Africa.* The University of Dar-es-Salaam. Pp. 28-34.

MWAISEJE, B. 1982. *Univ. Sc. Journ.,* 3 : 35-42.

PANIKKAR, N. K. 1966. Fishery resources of the Indian Ocean. IIOE. *Collected reprints, UNESCO,* 5 : 374-378.