

# RESEARCH REPORTS IN THE ECONOMICS OF GIANT CLAM MARICULTURE

Working Paper No. 39

Giant Clams in Japanese Cuisine –  
Brisbane Trials and the Use of Giant Clam Meat  
in the Ryukyus

by

Clem Tisdell  
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Yoshihiro Kuronuma

March 1993



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**by**

**Clem Tisdell<sup>2</sup>**

**And**

**Yoshihiro Kuronuma<sup>3</sup>**

**March 1993**

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<sup>2</sup> School of Economics, The University of Queensland, St. Lucia Campus, Brisbane QLD 4072, Australia  
Email: [c.tisdell@economics.uq.edu.au](mailto:c.tisdell@economics.uq.edu.au)

<sup>3</sup> School of Economics, The University of Queensland at the time of writing. Now at Otsuma Women's University, Japan. Email: [sbt@otsuma.ac.jp](mailto:sbt@otsuma.ac.jp)

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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.

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For more information write to Professor Clem Tisdell, Project Co-ordinator, Economics of Giant Clam Mariculture, Department of Economics, University of Queensland, St Lucia 4067, Brisbane, Queensland, Australia. Email: [c.tisdell@economics.uq.edu.au](mailto:c.tisdell@economics.uq.edu.au)

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# **Giant Clams in Japanese Cuisine – Brisbane Trials and the Use of Giant Clam Meat in the Ryukyus**

## **ABSTRACT**

This paper reports the responses of both chefs and tasters to trials of giant clam meat for food in two Japanese restaurants in the city of Brisbane, Queensland, Australia. The trials were conducted in mid-December 1992 (summer in Australia) in order to determine the potential for using giant clam meat for food in Japanese restaurants in Brisbane. The Japanese chefs are able to use giant clam meat effectively in Japanese cuisine, although they had no previous experience in preparing and using it. The tasters (three Australians and four Japanese) were supportive of all tested recipes (e.g. sunomono, sushi and grilled giant clam with salt) prepared by the two participating Japanese restaurants. The results indicate that, with suitable preparation and presentation in Japanese cuisine, giant clam meat can gain acceptability as an ‘exotic’ specialty item. This report also outlines the procedures followed and the cost of these trials, and draws inferences about the economics of using giant clam meat in Japanese dishes. Some of the selected recipes for using giant clam meat from the Ryukyus are given. The market for giant clam meat in the Ryukyus (Okinawa prefecture) is also considered and there is some discussion of whether Australian suppliers could economically supply that market.

**Keywords:** Giant clam mariculture, Giant clam meat for food, Japanese restaurants, market for giant clams in Ryukyus, sunomono.

**JEL Classification:** Q57, Q21, Q22

# GIANT CLAMS IN JAPANESE CUISINE - BRISBANE TRIALS AND THEIR USE IN THE RYUKYUS

## 1. Introduction

There is a widespread view in the South Pacific that Asian restaurateurs know giant clam meat and would be eager to use it. To investigate this view, two surveys of Asian restaurants in Queensland and one of Japanese restaurants in Brisbane were undertaken. The results were summarised in two reports in this series (Tisdell, 1992, Tisdell. and Kuronuma, 1992). These reports pointed out that most Asian and Japanese restaurants in Queensland were interested in using giant clam meat in their cuisine but few knew of recipes for using giant clam meat and most had little knowledge of how to prepare it. Moreover, it was found from the sample of Japanese restaurants that while a potential market exists amongst those restaurants in Brisbane for giant clam meat, this market needs to be developed (Tisdell and Kuronuma, 1992)

This paper provides information on the results of trials using giant clam meat for dishes in Japanese restaurants in Brisbane. These trials were conducted in two Japanese restaurants (listed in Appendix 3) in Brisbane city in mid-December, 1992. These accounted for twenty percent of the Japanese restaurants in Brisbane.<sup>1</sup> Chefs and tasters were asked to fill out the survey forms using the survey questionnaires reproduced as Appendix 1 and Appendix 2, respectively. Two species of live giant clams (*Tridacna crocea*, *Tridacna maxima*) were ordered from a commercial grower of giant clams on Fitzroy Island near Cairns (see Appendix 4 for the name and address). Two batches each consisting of half a dozen of each species were air shipped from Cairns to Brisbane on two separate occasions.

