REPORT ON A STUDY OF THE MARKET FOR
GIANT CLAM PRODUCTS
IN TAIWAN, JAPAN, HONG KONG AND SINGAPORE

Commissioned by the Export Market Development Division
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REPORT ON A STUDY OF THE MARKET FOR
GIANT CLAM PRODUCTS
IN TAIWAN, JAPAN, HONG KONG AND SINGAPORE

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In conjunction with the
South Pacific Forum Fisheries Agency

Commissioned by the Commonwealth Secretariat's Export Market Development Division and financed by the Commonwealth Fund for Technical Co-operation

The views expressed in this report do not necessarily reflect those of the Commonwealth Secretariat
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Preface

This market survey was conducted as a follow-up to an initial study of miscellaneous marine products carried out by Mr. C. Carleton of Nautilus Consultants and commissioned by the Export Market Development Division of the Commonwealth Secretariat for the South Pacific Forum Fisheries Agency.

The primary market to be investigated in this survey was Taiwan (Republic of China) where there was known to be a market for giant clam meat. Unconfirmed reports of markets for giant clam adductor muscle in Japan, Hong Kong and Singapore required that those countries be included in the survey. Knowledge of the scope of potential and existing demand is vital to the future of giant clam mariculture and to the creation of a clam farming industry.

The consultant was faced with two major problems which hampered the collection of the data required to provide accurate, detailed analyses of existing demand in Taiwan and the potential market in the other three locations. In Taiwan, giant clam meat is imported illegally, so statistics are not available; however, the consultant does have the confidence of many people directly involved in the illegal giant clamming industry. Although some were reluctant to comment in specific detail at times, they were generally cooperative on the understanding that their names would not be included in this report. Under the circumstances, it is felt that the findings of this survey regarding Taiwan present as accurate picture as is possible to obtain.

In Japan, Hong Kong and Singapore, giant clam meat is virtually unknown as a product and it would not be available in consistent supply for at least five or six years, even if farming commenced on a large scale in the immediate future. In these circumstances, appraisal of the potential for giant clam products in these three locations must remain largely speculative.
Summary and Conclusions

Summary

The findings of the survey indicate clearly that Taiwan is the only one of the four locations visited in which there is an established market for giant clam meat. The demand there is specifically for adductor muscle and is confined to the exclusive restaurant trade. Collective expert opinion placed the market ceiling for adductor muscle at approximately 100 tonnes per annum. It was estimated that the volume which reached the market in 1985 was about half that figure and the supply trend showed a gradual decline.

The number of vessels engaged in clam fishing at the time of the survey was quite small and has been reducing steadily. The term "clam boat" is somewhat of a misnomer as these vessels also fish for other species of marine creatures. To base estimates of annual adductor muscle catches on the assumption that the average clam boat may make 3 voyages each year and take 10 tonnes per trip is erroneous.

The off-the-boat price for adductor muscle varies according to species, size and colour. In January 1986, the base price for the lowest grade muscle was US$7.50/Kg. and the highest grade prices range from US$21.25. It is not known to what extent the price is affected by inadequate supply but it would appear that the steady increase in price over the years has been influenced by usual inflationary pressures. It is the widely-held view of people in the clamming industry, in particular, and in the fishing industry, generally, that increased supply and legal importation of adductor muscle would result in a dramatic drop in price. The cultural aspect of the adventure of "eating the forbidden fruit" was given as a major consideration in forecasting a price drop. Restauranters, generally, were not so supportive of this view.

While, at present, only frozen adductor muscle is supplied to the market, there was some interest in a fresh/chilled product expressed by restauranteurs who felt that patrons would be prepared to pay a higher price for freshness. The idea of live clam imports also aroused interest. There was an overwhelming lack of enthusiasm for dried or processed muscle in packaged or canned form, nor was there any interest in the rest of the flesh of the animal or the shell. The idea of dried clam muscle as a substitute for scallop was also rejected.

It was the consultants' view that the market for giant clam adductor muscle does not have significant growth potential within the confines of the exclusive restaurant trade. To broaden the market to include lower quality restaurants and other retail outlets could only be achieved at a much lower price for the product. Taiwanese sources all reacted negatively to the idea of such a broader market.

In Japan there is some evidence to suggest that canned clam adductor muscle was imported into Japan from Taiwan in the late 1960s. A small quantity of frozen muscle is reported to have been available to the Chinese restaurant trade up to ten years ago at the peak of Taiwanese clam fishing activity. No evidence could be found of an existing market in Japan at the time of the survey. The sushi restaurant trade offers the best, if not the only, prospect for a potential clam meat market. A small number of major importers expressed a keen interest in receiving samples of chilled and frozen adductor muscle, the whole flesh and live animals. There was no apparent interest in importing dried giant clam adductor muscle; particularly as a substitute
for dried scallop; neither was there any interest in giant clam shell.

Hong Kong, although it has no existing market, might prove to have the greatest potential of the four locations visited. Taiwanese sources generally hold that view. Companies approached had, at best, scant knowledge of giant clam but all were receptive and asked for samples. Dah Chong Hong Limited, one of Hong Kong's largest trading houses was most optimistic for the prospects for a clam meat market. If samples of chilled and frozen adductor muscle are found to be marketable this company estimates that it would accept about 250 tonnes annually. Interest was also expressed in sampling the whole flesh and in experimenting with drying and processing techniques. Quite significantly, it was thought that there might be a considerable market for a dried/processed product in the People's Republic of China.

In Singapore, it was reported that small quantities of adductor muscle have arrived at irregular intervals, from the area between Mindanao and the Celebes. There was no evidence of a market in Singapore and it is probable that any clam imports are redirected to the lucrative Taiwanese market. One Singaporean seafood importer is keen to find a steady supply of fresh or frozen adductor muscle for the Chinese restaurant and hotel trade in Singapore, Malaysia and Thailand. The estimated total volume for all three countries is 50 tonnes per annum. Two other companies requested samples of fresh or frozen muscle and one was keen to trial live clam imports. An estimated annual demand for Singapore was 10 tonnes. As was the case in the other three locations, companies surveyed were all negative about the prospects for a market in giant clam shells.

During the survey, in all four countries visited, comments generally indicated a consumer desire for a fresh rather than a dried product. The degree and extent of affluence throughout these countries is steadily improving. The demand for freshness of seafood products is also increasing and cost is becoming less of a consideration. Restauranteurs expressed a preference for airfreighted chilled muscle over the frozen product; patrons would be prepared to pay more for what they know to be a fresher product. Restauranteurs and chefs were keen on the possibility of importing the live animal for display in their fish tanks. Even though there was no consideration of using anything other than the adductor muscle, there was confidence that the live product would be viable financially, as well as a great attraction for patrons.

Conclusions

1. The current market for giant clam adductor muscle is effectively confined to the Taiwanese exclusive restaurant trade.

2. The capacity of this market does not exceed 100 tonnes per annum.

3. Price levels range from US$7.50 to US$21.25/Kg. and above depending on species and size. (Delivered Taiwan)

4. It would be possible to establish volume markets for fresh/frozen adductor muscle in such countries as Hong Kong or Japan at total levels of several 100 tonnes per annum.

5. The securing of any significant new markets would likely have to occur at price levels around US$10.00/Kg., delivered.

6. The prospects for successfully marketing giant clam adductor muscle as a substitute for scallop, dried or in other forms, are poor.
Recommendations

It was a source of some frustration for both the consultant and interested parties in Japan, Hong Kong and Singapore not to have available either an actual sample or an adequate set of photographs showing marketable clam products. News of the outcome of trialling samples in Japan and Hong Kong is urgently required as it will play a major role in determining the future of plans for clam mariculture and farming. It is, therefore, strongly recommended that the SPFFA takes steps to arrange for the earliest possible despatch of samples to at least one interested firm in each of Japan and Hong Kong. The two companies recommended are Taiyo Company in Tokyo and Dah Chong Hong in Hong Kong.

If clam farming does develop as an industry among South Pacific Forum countries, supported by a flourishing market, strong competition may come from other quarters. The Philippines has been involved in research into giant clam mariculture for a number of years; there are vast areas suitable for clam farming and the Philippines is in closer proximity to the Asian markets. In the long-term, given a stable domestic political environment and the necessary financial aid to establish an industry there, the Philippines could capture a large share of those markets. Successful Taiwanese endeavours to participate in farming joint ventures could also have a dramatically adverse influence on the fortunes of established and prospective farms in Forum countries. The SPFFA should assume responsibility for the regular monitoring of the situation in the Philippines and Taiwanese involvement in the industry.

With those possible Philippine and Taiwanese scenarios in mind, together with the uncertainties of markets in Japan and Hong Kong, serious consideration should be given to surveying other sources of demand. Potential markets in China, the United States and France, in that order of priority, should be explored. Assuming that suitable drying/processing techniques can be applied, it is suggested that, in conducting any future market surveys, the processed clam adductor muscle should be presented as a new product, even if there is a strong similarity with dried scallop adductor muscle. If clam were found to be a close substitute for the latter, the forecasted over-production of Japanese scallop might adversely affect the stability of newly acquired (scallop substitute) clam markets. It is strongly recommended that, before mounting any new market studies for giant clam products, steps are taken to ensure the availability of product samples for the consultant.

SPFFA could examine the feasibility of the establishment of a clam farming cooperative within the Forum or, alternatively, an office under the auspices of the Agency to service the industry. One of the primary functions of such an organization/office would be to provide the mechanism for setting up and maintaining a reliable marketing link with the Taiwanese market, in the first instance, and to facilitate arrangements for penetrating any other markets.
Acknowledgements

Thanks are due to both Dr. J. L. Munro, of the ICLARM South Pacific office, who reviewed Part I, and to Mr. G. A. Healinga of the Palau Micronesian Mariculture Demonstration Centre who also reviewed Part I and provided the illustrations appearing on pages 3, 14 and 16.
PART ONE

A review of the Giant Clam resource and related activities

in the Indo-Pacific region
1.0 Biology

1.1 General description

The Tridacnid family of giant clams consists of two genera and seven species, *Tridacna gigas*, *T*. *derasa*, *T*. *maxima*, *T*. *squamosa*, *T*. *crocea*, *Hippopus hippopus* and *H*. *porcellanus*. The giant clam is widely distributed throughout the tropical Indo-Pacific, and the ranges of *Tridacna gigas*, *T*. *derasa* and *Hippopus hippopus*, the three species most heavily exploited for food, are shown in Fig. 1, which is taken from Munro and Heslinga (1983). Areas of local extinctions alluded to below are not shown. *T*. *gigas* and *T*. *derasa* are the largest giant clams; *T*. *gigas* has a shell length of up to 137 cm. (54 inches) and a weight of over 300 Kg, while *T*. *derasa* is considerably smaller reaching lengths of over 50 cm. (20 inches). *T*. *squamosa* and *H*. *hippopus* exceed 40 cm. (Munro 1983). *T*. *gigas* is the largest bivalve mollusc ever to have existed, although the giant squid, also a mollusc, is very much larger.

