

RESEARCH REPORTS IN THE ECONOMICS OF GIANT CLAM MARICULTURE

Working Paper No. 7

Exploring the Demands for Farmed Giant
Clams and their Components: Approaches and
Problems

by

Clem Tisdell

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The technical feasibility of culturing giant clams for food and for restocking tropical reefs was established in an earlier ACIAR project. This project is studying the economics of giant clam mariculture, to determine the potential for an industry. Researchers will evaluate international trade statistics on giant clams, establish whether there is a substantial market for them and where the major overseas markets would be. They will determine the industry prospects for Australia, New Zealand and South Pacific countries, and which countries have property right factors that are most favourable for commercial-scale giant clam mariculture. Estimates will be made of production/cost functions intrinsic in both the nursery and growth phases of clam mariculture, with special attention to such factors as economies of scale and sensitivity of production levels to market prices.

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TABLE OF CONTENTS

	Page No.
Abstract	1
1. Introduction	3
2. Demand for Shells	3
3. Demand for Aquarium Specimens	6
4. Meat	7
5. Demand for Seed and Broodstock	11
6. Subsistence and Semi-subsistence Demand	12
7. Concluding Comments	12
8. Acknowledgements	14
9. References	14

Exploring the Demand for Farmed Giant Clams and their Components: Approaches and Problems

ABSTRACT

The technical possibility of farming giant clams has been established by the Micronesian Mariculture Demonstration Center (MMDC), by the Australian Centre for International Agricultural Research (ACIAR) and other organizations. Enterprises have already been established to farm giant clams commercially. However, the extent of market demand for giant clams and their components has not been established. Clearly the economics of farming will depend both on demand factors and cost considerations. To determine the likely demand for farmed clams is not an easy task. Such markets as have existed in the past have been based on natural stocks. Supply from these has been uneven and has not been sustained due to overharvesting. Pre-existing markets for natural clam stocks and their components are likely to provide at best an imprecise guide to the demand for farmed clams. For example, natural stocks have been insufficient or protected in some areas such as Australia which has meant that a local market for clam meat has not been established. Clam meat for consumption would be an experiential good for Australians and Westerners and, one suspects, many Asians, including Japanese.

Markets exist for giant clams as aquarium specimens and for their shells. Surveys have recently been undertaken in Australia to determine the size of the Australian market for these end-uses and the main findings are reported.

The market for clams for meat is likely to be difficult to gauge. In many markets the product would, in effect, be a new product, and for example, new product cycles might apply. In the past attempts have been made to use international trade statistics and the market for possible substitutes, e.g. scallops as a guide to the potential market. These approaches all have drawbacks. As for substitutes, it would for example seem that substitutes for clam meat would vary with the age and method of preparation of the clam. Younger clams, say on the half-shell, can be used as *entrée* items and might, up to a point compete with other *entrée* items such as oysters. Older clams are usually separated into muscle and mantle components which can be frozen and which lend themselves to retail sale in blister packs. Evidence about

likely commercial demand remains fragmentary but available data will be reviewed. Given the data problems and the likelihood that to some extent ‘supply creates its own demand’, standard economic analysis may be of limited value in determining the demand for clam meat. Some observations will also be made on other possible uses of and markets for giant clams and on subsistence demand for clams.

Keyword: Giant clam farming, supply and demand of giant clams,

JEL Classifications: Q57, Q21, Q22

Exploring the Demand for Farmed Giant Clams and Their Components: Approaches and Problems

1. Introduction

The technical possibility of farming giant clams has been established by the Micronesian Mariculture Demonstration Center (MMDC), by the Australian Centre for International Agricultural Research (ACIAR) and other organizations. Private enterprises have already been established to farm giant clams commercially. However, the extent of market demand for giant clams and their components has not been established. The economics of farming giant clams depends on both demand and cost factors, this paper concentrates on the demand side. Nevertheless the cost side is also being investigated as part of ACIAR Project 8823 (Economics of giant clam mariculture) and will be the subject of other papers.

To determine the likely extent of demand for farmed clams is not an easy task. Such markets as have existed in the past have been based on natural stocks. These stocks have not been a source of sustained or regular supply. In many cases these stocks have been severely or completely depleted and in Australia have been entirely protected, except for their limited harvesting by Australian aborigines for their own use. This means that in Australia, a local market for giant clam meat has not been established even though Australia has large stocks of clams in its tropical waters. Shortage of available supplies have curtailed the development or continuation of markets for giant clam meat. Hence giant clam meat would be an experiential good for most Australians and Westerners and many Asians including many Japanese.