The next section describes the trials of giant clam meat in dishes in Japanese restaurants in Brisbane, the cost involved and assesses the suitability of giant clams for such dishes. Selected recipes used for preparing giant clam meat in the Ryukyus (Nansei-Islands), the only part of Japan where giant clam occur naturally and are traditionally used for food, are

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<sup>1</sup> As of December, 1992, ten Japanese restaurants existed in Brisbane. One take-away shop is excluded from this figure.

provided in section three as additional information. Aspects of the market for giant clam meat in Okinawa are also outlined. This is a potential export market for farmed clam meat from Australia.

## **2. Trials of Giant Clam Meat for Food in Japanese Restaurants in Brisbane**

### *2.1 Description of the trials*

The two batches of clams obtained for these trials were supplied from the land-based hatchery/nursery facility at Fitzroy Island, operated -by Reefarm Pty. Ltd. They were grown entirely by mariculture in land-based tanks (Cf Tisdell and Menz, 1992). Each clam was placed in a separate plastic bag containing saltwater and each bag was secured by a tie (see photograph 1). Each batch was then placed in a Styrofoam container (see photograph 2) before shipping. Each batch was packed in the afternoon, transported by terry to Cairns and from there by road to Cairns airport, and freighted to Brisbane overnight and collected from the Brisbane domestic air cargo terminal of Ansett Airlines at about 9.15 am. They were transported to the University of Queensland and held for about 3-4 hours before being taken to the restaurant for the trial. This was necessary because a suitable time had to be arranged with the restaurant, and a time around 2 p.m. was most suitable because most lunch-time customers had finished their meal by then. Thus the clams were packed for approximately 20 hours before the trials began. All the clams remained in excellent condition.



**Photograph 1: Each tridacnid clam has been packed individually in its own plastic bag with seawater before being placed in the Styrofoam container for transport.**



**Photograph 2**

The first batch of clams arrive at the University of Queensland in a Styrofoam container held by Dr. Y. Kuronuma.

## 2.2 Costs

The cost of deliveries of small batches is generally higher per unit than large batches. We decided to purchase two small batches since the trials were to be held on different days and we wanted to ensure that the live clams were in good condition when used. A dozen clams were used in each trial, and a half of these were *T. crocea* and the remainder, *T. maxima*. These were the species most easily available from the supplier who was growing them mainly to supply the aquarium trade. Furthermore, they were also known to be the two most popular species for eating in the Ryukyus.

*T. crocea* cost A\$4.50 each and *T. maxima* A\$5.50 each at the farmgate. These prices were determined by prices in the market for these species as aquarium specimens. The supplier arranged for the clams to be delivered to Cairns airport free of charge to us, but the Styrofoam container had to be purchased at A\$4.00 per delivery (see photograph 1). Air freight from Cairns to Brisbane was about A\$20.00 per delivery. A restaurant would also have the cost of delivery from Brisbane airport to its restaurant. Such a delivery in Brisbane by taxi truck would be about A\$5.00 per time. Thus the total cost of each batch of a dozen delivered to a Brisbane restaurant is as set out in Table 1. In this case, the shipping costs per clam was \$2.33 each, so the total landed cost for *T. crocea* was A\$6.83 each and for *T.*



*maxima* A\$7.88 each. Shipping costs per clam would be considerably lower for larger-sized batches. Furthermore, on regular orders, the supplier may be prepared to give a discount on the clams. Furthermore, there is a potential for the price of clams at the farmgate to come down if demand rises because considerable economies of scale are possible in land-based aquaculture facilities for growing clams.

**Table 1: Costs of Giant Clams Delivered - for delivery of a batch of 12 to a Brisbane Restaurant from Cairns.**

<b>Farmgate Cost</b>	<b>A\$</b>
6 x <i>T. crocea</i> <sup>a</sup> at A\$4.50 each	27.00
6 x <i>T. maxima</i> <sup>b</sup> at \$5.50 each	33.00
<b>Shipping Costs</b>	
Styrofoam container	3.00
Air freight	20.00
Taxi truck delivery from Brisbane airport	<u>5.00</u>
<b><u>Total shipping costs</u></b>	28.00
<b>TOTAL COST PER BATCH</b>	<b>88.00</b>

- <sup>a</sup> All the *T. crocea* shipped from Cairns were about 2-years old. Their shell length ranged from 3 – 5 cm each with a width of around 3 cm. Their weight in the shell was 15–20 gm each and the wet weight of the meat of each was 2–3 gm.
- <sup>b</sup> The *T. maxima* shipped from Cairns were also approximately 2–3 years old. The length of their shell was 5–7 cm each and their width 4–5 cm. Their weight in the shell was 20–30 gm each and the meat of each weighed 4–6 gm wet.