The effect of heavy harvesting on *T*. *gigas* and *T*. *derasa* by human predators, both local subsistence and commercial fishermen from growing populations and foreign poachers, has led to many areas where these two species are now thought to be extinct, including large portions of Indonesia, the Philippines, Fiji, Micronesia and southern Japan (Heslinga and Fitt in press). *H*. *hippopus* is also taken by foreign poachers on occasion (Dawson in press).

The habitat of giant clams seems varied; *T*. *derasa* and *T*. *gigas* are reported as occurring at depths from half a metre to at least twenty to thirty metres, usually on sandy or coral rubble areas in moderately exposed parts of reefs and outer reef slopes. These two also occur imbedded in coral heads, a location also favoured by *T*. *maxima* and *T*. *crocea*. *T*. *squamosa* is found in areas of sheltered water, on sandy or coral rubble bottoms, sometimes at a depth of only a few centimetres but also observed at depths of up to 20 metres. *H*. *hippopus* is usually found in perhaps the most vulnerable of habitats, shallow reef and sand flats. (McKoy, 1980, Hester and Jones, 1974)

The unique biological feature of the giant clam is the symbiotic relationship between the animal and a form of algae (microscopic plant) which lives within the outer tissue of the giant clam's mantle. A symbiotic relationship is one where two different organisms live one attached to the other or one within the other, to their mutual advantage. In the shallow, sunlit tropical waters occupied by giant clams the algae within the mantle carries out the normal photosynthetic process of converting sunlight, carbon dioxide and nutrients dissolved in the surrounding sea water into sugar-like products which, in turn, pass into the giant clam's blood stream and become the animal's main, and possibly only, source of nutrition. This process, called autotrophy, or self-feeding, resulting in the absence of the need for external food, has given rise to the description of the giant clam as being "the only self-feeding potential farm animal known to mankind" (Munro 1984).

1.2 Growth Characteristics

While production rates, discussed in Chapter Three, are high, particularly in aggregate, the giant clam is, in fact, a long-lived animal; and the smaller species are slow growing. *T*. *maxima*, for example, takes five years for fifty per cent of an age group to reach maturity, at which time the animal only measures one hundred
Fig. 1 Current distribution of Giant Clams.
Fig 2. A *T. Gigas* in the Republic of Palau.

mm. (four inches) in length. It takes eight years for all individuals in an age group to reach maturity (McKoy 1980). *T. gigas* and *T. derasa*, however, exhibit very much higher growth rates, as is discussed below.

Results obtained at the Micronesian Mariculture Demonstration Centre (MMDC), Koror, Republic of Palau, for laboratory reared specimens indicate that a typical three year old *T. derasa* would have a shell length of one hundred and fifty-five
In terms of meat weight, there would be forty-two g. of mantle, fifteen g. of adductor muscle and an overall meat weight of 93 g. Stocking densities used for the nursery culture of clams of this size is forty-eight specimens per square metre. Projecting this density over an area of one hectare, representing four hundred and eighty thousand specimens, the authors are able to derive a mantle production rate of 6.72 tonnes per hectare per year and an adductor muscle production of 2.4 tonnes per hectare per year. Total meat production would be sixteen tonnes per year (Heslinga, Perron and Orak 1984).

In a later paper (Heslinga and Fitt in press) growth rates for T. derasa beyond the age of three years are assessed to result in a quadrupling of meat weight between ages three and five years. In fact, T. gigas has the fastest absolute growth rate of any known bivalve, with T. derasa a probable second. (Heslinga pers. comm.)

More recently, Munro (1985), has offered a comprehensive analysis of available data on the growth rate characteristics of the giant clam species under consideration for commercial mariculture. This paper is reviewed in section 3.5 herein, mariculture yields, but it can be noted here that the author draws attention to the caution that it is still necessary to apply to many of the growth determining parameters. Much of the work of the International Giant Clam Mariculture Project (described in Chapter Four), is directed towards the more accurate determination of the growth rates to be expected in commercial giant clam mariculture.
2.0 Existing stocks and local utilisation

2.1 Data collection

Two systematic attempts have been made to develop regional data on the distribution, stock density and utilisation of giant clam.

The first survey took the form of a postal questionnaire and was conducted in 1983 by ICLARM. A good response was received and replies indicated that giant clams were heavily exploited throughout the region and were regularly consumed by the local inhabitants, with the exception of the western coast of peninsula Malaysia and Thailand. Where heavy population aggregations occur, for example Indonesia and the Philippines, the study indicated exploitation levels so high as to result in local extinctions. There was some evidence that foreign poaching pressure was also jeopardising the existence of local populations.

In the table of stock status below much of the data is derived directly from ICLARM (unpublished).

A second survey, also a postal questionnaire, was commenced in August, 1985 by Compass Consulting Services of Sydney, Australia (Compass). The questionnaire seeks information on import/export statistics, local consumption and local production. Results from this survey have not been used in this report.

2.2 Distribution

<table>
<thead>
<tr>
<th>Country</th>
<th>Species present</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Samoa</td>
<td>Tg, Td, Ts, Tm, Hh, Hp</td>
<td>Ts very uncommon. Tm is heavily exploited in all populated areas. Abundant protected stock of Tm at Rose atoll. Used for subsistence. Eaten raw or, sometimes, boiled in coconut water.</td>
</tr>
<tr>
<td>Federated States of Micronesia</td>
<td>+ + +</td>
<td>Tg and Td may exist on uninhabited reefs, but not seen alive. Recent fossils of Tg abundant in Kosrae, Ponape, Truk and Yap. All species under heavy pressure from local exploitation. Eaten raw, marinated, sun-dried or pickled in vinegar. Remote reef areas may be fished by poachers.</td>
</tr>
<tr>
<td>Fiji</td>
<td>? + + + ?</td>
<td>Tg and Hh thought to be extinct. Heavy artisanal and subsistence fishing in some areas close to major population centres. Other stocks relatively abundant. Few poachers reported. Mostly eaten fresh, marinated in lime juice and also coconut milk in some areas.</td>
</tr>
</tbody>
</table>
Some is smoked but mostly marketed fresh.

**Kiribati**

+ + +

Nothing known about state of stocks. Fished and processed for local consumption only, dried, salted or fresh. Response does not report Tm or Hh but range of both species includes Kiribati.

**Indonesia**

+ + + + +?

All species are overexploited and Td is very rare. Flesh used for subsistence only and not marketed. Shells used for making tiles.

**Malaysia**

+ + ? +

Common in some parts of east coast of peninsula Malaysia and in Sabah. Little use as food - mostly dried. Shells marketed.

**Marshall Islands**

+ ? + + +

Numerous in some areas. Some poaching has occurred. Used for subsistence, either dried or cooked as a chowder with curry and coconut milk or cooked with coconut milk.

**New Caledonia**

+ + + +

Fossil Tg found but none alive. Stocks not overexploited. Local fishery sells fresh or iced clams. In 1982 a commercial company exported 30 - 40 tonnes of clam meat, but this fishery is now banned.

**Northern Marianas**

+ 

Tg and other spp. extinct. Tm heavily exploited in the past.

**Papua New Guinea**

+ + + + +

All species used by subsistence fisheries. Td not found near to mainland. Tg not abundant on near shore reefs or near main towns. Some marketed smoked or fresh. Poaching is a serious problem in remote areas and many foreign vessels arrested in recent years.

**Philippines**

+ + + + +

Tg apparently now extinct in most areas except in the southern and western periphery of the country. Hp known only from the southern Philippines. All stocks heavily exploited for shells and meat. Mostly used for subsistence but some meat marketed.
<table>
<thead>
<tr>
<th>Country</th>
<th>Presence of Td</th>
<th>Utilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>French Polynesia</td>
<td>+</td>
<td>Used for subsistence, seldom marketed. Very abundant in lagoons, particularly if closed. Also scattered on outer slopes of high volcanic reef complexes.</td>
</tr>
<tr>
<td>Singapore</td>
<td>+</td>
<td>Both species very rare on reef slopes of islands. Previously exploited by islanders but now only by recreational fishing. Not marketed.</td>
</tr>
<tr>
<td>Solomon Islands</td>
<td>+ + + +</td>
<td>Presence of Td not yet verified. All stocks in good condition, especially in areas with religious constraints on eating shellfish. Regularly consumed fresh for subsistence in many areas. Approximately one tonne per year of clam meat sold in Honiara at $0.50/Kg. Shells used for craftwork. Clam poaching by foreign vessels is a problem.</td>
</tr>
<tr>
<td>Thailand</td>
<td>+</td>
<td>Stocks on west coast not heavily exploited. Shells are sold but meat not much used.</td>
</tr>
<tr>
<td>Tonga</td>
<td>+</td>
<td>Recent fossils of Hh can be found. Tm is most abundant species. Stocks heavily exploited for local consumption. Eaten raw or cooked. No poaching reported.</td>
</tr>
<tr>
<td>Tuvalu</td>
<td>+</td>
<td>Tuvalu falls in reported range of all Tridacna spp. Heavily exploited near villages for subsistence but healthy stocks elsewhere. No known poaching. Eaten raw.</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>+ + +</td>
<td>All species fished for subsistence and often sold in local markets. Sold fresh, soon after collection.</td>
</tr>
</tbody>
</table>

**Key**  

### 2.3 Utilisation

#### 2.3.1 Food

The primary use of the giant clam is, of course, the consumption of the fleshy portions of the animal as food. The average giant clam (excluding the shell) consists of three main portions: the adductor muscle (10-15% by weight), the mantle (50%) and the gonads and other internal organs (35-40%). The general regional practice is to eat all fleshy parts of the animal, with the...
exception of the kidney, which has an extreme bitter taste. It is unusual to see giant clam meat on sale in regional produce markets, but it can be seen on occasion, usually whole animals sold as a "string", equivalent to $3.00 - $5.00 per Kg.

2.3.2 Souvenir items Currently the most commonly sold giant clam derived commodity within the souvenir trade is the cleaned, un-processed shell. In Fiji, perhaps the region's most highly developed tourist destination, giant clam shells are readily available in the many tourist oriented souvenir/craft outlets.

