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Working Paper No. 9

Evaluation of International Trade Statistics on Giant Clams and Related Products and the Market for Giant Clam Meat

by

Dr John Stanton

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Evaluation of International Trade Statistics on Giant Clams and Related Products and the Market for Giant Clam Meat[1]

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Dr. John Stanton[2]

March 1990

[1] Research for this paper has been undertaken as a part of Australian Centre for International Agricultural Research (ACIAR) Project 8823 "Economics of Giant Clam Mariculture".

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Research for the project *Economics of Giant Clam Mariculture* (Project 8823) is sponsored by the Australian Centre for International Agricultural Research (ACIAR), G.P.O. Box 1571, Canberra, A.C.T. 2601, Australia. The following is a brief outline of the Project:

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

Commissioned Organization: University of Queensland.

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EVALUATION OF INTERNATIONAL TRADE STATISTICS ON GIANT CLAMS AND RELATED PRODUCTS AND THE MARKET FOR GIANT CLAM MEAT

ABSTRACT

This study examines whether international trade statistics can be used to provide a useful estimate of the extent of trade in, and the potential market for, giant clam meat. It evaluates the contribution of two reports which assessed potential export markets for giant clam meat. It also discusses the value of investigating the potential export market demand for giant clam meat using possible substitutes as a guide.

International trade statistics are found to be insufficiently disaggregated to draw any conclusions as to the volume of trade. In addition, even if the commodity could be distinguished, assessment of any country's potential market demand for giant clam meat would require an accompanying in-depth market analysis. The two previous studies of the potential export market demand for giant clam meat used differing methodologies and reached different conclusions. At one extreme, Compass suggested a very large potential export market to many countries based on a diverse range of clam meat uses. At the other extreme, Dawson conducted a market analysis in only four countries which focussed on identifying a narrow range of existing and potential uses.

This study examines the use of giant clam adductor muscle as a possible substitute for other seafood products using a characteristics approach and a review of studies of own-price, cross and income demand elasticities for seafoods. Substitution possibilities exist but the review suggests that market expansion, based on securing market share from adjacent commodities in characteristics space, may be difficult. Aggressive pricing to establish a market is likely to be counter-productive.

Keywords: International trade statistics, giant clam mariculture, supply and demand

JEL Classifications: Q57, Q21, Q22

EVALUATION OF INTERNATIONAL TRADE STATISTICS ON GIANT CLAMS AND RELATED PRODUCTS AND THE MARKET FOR GIANT CLAM MEAT

1. Introduction

Giant clam is the common name applied to a family of marine bivalve molluscs of which there are seven species. Five belong to members of the genus Tridacna and two to the genus Hippopus. References to their distribution, growth characteristics and their present status as a mariculture can be found in Dawson (1986) and Tisdell (1989). Although listed by the Convention for International Trade in Endangered Species (CITES) as an endangered species, the likelihood of successful giant clam commercial farming requires an assessment of their potential export markets.

All parts of the animal, except the kidney, are used; that is, the adductor muscle, mantle, gonads, other internal organs, and the shell. The adductor muscle is the meat most traded and valuable. The mantle is also consumed by indigenous groups who catch the clam but there appears to be little trade in this product.

This Report:

1. examines the usefulness of international trade statistics in giving an indication of the extent of the trade in, and the potential market for, giant clam meat;
2. evaluates the contribution of previous studies in assessing the potential market for giant clam meat; and
3. discusses the value of investigating the potential market demand for giant clam meat using possible substitutes as a guide.

2. Evaluation of Trade Statistics

Marketing analysts often use the value of imports of a particular commodity group as an indicator of the potential market size available for a commodity which appears to be similar

and for which they wish to appraise its export potential. The use of such import statistics by itself will be an inadequate indicator of the market potential for giant clam meat.

Any assessment of the export market opportunities for giant clam meat using import statistics must take into account the past, current and trend quantities and values of imports of it and apparently similar commodities; and the past, current and trend quantities and values of production of these commodities in the importing and potential importing countries. The types and effects of trade barriers on current import values and any likely effects with increased market penetration should also be assessed. Business practices existing in the target countries which can create barriers to import entry (such as the integration of wholesaling and retailing activities) will also need to be examined. These are only the broad demand elements and a complete appraisal of the potential market for giant clam meat would also require an assessment of supply and its determinants. One study which has attempted such an assessment of market opportunities in sea foods is Combs (1978). Observing trade flows can only be a partial guide to clam market opportunities and only if the level of commodity disaggregation sufficient to distinguish commodities which are close substitutes for each other.

Existing international trade data are inadequate in providing any guidance as to the potential markets for giant clam meat. There are five basic characteristics of international trade statistics:

coverage, commodity classification, valuation, exchange conversion and country designation.

> "All compilations of trade statistics provide information on the international movement of goods, but exactly what goods are included and what goods are excluded (the coverage of the statistics) depend on the particular practices followed. All countries show details of the different types of commodities moving in international trade, but how the detail is presented depends on the principles followed in establishing the system of commodity classification used in the compilation." (Allen & Ely, p.4)

The treatment of clam meat trade in international trade statistics suffers from a restricted coverage and an excessively broad commodity classification.