It might be noted that although the cost of each *T. maxima* was higher than that for *T. crocea*, the cost of *T. maxima* per gram of wet weight meat yield is much lower for *T. maxima* (see notes to Table 1).

### 2.3 The two trials and evaluation of results.

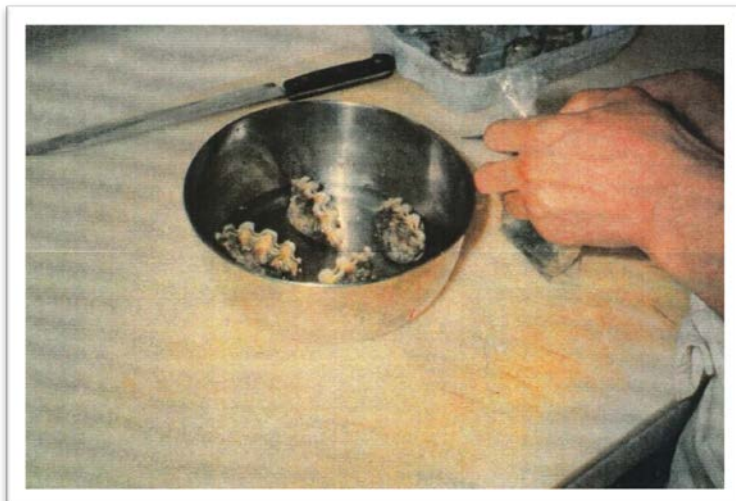
**FIRST TRIAL (SUNOMONO):** held on December 10, 1992 at Japanese Restaurant A. The chef of the restaurant decided to prepare *sunomono* (a vinegared dish) because the giant

clams supplied were not very large<sup>2</sup> (around six cm) and very little meat was available (see photograph 3). Firstly, the chef opened each bag (photograph 4) and each shell and separated the meat from the shell (photograph 5). Then, the kidney of each giant clam was removed (photograph 5). Salt was rubbed into the clam meat to sterilise it. Then, the clam meat was washed in fresh water (photograph 7). Finally; the clam meat was squeezed to press out the water and placed onto the dish (photograph 5) with some sliced vegetables (e.g. white radish, carrot) and lemon. Dressing was also placed in the same plate. This dressing is basically made from *mirin* (sweetened sake), salt, rice vinegar, *dashi* etc. The *sunomono* dish is shown in photograph 8.



**Photograph 3**

The clams supplied were relatively small in size – about 5 cm in width.