Market possibilities exist for the sale of giant clam shells, the sale of giant clams as aquarium specimens, and for the sale of their meat. Markets for breeding stock and for clams for growing to larger sizes may also be expected to develop if an industry based on farming becomes established. Subsistence use especially in the Pacific Islands may provide another outlet for cultivated giant clams.

2. Demand for Shells

A considerable market exists for the shells of giant clams and in the Philippines in the 1980s their shells. Here more valuable than their meat (Junio et al., 1986; Junio et al., 1987). The

Philippines has been the centre for international trade in giant clam shells and markets exist for such shells in most developed countries as decorative and souvenir items, and for their use in specialty restaurants e.g. as *entre* dishes. The existing market, however, for these shells is being constrained by the operation of CITES (Convention on International Trade in Endangered Species). Signatories to this Convention agree not to trade in the products of endangered species listed under this Convention or trade in these products subject to strict limitations. All species of giant clams have been listed under CITES. So the current trade in giant clam shells is limited to stock on hand, trade which has been granted an exemption or illegal trade.

Giant clam shells are being marketed in Australia and a survey was undertaken in August 1989 in Southeast Queensland of retailers and wholesalers of giant clam shells with a view to determining some of the characteristics of the market.. The detailed results have been reported elsewhere (Tisdell, 1989a) and only the main points will be summarized here.

About 100,000-120,000 giant clam shells per year seem to be sold in the Australian market at present. A clam farm therefore turning out 50,000 to 60,000 clams per year could supply the whole market, or at a turn off of 20,000 giant clams per year, 3 farms could satisfy the current Australian market for giant clam shells, it being borne in mind that clams are bivalves.

However shells from different species of giant clams are imperfect substitutes. The most popular species for its shell is *Hippopus hippopus* (the horseshoe clam) which appears to account for more than 80 per cent of sales in the Australian market, and did so even when giant clams were not in so short supply as at present (Herbert, 1986). Horseshoe clams serve a number of utilitarian purposes. They can be used for *entrée* and *mornay* sets, for ash trays and soap holders. They are not easily broken and are suitable for microwave use. In addition there are attractive markings on the back of the shell. A size of about 6-8 inches (15-20cm) is most popular.

Shells of *Tridacna squamosa* (the fingernail clam) are the second most frequently sold of the clam species and are mostly used as indoor decorative items. The shells of *Tridacna porcellanus* (the china clam) are also in demand as indoor decorative items but they are in extremely short supply.

Of the larger species of clams, demand is principally for the shells of the largest of all, *T. gigas* which is used mainly for outside landscaping (e.g. around pools) and for interior

decorating. Preference is for the larger shells.

There is little demand for the shells of *T. crocea* (the burrowing clam), of *T. maxima* and *T. derasa*. The outside of these shells is often like 'pocked' concrete, lacking in colour and without an attractive conformance. The interior of these shells is usually off-white or cream and consumers prefer the inside of shells to be white and as clean-looking in appearance as possible.

There appears to be very low cross elasticities of demand between the shells of *T. gigas* and those of other varieties. Cross elasticities of substitution between the shells of *H. hippopus* and those of *T. squamosa* and *T. porcellanus* also appear to be quite low.

It might be noted that for most of the species which appear to be favoured for their meat, the demand for their shells is weak. The Micronesia Mariculture Demonstration Center (MMDC) has promoted *T. derasa* for farming for its meat. *T. gigas* has been favoured by the research team at James Cook University for its meat. While the shells from this species are in demand, this appears only to be so for larger shells and it may not be economic to hold these species in cultivation until their shells grow to the size which is in most demand. *T. crocea* is favoured in the far south of Japan (Okinawa area) for its meat and the species is being experimentally farmed. As far as I am aware no substantial farming of species other than *T. gigas*, *T. derasa* and *T. crocea* has been embarked on at this time.