Foreign trade statistics usually will be compiled from copies of export and import documents

which are prepared by exporters, importers, or their brokers or agents at the time goods enter or leave the country. Clam fishing raises the problem that illegal fishing will go unrecorded because of the lack of documentation. In addition, coverage may also be affected by the conventions covering the recording of merchandise trade. Specifically,

> "Fish and salvage sold abroad or to foreign vessels off national vessels, and fish and salvage landed from foreign vessels in national ports should be excluded from merchandise trade statistics, but, where important, should be recorded and published separately." (U.N. International Trade Statistics Yearbook, 1987, p XII)

Classification is covered by the general principles of the United Nations Standard International Trade Classification (SITC). The classification problem consists of providing sufficient detail to distinguish the commodity in question. In general, most countries subscribe to the SITC classification system. The current system provides for a different code for exports and imports. The Australian Harmonized Export Commodity Classification (HECC), which follows the SITC Revision 2, is

0307:	Molluscs, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; aquatic invertebrates other than crustaceans and molluscs, live, fresh chilled, frozen, dried, salted, or in brine.
0307.9:	Other (after excluding oysters, scallops, mussels, cuttlefish, octopus, snails. "Other" thus covers abalone and other residuals.
0307.91:	Other dissected according to preparation- Live, fresh or chilled.
0307.91.90:	Other
0307.99.90:	Other than abalone, otherwise treated as in 0307.91.

Even if this level of disaggregation were available for all countries' import and export data, identification of clam meat trade would still not be a simple task. The eight digit class is often a residual item which needs to be examined for each country in order to identify the products. However, neither the six nor eight digit disaggregation level provide a consistent basis for considering the products included in them as being close substitutes. While the classification is based on an apparent similarity of physical characteristics a multi-product class is unlikely to be consistent with a designated market because there is no consideration whether products

are potential substitutes in terms of offering a similar quantity, quality, mix and value of characteristics. The import classification is similar. For example:

037: Fish, crustaceans and molluscs, prepared or preserved, NES

037.20: Crustaceans and molluscs

037.20.29: Other.

Again, the statistics tend to be excessively aggregated.

Published international trade statistics surveyed at the international organization level such as United Nations, International Trade Statistics; and F.A.O., Fishery Statistics, present their trade flows for this commodity group at the four and three digit levels respectively. Thus, the FAO Yearbook of Fishery Statistics 1988, presents its trade data for the commodity group "Crustaceans and molluscs, fresh, frozen, dried, salted etc.". Although production data in this source is separated according to several groups, of which the most relevant is "clam meat, frozen", only five countries' production is reported, the term covers a very wide range of marine animals with no indication of their uses or substitutability, while problems of coverage arising from the monitoring of production and illegal trade remain. With these caveats Table 1 presents the production statistics for these leading clam producers for the years 1982 to 1986. The large volume suggests that giant clam farming may not add significantly to world clam production for many years. However, the impact on trading prices and quantities may be much greater for products close to it in the hierarchy of substitution if giant clams' uses are confined to a small sub-market.

TABLE 1

Production of Clam Meat, Frozen 1982-86 (Tonnes)

Country	1982	1983	1984	1985	1986
Canada	1139	790	957	1224	822
Chile	84	213	465	568	663
China	9843	10769	10339	10752	10276
Korea rep.	2248	2231	2197	1375	2311
USA	46082	47960	54275	53641	52465

Source: FAO Yearbook Fishery Statistics, Rome, 1988. p122

A study of the trade and production statistics published by each country that might be involved in the giant clam trade (exporters and importers) would be more costly yet it is doubtful whether it would yield results which define the trade in giant clams. For example, *Fiji Fisheries Annual Report 1988* provides fish export data at the six digit level by volume, value and destination. However, the relevant commodity groups are:

036.010: Crustaceans and molluscs live; and

036.020: Crustaceans and Molluscs, chilled, frozen, salted etc.

The diversity of products in this group ranges from lobsters crabs and prawns to bivalves, gastropods and echinoderms. Even within the bivalve family there is a diverse product range of which giant clams constitute only one part. Substitutability between crustaceans and molluscs is likely to be very poor while within the mollusc family the diversity of culinary uses is also likely to restrict substitutability. The basic problem is that published international trade commodity data is largely a response to its importance to individual countries and the magnitude of trade flows. It is not a response to expected growth. One would expect to find trade statistics for giant clams in the Molluscs N.E.S. (not elsewhere specified)commodity group, even at the eight digit level; for importing countries.

A general picture of world trade flows and restrictions to trade for the three digit commodity group, “crustaceans and molluscs, fresh, frozen, etc.” can be drawn using U.N. published trade data as well relatively recent OECD reports (1985, 1989) on the fish trade. Three economies dominate the importation of shellfish: Japan, USA and France. Table 2 provides an indication of the size and value of this market.

TABLE 2

Imports of SITC Group Crustaceans & Molluscs

Selected Countries 1986

Country	Quantity '000 Tonnes	Value US$ Million
USA	263	2,249
Japan	608	3,197
France	132	454

Source: OECD 1989, Table 1.

Table 3, provides the main components of shellfish imports for the three major importers. While clam imports into Japan may be a small percentage part of its total shellfish trade its value is still large. Yet the value is not an indication of potential market opportunities because it is not evident that the many clam species are all substitutable for each other in this or other large shellfish markets.

TABLE 3

Shellfish[a] imports by Japan, USA and France according to major species, 1981

	Yen million	US/Yen	US million	%
Japan, total	431 459	0.004552	1 964	100
Spiny lobster	5 404		25	1
Shrimp	161 725		736	37
Crabs	31 039		141	7
Squid	68 776		313	16
Octopus	100 450		457	24
Abalone	1 896		9	
Clams	18 148		83	4
Scallops	1 270		6	
Other	42 751		194	11
United States			1 244	100
Crabmeat, fresh or frozen			23	2
Scallops			113	9
American lobster			53	4
Spiny lobster			256	21
Shrimps			715	57
Other			84	7
	FF.	US/FF.		
France, total	1 580	0.184753	292	100
Oysters	11		2	1
Squid, octopus	105		19	7
Mussels, scallops, etc.	201		37	12
Other mussels and crustaceans	23		4	1
Lobster and Norway lobster	279		52	18
Crabs	56		10	3
Shrimp	692		128	44
Other crustaceans	76		14	5
Other	137		26	9

a) Excludes preserves ($84 million).