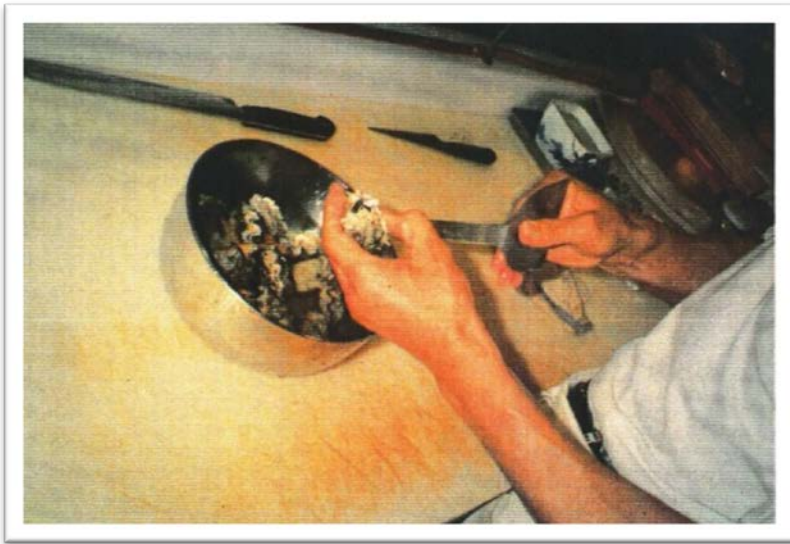


**Photograph 4**

The chef removing clams from their individual plastic bags

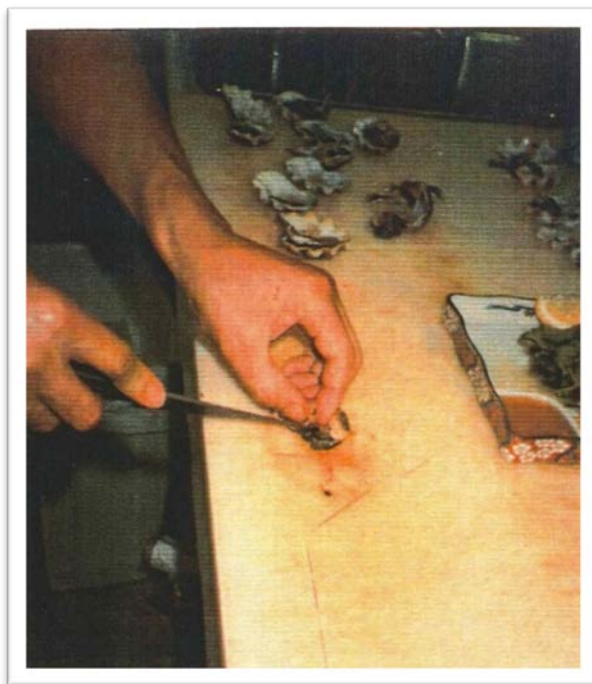
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<sup>2</sup> However, as a result of a telephone contact to the commercial producer in Cairns after this first trial, the producer mentioned that these are the preferred sizes in Okinawa for *T. crocea* for food.



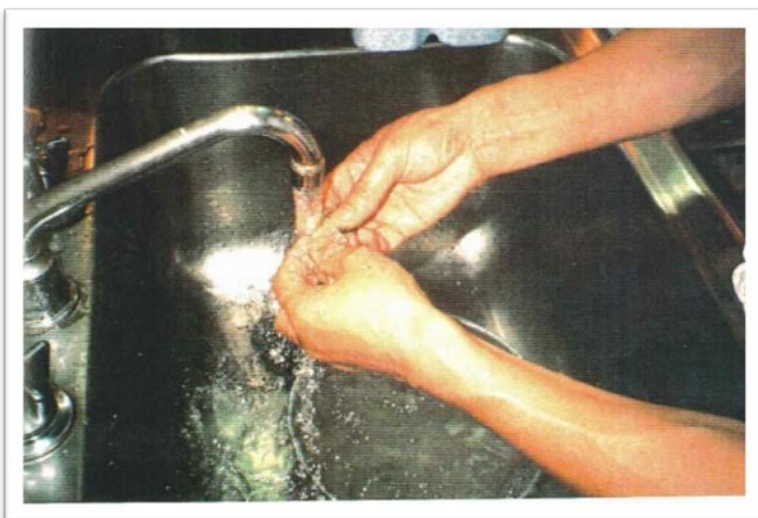
**Photograph 5**

Clams being opened by the chef of restaurant A.



**Photograph 6**

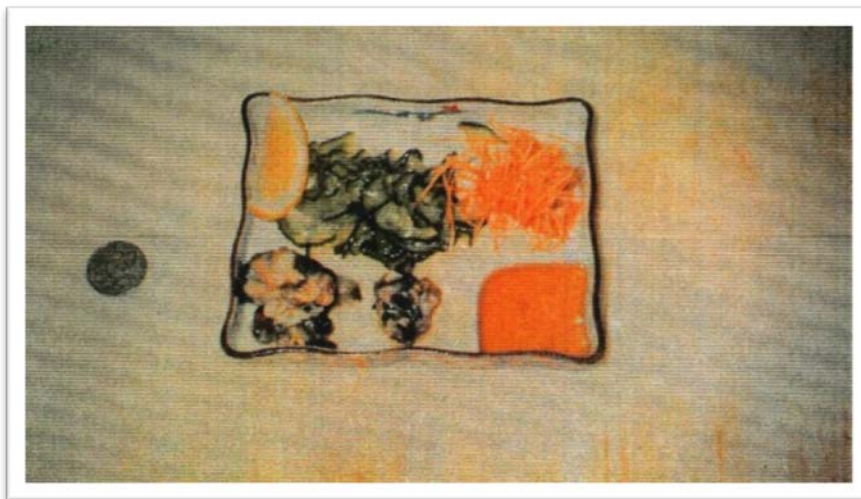
Kidney being removed from clams by the chef.



**Photograph 7**

The chef washing the clam meat.