At the market vendor level, the shells are mostly *T. maxima* with some *T. derasa*, and are generally restricted in size to under twenty cm. A single shell in the larger size range is priced at $0.50 - $1.00 while a high quality matched pair of fifteen cm. length can fetch $1.50. Smaller pairs of high quality are priced at $1.00 while single small shells (five to ten cm.) fetch $0.20 - $0.30 each. Some *T. maxima* had the characteristic protruding flutes chipped off the shells to resemble *T. derasa*. The smallest shell observed, amongst many small shells, was a two cm. *T. derasa* with an asking price of $1.50. In established, up-market retail outlets in Fiji, specimen giant clam shells are readily available at around $5.00, but are imported almost without exception.

In Tonga, where the tourist volume is much less, a local dealer accumulates giant clam shell for opportunistic sale to tourists, using a road-side plot for this purpose. (See Fig. 3.) Over three thousand shells are on display, mainly large (forty cm.) *T. maxima* with some *T. derasa*. Attractive smaller shells (fifteen cm.) are available for $0.20, while the large shells command an asking price of $4.00. It was reported that the large *T. maxima* were being accumulated for an export order at $5.00 each; approximately two thousand such shells were on hand.

Further from the point of harvest, as would be expected, prices are considerably higher. In Honolulu, for example, prices as high as $70.00 for a single unmounted shell have been reported (Heslinga and Perron 1983). In general however, prices are much lower. *H. hippopus*, *T. derasa* and *T. squamosa* are all widely sold, with good quality, attractive specimens mounted on wooden or perspex stands priced between $10.00 and $20.00. Shells are on sale fashioned into lamp-shades, pot-plant holders, bases for ornaments, etc. In general, such applications are not aesthetic successes. The high reported retail prices in Honolulu reflect two factors; firstly, it is the abnormally high prices that are noticed and reported while the more typical, lower prices go unreported, and secondly the high retail prices reflect very high retail mark-ups and a degree of tourist-directed speculative pricing, and are certainly not indicators of potentially high prices further back along the supply chain, particularly at the primary production level.

In general, throughout the Pacific where giant clam shells are sold at retail level to the tourist trade, fine specimens in the 10 - 20 cm. (anything much larger than this could represent a weight/size problem) fetch $5.00 - $10.00, often less. This price range is applicable to those shells sourced externally, usually the Philippines. Locally obtained shells sold at the market vendor level appear to have very low "reserve" prices indeed, characteristic of an already over-supplied, buyer's market.

2.3.3 Craftware Giant clam shells have played a utilitarian role in traditional Indo-Pacific societies, being used most commonly as water containers, often for the rinsing of hands during and after meals. In Tuvalu large giant clam shells are
used as water troughs for pigs. Rapson (undated) reports the fashioning of axe heads from giant clam shells in the Manus islands of Papua New Guinea. No doubt the attractive shells were used, as they are now, for enhancing the appearance of living areas, both inside and out. Further working of the shell was undertaken in some areas, notably the Solomon Islands where local artisans still excel in the manufacture of craftware from the giant clam shell. There are reports of an Indonesian tile-making operation using giant clam shells as the raw material.

2.4 Representative situations

As mentioned above it is not possible to draw in detail a comprehensive picture of
regional stocks and utilisation due to the incomplete nature of the data available. An attempt is made below to overcome this shortfall by describing three situations where studies are available or data has been gathered, which illustrate the range of possible stock utilisations. The first locality described is Helen reef, to the extreme south of Palau, where local effort is absent but foreign poachers have exerted heavy pressure on the resource. Secondly, Tongatapu, the main island of Tonga, is described, where the converse is true; pressure on the resource is solely from local subsistence and artisanal fishermen. Lastly, the island of Viti Levu in Fiji, where both local and foreign giant clam harvesting occurs concurrently, is described to illustrate the impact of this hybrid situation.

2.4.1 Helen Reef

Helen Reef, Republic of Palau, is a small, uninhabited coral atoll situated at approximately lat. 3 degrees North and long. 131 degrees East, an isolated location to the North-west of Irian Jaya and the East of Borneo. Only a small sand island remains above the surface at high water. In 1972 a National Marine Fisheries Service (NFMS) survey of giant clam stocks at Helen Reef was conducted for the administration of the then Trust Territory of the Pacific Islands (Hester and Jones 1974).

A variety of techniques were used to assess stock levels, and in general terms the survey concluded that the giant clam stock had remained nearly untouched. Large populations of all giant clam species except T. squamosa and H. porcellanus were discovered, the low estimates of standing stock numbers being T. gigas 49,800, T. derasa 32,800, T. maxima 1,700,000, T. crocea 3,700,000, and H. hippopus 44,600. The scarcity of juvenile giant clams was noted.

In 1975, following repeated evidence of foreign fishing vessel poaching on Helen Reef, a second survey, reported in Bryan and McConnell 1976, was made. This survey showed that systematic harvesting of the three largest species (T. gigas, T. derasa and H. hippopus) had occurred, as evidenced by the extraordinary numbers of dead (i.e. empty) shells; of the 210 T. gigas counted only 4 were alive, of 174 T. derasa 6 were alive and of 480 H. hippopus only 22 remained alive. Standing stock estimates for T. gigas and T. derasa were down sharply on the 1972 figures with T. gigas at 8,600 (17% of 1972) and T. derasa 12,900 (39%). The report concluded that the area no longer represented a viable catching area in terms of catch per unit effort, and that those giant clams remaining were only those that had been overlooked by previous fishing activities.

In the 37 month period between the first survey in March 1972 and the second in April 1975 it can be safely assumed that the reduction of approximately 40,000 T. gigas and 20,000 T. derasa resulted from the activities of illegal poachers acting virtually without hindrance in a formerly virgin area. That such numbers have evidently been harvested in such a small area, (Helen Reef is 24 Km by 9 Km. with an oval, encircling, 1200 m. wide reef) indicates the far greater numbers that will have been taken from similarly vulnerable areas throughout the region. It also illustrates the speed with which an area such as this can be reduced to marginal ecological viability by unrestricted harvesting.

2.4.2 Tongatapu

Tongatapu residents are active in the gathering of giant clams from the surrounding waters as a supplemental food source and also, perhaps principally, as an income-earning enterprise serving the urbanised area of Nuku'alofa. There is no evidence that giant clam poaching activities have extended to Tongan waters. Total giant clam landings (whole weight) in Tongatapu (population sixty-four thousand) are recorded in McKoy (1980). They are derived
from records of total "shellfish" landings and assume that giant clams make up eighty per cent of such landings and that recorded landings only comprise half of the actual landings. During the period 1974 - 1978, McKoy estimates a growth in landings from twenty-four tonnes to one hundred and fifty-three tonnes and indicates that catches at the latter level could not be sustained.

*T. maxima* was the species most frequently harvested in Tongatapu during the period of the study, comprising ninety-four per cent of market samples and ninety-seven per cent of field observations. The average size of marketed *T. maxima* was one hundred and forty mm. in length and four hundred and seventy g. in total weight, giving a notional annual harvest of over two hundred thousand giant clams, based on a stabilised annual landing level of one hundred tonnes in Tongatapu. The average wet meat weight of the *T. maxima* marketed was 75 g., or fourteen per cent of the whole weight.

These figures can be used to derive an annual consumption figure of 3.3 giant clams per capita, and two hundred and fifty g. of meat (all fleshy parts of the animal are consumed). R. Efsy in FFA 1985, uses a per capita annual seafood consumption figure of twenty kg. in Tonga, so giant clam contributes a minor proportion (1%) of this intake. Nonetheless, giant clam harvesting comprises a significant fishing activity in Tongatapu, probably the most intense and sustained locally-based pressure in the region. At the time of the McKoy study harvesting methods were restricted to reef collecting and free diving. By 1985, however, widespread use is made of aqualung equipment, spreading and increasing the already heavy pressure on the resource. Giant clam volumes through the Vuna market in Nuku'alofa are now considerably less than was the case in 1980.

**2.4.3 Viti Levu** Viti Levu is the largest and most populous island of Fiji. The eating of shellfish was not widespread in Fiji in earlier times, the practice being promoted by later Polynesian colonists from Samoa and Tonga; evidence of this is found, for example, in the fact that the Fijian word for the giant clam, *Vasua*, is a Polynesian borrowing. (*Tonga - Vasuva, Samoa - Faisua*). Nonetheless, in modern times, shellfish form a valuable and considerable item of daily food, with the giant clam being, perhaps, the most prized. (*Burrows 1940*)

The account below is based largely on unpublished reports of the Fiji Fisheries Division (*Anon 1985*).

Supplies of giant clam meat to municipal markets on Viti Levu have averaged 10 tonnes per annum over the period 1978 - 84, with the largest proportion being sold in markets in the western side of the island, which has more ready access to suitable grounds.

Commercial harvesting of giant clam by local Fijian enterprises began in the early 1980's, being conducted mostly by the government-controlled National Marketing Authority and one private organisation. Giant clam entering the commercial sector is principally exported, originally to Australia and New Zealand, but now also Taiwan. Prices paid by commercial buyers in Fiji for giant clam meat show some fluctuation but are in the area of F$6.00 - 11.00 per Kg. for muscle, F$0.60 - 1.50 per Kg. for mantle. Whole flesh prices have varied between F$1.50 and $3.00 per Kg. Current collection volumes by the commercial sector appear to be around 20 tonnes per annum, of which perhaps half, or more, is exported.

Purely subsistence catches throughout the whole of Fiji are estimated at 20 tonnes per annum, but the subsistence catch taken on Viti Levu will be considerably less than this. It can be noted here that a proportion of the volumes contained in both
the municipal market and commercial sector statistics will relate to harvesting away from Viti Levu.

The extent of foreign poaching of giant clams is unknown, although a number of confiscations and arrests have occurred in Fiji waters.

Due to the sustained pressure of subsistence fishing over hundreds of years, the upsurge in artisanal fishing with the introduction of the market economy, and more lately commercial sector export buyers, compounded to an unknown, but significant degree by foreign poachers, the Fijian giant clam stocks are now at a low level and the framing of exploitation guidelines is being urgently pursued. Already, however, *T. gigas* has been exterminated in Fiji waters.
3.0 Mariculture

3.1 Introduction

Giant clam mariculture operations are in existence at a number of locations in the region. In describing them below, the distinction is made between hatcheries, where giant clams spawn and larvae are raised, and nurseries, where seed clams are on grown. Hatcheries may include nurseries.