Source : OECD PROBLEMS OF TRADE IN FISHERY PRODUCTS, 1985, p.301.

The problems of establishing giant clams in the clam market, outside existing culinary uses, can be noted from the OECD (1985) general observation of demand for shellfish:

“Apart from .the different species- consumed, each of the major OECD markets portray special characteristics of consumer orientations. The products, the channels of distribution and the methods of buying, selling and transportation are often different. Regulations regarding standardisation and grading reflect the nature of the market and where the end products are consumed: and government laws and regulations affect the market environment (including competition) and are a determinant of pricing policy (p.299).

Tariffs applying to imports of shellfish, including clams, in selected OECD countries are listed in Table 4.

TABLE 4

Tariffs and Preferences

Crustaceans and Molluscs (CCCN 03.03)

Australia	Free/expt., Bex, OP
New Zealand	0-25% & $NZ 0-7.50/100 kg, Bex, GSP, OP
Canada	Free/expt., 8%, B, GSP, OP
United States	0-18.1%, Bex, GSP, Free/expt. B
Japan	3.0-15%, Bex, GSPex
EEC	0-25%, Bex, IQex, GSPex, OPex
Norway	0-1 NKr/kg
Sweden	SKr 0-120/100 kg, Bex, GSPex, OPex
Iceland	Free/expt., Bex
Finland	Free/expt., B
Turkey	25%
Austria	15%, Sch 2 000/100 kg Bex, GSPex, OPex
Switzerland	Free/expt., Bex, GSP, OP

B = bound in gatt. GSP = General system of preference. OP = other preference

Source: OECD 1989, p.26.

In two major potential markets for giant clam meat, Japan and the USA, tariff measures are unlikely to restrict any trade. In the former, tariffs for shellfish vary from between three

percent to fifteen percent. In the latter, the relevant category is duty free. Taiwan, a known major consumer of giant clam meat, has significantly higher restrictions which could impede legal trade (Combs, p39, Dawson, p26).

3. The Contribution of Previous Studies

Two recent studies have surveyed the market for giant clams. Their assessment techniques and conclusions differed. The Compass Report (February, 1986) was primarily based on responses to a postal questionnaire sent to Australian Trade Commissioners representing seventeen countries in the Indo- Pacific area expected to be either exporters and/or importers of clam meat. The Dawson Report (September 1986) was the culmination of an in-depth market survey of four potential giant clam markets (Taiwan, Japan, Hong Kong and Singapore) which apparently involved visits and assessments in these countries. Differing budgetary considerations may have determined the appropriate market survey techniques and also imposed constraints on their application.

The Compass Report

A questionnaire was sent to Australian Trade Commissioners representing Burma, China, Fiji, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Papua New Guinea, Philippines, Singapore, Solomon Islands, Thailand, U.S.A., and Vanuatu. No response or information was apparently received in relation to five countries by the time of publication. These were Burma, Korea, Fiji, New Zealand and Solomon Islands.

The study sought to identify existing or potential markets for giant clam meat by identifying the volume and value of exports, imports, production and consumption of “clam meat”. This term can and does include other molluscs and it is not possible to say whether these have a close substitutability with giant clam uses. As a copy of the survey document is not included in the Report it is not possible to assess if the responses include only giant clam meat. However, given the geographic distribution of the giant clam it is fairly obvious that the production statistics for the USA include species which are not giant clams. Again the question which must then be addressed is whether a giant clam market has been identified by the process of identifying trade, production and consumption of a wider product range.

The Report identifies major Asian importers of “clam meat” as Japan, Malaysia and Singapore. Taiwan and Thailand are major consumers but measured imports are small. In the

former's case this may arise from a high level of illegal imports. The USA is also recognised as major importer and producer of "clam meat".

The sources for country data are generally mollusc production and trade, a category which includes not only octopus and squid but also all forms of bivalves. The relevant commodity market should encompass only products which consumers consider are close or potentially close substitutes in terms of characteristics and prices. An approximate assessment of market demand can then be obtained by summing domestic production and imports, less exports. To assume substitutability in consumption among the diverse range of molluscs produced and traded is an heroic assumption. In summary, the Report does not provide a useful guide to the potential market for giant clam meat.

The Dawson Report

A market survey approach was utilised. The consultant was able to visit four countries (Taiwan, Japan, Singapore and Hong Kong) and conduct wide ranging discussions with trading companies, restaurants and fishermen. The approach identifies the market for giant clam meat in terms of an expansion of its existing use.

Pages 1 to 12 of the Report outline the Tridacnid family of giant clams, its growth characteristics, its geographic distribution in the Indo-Pacific region, uti1isat:i.on of the animal in terms of the meat, souvenir items and craftware, and natural stock levels in the Forum Fisheries Area. Pages 13-21 outline the development of mariculture, the international giant clam mariculture project, and foreign (especially Taiwanese}, fishing activity. Pages 22-34 are surveys of the market for giant clam meat 1n each of the four countries.