Whether or not it might be economic to farm some species of giant clams principally for their shells remains to be determined. Retail and wholesale prices for clam shells in the survey area were collected. The average price varied according to the size of the shells. For example the average prices for *H. hippopus* shells 6-8 inches (15-20cm) in size was \$1.55 wholesale and \$3.22 retail. Assuming that this species was farmed for its shell and that a 100 per cent markup applies, growers selling direct to wholesalers could expect to receive around 78c per shell, that is \$1.55 for the shells from one clam given that the giant clam is a bivalve.

To obtain some indication of the depth of the market as opposed to its current size, questions were asked about the likely responsiveness of the price of clam shells to changes in the quantity of supply of shells. The results from the answers to question 16 of the survey (Tisdell, 1989a) were inconclusive. Respondents were almost equally divided in their opinion

of whether the price of clam shells is sensitive to their supply.¹ However question 17 was designed to elicit more specific information. From this it emerged that demand would be elastic up to a doubling of supply of shells and many respondents thought that for up to a 20 per cent increase in the supply of clam shells the price of shells would remain unchanged.

It seems that about half of the retail sales of giant clam shells in this region are to tourists, of whom 80-90 per cent are domestic tourists. Foreign tourists are resistant to purchasing giant clam shells because of the weight of such shells. The other main customers for shells are restaurants and a considerable proportion is sold directly to local householders.

Virtually all outlets for clam shells indicated an interest in purchasing giant clam shells from farms and a number of suggestions were received about the type of product being sought. These are set out in Tisdell (1989a) and will not be repeated here.

Possibly the market for clam shells in developed countries is of the order of 20 times that for Australia. Overall it would represent a substantial market. Markets exist in the United States, Japan and Europe for clam shells judging from previous reports of the Philippines which has been the main source of these shells worldwide.

3. Demand for Aquarium Specimens

A market appears to exist for giant clams as aquarium specimens and MMDC (Palau) is currently involved in the export of *T. derasa* for this purpose. Exports are routed via Hawaii to the USA and to Europe - mainly to England and West Germany. MMDC began marketing 1-2 year old specimens of *T. derasa* as aquarium specimens in 1987-88 and reports that the current demand exceeds its available supply, even though the size of the market is not known (Heslinga, Watson and Isamu, 1988, p. 50)

However, it seems likely that the world demand for giant clams as aquarium specimens is much smaller than for shells. For one thing the demand is limited to owners of specialized aquariums. Purchasers need saltwater aquariums and may require special lighting. Clams are very suitable specimens for aquariums designed to hold live coral aquariums are becoming more popular.

¹ Note: In Tisdell (1989a) p. 16, second paragraph, the words 'price' and 'supply' should be transposed.

We conducted a survey of retailers of aquarium supplies in Southeast Queensland in August, 1989 with a view to obtaining some information about the likely demand for giant clams as aquarium specimens (Tisdell, 1989b). Because Australia does not permit the import of live giant clams and since the species is fully protected in Australia, aquarium shops had little opportunity to trade in these species, even though some retailers had obtained supplies in the past.

A number of retailers expressed interest in purchasing farmed clams for retail. They indicated that they preferred smaller-sized clams with colourful mantles. It seems likely that *T. crocea* and *T. maxima* would be preferred species as aquarium specimens because of their colourful mantles and smaller size. Heslinga (1989, p. 317) reports *T. crocea* and *T. maxima* retail sales in West Germany at US\$16.50 each, , and that small tridacnid specimens retail in the United States at about US\$10.50 each and wholesale at about US\$3-5.

In Australia, retailers suggested that giant clams for aquariums would retail at \$10-20 each and indicated that reasonable wholesale prices would be between \$3-10.

Most retailers of aquarium products expressed interest in selling giant clams obtained from farming provided they could be made available on a regular basis and in small lots. Some had been offered specimens by a clam farm in Northern Queensland but the batch size offered of 1000 was too high.

It emerged from the survey that the Australian market for giant clams for the aquarium trade is likely to be small. Possibly about 5000 clams could be absorbed by the Australian aquarium trade annually at the prices suggested as reasonable by sellers in the aquarium retail trade. The annual market for aquarium specimens would seem to be less than one-tenth of the size of that for giant clam shells.