There are two principal research/commercial hatcheries currently producing seed clams in the region; one at Koror, Republic of Palau, and one at Townsville, northern Queensland. In addition, the University of Papua New Guinea has limited experimental facilities at Motupore Island, as does Silliman University in the Philippines, and there are two, possibly three, commercial operations in Queensland, and two in the Marshall Islands, in the early stages of commencement. Bottom-based tray nurseries for the on growing of seed clams from the Palau hatchery have been established in Palau, the Marshall Islands and the Federated States of Micronesia, in Yap and Pohnpei States (Heslinga and Fitt in press). More recent advice indicates that the Marshall Islands now intend to develop their nursery using Marshallese giant clam stocks.

Current production of the Palau hatchery is restricted to T. derasa, while the Townsville installation, operated by James Cook University at Orpheus Island, primarily produces T. gigas.

At the South Pacific Commission's 17th Regional Technical Meeting in Noumea, 5 to 9 August, 1985, discussions were held on the commercial mariculture of giant clams and attention was drawn to the potential risks of transferring giant clam breeding stock within the region. These risks were seen to include the introduction of undesirable diseases, parasites, predators and inferior strains together with other, possibly unforeseen, ecological consequences. Delegates agreed on a schedule of control measures to combat such risks, as set out below.

a) Transfers be restricted to the species original distribution

b) Transfers should be preceded by a four week quarantine period

c) Arriving giant clams should be subject to a six month quarantine period

d) Transfers should be made as early in the giant clam life cycle as possible

e) The country of origin should certify its adherence to the above.

These procedures represent guidelines only and remain subject to adoption and implementation by the authorities in the countries concerned. (Anon 1985).

3.2 Micronesian Mariculture Demonstration Centre (MMDC)

The MMDC is located at Koror, Republic of Palau, Caroline Islands and is the region's only commercial-scale hatchery. Development work at MMDC has largely been funded by the Pacific Fisheries Development Foundation (PFDF). MMDC has served as a base for giant clam research in the tropical Pacific since 1974, although, prior to World War Two, the Japanese administration sponsored work on giant clams at the Palau Tropical Biological Station.
The U.S. National Marine Fisheries Service administers funds made available to it under the Saltonstall-Kennedy Act from duties on fish products and has allocated a portion to the PFDF for further support of the MMDC and also for the extension of the work in clam culture in Pohnpei State, Federated States of Micronesia.

3.3 Mariculture methodology

The methods currently used in commercial scale hatcheries and nurseries are outlined below and are based on the descriptions of the work undertaken at the MMDC in Heslinga et. al. (1984), Heslinga and Watson (in press), and Heslinga and Fitt (in press). The rearing process is described in four steps: spawning, larval culture, juvenile rearing and on growing seed clams. No food of any kind is provided to the young giant clams during any of these four stages, other than that occurring naturally in the sea water in which they are immersed.

Spawning Mature giant clams are held in large tanks and induced to spawn by a variety of methods, the most effective of which are reported to currently be the administering of serotonin injections or the use of fresh or frozen gonadal material. All mature giant clams are simultaneously hermaphroditic and the spawning process consists of the
release of sperm over a long period followed, after a pause, by the release of eggs by the same individual. In hatchery practice, the concentration of sperm is drastically reduced by flushing the tanks between the two phases to restrict multiple fertilisation of the eggs and resultant infertility. Giant clams are extraordinarily fecund - a specimen of *H. hippospus* is reported to have spawned approximately twenty-five million eggs in a single day (Jameson 1976). In practice, tens of millions of surplus clam embryos are available for return to nature, as a result of this high fecundity, when the fertilised eggs are siphoned off into tanks for larval culture.

**Larval culture** The fertilised eggs mentioned above are left undisturbed in the tanks into which they have been siphoned where settlement onto the walls and bottom begins within seven days. Seawater flow through the tanks of unfiltered, plankton-rich lagoon water is begun after nine to ten days. After ninety days the clams are large enough to scrape off and transfer to raceways as juveniles. Perhaps one per cent of the embryos originally present in the tank survive to the end of the first ninety day period.

Up to ten thousand giant clams of a size greater than five mm. have been raised in each ninety day cycle of this method, using a twelve thousand litre tank.

**Juvenile rearing** The five mm. giant clams are transferred from the settlement tanks to plastic trays containing stone chips and placed on the bottom of shallow concrete raceways where a moderately strong flow of unfiltered seawater is maintained. When subsequent thinning is required, the fact that the giant clams attach themselves by means of byssal threads to the substrate, does not result in injury or mortality due to the use of the chips. The problem of smothering by growths of algae in the trays and on the giant clams themselves is controlled by the stocking of cultured trochus shells which graze on the algae.

Limited experience indicates that a size of three to four cm. is necessary to ensure adequate survival of juvenile giant clams when placed in a predator exclusion cage on the natural sea-bottom. This would indicate a period of perhaps six to eight months in the intensive, juvenile-rearing, land-based phase and this may well be the major cost determinant and production-volume constraint in commercial mariculture.

**On growing seed clams** When large enough to be transferred from the juvenile-rearing raceways the giant clams are placed inside lightweight plastic trays resting directly on the shallow sea bottom with a layer of stone chips on the base. The trays are covered with a polyethylene mesh to prevent the intrusion of predators such as fish, snails, crabs and octopuses, although smaller snails are able to penetrate the mesh. They are controlled by periodic manual inspection and removal by divers. Algal fouling of the mesh is controlled by the grazing of naturally occurring fish. (Figs. 4 & 5).

After about eighteen months of ongrowing the giant clams can be removed from the trays and placed directly on the sea bottom, at which stage no further care is required.

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3.5 Yields

Munro (1985), projects a range of possible production yields using estimates of the best and worst survival rates and the lowest and highest likely growth rates. His assessment of these parameters is based on work in Papua New Guinea (Munro and Gwyther in prep.), Palau (Munro and Heslinga 1983) and the Great Barrier Reef (Pearson, Munro and Farrel in prep.). There remains a wide spread between the higher and lower estimates, caused largely by the differing environmental conditions at the three sites, and work continues to define these parameters more precisely. For example, tables in Munro (1985), show projected individual growth rates and total biomass estimates for the best and worst cases; in year five the total biomass from an initial stock of ten thousand giant clams is projected to range between forty and one hundred and forty-two tonnes depending on the parameters adopted.

The most recent advice received indicates that it would still be premature to indicate specific likely growth rates in a general review of this nature. As noted above, work is in progress to accurately establish site-specific growth and mortality parameters.
4.0 The International Giant Clam Mariculture Project

4.1 ICLARM

ICLARM (International Centre for Living Aquatic Resources Management) was established in the Philippines in 1977. It was designed to fill a need for an international fisheries research centre concentrating on fisheries management and aquaculture, particularly as these areas might impact on developing nations. ICLARM's activities have been designed to be carried out in an inter-disciplinary fashion, in full co-operation with interested institutions. The fact that ICLARM has no laboratory facilities has served to assist in achieving this objective.

The Rockefeller Foundation contributed the main funding for ICLARM's activities from inception until 1983 (ICLARM is a non-profit making institution). Since that date core support has come from the U.S. Agency for International Development (USAID), the Australian Development Assistance Bureau (ADAB), Norway, and the Ford Foundation, together with other donors. Various other agencies have contributed funds on a project basis.

4.2 The International Giant Clam Mariculture Project

This collaborative project is being conducted by ICLARM, James Cook University of North Queensland (JCUNQ) and other interested institutions in the tropical Indo-Pacific region. While the giant clam products market study being conducted by the South Pacific Forum Fisheries Agency (FFA) was originally conceived as follow-on work from the market survey for miscellaneous marine products (Carleton 1984) funded by the Commonwealth Fund for Technical Co-operation (CFTC), it is being closely co-ordinated with the Giant Clam Mariculture project, and will supplement some aspects of module (3) below.

The following description of the project's activities is taken from ICLARM's Project Description (Munro 1984).

"(1) A major scientific effort at JCUNQ aimed at solving a wide array of problems relating to Tridacnid biology, ecology and cultivation.

(2) Development by ICLARM of a basic hatchery facility within the equatorial zone of the Indo-Pacific and preferably within the limits of distribution of most species of Tridacnids, at which the results of research will be applied on a systematic basis.

(3) A module operated by ICLARM and concerned with the organisation of regional studies on topics such as the status of giant clam stocks, processing methods, current and future markets for giant clam products and social and economic evaluations of various mariculture operations.

(4) A module for supporting research on a variety of locale-specific or development-oriented topics at institutions within the Indo-Pacific. This has a significant training component."

Module (1), the JCUNQ scientific effort, has been funded by a grant from the Australian Centre for International Agricultural Research (ACIAR). The grant is for a three year period, commencing in June, 1984. The project, jointly co-ordinated by Dr.J.S. Lucas and Dr.J.L. Munro, and utilising a number of JCUNQ
researchers together with other co-workers in Fiji, Papua New Guinea and the Philippines, is well underway, and it is expected that a better understanding of clam reproduction and larval and juvenile ecological requirements will emerge, leading to enhanced, scientifically based, cultivation practices.

Module (2), the establishment of a hatchery, has as its primary aim the development of an economically viable hatchery and nursery system for giant clams, incorporating developments from module (1), and is a collaborative project between ICLARM and the Solomon Islands Fisheries Department. ICLARM has entered into negotiations to obtain a site for such a hatchery on Guadalcanal, in the Solomon Islands, and it is anticipated that an enabling agreement between ICLARM, the Guadalcanal Provincial Government and the Government of the Solomon Islands will be executed in the near future. It could be anticipated that the first spawning would take place within six months of commencement with cultivated clams being placed in natural grow-out areas within eighteen months. The project is scheduled to run initially for three years, followed, subject to appraisal, by a second three year period.

Initial funding for this module has been provided by the United Kingdom Overseas Development Administration, the Skaggs Foundation and ICLARM core funding from ADAB.

Module (3) consists of four specific sub-projects:

- **Assessment of regional stocks and current local utilisation.**

- **Market assessment of giant clam derived products.** Market studies are currently underway for shells in the Philippines and for local and export markets in Fiji. ICLARM is awaiting the outcome of the Commonwealth Secretariat/FFA market study before considering further work in this area.

- **Giant clam processing and product development.** ICLARM has despatched 25 Kg. of giant clam meat to the Tropical Development and Research Institute (TDRI) in London to initiate processing and product development. Further, Solomon Islands based product development work is planned for 1986-87.