For Taiwan, Dawson examines the supply of giant clams, the pattern of distribution, the product and price structure, importation requirements, market entry and future development (demand). For the other countries the markets are less identifiable so the studies are concerned with identifying market opportunities in terms of potential buyers and importation requirements. The study identifies Taiwan as the only country where there is an established market for giant clam meat. There was a difficulty in establishing this market because illegal fishing operations and importation of giant clam meat render official statistics useless. However, Dawson assesses the giant clam adductor muscle market (based. on restaurant trade) at approximately 100 tonnes per annum. He assesses the other countries as not having a significant giant clam meat-market; that is, in countries such as Japan, demand arises

primarily from Chinese ethnic groups. A very large mollusc adductor muscle market exists in Japan using scallop, pen shell and other clam species but not apparently the giant clam. While domestic production of some molluscs is large and growing, Japanese adductor muscle imports declined from 2172 tonnes in 1982 to 900 tonnes in 1984, apparently due to import replacement. The major exporters were Korea, China, Philippines, Chile and New Zealand; countries not noted for giant clam stocks.

The off-the-boat price of adductor muscle varies according to species, size and colour in Taiwan, "In January 1986, the base price for the lowest grade muscle was US 7.50/Kg and the highest grade price range from US$21.25" (Summary page). Frozen adductor muscle was the main form of supply. Dawson notes an interest by restaurateurs in the fresh/chilled product, but no enthusiasm for a dried or processed form.

The high quality restaurant market for giant clam adductor muscle was assessed as not having significant growth potential. However, the market can only be widened to lower price restaurants and retail outlets by a lower product price. His assessment that the 1986 market for giant clam adductor market was 100 tonnes p.a. places it as a very small part of the Taiwanese bivalve market demand which in 1984 apparently consumed 25853 tonnes of hard and freshwater clams (Compass, p.20).

Dawson could not find an existing market in Japan for giant clam meat although he argued that the sushi restaurant trade offered the prospect of a market. In Hong Kong, bivalve non-giant clam adductor muscle use also exists; that is, any trade in giant clam meat is apparently negligible. However, the possibility of development of a fresh/frozen market exists in both countries although the potential scope is not specified other than at "total levels of several 100 tonnes per annum" (Summary page).

Similarly, Singapore, Malaysia and Thailand also consume adductor muscle, although not apparently from the giant clam family. If there is close similarity in characteristics among adductor muscles and a comparable cost and price structure then a potential market exists. Dawson estimates 50 tonnes p.a. of giant clam adductor muscle as the potential market from these three countries. To secure new markets the price level for giant clam adductor muscle (1986) would need to be approximately US$10.00/kg delivered and the possibility of it being used as a substitute for scallop (a major product) would also be poor.

Dawson's study provides useful information on the giant clam trade and the consumption

possibilities which help to define the existing market for the product. He is most detailed in relation to Taiwan.

As with other countries, Taiwan's statistics do not distinguish the various species of shellfish (p-.22) as molluscs such as snail, trochus and abalone are included. Dawson outlines the pattern of supply of giant clam and, in particular, the illegal operation of Taiwanese fishing boats. His information suggests that clam poaching activity peaked in 1976, and there was a view that wild clam stocks which were accessible and safe could be exhausted in "two to three years" (p.24).

Fresh/frozen adductor muscle is the only form of the product which appears to have an established market. The dried or processed form does not appear to be attractive to the restaurant trade in the four countries directly surveyed although Hong Kong sources "thought that there might be considerable market for a dried/processed product in the People's Republic of China." (Dawson & Philipson, p.91)

Given the trade data's deficiencies, the product and price information which Dawson provides is a useful basis for considering the potential for product substitution among molluscs. There were three grades with prices to the suppliers (trawlers?) as at February, 1986 varying by grade as follows:

Grade	price per kg $US.
first	from $21.25
second	from $17.50
third	from $7.50.

(Dawson p.25)

Grading was apparently based on species, muscle size, whiteness and texture, with size and species closely interrelated. Prices also varied between various entry points. As there is a wholesale network restaurant purchase prices must be significantly higher. Taiwanese clamming activity was largely by illegal means so considerable doubt attaches to the pricing structure if trade was to move to a legal basis depending on a regular, and probably increasing supply of the product. Dawson cites an opinion that the exotic nature of the

product is a major determinant of its consumption and that if the product was supplied legally the price might fall by as much as 50 percent (p.26). The extent of any price fall can only be conjectured given the lack of information on projected supply changes which might result from mariculture activities. It is more useful to note that one could expect both snob and bandwagon effects with any legalization and increased regularity of supply, as well as income and substitution effects from any changes in price. But s1nce the amount of expenditure on clams as a proportion of total expenditures is likely to be low, the income effect 1s likely to be small.

While Japan trade in giant clam meat is apparently non-existent or negligible (p28) at least one North Queensland project is targeting the sushi/sashimi restaurant market for adductor muscle. Dawson notes that 'kaibashira' is the Japanese term referring to adductor muscle from any mollusc prepared in either fresh, frozen, boiled, boiled and dried, and canned forms.(p.30)and that its production, imports and consumption are very large. Increasing domestic production of scallop appears to have dampened imports. Against a background of increasing domestic production and lower domestic prices, Dawson suggests that the use of giant clam as a substitute for scallop abductor muscle may be poor. Again, a lot will depend on the delivered prices of the farmed giant clam and its characteristics. The substantial Japanese scallop export markets in the USA, Hong Kong and elsewhere may be easier to penetrate.