4. Meat

One of the main motives for developing giant clam culture is that it might provide a source of meat, especially in tropical atoll countries. Commercial growers have also been lured on by the prospects of clam meat sales in Asia, especially to Taiwan and Japan. Heslinga reports that “tridacnid clam adductor muscle is popular today in Southeast Asia both in dried form (for Chinese soups, stews and snacks) and raw (for Japanese sashimi and sushi dishes)”

(Heslinga, 1989, p. 307). Frozen adductor muscle is said to fetch about US\$25/kg exvessel in Taiwan (Heslinga, 1989, p. 307). In 1983, Munro reported a market for dried adductor muscle in Hong Kong. Dried adductor muscle (weighing about 30 per cent of the live product) was fetching up to US\$120/kg retail and competing with dried scallop from Japan at US\$90/kg. A large market is said to exist for the adductor muscle in Southeast Asia (Munro and Lucas, quoted by Heslinga, 1989, p. 307).

The meat of the giant clam may be divided into adductor muscle and mantle (soft tissues) and these may be marketed in fresh, frozen or dried form². But in young clams, say of less than 2-3 years old, the adductor muscle is relatively small and it is not likely to be worthwhile to separate it from the mantle. These clams would probably obtain the best market if marketed alive and used raw. In the case of farmed clams, commercial pressures (interest rates, mortality rates, cash flows) will weigh in favour of marketing them as early as possible. Hence, it is not clear that farms will produce clams of an age and with characteristics which were present in natural populations of giant clams.

This may mean that pre-existing markets for giant clam meat may not be a good guide to future prospects (Tisdell, 1989c). For example, the Taiwanese generally only used the adductor muscle and discarded the remaining 85-90% of the living flesh. There is a considerable degree of uncertainty about the existing demand for giant clam meat and the potential demand for it and conflicting views have been expressed in the literature about this. Munro (1983) was probably the first author to explore the market for giant clam meat and as indicated above suggested that a substantial market might exist for it in North and Southeast Asia. The first major study of the market potential for giant clam meat in North Asia and Singapore was undertaken by Dawson (1986) and Dawson and Philipson (1989). Munro (1983) believed that a substantial market might exist in North Asia on the basis of high prices reported as being paid for giant clam adductor muscle, possible quantities of imports and the substantial demand for other seafood products which were believed to be substitutes.

In exploring the potential demand for giant clam meat a number of different approaches have been tried. These include

- (1) taste-testing of clam meat dishes or their introduction on an experimental basis in

² Actually for some purposes it is more appropriate to divide the meat into adductor muscle, and edible soft tissue consisting of two components: (1) mantle and (2) gonads together with other soft tissues. Only the kidney is inedible. Some groups e. g. Tongans regard the gonads as a particular delicacy.

restaurants

- (2) Analysis of international trade statistics for trade in giant clam meat and possible substitutes
- (3) Interviews with sellers of seafood and/or those involved in the sale of giant clam meat
- (4) Analysis of demand for substitutes
- (5) Analysis based on ethnic populations, and knowledge of tastes of ethnic groups.

Taste-testing, for example, was carried out in 1987 using the 2-3 year old clams from Orpheus Island Research Station in Japanese cuisine at Inaka Japanese Restaurant, Parramatta (Australia) by a taste-panel (Cowan, 1988). The composition of the taste-panel was not stated. The results, however, indicated that these clams were very suitable for 'Sunomono' and 'Wafu Salad'. Similar taste-testing and test marketing is expected to be undertaken in Guam and in Hawaii using clams from MMDC, Palau, as a part of a University of Hawaii Corporation's project on the marketing of giant clams.³

There have been efforts to collect statistics on exports and imports of clam meat in the Pacific by surveying appropriate government departments involved in international trade in marine products (Carleton, 1984). But these studies have been inconclusive because of the poor quality of the data. For one thing, much of the international trade in the past in giant clams appears to have been illegal e.g. clam meat illegally imported into Taiwan to avoid import duty (Dawson and Philipson, 1989, p. 111).

There is the further difficulty that giant clams are not always identified as such but may be included under a more general trade category such as molluscs. Dawson and Philipson (1989, p. 111) suggest that "the use [in Mandarin] of one colloquial term, *compoy*, for various species of shellfish results in vague statistics and misinformation". They state later on the same page:

³ This project is being co-ordinated by Professor Yung C. Shang, Department of Agriculture and Resource Economics, University of Hawaii.