- **Socio-economic considerations of giant clam mariculture in a regional setting.** Future studies are planned to consider socio-economic impacts of proposed sites and also production economics. In addition, and independently of the ICLARM project, ACIAR have engaged Professor C. Tisdell of the University of Newcastle, Australia to conduct a socio-economic study of giant clam exploitation, marketing and future mariculture.

Module (4), the regional research activity, is currently being conducted by the University of the Philippines, Silliman University, University of Papua New Guinea, and the University of Newcastle upon Tyne (in Indonesia).
5.0 Foreign Fishing Activities

5.1 General

It is not possible to obtain a comprehensive picture or compile accurate statistics on foreign giant clam fishing effort in the region due to the illegal nature of such activities, which results in total non-reporting. Fragmentary evidence can be obtained from the occasions when illegal giant clammers are intercepted by national surveillance units and when the results of such interceptions are reported.

5.2 Taiwanese activities

It appears that illegal giant clam fishing in the region is confined to Taiwanese based and crewed vessels who land their catch to their home ports in Taiwan, although the ultimate destination of the landings is not known. The typical Taiwanese giant clammer is a forty to seventy tonne wooden junk, retired because of age from either long-lining or trawling, although the vessel may still hold such licences to disguise her new activities. The vessel could carry a crew of perhaps twenty of whom all but three or four would engage in diving operations. Operating on an area of reef not formerly subject to heavy exploitation, and using only snorkel equipment, such a vessel and crew can expect to harvest at least a tonne of giant clam adductor muscle each full day. In trial commercial fishing operations conducted in the Solomon Islands in 1983 (Enekevu unpublished), thirteen hundred and eighteen giant clams, mostly *T. gigas* were harvested for an average adductor muscle weight per giant clam of nine hundred and thirty grammes. An average one tonne day would therefore require the harvesting of approximately eleven hundred giant clams, on this basis, and the full load of an average giant clammer of ten tonnes, eleven thousand giant clams.

Taiwanese illegal giant clam harvesting activities are thought to have increased in their geographic range as grounds closer to the vessels' home port (Kaohsiung, in southern Taiwan) have been fished out. Poaching voyages have extended progressively through the Philippines, Micronesia, Indonesia, and Melanesia reaching their most distant points, perhaps, in the Great Barrier Reef and Fiji in the south and east, and Kiribati and the Marshall Islands in the north and east. The range of such voyages attests to the attractiveness of the ventures to their promoters, described by Carleton (1984) as "powerful and effective businessmen, not happy to see business opportunities go to waste".

As stated above, the annual harvest of illegally obtained giant clam adductor muscle landed into Taiwan cannot be ascertained, but has been variously estimated at between one and four hundred tonnes. Dawson (in press) records that between 1967 and 1984 a total of more than one hundred and twenty tonnes of giant clam adductor muscle was found on thirty-nine Taiwanese boats apprehended in Australian waters and notes that in 1979 the Taiwanese authorities produced a list of thirty-seven vessels suspected of being engaged in illegal giant clamming activities at that time. Subsequently nine of the vessels on the list, and another nine vessels not on the list, have been detected in Australian waters. If each of the forty-odd boats only completed one full trip each year it would represent four hundred tonnes.

Carleton (1984) suggests from Taiwanese production statistics analysed by him that adductor muscle annual supplies entering Taiwan from distant water giant clam fishing activities average three hundred and seventy tonnes per annum, although he
is careful to indicate the interpretive nature of this projection.

Against these higher estimates are the accounts of Taiwanese informants who have maintained that the total annual landings to Taiwan, even during the earlier years of high landings, are no more than one hundred tonnes. Certainly there is a danger of over-estimation when considering potential vessel capacities, due to the opportunistic practices of the Taiwanese fishermen, who are prone to fill the hold with anything they come across that is saleable, and not restrict themselves to giant clam. The reliability of official Taiwanese statistics in this area is also open to question.

On balance, as is discussed in 6.1.2, the higher projections must be rejected in favour of the extensively corroborated accounts of Taiwanese industry principals.

5.3 Aggregate foreign harvest

Taking account of the harvesting of the smaller species, *T. deraasa* and *H. hippopopis*, which have an adductor muscle approximately one third the weight of *T. gigas*, and postulating a minimum foreign caught adductor muscle harvest of one hundred tonnes from the above, and noting the reduced average size of giant clam now being harvested, it can be estimated that between three hundred thousand and four hundred and fifty thousand giant clams are being harvested illegally from the tropical Indo-Pacific for supply to South-east Asian markets each year. It seems certain, as other authors have suggested, that the total illegal harvest of giant clams over the twenty-odd years that such activities have occurred in the region can safely be measured in the millions.

5.4 Controlling the foreign harvest

As stated above, Taiwanese illegal poaching is widespread throughout the region; seizures of Taiwanese vessels by national authorities have occurred in Australia, Papua New Guinea, Solomon Islands, Palau, Federated States of Micronesia and Fiji. These seizures have in general resulted from chance sightings, often by local inhabitants, of giant clam vessels venturing close in-shore in populated areas. It can be supposed that the typical voyage is completed without detection, at least by those with the means and inclination to report such activities to responsible authorities.

The Australian experience can be used to illustrate an effective programme of deterrence based on two components - surveillance, apprehension and prosecution by the Australian authorities themselves and a back-up activity by Taiwanese authorities of vessel inspection, crew interrogation and administrative penalties on their own nationals. The account below is based largely on Dawson (1984).

Taiwanese vessels began illegal giant clam activities in Australian waters in the mid-1960's. The Australian government, motivated largely by conservation concerns in the Great Barrier Reef area, instituted an intensive aerial surveillance system, which, augmented by concerned recreational and commercial boat operators, virtually ensured that no illegal giant clamming activities could take place without detection, and apprehension was efficiently effected using charter boats and navy patrol boats stationed in the area. Prosecutions resulted in increasingly severe penalties with, eventually, the forfeiture of the vessel, catch and gear, together with fines and forced repatriation of the crew becoming almost standard. Sixty incidents involving the detection of giant clam poachers are described in
In 1979, in the lead up to the declaration of the Australian Fishing Zone (AFZ), Taiwanese authorities were warned that continued illegal activities would jeopardise Taiwan's position in gaining access rights to the AFZ. In response to this commercial pressure, perhaps more than a shared concern for conservation aspects, the Taiwanese government constituted a special committee empowered to inspect suspected boats prior to departure from Taiwan, inspect them again on return, interrogate the crew and impose penalties including the suspension of the vessel's licence and the master's certificate for up to two years, for those found to be engaged in illegal giant clam fishing. The committee acted effectively for a period, although was always more concerned with illegal fishing in Australian waters than elsewhere.

The combined effect of these two components - almost certain apprehension by the coastal state and effective sanctions by the flag state, combined to result in the virtual cessation of illegal giant clam activities in the AFZ.

In the regional setting, surveillance activity of the intensity required to ensure a high probability of detection would be impractical and, in many cases, the vessels necessary to effect apprehension are not available. Accordingly, to control this illegal activity, regional states will have to resort principally to the second component, the use of sanctions by Taiwan herself, should that country prove willing to re-institute and widen such controls.
PART TWO

The market in South East Asia and Japan

for Giant Clam derived products
6.0 Country reports

6.1 Taiwan

6.1.1 Summary In Taiwan, there exists a well-established, buoyant market for frozen giant clam adductor muscle. However, for two basic reasons, it is impossible to determine accurately the size of the market.

Firstly, virtually all clam meat supplied to the market enters the country illegally - this aspect will be dealt with later. Secondly, the use of one colloquial term, compoy, for various species of shellfish results in vague statistics and misinformation (1). 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.

The market for giant clam adductor muscle is confined to the exclusive restaurant trade, particularly those specializing in seafoods. Some of the larger international hotels also list compoy dishes on their Chinese menus. Opinions and estimates of the size of the clam meat market and the volume reaching the market were sought from clam boat owners and masters, shipping agents, distributors and restaurateurs. Their collective assessment regarding volume of supply to the exclusive restaurant market is as follows:

1984 70 - 80 tonnes
1985 50 - 60 tonnes

( market capacity approximately 100 tonnes.)

Previous estimates, suggesting a figure of around 200 tonnes and higher for the market capacity, were erroneous; this can be attributed to the fact that they were based, in part, on faulty Taiwanese Government compoy statistics and partly because of a lack of access to informants directly involved in the clamming industry. It is also the considered opinion of such informants that the existing market has very little growth potential. The number of restaurants/hotels throughout Taiwan providing the market for giant clam meat stands at between 90 and 100. Taipei's market, which accounted for approximately 30 tonnes of muscle in 1985, is the largest by far, with about 50 retail outlets. The other major centres in order of market volume are Tai Chung, Kaohsiung and Tai Nan. The capacity for the Taipei trade, given adequate supply, is estimated to be about 120kg per restaurant per month. Compare this with the situation in Kaohsiung, where one of the more popular medium-sized restaurants currently averages 50kg monthly and this is thought to be slightly higher than for most such restaurants.

Note 1. The two Chinese characters in the name pronounced "ganbei" in Mandarin, the national language for both Taiwan and the People's Republic of China, translates literally into dried shellfish or mollusc. In the local Taiwanese dialect, the same two characters are pronounced "compoy". This term "compoy" or "ganbei" is accepted as a general word for bivalve mollusc and as such includes both giant clam and mollusc. It has also been used to include other mollusc varieties. To give an example, 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.
6.1.2 Pattern of Supply  Chinese cuisine stands out around the world in terms of the variety and exotic nature of dishes. There are several different styles of Chinese cuisine; Shanghainese, Cantonese, Sichuanese, to name a few of the more commonly known ones. They are grouped by province or locality and each has its own specialties. Among Chinese, it is only the Taiwanese who boast giant clam adductor muscle as a delicacy in their repertoire of of exotic dishes.

The Pescadores archipelago, west of Taiwan in the Taiwan Straits, lies within the region where some giant clam species occur. Occupation of islands in the Pescadores group beginning in the fourteenth century by seafaring Fukienese from the mainland province adjacent to Taiwan probably marks the origin of compoy as a Chinese dish. The giant clam habitat extends as far north as the Riau archipelago to the north of Taiwan and Okinawans are known to fish for it. In fact, as the Taiwanese overseas fishing fleet developed in the post-war years, Okinawan masters, engineers and ordinary seamen featured prominently among clam boat crews right through to the late 1960s. No doubt, this was a legacy of the 50 years of Japanese occupation of Taiwan which ended in 1945.