In Hong Kong and Singapore no established market demand for giant clam meat could be found. Dawson believes that transhipments may be involved from these countries to Taiwan. In both countries a potential market is seen to exist in Chinese cuisine restaurants using bivalve adductor muscle.

Summary and Comments on The Two Reports

Both Reports confirm the view that international trade data on giant clams difficult to obtain and what can be obtained is also likely to be unreliable. The extent and value of the trade is unknown. Use of aggregate mollusc or bivalve commodity groups cannot provide an indication of market size for giant clam meat because there is very little information to indicate the extent of substitutability. Additionally, it is the adductor muscle which is the part of the giant clam which is mainly traded. By-product uses, especially of the mantle, have not been explored.

Dawson's country surveys shows that there are entrepreneurs willing to try and create market opportunities but at present the existing giant clam meat markets shown to be very narrow and based primarily on Taiwan. In this country and the others there may be problem in widening usage beyond this up-market, restaurant niche.

Both studies have problems in identifying the current supply and disposition of giant clam meat with any degree of accuracy. Provided the clam adductor muscle is not an inferior good one could expect, with rising per capita incomes and populations, the potential market for adductor muscle alone to increase. Because there are no reliable estimates of existing demand, with prices inflated by the illegality of a large part of the trade, projections are difficult.

Compass assesses market potential in a broad sense because it does not address whether there is close substitutability in consumption between all forms of bivalve molluscs. The study implies there is a single market in the sense that, providing there is price competitiveness, giant clam meat could meet the needs of existing consumers of ‘clam chowder’ and many other kinds of shellfish in different countries. If price competitiveness cannot be attained then the giant clam market will be confined to a small niche. There are underlying assumptions that taste differences are minimal; and that other characteristics such as texture and colour are relatively unimportant. If they are important, then there is no basis for examining the aggregate market for clam meat.

On the other hand, Dawson's study may be unnecessarily restricting the assessment of potential market size. The focus on giant clam adductor muscle in the restaurant trade identifies an existing market based on higher price Chinese cuisine and the possibility of use in higher class Japanese sushi restaurants. Expansion of this trade requires close characteristics substitutability and price competitiveness with other more widely used mollusc adductor muscles such as those of scallops and pen-shells. However, there is the perverse possibility that, if there is a snob effect, greater accessibility of the product may reduce the value of the potential trade.

The difference in the scope of each market study is important. Compass envisages a growth in demand for giant clam meat over time based on its substitution for other marine bivalve molluscs as well as a growth in demand from existing culinary uses. Dawson examines existing Chinese and Japanese culinary uses for the giant clam. The potential growth 1n

demand is investigated from this viewpoint and from the possibility of substituting it for other adductor muscles in similar culinary uses.

4. The Market for Substitutes as a Guide to Potential Market Demand

It may seem a paradox but, although the giant clam is restricted in international trade as an endangered species, in order to examine its potential market it is necessary to treat it as an underutilised species. The rationale is an apparent lack of trade in the product at the present time although it may have been traded on a larger scale in the past; an apparent lack of familiarity with this species in Japan and in other countries outside of Taiwan and, in Taiwan, its apparent confinement to higher priced restaurants; and the likelihood that greater familiarity with giant clam edibility characteristics will have to be established in potential importing countries.

The meat of bivalve molluscs differ in terms of size, texture, colour, species and age. According to Tisdell (July, 1989, p5), harvest of farmed giant clams may be optimal from 2-3 to not more than 5 years of cultivation. Over its period of growth its edibility characteristics may alter, increasing its substitutability with some species and reducing it with others. While the meat may be a potential substitute for differing bivalves depending on when it is harvested, at any point in time the harvested animal can only occupy one area of characteristics space.

Edibility characteristics will determine the potential market opportunities. For example, if a two year clam is similar in edibility characteristics to an oyster, depending on price competitiveness, a very large potential market is possible. The identification of markets for an underutilised species such as the giant clam can probably only be achieved by assessing the potential for substitution with species which are marketed. Combs (p78) uses classification of edibility characteristics in assessing export market opportunities for underutilised seafoods. Edibility characteristics which can be used to classify seafood are flavour intensity, fat content, odour, colour, flakiness, firmness, coarseness and moisture. Flavour is often associated with colour and fat content while flakiness, firmness and coarseness are aspects which can be covered by the term texture. These two characteristics are used in Diagram 1 to examine some of the issues involved in assessing the potential giant clam meat market.

The characteristics approach (Lancaster, 1971) argues that the classification and relationship of products is aided by distinguishing between the product itself and the various characteristics or attributes a potential consumer perceives that it offers. In the context of fresh or chilled shellfish meat, assume that it is possible to objectively measure the key edibility characteristics of flavour intensity (0 for no flavour, 100 for perfect) and texture (0 for very poor, 100 for perfect). The use of flavour to encompass several characteristics and the assumption that it can be measured without inconsistency is a simplification for heuristic purposes

From the viewpoint of the consumer, if products offer precisely the same mix and quantities of the characteristics per unit of each product, then the products are perfect physical substitutes. If products offer the same characteristics, but in different proportions and/or different amounts of each characteristic per unit of the product, then they are imperfect physical substitutes. Whether products which are perfect or imperfect physical substitutes will be close substitutes in the market, that is, whether their cross elasticities of demand will be high and positive, will depend on whether their prices are in a range that make them feasible substitutes.

Table 5 assigns arbitrary characteristic values for a range of products. Each product could be considered a specific type of bivalve meat, such as Pacific oyster, razor clam, abalone, scallop and pen shell. The ratios of the characteristics mix for each product is plotted in Diagram 1. Each ray is labelled using the lower case. Given the wide range of shellfish species marketed and consumed worldwide, many products could have similar mixes and values such that characteristics space is likely to be very crowded.