The chef of this Japanese restaurant was able to use giant clam meat to prepare *sunomono* although he had not used giant clam meat before. The chef was asked to fill out the questionnaire which is reproduced in Appendix 1. According to the chef, giant clam meat is suitable for *sunomono* and with larger-sized clams he felt that the effort in preparing it from this source would not be greater than for alternatives (question 6). However, he would not be interested to use giant clam meat for this dish again (question 7) if giant clams were as small as those supplied. This is mainly because the yield of meat from small shells is low in relation to effort in preparing this dish if the meat is supplied with shells (question 9). Effort and time is required to remove the meat from the shell. However, he would like to use giant clams for this dish and other dishes (e.g. sashimi) if giant clams were supplied of a larger size (size around 15-20 cm or more). He also thought that the restaurant could use one giant clam of 15-20 cm shell width to prepare two sashimi side-dishes or entrees. The chef would modify his methods of preparing *sunomono* if giant clams were used (question 8). According to the chef, it would be desirable for the giant clam meat to be either salted or vinegared and stored in a refrigerator for several days before being used to prepare *sunomono*. This would eliminate its strong sea flavour, especially that of *T. crocea*.<sup>3</sup> The chef thought that a very small serve of this trial dish would retail at around A\$5 per customer (question 10). He mentioned that this giant clam *sunomono* side dish could be introduced as a new or special item on their menu.



**Photograph 8**

The sunomono dish prepared by restaurant A

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<sup>3</sup> This suggests that it would be most economical to do this at or close to the farm site e.g. in this case in Cairns. This would cut down on freight costs and the salt or vinegar would act as a preservative. Also other species of clams such as *T. gigas* may be more economical to use in sunomono.

The restaurant owner (who is also the chef) was concerned about storage of giant clams. He mentioned that a Tasmanian company had supplied cold water systems for storing Tasmanian live seafood, such as abalone, in their restaurant. Giant clams cannot be stored in this cold water tank. This restaurant also has a warm water tank containing crabs. Clams could be kept in this water tank for a limited time if it is protected from the crabs. From the owner's perspective, a small serve of this *sunomono* dish would sell retail at A\$12-15 and probably two to three dishes could be prepared from a giant clam 15-20 cm in size.

Using the method of preparation adopted, *sunomono* in this case, only enough meat was obtained from the dozen clams used for a small side dish or entree for around three to four people. If this were to retail at around A\$12 per serve, this would mean a total of A\$36 - A\$48 in receipts. This would not cover the basic cost of the clams. However, if the approach suggested in footnote 3 is followed and say older specimens of *T. gigas* are used, the price of the meat could be much lower.

As a result of telephone contact with the producer of the giant clams in Cairns, the producer suggested that four giant clams in the shell might sell as a *sashimi* side dish or entree for A\$18. This would still require price of giant clams ex hatchery to be much lower than at present for the restaurant to recover costs.

Five persons tested the dish and were asked to fill out the questionnaire which is reproduced in Appendix 2. All tasters were very familiar with seafood cuisine including Japanese seafood dishes. Table 2 summarises the binary answers to questions 6 to 13 except question 10 by all tasters. The questions were designed to determine the following:

- Q6. Whether the tasters liked the dish.
- Q7. How the tasters would rate the dish for eating on special occasions.
- Q8. Whether the tasters would like to try the dish again in the future.
- Q9. Whether the tasters would be prepared to buy the dish as a speciality item.
- Q11. What the tasters thought about the texture of the clam meat in this dish
- Q12. The opinion of the tasters about the flavour of the giant clam meat in this dish.
- Q13. The views of tasters about the colour/appearance of the giant clam meat in this

dish.

**Table 2 Responses to Questions 6 to 13 (except Q10) by Tasters: First Trial (*sunomono*)**

	Q6	Q7	Q8	Q9	Q11	Q12	Q13
Taster A	Yes	Acceptable	Yes	Maybe	Poor	Not a Problem	Poor
Taster B	Undecided	Poor	Yes	Yes	Not a Problem	Good	Poor
Taster C	No	Poor	Yes	Yes	Poor	Not a Problem	Very Poor
Taster D	No	Poor	No	Yes	Poor	Poor	Poor
Taster E	No	Poor	Yes	Yes	Poor	Not a Problem	Poor

Taster A: Australian male, age 50's; Taster B: Australian female, age 30's; Taster C: Japanese male, age 30's; Taster D & E: Japanese males, age 40's.