Taiwanese fishing companies have been the only suppliers of giant clam meat for the Taiwanese market. The number of vessels actually licenced to take compoy was quite small and their declared area of operation was restricted to the South China Sea. As stated earlier, compoy included other species of shellfish in addition to giant clam. However, fishing for clam was permitted only from April through to July. Generally, these instructions regarding the season and area of operation were ignored and licenced compoy fishing boats poached clam in other than designated areas. The last five compoy fishing boat licences were rescinded in September 1982, mainly because of pressure brought to bear by the Australian Government. Australia had been subjected to nearly 20 years of Taiwanese clam poaching on the Great Barrier Reef and, in 1982, intimated that the trawl-fishing operations of the large Taiwanese fleet licenced to fish in Australian waters could be adversely affected if the illegal clam boat activity did not cease.

The great majority of vessels engaged in illegal clamming operations have been licenced as long-liners. Most boats have been old, dilapidated wooden junk types with a displacement of 40-70 tonnes. Such vessels would have outlived their usefulness as long-liners and have been purchased very cheaply for the specific purpose of the high risk business of clam poaching. Some larger steel-hulled vessels, either gill-netters or former Japanese long-liners have also been involved. One obvious indicator that a vessel is being used for clamming is the presence of one or more motorized dories on board. (Dawson in press).

On average, a catch of ten tonnes of adductor muscle is the target. However, to describe a vessel as a clam boat is not to say that it is involved exclusively in fishing for clam. Clam boat operators are very much opportunists. A clam catch target of ten tonnes is seldom achieved and clam boat crews, particularly in more recent times, will take whatever is of value and is available. Between November 1975 and August 1986, 16 of the 23 clam boats apprehended in Australian waters had a mixed catch on board. As well as clam meat, catches included triton, trochus, green snail and helmet shell and meat, fish, crayfish, octopus, turtle and propoise. One vessel had 6.5 tonnes of turtle meat on board (2).

Note 2. One seafood restaurant visited by the consultant in Kaohsiung had two trochus meat dishes listed on the menu under the compoy section heading and they were slightly more expensive than the giant clam adductor muscle dishes on the same menu.
The clam is either trans-shipped to coastal vessels just prior to the clammer re-entering port or its is smuggled in on board under layers of fish or in elaborately constructed hidden holds. Nearly all of the clam boats operate out of Taiwan's largest fishing port of Kaohsiung and, except for a few isolated cases, clam catches are landed there or at nearby smaller ports.

Clam poaching activity peaked first in 1975/76, and again in early 1979. The number of boats operating during the former period is not known but in the two years from November 1974 to November 1976, there were 22 clam boat incidents on or near the Great Barrier Reef in Australia, which resulted in the loss of 15 vessels, either through confiscation, shipwreck or sinking. (Dawson 1985). An estimate of the number of boats operating around late 1978 to mid-1979, special measures were implemented by Taiwanese authorities in an effort to control the clam boat situation; by the end of that year, 22 boats, on return to port, were revealed as having been involved in illegal or "unlicenced fishing for compoy, i.e., clam and other shell fish". (Dawson 1984). It is significant to note that only 8 out of the 22 boats were recorded as having any clam meat among their catches of shell fish; only 2 boats had approximately 10 tonnes of clam meat on board, the other 6 had 1.2 tonnes or less.

According to a most reliable source, who is a central figure in the clamming industry in Kaohsiung, only 13 vessels, operating out of Kaohsiung, were known to be engaged in taking clams at the beginning of 1986. Those involved in the industry consider that wild clam stocks in areas which are accessible or safe for them to operate will have been exhausted in two or three years thus bringing to a virtual end this source of supply. With such a likely eventuality, the creation of a clam farming industry would be essential to meet the demand for the product in Taiwan.

Apart from actually fishing for clam muscle, other methods have been employed to obtain this product illegally. There is evidence of Taiwanese fishing company representatives and other businessmen going to several countries belonging to the South Pacific Forum and others in the region seeking, sometimes successfully, collaboration with local people in "joint ventures". When a deal is struck, the locals, having no knowledge of the high prices paid to suppliers in Taiwan, accept meagre payment for their efforts. Under such agreements, the locals take the clam and meet a Taiwanese vessel at an arranged, safe rendezvous point and effect the transfer. Sometimes local Chinese residents have acted as agents for the Taiwanese concerns. Hong Kong has been used as a staging point for smuggling a small amount of clam meat from Palau to Taiwan by one Taiwanese operator.

Some Taiwanese fishing vessels are known to have carried large quantities of rice wine, beer and cigarettes to be used for trading in clam muscle with indigenous people; particularly in Papua New Guinea.

There have also been instances when Taiwanese fishing companies have been duped into buying "licences" to take clam in Pacific island countries. Some of these false documents have been purchased from unscrupulous fellow countrymen and some through the collusion of indigenous people. The most noteworthy case involved an American San Francisco based company run by an ex-patriate Taiwanese. This company acquired seven licences to "search for scallop", covering all Solomon Islands territorial waters. Translated into Chinese, the licences read, "to fish for compoy". Five of these licences were sold to respectable Taiwanese businessmen, whose companies were engaged in legitimate fishing operations, for a total sum of US$400,000. For what was believed to be a legitimate venture,
approval was granted by the Taiwanese Fisheries authorities and the first vessel set out for the Solomon Islands in February 1983. It was apprehended after a few days of clam taking. The American company became the subject of legal action both by the Solomon Islands administration and the duped Taiwanese businessmen. Apparently undeterred, this same American company, later in 1983, sought licences to search for scallop in Papua New Guinea. However, this attempt to secure licences failed.

The Solomon Islands affair and other cases, in which the Taiwanese Government has approved Taiwanese clam fishing operations based on what has turned out to be fake documentation, have seriously damaged Taiwan's reputation throughout the region. Concerned over its image and the trouble caused by so-called licenced clamming operations, the Taiwanese Government now rejects all requests for approval of Taiwanese involvement in clam fishing activities; regardless of whether foreign agreement or licence documents can be proved to be genuine or not.

6.1.3 Distribution As might be expected, considering the illegal nature of the clam fishing industry and supplying the product to the market, those distributors interviewed were only prepared to discuss their business in general terms. Assurances were given that their names would not be published; one distributor was willing to have his name appear in this report.

Some clam boat owners have their own distribution nets which include selling directly to restaurants. In the main, however, the product passes through two stages of wholesale distribution before it reaches the restaurants. Kaohsiung is the hub from which the great majority of clam muscle is moved to all parts of the country; it is the only source of large scale regular supply for the Taipei market. This supply system is supplemented through small operators in other ports on an irregular basis. Restaurants order weekly or even daily and usually can obtain supplies at short notice from one of several secondary wholesalers.

6.1.4 The Product and Price Structure The only giant clam product, for which there has existed a market in Taiwan is fresh/frozen adductor muscle. It is not been supplied to the market in dried or processed form. An old clam boat captain indicated that the muscle can be sun-dried if it is cut in cross-sections 2 or 3cm thick. Okinawans used to dry the muscle (this was probably before on-board refrigeration was available to them). Taiwanese, from clam boat owners to chefs, were all quite negative about the prospects for a dried product. They dismissed the suggestion that dried clam adductor muscle might serve as a substitute for dried pectan scallop muscle. Of course, the former is not available for any comparison to be made and until it has been tested in the market place, such claims, as have appeared in some publications and hand-out literature referring to the value of dried giant clam adductor muscle and the volume currently being traded in Asia, should be disregarded. The wholesale price of dried scallop adductor muscle to retailers is approximately US$87 per kilogram. The volume imported is not known.

Taiwanese have colloquial names for five species of Tridacna clams and have grouped them into three price gradings. English translations of these names, the gradings and February 1986 prices paid to clam boat owners for each grade are as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Name</th>
<th>Price per Kg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>old clam, blue or</td>
<td>from approx. US$21.25</td>
</tr>
</tbody>
</table>
green clam  
Second red clam from approx. US$17.50  
Third dragon teeth clam, stone clam. from approx. US$7.50

"Old clam" and "blue/green clam", without doubt, refer to YT. GigasV and Y. T. DerasaV, respectively; "red clam", it is believed, equates to Y. Hippopus hippopusV; and the two third grade clam names probably refer to YT. SquamosaV and YT. CroceaV, respectively. According to one reliable informant, a clam boat owner, the muscles of different species are indentified by their shape.

Quality criteria are size, whiteness and texture. "Old clam" is most in demand; the larger the muscle, the higher the price. The muscle of an adult YT. GigasV weighs around one kilogram, but in recent times, muscles of this size are rare. According to one of Taiwan's most experienced clam boat captains, on average, what are considered large muscles being supplied nowadays number three to the kilogram. Two out of every three muscles taken by Taiwanese fisherman are small; perhaps half that size. The optimum age for harvesting cultivated clams is considered to be six to seven years; the muscles of clam that size would number about six to the kilogram. In October 1983 the price of first grade muscle ranged from US$20 per kilogram.

Restaurants in Kaohsiung, the main port of entry of the product, pay upwards from about US$25 per kilogram for first grade muscle. The price paid by restaurants in Taipei can be as high as US$31. This price differential should be noted by potential exporters of the product to Taiwan who would probably be considering Taipei or its closest port, Keelung as the port of entry, rather than Kaohsiung. It is also important to note that there was general agreement among informants that the product would not maintain its price if the supply exceeded the estimated exclusive restaurant trade's market capacity of 100 tonnes. Some expert opinion considered that the price might drop as much as fifty per cent if clam meat were no longer supplied illegally - the attraction of eating an exotic delicacy which had been smuggled into the country would be gone.

Clam presents very well in a variety of dishes. "Old clam" is preferred for cooked dishes, whereas "blue/green clam", which is reportedly tougher in texture, is favoured for raw dishes. However, either is acceptable for cooked or raw dishes. As a hot dish, clam muscle is boiled, steamed, stir-fried or deep-fried. When eaten raw, it is sliced into thin strips and served with salad and a type of mayonnaise.

6.1.5 Importation Requirements Under Taiwanese Board of Foreign Trade regulation, C.C.C. 31737-16, the only limitation on the importation of fresh, frozen or dried compoy is that it be procured from cholera-free areas. Giant clam meat would come under the compoy category. To highlight the unreliability of Taiwanese statistics, according to official figures quoted to the consultant, the volume of compoy (all varieties), imported in 1984 was 285 kilograms of frozen products and 25 kilograms dried. The seafood section of any Taipei department store might carry that amount of dried scallop adductor muscle, imported from Japan and Korea.