TABLE 5

Product	$ Price per kg.	Characteristics Rating		Mix Ratio	Price per Charact. Unit.
		Flavour	Texture		
A	10	80	20	4:1	$0.10
B	10	75	50	1.5:1	0.08
C	10	60	60	1:1	0.083
D	10	30	80	1:2.67	0.09
E	10	20	80	1:4	0.10

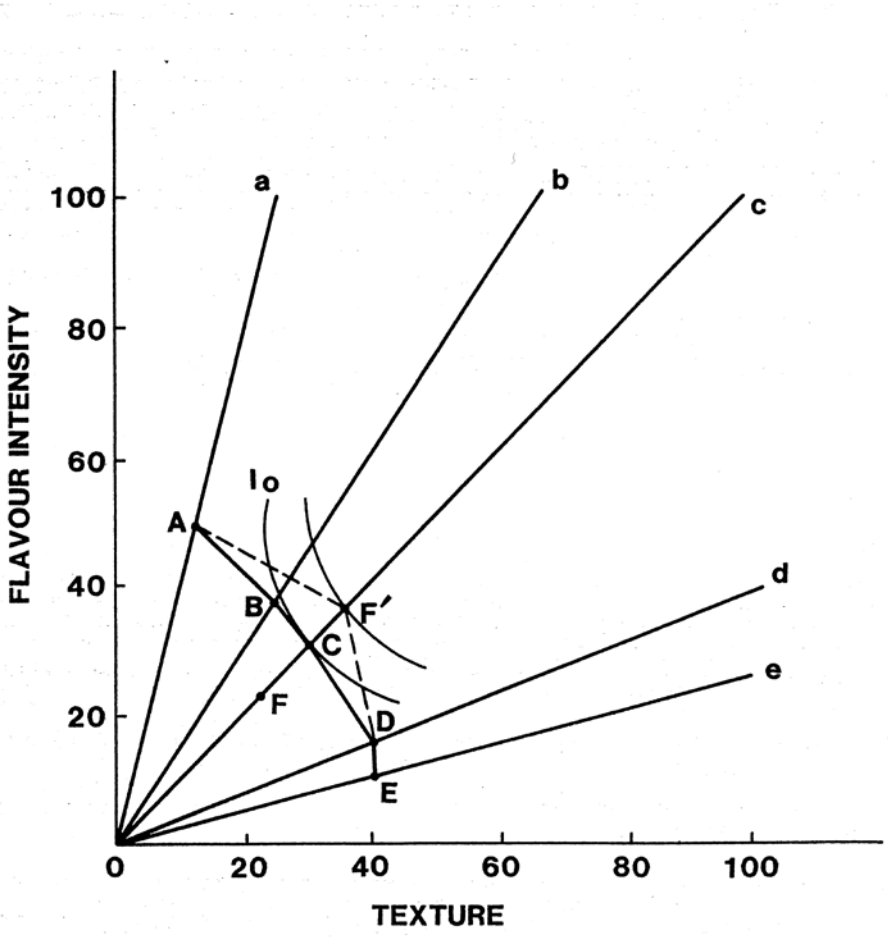

Diagram 1

Each product could be plotted as a point on its relevant ray depicting its physical quantities of each characteristic. However, it is more fruitful to take into account the effects of prices on consumer choice. Price per unit of characteristic is highest for products A and E and lowest for B. Assuming perfect product divisibility a consumer with a seafood budget of, for example, $5 would obtain less total consumption of both characteristics by purchasing A or E. Prices and the consumer's budget defines the maximum attainable combination of characteristics from each product. These points are labelled in the upper case. The joining of these points is labelled the consumer's efficiency frontier. If the consumer's preference pattern is given by the indifference curve I_o, the tangency of the curve with the frontier indicates the optimum consumption point.

Assume that farmed giant clam meat, approximately 3 years old, now comes on the market (product F). Its characteristics ratings are 50:50, giving it the same ray as product C, but with

less total flavour and texture. If its initial price is poorly set, for example $12 per kg, for the same budget constraint its maximum potential consumption point is point F and the substitution of product F for C is unlikely to occur. If the price of F is reduced to less than $8 it displaces C on the efficiency frontier. Its substitution for other products with adjacent characteristic mixes is also likely to occur if F's price is further reduced. The consumer's frontier and consumption moves out to the point F' when F is reduced in price to $7. This excludes adjacent product B, as well as product C.

This analysis can be used to draw some useful conclusions on the question of market potential. The approach assumes that consumer preferences exist for all parts of characteristics space. However, finding and holding a market will be easier if the product characteristics ray is occupied by only one product and adjacent product rays are distant. Positioning the product in terms of both characteristics and price will thus determine the market potential. There may be insufficient data on the edibility characteristics of giant clams at various ages and their feasible prices to select this position at present. When it is positioned in the market it may substitute for other species with similar characteristics, for different qualities of the same species or for a different form of processing.

Empirical Evidence on Substitutability

Studies of own-price demand elasticities and substitution patterns among other forms of seafood may provide limited guidance on the extent to which giant clam meat is likely to be a substitute for other forms of molluscs.