“This term ‘compoy’ or ‘gambei’ is accepted as a general word for bivalve mollusc and as such, includes giant clams and mollusc ... in the past Taiwanese fishing boats licensed to take compoy, fished for trochus, green snail, abalone etc. as well as giant clam. Compoy also refers to dried scallop imported from Japan and South Korea. Unfortunately, Taiwanese Government compoy statistics are not representative of any one specific variety. No reliance can be placed on Taiwanese official statistical data regarding either giant clam or scallop.”

It seems that giant clams are included in Taiwanese (Fukienese) cuisine in cooked, fresh (raw) and dried form but only the adductor muscle is used. Hence there would be no outlet for a large proportion of the clam's meat in this market and giant clams may have to be reared to an older age (5-7 years) to obtain adductor muscles of a size suited to this market.

Munro (1983) suggested that giant clam muscle might be regarded as a substitute for scallop or more generally *kaibashira*, “a Japanese generic term meaning adductor muscle from any mollusc prepared in either fresh, frozen, boiled and dried or canned forms” (Dawson and Philipson, 1989, p. 120). On the basis, however, of the report of their consultant in Japan, Dawson and Philipson (1989, p. 120) “found a general lack of support for the proposition that giant clam be considered a substitute for scallop”. However, further reading of their text indicates that clam adductor muscle could be substituted for that of scallop even though it would not be a very close substitute and would have to be cheaper in price to penetrate this market. The real problem appears to be a glut of scallop supplies and this will keep the price of scallop relatively low. Dawson and Philipson (1989 p. 161) comment:

“The forecast glut situation in Japan in the near future would seem to indicate that the prospects of penetrating the kaibashira market with giant clam adductor muscle as a scallop substitute are poor. However, the comment of one Japanese seafood importer suggested that there would be a limited potential for a scallop substitute if it were half the price of the genuine article.”

Clearly if one is going to use the demand for substitutes as a guide to the potential demand for giant clam meat, it is necessary to identify substitutes correctly and have a guide to the degree of substitutability present. However, this is sometimes more difficult to do than may appear to be the case at first sight. For example, products may be substitutes which have dislike physical characteristics. For example, if raw giant clam is ideal in entrees it may be a

substitute for other entree items that are not even seafood based.

It might be thought that young clams, being bivalve molluscs, would be substitutes for oysters. While this may be so up to a point, one should not be too hasty in accepting this proposition. For example, Cowan (1989, p. 257) states that:

“Because of the necessary preparation (removal of kidney, etc.) before the clam meat can be eaten, it was felt that 2-year-old clams, despite the size similarity, did not fit the same market image and niche as oysters and mussels, which can be eaten as is. In this regard, it is possible to think of giant clams as similar to abalone, which of course are a much higher value product than oysters.”

From the above, there clearly is still much yet to be learnt about the substitutability of giant clams for other products and some way to go before the demand for substitutes can be used to gauge the potential market for giant clam meat.

No sustained study has been undertaken of the potential market for giant clam meat in Australia and New Zealand. We are in the process of investigating the possible market by interviewing ethnic groups which have knowledge of giant clams and are known to consume them in their countries of origin. For example, Australia has a number of Pacific islanders as immigrants and even more so New Zealand. We have already carried out interviews with members of the Tongan community in Brisbane and indications are that they would be very interested in purchasing giant clam meat on a regular basis. We intend to interview other groups from the Pacific Islands and from Asia to determine their interest in buying giant clam meat from farmed clams. While these groups (as well as Asian tourists) may provide Australian sales possibilities for giant clam meat, native-born Australians may also be interested in consuming giant clam meat in suitable cuisine if introduced to it. Australia and New Zealand may provide a potential market for farmed giant clam meat from the South Pacific Islands, assuming that Australia is unable to satisfy fully its own market at competitive prices or exports most of its supplies say to Japan.

5. Demand for Seed and for Broodstock

Apart from the sale of giant clams for consumption, they may be sold for use in mariculture. For example, 'seed' or young clams may be sold as stock for further rearing. Excess demand

is said to exist for juvenile clams in 20-100mm range with governments in the Pacific Islands and in the Caribbean being interested in stock enhancement or experimental introductions (Heslinga, 1989, p. 317). Prices of over one dollar each (U.S.) are paid for such seed. However, the price is not commercially determined since to a large extent importations are financed by foreign aid. However, in the longer term a commercially motivated demand for such seed may eventuate.