As from 1 February 1986, the F.O.B. tariff rate for fresh/frozen compoy products is NT$130 (approx. US$3.25) per kilogram or 50% whichever is higher, and NT$738 (US$18.45) or 50% for dried compoy. The previous rates had been NT$160 (US$4.00)
or 60% and NT$885 (US$22.12) or 60%. Fisheries authorities have indicated a willingness on the part of the Taiwanese Government to negotiate tariff rates with individual exporting countries. The consultant is of the view that the Taiwanese would be amenable to requests for tariff reductions on giant clam products raised by Pacific Island States on an individual basis. It is felt that those countries which have been subjected to heavy exploitation of their wild giant clam resource by Taiwanese illegal fishing operations would be in a strong position to bargain as the Taiwanese Government seems keen to cleanse its tarnished image.

The Taiwanese authorities gave no indication of any specific requirements regarding packaging and labelling. It is suggested that those standards required for importation into Japan (see the section on Japanese Importation below for details), should be used for Taiwan as well.

6.1.6 Market Entry and Future Developments. It is expected that, if the product were readily and legally available from exporting countries, there would be no shortage of major seafood companies with countrywide distribution networks keen to buy. However because such companies would not have been involved in distributing clam muscle illegally, a marketing link would need to be established. One major difficulty in achieving this is in the language problem. Very little English is spoken in Taiwan, and even when interpreter/translators are available, the quality is often poor. The most effective way of establishing and maintaining contact with Taiwanese buyers would be to find a reliable local agency in Taipei.

The Taiwanese will endeavour to move into the clam farming industry. From the technological aspect, Taiwan is among the world leaders in aquaculture/mariculture techniques and is well placed to enter the field. Their cultivated prawn exports to Japan alone was 17,000 tonnes in 1985, an increase of 9,000 tonnes over the 1984 figure. In terms of production potential, Taiwan's capacity is very limited; the only areas within her territorial waters suitable for giant clam farming are the Pescadores archipelago adjacent to Taiwan and the Central and Southern Spratly archipelagoes in the South China Sea. The Pescadores lie at the northern latitudinal extremity of the giant clam habitat and sovereignty over the few islands in the two Spratly groups occupied by the Taiwanese is also claimed by the Philippines, Vietnam and the Peoples Republic of China. It is most probable that Taiwanese businessmen will seek involvement in clam hatchery and farming joint-venture arrangements in various countries throughout Oceania. There is some evidence to indicate that Taiwanese overtures have already been made for such projects in at least two South Pacific Forum countries. The advantages to local growers of participating in partnerships or co-operative ventures are that the Taiwanese would provide capital, technology and access to the market. On the reverse side of the coin, if Taiwanese business interests were to play a dominant role in supply, over the long term, indigenous growers might be placed at some disadvantage by losing touch with the market situation in Taiwan.

It is probable that some prospective clam farm operators, particularly in remote areas, might face transportation difficulties in getting their product to the market. A joint-venture arrangement with Taiwanese fishing interests, whereby they provide the transportation might be contemplated. If it were the desire of the local farmers, the Taiwanese participants in the joint-venture would also be prepared to carry out the harvesting as part of the agreement. The current attitude toward joint-ventures by the Taiwanese Government would be a vital consideration for such plans; consultation with them should be the first step. The Governments of exporting countries which might permit joint-venture arrangements would need to give their attention to surveillance and other measures
to ensure that poaching of wild stocks within their territorial waters did not occur when the participating Taiwanese vessel was on route to and from clam farms. On the Taiwanese market, adult *Tridacna Gigas* adductor muscle brings the highest price. Muscle of this size (approximately 1 kg) will not be available from clam farms and the temptation for Taiwanese vessels to take clam illegally will still be there. The fact that it would be extremely difficult to prevent poaching by Taiwanese vessels, while transiting other countries’ waters on their way to a particular country for joint-venture operations, is of real concern to the Taiwanese Government.

### 6.2 Japan

#### 6.2.1 Summary

The consultant found no evidence to indicate that, currently, giant clam meat is being imported into Japan. Prior to this survey being conducted, a reliable source stated that in 1968, a Chinese company in Japan was canning giant clam adductor muscle under the label “Pacific Scallops”. There were two grades of this product; one large piece of muscle, trimmed to fit the can size, was the top quality product and a second grade can contained a number of small pieces. The clam muscle was reported to have been imported from Taiwan. Retail outlets for canned clam muscle were Chinese foodstuff stores in Yokohama and Kobe. These two cities were then, and still are today, the major centres of concentration of Japan’s ethnic Chinese community.

During the survey, the consultant was unable to find anybody, either in Government or private enterprise circles, who could corroborate this information. However, a representative of one of Yokohama’s largest Chinese restaurants confirmed that frozen giant clam adductor muscle had been available to restaurants in small quantities on an ad hoc basis up until about ten years ago. An aged Taiwanese clam boat captain, interviewed in December 1985, indicated that some muscle had gone to Japan up to the early 1970s. It is noteworthy that the same person regarded Hong Kong, rather than Japan, as having the greatest market potential. This is an interesting comment, as the supply reaching Japan was catering almost exclusively to a Chinese community demand. The total ethnic Chinese population in Japan in 1986 numbers only 150,000. Time and the integration process in such a strongly monocultural country seem to have whittled away the distinctive character of Chinese commercial centres and Chinese people, generally, in Japan. Chinatowns in Yokohama and, more particularly, Kobe are perceived as being somewhat diluted in form and resident ethnic Chinese appear to be very much acculturated. The cuisine offered by Chinese restaurants seems quite standard, comparatively narrow in range and catering to the tastes of the host community. For these reasons, in spite of the fact that there has been a demand for giant clam meat from this quarter in the past, Japan’s Chinese community should not be considered as providing a significant market potential.

With regard to the overall potential for a giant clam meat market, Japanese expert opinions varied from extreme pessimism to mild enthusiasm. Generally, it was felt that the most likely, if not the only, prospects lay in the exclusive sushi restaurant trade. Some doubts were cast over the likelihood of success in introducing giant clam adductor muscle into the sashimi (raw seafood) section of the sushi trade. Some companies have attempted to establish a trade in giant clam meat in past years but all had failed. The common complaint had been that the texture of the muscle was too tough for sashimi. The consultant, having eaten a variety of sashimi dishes and Taiwanese raw clam muscle dishes, tends to agree with that opinion. Six to seven year old clams (considered to be the best age for harvesting) number about six pieces to the kilogram. It has been suggested that
the muscles of smaller clams might be softer and so more suitable for sashimi.

6.2.2 Representative Buyers  Four companies expressed interest in sampling giant clam meat;

Taiyo Fishery Company Limited, is the largest fishing company in the world and has its own distribution net of auctioneers and wholesalers throughout Japan. Taiyo is interested only in fresh or frozen muscle. Fresh/chilled muscle would be required for the most exclusive sushi restaurants and Taiyo's initial plan is to test this sector of the market. The frozen product would be suitable for the lower quality restaurant trade. The requirements laid down by Taiyo are that the product be "fresh, white and without smell". Interested parties can contact Taiyo directly regarding sample details.

Because giant clam meat is a product of which only few Japanese businessmen have even scant knowledge, and the fact that it will not be available in any quantity for several years, it was not possible to obtain any price forecasting. Taiyo, however, working on the basis of six pieces of chilled muscle per kilogram as the probable size and type of clam product, drew a comparison with Horse mussel which was being imported in small quantities from New Zealand; there were six chilled mussels to the kilogram and the landed price in February 1986 was approximately US$20 per kilogram. This might serve as a useful guide. Japan imports about 500 tonnes of fresh and dried Horse mussel a year, mainly from Korea. It was suggested that if clam adductor muscle was acceptable as a product for the sushi trade, the potential volume might be similar to that of Horse mussel. Another potential price indicator, and, perhaps, a more appropriate guide, might be the Tairagi muscle, ten pieces to the kilogram, were seen at Tokyo's Tsukiji Wholesale Fish Market at a price of approximately US$65 per kilogram. This price was at the third stage of wholesale handling.

Kasho Company Limited, has fishing interests in Indonesia and about three years ago the Indonesian branch office proposed the import of giant clam meat to Japan from that country. The head office rejected the idea because it was an unknown product and freezing facilities in Indonesia were considered inadequate. However, even though there is an awareness that the attempts of other firms to introduce clam meat had been unsuccessful, the company has expressed interest in trialling samples of chilled/frozen muscle, as well as the whole flesh with the kidney removed. The company proposed sampling muscle and whole flesh from two to seven year old clams. It was thought that flesh from younger animals (3-4 years) might trial best. One sample, size and composition to be arranged, would be required each week for two to three months. The company also requested a set of captioned photographs showing the product in various forms, e.g. the live clam, killing method, flesh in an open shell, and removal of kidney and muscle; a measure should be included in each photograph to indicate size. It is estimated that if, after trialling, the product proved to be acceptable, wide-spread introduction to the market would take two to three years.

Daito Gyorui Company, which deals exclusively in seafood products, is keen to sample giant clam meat. The company considers that the range of shellfish available for the sushi trade has the scope to include more new varieties. They have asked for samples of live animals, and fresh and frozen muscle. It is also proposed to experiment with a new drying technique, currently in use for abalone, to process giant clam flesh. If successful, it could create broader market opportunities. Moreover, Daito Gyorui is in favour of assisting exporting countries in developing their own industries and would be prepared to send experts
to teach this new processing technique.

If, after sampling, giant clam meat proved to be acceptable, the company would advise on the suitable form of the product, i.e., fresh, frozen or dried and work out a price range. The company will supply details of sample requirements on request. A set of photographs, similar to that required by Kasho Company mentioned above, would also be necessary.

The North Borneo Fishing Company (Japan) was less than optimistic about the prospects of a giant clam product but was prepared to accept a small initial sample (about one kilogram) of chilled and/or frozen muscle. It was thought that the exotic nature of the giant clam would be a drawback rather than an advantage in introducing this new product to conservative Japanese consumers.

6.2.3 Japan's existing adductor muscle market Kaibashira is a Japanese generic term meaning adductor muscle from any mollusc prepared in either fresh, frozen, boiled, boiled and dried or canned forms.

Kaibashira is obtained from the following species: Hotategai (scallop), Itayagi (scallop), Tairagi (pen shell) and Bakagi (clam). The most popular of these species, by far, is the Hotategai adductor muscle; Tairagi is also popular.