The own-price elasticity of demand (n_{ii})measures the percentage change in quantity demanded of i, resulting from a small percentage change in its price. If own-price elasticity of demand is inelastic (less than unity) then market size (total sales revenue) may decrease if mariculture leads to an increase in supply of giant clam. Cross elasticity of demand (n_{ij})is defined as the percentage or proportionate change in quantity demanded of product i divided by the percentage or proportionate change in the price of product j, all other variables in the demand functions of both products remaining unchanged. The main purpose of measuring the cross elasticity is to assess whether consumers view the two products as related, how they are related, and the strength of the relationship. A positive value for nil is an indication of substitutability, with the higher the coefficient value the greater the substitutability.

If there is a high degree of substitutability the values of the cross elasticities in both directions

will be high such that if any small price fall occurs, the product whose prices is held constant will suffer a severe fall in sales. No particular value of n_{ij} can be advanced as the crucial dividing line for market separation. There will be a chain of cross elasticities among seafood products. A low positive elasticity between two products indicates limited or poor substitutability.

The value of the own-price elasticity of demand will be influenced by the positioning of substitutes; If giant clam adductor muscle is a very close substitute for scallop adductor muscle, and the price of the former falls, we would expect to see a large proportional increase in the quantity demanded of clam; that is, an own-price elasticity for clams greater than unity. If scallop is the only close substitute we would also expect that the value of the coefficient for the cross elasticity of demand for scallop with respect to clam prices to be positive and high. However, because of the large number of possible substitute relationships the strength of this predictive relationship may be highly variable for any pair of commodities.

The income elasticity of demand (n_{iy}) measures the percentage change in the quantity of commodity i demanded resulting from a 1 percent change in income, y. Positive values for n_{iy} would strengthen the argument for a demand growth for giant clam meat over time given the rising per capita income of existing consuming nations such as Taiwan, and in potential consuming nations such Japan, Hong Kong and Singapore, where adductor muscle in fresh and frozen forms is already widely used in Chinese cuisine. Other countries, such as the USA, with high and still rising per capita incomes and a large Chinese and Japanese cuisine following, could also be potential markets. However, except in Taiwan, what may be required is a change in tastes if the attributes of existing abductor muscle used in cooking differ significantly from that of the potential substitute, giant clam. Increases in income may be expected to increase the demand for giant clam meat in the exclusive Chinese restaurant trade, but market growth at a more rapid level may require taste changes accompanying income changes. For example, in 1987 a Japanese cuisine restaurant in Sydney was supplied with two and three year old clams for the preparation of 7 experimental dishes for tasting by a consumer panel. The mantle meat was considered to have an odour of seaweed or kelp However, the panel favoured two mantle meat dishes over those including adductor muscle. Potential customers were thought to be gourmet Chinese and Japanese restaurants. Despite the size similarity of the two year clams to oysters and mussels, the panel did not consider clams competed directly with these products mainly because of the extra preparation required

for the giant clam. Rather, clams were seen as "similar to abalone" (Cowan, p.256).

While there is a growing body of studies estimating own-price, cross and income elasticities for a range of commodities, very little appears in relation to fish products and specifically to shellfish products. Demand studies of meat products such as beef, pork and poultry and their cross price elasticities may provide general guidance as to the way consumers view substitutability among white and red meats, but this is not of help in considering whether consumers view various shellfish as substitutes.

Cheng & Capps (1988) focus on the lack of studies of the demand for seafood products using disaggregated fish species data. Their study uses a 1981 Seafood Consumption Survey conducted for the National Marine Fisheries Service, USA. The Survey investigates only AT HOME seafood consumption expenditure in the USA drawing on information from 9422 households. As away from home outlets accounted for approximately 60 percent of total seafood consumption the study conclusions cannot be used as a generalized explanation of fish demand determinants. Being based on a household expenditure survey, the study examined socio-demographic influences such as occupation, household income, age, race and religion, on the consumption pattern. Of the 200 or more seafood species currently marketed in the USA only the most important market species were analysed. Price variables for red meat and poultry were included in order to examine substitution effects between fish products and these two. Unfortunately, cross elasticities among the various fish species was not analysed.

The relevant elasticity estimates are presented in Table 6 below. The values indicate that, excepting oysters, fresh and frozen shell and finfish demand tends to be price inelastic. Cross elasticities of the ma1n species shellfish with poultry and beef are positive but very low, implying a very weak substitute relationship. The income elasticity of demand for shellfish is also positive but low, with the results statistically significant for only two of the three species.

TABLE 6

Recent seafood Demand Elasticity Estimates, USA

Fresh & Frozen Products	Own-price Elasticity	Cross Price Elasticity poultry	Cross Price Elasticity red meat	Income Elasticity
Shellfish				
crabs	-0.7713*	0.1212	0.0314	0.4610*
oysters	-1.1320*	0.3105	0.1991*	0.1769*
shrimps	-0.6956*	0.3437	0.0257	0.0365
total shellfish	-0.8850*	0.9642*	0.0265	0.1114
Finfish				
cod	-0.5358*	0.6051*	0.1710*	0.0632
flounder/sole	-0.4500*	-0.5501	-0.0574	0.0368
haddock	-.5557*	-0.4033	0.0096	-.0.0062
perch	-0.7039*	0.3157	-0.1035	0.0172
snapper	-0.9720*	-1.7752*	0.1568*	-0.1087
total finfish	-0.6746*	0.0382	0.0184	0.1405*

* = significant at .10 level.

Source: Cheng & Capps, p.540.

Estimates by other researchers of demand elasticities for fish products are provided in Table 7. These studies mainly relate to the USA. Cheng & Capps observe that their estimates of own-price elasticities for cod, perch and flounder compare favourably with estimates given by Tsoa, Schrank and Roy. Considerable differences among USA estimates could be expected, being the result of differing data sources and the significant regional and socio-demographic differences to be found in the USA. A-fortiori, such differences could be expected to operate on estimates among countries, reducing the validity of using one country's coefficients in estimating the market for a single seafood product such as giant clam.