Some interesting observations can be made from Table 2. Firstly, all the Japanese tasters did not like this dish (question 6) mainly because it tasted too strongly of the sea and had a bitter after taste. On the contrary, one of the Australian tasters (taster A) did like this dish because it is unusual. Almost all tasters (four out of five tasters) rated this *sunomono* as a poor dish for eating on special occasions (question 7) because the amount of meat was too small, it had a 'bitter' taste and an unattractive mantle/meat colour. Several tasters mentioned that the quantity of this dish was too little to judge accurately on this matter. Only taster A rated the dish as acceptable for eating on special occasions and commented that he would probably try it if this dish were available and if he had an overseas visitor. All tasters except one were interested to try this dish again in the future (question 8). Although taster D (Japanese) did not show any interest in trying this dish again, he mentioned he may consider it if the clams were larger than in the trial. Larger-sized giant clams were preferred by all other tasters. All tasters showed their interest in buying this particular dish as an entree if the size of giant clams were larger (question 9). Three tasters (two Australian and one Japanese) indicated that a maximum reasonable price for a small serve of this trial dish (*sunomono*) would be A\$10-

12 per head. The owners of the restaurant thought that such a serve would sell at between A\$12-15 per dish as a special item.

Tasters were asked if they had any suggestions about how this particular dish might be improved (question 10). Eighty percent of the tasters (four out of five) indicated that the dish would probably be more acceptable to the customers if giant clams of larger size were used in this dish. One Japanese taster mentioned that the dish might be improved if the strong sea flavour was removed, especially in *T. crocea*. An Australian female taster provided possible alternative recipes to sunomono. The suggested recipe was *Kokoda* (Fijian dish of *Escabeche*) style cuisine based on lime juice and coconut milk and using only the muscle. However, larger sized clams would be needed for the preparation of this dish. The texture of the clam meat in this *sunomono* dish was rated as poor by all tasters except one who rated it as no problem (question 11). Eighty percent of tasters indicated that it was too chewy to eat.

Questions 12 and 13 were designed to provide information about how tasters rated the flavour (Q.12) and the colour/appearance of the clam meat in this dish (Q13). Sixty percent of the tasters answered 'Not a Problem' in relation to the flavour of giant clam meat. The chef, however, who also tasted this dish found the flavour to be poor because of its strong fresh sea flavour and its after taste, especially for *T. crocea*. On the other hand, the Australian female taster rated this dish as 'good' because of its fresh sea flavour. All tasters rated the colour/appearance of this dish to be poor (Q13). Taster C (Japanese) even indicated 'very poor' for the colour/appearance of the clam meat in this dish. This was mainly because the mantle, which is a black/dark colour, was included with the muscle which although creamy, was very small in size. Thus this dish appeared to be unattractive in colour/appearance. General comments on the first trial and this sunomono dish were mainly as follows: there was little meat for one dish; it may have potential for other recipes (e.g. soup) if giant clams of this size are used.

**SECOND TRIAL:** held on December 11, 1992 at Japanese Restaurant B.

Following the experience of the first trial, a chef of restaurant B was asked to prepare three different dishes including *sushi* (photograph 9), *sunomono* (photograph 10), and grilled giant clam with salt (photograph 11) using *T. crocea* and *T. maxima* of the same size as in the first trial. As can be observed from these photographs, the chef used the shells of the giant clams to serve each dish. The method of preliminary preparation was exactly the same as for the

first trial (photographs 4-7). The chef then used both *T. crocea* and *T. maxima* to prepare three different dishes -*sushi*, *sunomono* and grilled giant clam meat with salt.

The chef of this Japanese restaurant was able to prepare giant clam meat for *sushi*, *sunomono* and grilled giant clam with salt although he had no previous experience in using giant clam meat in Japanese cuisine. According to him, the difficulty of using giant clam for *sushi*, *sunomono* and giant clam would only be about the same as for alternative material if giant clam meat could be provided shucked and either fresh or chilled (Q.6). Although this chef did not take as much preparation time as the chef of the first trial, he mentioned that it takes time to prepare if clams are in the shells because the process shown in photographs 4-7 is required. The chef of this Japanese restaurant would be interested in using giant clams for these dishes again (Q.7) if the size of the giant clams were at least two to three times larger than those supplied. These comments mirror those of the chef at the first trial. This indicates that giant clams 15-20 cm wide, which occur at around 4 - 6 years old for these species, would have more potential for use in Japanese cuisine. The chef of this second trial also mentioned that he would like to try giant clams for sashimi (raw sliced clam meat in this case), grilled with butter, and also with macaroni and cheese.