During the survey, the consultant found a general lack of support for the proposition that giant clam adductor muscle be considered as a substitute for scallop. The primary reason given was that the volume of local production of Kaibashira is steadily increasing and it is expected that Japan will experience a glut in the market in the near future.

At the close of World War II, when the USSR claimed and occupied a number of small Japanese islands to the north of Hokkaido and the territorial seas surrounding them, local fishermen were denied access to their traditional fishing grounds. Many have been forced out of that industry and, in increasing numbers, have turned to scallop mariculture. The principal Japanese scallop mariculture areas are located in northern Hokkaido.

According to the FAO Yearbook of Fisheries Statistics of 1985, Japan's Hotategai scallop production increased from 6,900 tonnes in 1964 (4.4 percent of world production) to 176,400 tonnes in 1982 (35.3 percent of world production) and Japan moved from fifth to second largest producer, behind the United States. Annual production of all Kaibashira species is now in excess of 200,000 tonnes. (Anon. 1985).

Japan also imports substantial quantities of Kaibashira, with the maximum in recent years being 2,172 tonnes in 1982. Since that peak, up to the end of the third quarter in 1985, there had been a continuing decline in the volume imported. Import prices rose steadily up to the end of 1984, as shown by the Table below:

<table>
<thead>
<tr>
<th>Year</th>
<th>Tonnes</th>
<th>Yen/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>'80</td>
<td>135</td>
<td>1615</td>
</tr>
<tr>
<td>'81</td>
<td>1270</td>
<td>2014</td>
</tr>
<tr>
<td>'82</td>
<td>2172</td>
<td>2160</td>
</tr>
<tr>
<td>'83</td>
<td>1161</td>
<td>2803</td>
</tr>
<tr>
<td>'84</td>
<td>900</td>
<td>3655</td>
</tr>
</tbody>
</table>

- 30 -
In the first nine months of 1985, 639 tonnes of Kaibashira were imported into Japan at an average rice of 2884 Yen/Kg. Import prices vary considerably depending on the exporting country; in 1984 Korea averaged 3903 Yen/Kg while the Philippines only averaged 633 Yen/Kg. The sources of imports for that year were as follows: Korea - 815 tonnes, China - 36 tonnes, Philippines - 30 tonnes, Chile - 4 tonnes, and New Zealand - 4 tonnes.

Exports of processed Kaibashira are made principally to Hong Kong which received 499 in 1984 with a total value of 5207 million yen or 10,435 Yen/Kg. Large amounts of Hotategai (scallop) adductor muscle are also exported frozen to meet western market preferences. In 1984, 4,146 tonnes were exported to U.S.A., 1,722 tonnes to France and 289 tonnes to other countries.

In summary, there is an existing large-scale trade in adductor muscle in Japan, centred around the scallop. Imports, exports and local production and consumption are all measured in the thousands of tonnes per annum. Import prices for frozen adductor muscle vary widely, but can be as high as US$20/kg., while exports of boiled, dried adductor muscle to Hong Kong fetch over US$50/Kg.

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 could be limited potential for a scallop substitute if it were half the price of the genuine article. This view was based on the experience of importing Rokogai (Loco) mussel from Chile as a substitute for abalone. Rokogai reaches the market at half the price of abalone and, unknown to patrons, is used in place of the later in low quality sushi restaurants.

Considering the volume of scallop exports from Japan to the United States, Europe and Hong Kong, the prospects of penetrating those markets with giant clam adductor muscle as a substitute might be more promising.

6.2.4 Importation Requirements Japan has an import quota (IQ) on shellfish meat based on value, not on quantity; some categories of fish, such as horse mackerel, are also included. The IQ covers frozen, fresh and dried shellfish meat. The value of current imports under this IQ system is well under the ceiling of US$40,000,000, so there will not be restrictions on giant clam products in this regard. Three-quarters of the IQ system is allocated to companies which are already involved with such imports and the remaining one-quarter to companies which wish to enter the trade. Giant clam imported in the shell will not be subject to the IQ. There is an F.O.B. tariff of 10%.

Special provisions apply for Cholera areas, e.g., squid and shrimp imports from Indonesia and Thailand require certification for clearance from those governments and are also subject to Japanese quarantine investigation. The above-mentioned quarantine provisions do not apply to live giant clam imports; responsibility for hygiene rests with the importer or restaurateur. There are no quarantine requirements for sun-dried products, except where chemicals are used in processing. The only requirements for packaging is that a waterproof container be used.

6.3 Hong Kong

6.3.1 Summary Reliable information indicates that Taiwanese interests, operating
on a relatively small scale, are bringing frozen clam muscle from Palauan waters into Hong Kong and smuggling it from there to Taiwan. It is possible that insignificant amounts of clam muscle go directly to selected local restaurants, but, overall, it can be stated that there is no existing market for clam meat in Hong Kong. However, the prospects for establishing a market would appear to be quite sound.

6.3.2 Representative Buyers Of the companies approached during the survey, all were desirous of receiving samples of clam products, although only two executives interviewed had seen or tasted clam; one in a Taipei restaurant and the other as a guest of Palauans in Palau.

The most promising response came from one of the Hong Kong's largest trading companies, Dah Chong Hong Limited. This firm has an extensive distribution net throughout Hong Kong, including a chain of thirteen supermarkets and a number of restaurants. Provided that the results of sampling proved positive, and working on a landed price requirement (on current values) of US$10 per kilogram for frozen muscle Dah Chong Hong would take up to 20 tonnes per month. Three important points emerged from discussions with this Company: a. the estimated price mentioned above was considered commercially workable; b. they wanted long-term marketing; and c. a four-month letter-of-credit would be available to exporters. The importance of maintaining a high standard of quality control was also stressed. It was pointed out that Hong Kong consumers are unforgiving and any lapse in quality control could result in a loss of the market for a period of years.

A sample of less than ten kilograms would be required together with a set of captioned photographs, similar to that required by Japanese firms. An explanation of the giant clam and instructions for handling the live animal would also be required. The sample should include live clam (three to four years old), and frozen whole flesh with kidney and guts removed as well as frozen muscle. It is possible that Cantonese people (over 95% of Hong Kong's population) might show a liking for the whole flesh. Samples would be sent to restaurants belonging to the Company for experimenting; drying techniques will also be tried. It is felt that there could be considerable potential for a dried product in China. Frozen samples should be wrapped individually (IQF form) in plastic bags before snap freezing to avoid freezer burn. Muscle samples should be trimmed and well presented.

The terms of reference for this survey did not include the provision of samples for prospective importers of giant clam products. However, it was considered that, because so much hinged on the outcome of the Dah Chong Hong trialling and experimenting of clam products, the consultant should initiate action in an attempt to make the required samples available. Approval was sought from the Government of the Republic of Palau to allow the Micronesian Mariculture Demonstration Centre in Koror to prepare one sample for shipment to Dah Chong Hong. Unfortunately, the prohibition on the export of wild clam products written into the Palauan Constitution proved to be too difficult an obstacle to overcome and the attempt failed.

It is the opinion of the consultant that Dah Chong Hong company stands out as the one interested firm which has the capacity and expertise to effectively promote giant clam products. It is recommended that would-be exporters approach that company first. The names of other firms interested in receiving samples appear at Annex II. One of those firms, Kam Bo Brothers Trading Company, was particularly...
interested in importing live clam from Palau. The company has established a fish ranching operation in Palau and, using its own vessels, ships live garoupa to Hong Kong. It is envisaged that live clam might be transported by the same means.

6.3.3 Importation Requirements Disease-free certification issued by Governments of exporting countries is a requirement for all fresh, frozen and dried products imported into Hong Kong. There is no import tax or tariff. Products should be enclosed in plastic inside ten kilogram hard cardboard cartons.

6.4 Singapore

6.4.1 Summary It is possible that a small market for giant clam muscle exists in Singapore. If so, it would be on a very limited scale involving a handful of restaurants. Clam, reported to be gathered in the area between the Celebes and Mindanao, is supplied frozen in small quantities on an irregular basis by Indonesian sources. The Singaporean importer of the clam muscle has business interests in both Singapore and Taiwan (he was in Taiwan when the survey team was visiting Singapore). Because both the Government's Primary Production Department and Seafood importers interviewed had no knowledge of any existing market in Singapore, it is likely that the imports mentioned above on-shipped to Taiwan.

Prior to the survey being conducted, the consultant was contacted by a Singaporean importer requesting information on the supply of clam muscle. This company and two others included in the survey assess the potential market volume for Singapore to be 10 tonnes of fresh/frozen clam muscle annually.

6.4.2 Representative Buyers The director of Seamark Fisheries Pty Ltd. is familiar with the product and is optimistic for the market prospects in Singapore, Malaysia and Thailand. He estimates a total market volume of 50 tonnes of muscle for the Chinese restaurant trade in the three countries. Seamark Fisheries has also expressed an interest in establishing a clam farm in the region and intends to carry out a feasibility study on potentially suitable sites in Malaysia and Thailand.

Another importer, Seafood Distributors Pty Ltd., noted the growing demand among Singaporeans for fresh and live seafood products, and expressed a particular interest in sampling live clam, in addition to chilled/frozen clam muscle. This company already has holding facilities for live marine imports but would require advice on handling procedures for giant clam, such as correct water temperature, salinity, lighting, etc.

High Tide frozen Foods Pty Ltd., a major seafood importer, requested samples of chilled/frozen clam muscle. The managing director of High Tide thought that six pieces of muscle per kilogram might be too large for some consumers and suggested that smaller pieces be included in samples. It was felt that small pieces, suitable for dishes for one or two people, might prove to be an attractive item. Price was given as an underlying factor for successful importation, although no estimate of a price level was given. There was also a suggestion that Singapore should be seen as a major distribution point for all parts of Asia, particularly for Australian products.

6.4.3 Importation Requirements There are no import duties or tariffs for Singapore. From the health and quarantine aspect, the Primary Production Department is not interested in chilled/frozen meat imports, provided that there is disease-free certification and that the exporting country is non-cholera
designated area. However, initial and follow-up monitoring is carried out on live imports. The question of whether clam farms in exporting countries would be Government licensed was asked; and it was suggested that Government authorities should conduct tests to ensure the suitability of water and other conditions for clam ranching. Packaging requirements are the same as for Hong Kong.
LIST OF PERSONS CONTACTED

Note: Sources directly involved in the illegal clamming industry provided information on the understanding that their names would not appear in this Report.

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