Table 7: Estimated demand elasticities for fish products: assorted studies

PRODUCT	COUNTRY	OWN-PRICE	CROSS	INCOME	PRIMARY RESEARCHERS
ATLANTIC GROUNDFISH	USA	-1.000		+1.847	ANDERSON
COD		-.405 a -.460 b			TSOA, SCHRANK & ROY
FILLET/STEAKED FISH				+.082 to +.134 +.192	PERRY KEITHLY
		-.549 a -1.040 b	+1.813		FIN FISH FLOUNDER & SOLE
			+.467 +.303	KEITHLY	FRESH SEAFOOD FROZEN SEAFOOD
		-1.00 -.606 a -.702 b		ANDERSON TSOA, SCHRANK & ROY	HALIBUT OCEAN PERCH
FRANCE			+3.1	DEVORETZ (1985)	SALMON - CANADIAN - ALL TYPES
					UK
					ITALY
					SWEDEN
					W. GERMANY
				- CHINHOOK	FRANCE
					UK
					ITALY
					SWEDEN
			W. GERMANY		
	- CHUM		FRANCE		+1.10
			UK		+2.30
			ITALY		+1.01
			SWEDEN		+1.00
ANDERSON			W. GERMANY		-0.006
	SARDINES		USA	-.9837	
KEITHLY	TUNA			-.8632	+.239
SEAFOOD		-.465		+.165	CAPPS
				+.062 TO .175	PERRY
) FISH				+.303	KEITHLY
) SEAFOOD				+.058	DEVORETZ (1982)
) CANADIAN SALMON	FRANCE			+.023	
- ALL SPECIES	UK			+1.70	
	ITALY				
	CANADIAN EXPORTS	-13.8	9.2		
- SOCKEYE		-7.3	1.4		
- PINKS					- PINKS
-12.9	10.4				- CHUM
-.1487			ANDERSON		
-.6047				CRABS	USA
-.5995				CLAMS	
-.6724				NORTHERN LOBSTER	
-.6337				OYSTERS	
		+.543	KEITHLY	SEA SCALLOPS	
		+.069 TO .344	PERRY	SHELLFISH	
		+1.12	DOLL		
	ANDERSON		SHRIMP		-.63
					-.3099

a - short run elasticity b - long run elasticity

soa, Schrank & Roy.
er References.

SOURCE: compiled from Cheng & Capps; Shaw & Muir; Staniford; Ts
They cite the primary sources listed in column 6. Refe

Tables 6 and 7 make clear the lack of demand elasticity studies for shellfish and the general lack of cross elasticity estimates among seafoods. The own-price elasticity estimates for nearly all forms of fresh seafood, including most shellfish species, suggest that it is price inelastic while the remaining estimates hover close to unit elasticity. The implication of the inelastic cases is that increases in the supply of a species is likely to cause large falls in its price and a decline in market size (total revenue). Cross elasticity estimates among fresh seafoods are notably absent. However, if giant clam is similar to other shellfish species (Cheng & Capps oyster result appears anomalous) the low own-price elasticities suggest limited substitution possibilities for clam meat using pricing strategies. A small price reduction in giant clam meat will bring forth only a small quantity response and a likely fall in total revenue.

Income elasticities vary widely, and tend to be high and positive for some fresh food species but are weak for the shellfish listed. The fresh salmon income elasticities vary widely according to type and country, emphasising the importance of consumer perceptions in treating some outwardly similar products (chinhook salmon) as being superior and thus resulting in a high income elasticity. Marketing of a limited quantity product such as giant clam may be able to establish it in this category. The very high own-price and cross elasticities for the various types of Canadian canned salmon provide a warning that consumer perceptions that products are similar can cause large swings 1n demand with considerable substitution occurring.

5. Summary

This study has investigated some of the issues involved in assessing the potential market for giant clam meat. Assessment using international trade data faces many obstacles. Assuming that suitable disaggregated commodity data exists, current imports into a country cannot by itself provide an adequate indicator of potential export opportunities. Trade barriers, business practices, trends in production and trade all require examination. In the case of giant clam meat the first hurdle was insurmountable: the commodity data is excessively aggregated and also possibly inaccurate due to illegal catching and trading.

The Compass and Dawson Reports have both addressed the question of the potential market for giant clam meat. The former uses trade data which is probably too aggregated to distinguish those imported commodities where giant clam meat could possibly be used as a

feasible substitute. The potential market which is recognised is too wide. The latter study focusses primarily on the existing import market demand for giant clam meat and its potential growth. As there is always the possibility of substitution between adjacent commodities in characteristics space, and the edibility characteristics of giant clam can alter with age, the assessment of market potential is perhaps too restricted.

Substitution possibilities exist but a review of the evidence on demand elasticities for various seafoods suggest that market expansion based on securing market share from adjacent commodities may be difficult. Considerable marketing effort will be needed to find the best location in characteristics space and then establishing the product in this position. If giant clam meat's own-price elasticity is low, as seems likely, aggressive pricing to establish a market is likely to be counter-productive. Non-price marketing strategies are likely to be more rewarding. It also follows that both demand and supply will need to be closely monitored and controlled as excessive supply increases are likely to cause large price falls over time. In spite of rising incomes in many potential consuming nations, income elasticities for shellfish may not be high enough to obviate a close monitoring of supply growth.

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