Using giant clams as a material for preparing *sushi*, *sunomono* and grilled clam with salt, the chef would not modify his method of preparation except that he would prefer to use larger-sized clams. He would expect a small serve of these trial dishes to sell retail at around A\$5 for *sushi* (two *sushi*), A\$8-10 for *sunomono*, and A\$10 for grilled giant clam (Q.10); The chef thinks that these dishes would probably be only prepared as special entrees but not for main courses. He commented that these giant clam dishes can be introduced as a special item on their menu and this would be an advantage of these dishes. The chef in the first trial made a similar comment. The chef in the second trial also indicated that he has some worries about food poisoning. This was partially because giant clam meat was unknown to him and he was not confident of the standard of handling in Australian seafood markets. Generally the chef thought that the size of the clams was not suitable for these trial dishes (Q.9) but that these dishes had good potential as special items in the restaurant's menu if the size of the giant clams were larger.

Four tasters (two Japanese and two Australians) were also asked to fill out a questionnaire for each of these trial dishes. The questionnaire is reproduced in Appendix 2. Tables 3, 4, and 5 summarise the binary answers to question 6 to 13 (except question 10) of each of the testers.



Some interesting observations can be made from the three tables (Tables 3, 4, and 5). Firstly, all tasters (both Australian and Japanese) liked all three trial dishes (Q.6) including the *sunomono* dish which was disliked by most in the first trial. This may partially be because of the excellent presentation made by the chef on the second trial, although this is subjective. All tasters commented that they preferred *T. maxima* to *T. crocea* for most of the dishes. This is because *T. maxima* has a very soft and smooth texture and a milder sea flavour. By contrast, *T. crocea* has a strong sea flavour and a (fibrous) chewy texture. The following summarises the responses of each of the tasters to the trial dishes.

**Table 3 Responses to Questions 6 to 13 (except Q10) by Tasters: Second Trial (sushi)**

	Species	Q6	Q7	Q8	Q9	Q11	Q12	Q13
<b>Taster A</b>	Both	Yes	Very good	Yes	Yes	Very Good	Good	Very Good
<b>Taster B</b>	<i>T. maxima</i>	Yes	Excellent	Yes	Yes	Very Good	Good	Good
	<i>T. crocea</i>	Yes	Excellent	Yes	Yes	Good	Good	Good
<b>Taster C</b>	<i>T. maxima</i>	Yes	Excellent	Yes	Yes	Good	Very Good	Good
	<i>T. crocea</i>	Yes	Very Good	Yes	Yes	Not a problem	Good	Good
<b>Taster D</b>	Both	Yes	Acceptable	Yes	Yes	Poor	Good	Good

Taster A: Australian female, age 30's; Taster B: Australian male, age 50's; Taster C: Japanese male, age 30's; Taster D: Japanese male, age 40's.

**Table 4 Responses to Questions 6 to 13 (except Q10) by Tasters: Second Trial (*sunomono*)**

	Species	Q6	Q7	Q8	Q9	Q11	Q12	Q13
Taster A	Both	Yes	Excellent	Yes	Yes	Very Good	Very Good	Very Good
Taster B	Both	Yes	Excellent	Yes	Yes	Good	Very Good	Good
Taster C	Both	Yes	Excellent	Yes	Yes	Very Good	Very Good	Good
Taster D	Both	Yes	Very Good	Yes	Yes	Good	Good	Good

Taster A: Australian female, age 30's; Taster B: Australian male, age 50's; Taster C: Japanese male, age 30's; Taster D: Japanese male, age 40's.

**Table 5 Responses to Questions 6 to 13 (except Q10) by Tasters: Second Trial (grilled clam with salt)**

	Species	Q6	Q7	Q8	Q9	Q11	Q12	Q13
Taster A	Both	Yes	Very good	Yes	Yes	Very Good	Good	Very Good
Taster B	Both	Yes	Very Good	Yes	Yes	Not So Good	Good	Not a Problem
Taster C	<i>T. maxima</i>	Yes	Very good	Yes	Yes	Very Good	Very Good	Very Good
	<i>T. crocea</i>	Yes	Acceptable	Yes	Yes	Very Good	Good	Very Good
Taster D	Both	Yes	Very Good	Yes	Yes	Good	Good	Very Good

Taster A: Australian female, age 30's; Taster B: Australian male, age 50's; Taster C: Japanese male, age 30's; Taster D: Japanese male, age 40's.