For those wishing to breed clams, the availability of broodstock can be a problem because in some localities suitable broodstock are not available naturally, have been protected or have been fished out. Thus a demand may exist for broodstock and in the longer term this could be satisfied from closed-cycle mariculture of clams. Already several generations of clams have been bred at MMDC using *T. derasa* and there seems to be no difficulty in closing the breeding cycle for all species. It should however be kept in mind that the demand for seed and for broodstock is a derived demand.

6. Subsistence and Semi-subsistence Demand

Considerable subsistence demand exists amongst Pacific islanders for giant clam meat and it is also consumed as a subsistence item in the Philippines and to a lesser extent in Indonesia and Malaysia. The extent of subsistence and semi-subsistence demand is, however, not accurately known. One of the driving forces behind the development of giant clam culture has been to provide new economic opportunities to subsistence populations in the Pacific, especially those located on coral atolls or those in areas containing coral reefs. Just how great is subsistence demand and semi-subsistence demand in these areas remains to be seen. To what extent will populations in these areas be prepared to make a consistent effort to rear giant clams to help satisfy their subsistence needs? What social or cultural factors (e. g. property right, factors) might favour or interfere with plans to satisfy these needs? The latter issue is for example being examined by Fairbairn (1990).

7. Concluding Comments

There is still much to be learnt about the demand and potential demand for the components of the giant clam. This is especially so in relation to the demand for meat. Dawson and Philipson (1989) suggest that demand for giant clam meat in Taiwan, Hong Kong, Japan and Singapore

is less than previous studies indicate⁴ (Munro, 1983, Munro and Heslinga, 1983). They claim (p. 111) for example that the market capacity for giant clam adductor muscle in Taiwan is 100 tonnes per annum. Given that the adductor muscle of a *T. gigas* clam of 5 to 6 years old weighs about one-third of a kilogram, 6,000 clams of this age would supply about 2 tonnes of adductor muscle. Therefore, an annual supply of 300,000 clams of this age would satisfy the whole Taiwanese market. Given a 60% survival percentage of seed clams to this age, 500,000 seed clams would need to be produced annually to satisfy this market on a continuous basis. This quantity might be supplied by five or fewer clam farms. So if these estimates are correct they would suggest that the North Asian market would not support very many clam farms. However, Professor Yung C. Shang is currently co-ordinating a new study of the North Asian market.⁴⁵

Recently Professor Masashi Yamaguchi, Department of Marine Sciences of the Ryukyus wrote to me as follows concerning the possible market for giant clams for meat in Okinawa and in mainland Japan:

“The local people [of Okinawa] love to eat giant clam ‘sushi’ using *T. crocea*, but the resource of this particular species has been overfished. Our summer months (from June to August) are the spawning season of the clam, and so their harvesting is prohibited, although demand for the clam is strong. Thus, there is a possibility for overseas producers of clams to sell fresh clams (live or chilled) to Okinawa. Small clams of the larger species (*T. gigas* and *T. derasa*) would be substitutes for *T. crocea* if accepted. We do not have the two large species around us, so that it is difficult to predict their acceptability. *Hippopus* is not accepted raw because they say it tastes no good, and is used pickled. It is not simply a matter of taste. Also textures and consistency are involved in acceptability, I assume. Giant clams are very alien to mainland Japanese, so it is harder to predict if the clams would be accepted in that huge market.” (Personal communication, 12/12/89)

It is interesting to observe that while biologists have tended to favour those species of giant clams which produce the greatest amount of biomass per unit of time (mostly species of the larger type - *T. gigas* and *T. derasa*) some groups of consumers could find the smaller species

⁴ Dawson (1988, p. 254) summarises this view as follows:

“The results of a survey of the market for giant clam products in Asia, which was carried out for the FFA in January/February 1986, revealed that the only existing market was in Taiwan and the product was frozen adductor muscle. The market was confined to the exclusive restaurant trade and the maximum volume was assessed by Taiwanese experts as being approximately 100t.”

⁵ See note 2.

tastier. For instance, Okinawans may prefer the taste and characteristics of *T. crocea*. By contrast some Australian aborigines (Palm Islanders) will not eat *T. crocea* but prefer *H. hippopus*. From an economic point of view, one must not only take account of the amount of biomass produced but also its value. So there is a need to examine the comparative demand for meat of different species of giant clam.

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