**SUSHI** (photograph 9)



**Photograph 9**

*Sushi* prepared by the chef of restaurant B

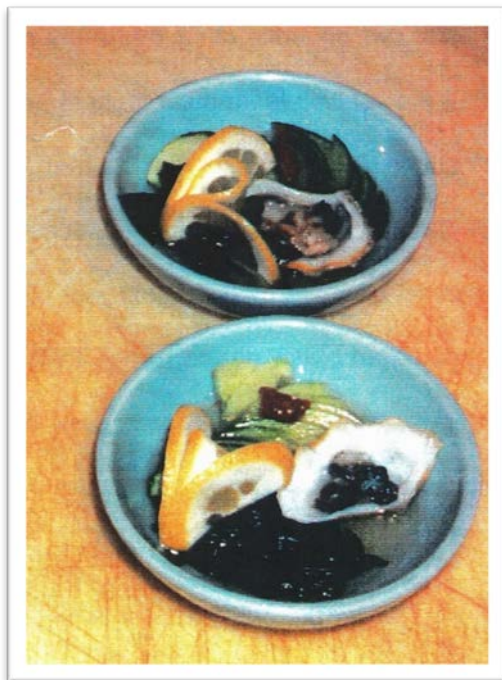
All testers rated *sushi* as ‘acceptable’ to ‘excellent’ (Q.7). The two Australian tasters and a Japanese rated this dish as excellent, particularly *T. maxima*. The chef (also a taster) rated this dish as ‘acceptable’. All tasters showed their interest in trying this dish again in the future (Q.8) and buying this dish as a special item (Q.9). Two Australian tasters indicated that a maximum reasonable price for a small serve of this trial dish *sushi* would be around A\$10-12 per serve, (three *sushi* in one dish) in this trial. Two Japanese tasters indicated that a price of around A\$4-6 per serve (two *sushi* per serve)<sup>4</sup> as reasonable.

Tasters were asked to make any suggestions about how a particular *sushi* dish might be improved (Q.10). Three tasters indicated that they had no suggestions. This indicates that the three tasters are most likely satisfied with this dish. A Japanese taster suggested that it would be better if more clam meat was used but other than that this *sushi* had good potential as a special item. The texture of the clam meat in this *sushi* dish was rated from ‘very good’ to ‘poor’. The two Australians rated the texture of this dish as ‘very good’ although one of them rated *T. crocea* as only ‘good’. A Japanese taster rated this dish as ‘good’ for *T. maxima* and ‘no problem’ for *T. crocea*. However, the Japanese chef rated this dish as ‘poor’ mainly because its dark mantle colour on the white vinegared rice gave a negative impression of this dish. All tasters rated this *sushi* dish as ‘good’ or ‘better’ in relation to its flavour (Q.12). Both Australians and one Japanese taster indicated that the flavour of *T. maxima* was better than that of *T. crocea*. However, the chef preferred the flavour of *T. crocea* to *T. maxima*

<sup>4</sup> In the case of *sushi* in Japanese cuisine, two *sushi* per serve is the standard serve.

because of its 'fresh sea food flavour'. Three out of four tasters rated the colour/appearance of this *sushi* dish as 'good'. (Q.13). This dish. All tasters rated this sushi as 'good' or better in relation to its flavour (Q.12). Both Australians and one Japanese taster indicated that the flavour of *T. maxima* was better than that of *T. crocea*. However, the chef preferred the flavour of *T. crocea* to *T. maxima* because of its 'fresh sea food flavour'. Three out of four tasters rated the colour/appearance of this sushi dish as good (Q.13). This includes the chef although he indicated 'poor' in response to question 11. One Australian taster (not so familiar with seafood) rated this sushi dish as 'Very good'. This indicates that this sushi dish would be attractive to customers, probably as an entree. General comments on this sushi dish were as follows: although *T. crocea* has a slightly stronger sea flavour, this dish was excellent and the presentation made by the chef was excellent. This dish might have been better if more meat was available from each clam. The dish has good potential as a speciality item for Japanese restaurants.

***SUNOMONO*** (photograph 10).



**Photograph 10**

*Sunomono* dish was prepared by the chef of restaurant B

The second dish tried was *sunomono*. This was rated as 'excellent' by three tasters and as 'very good' by one taster (Q.7). The chef (also a taster) commented that if the customer likes fresh clam meat this dish might have good potential as an entree. The other Japanese taster indicated that the taste of this *sunomono* dish was 'good' in its vinegar dressing. The fact too

that the dish was presented in individual clam shells added an exotic character to it. All tasters said that they would be interested to try this dish again in the future (Q.8) and all indicated that they would be prepared to buy this *sunomono* dish as a special item (Q.9). Although a maximum reasonable price for a small serve of this dish varies, the two Australian tasters indicated its price as A\$12-15, and a Japanese taster suggested around A\$5-10, depending upon the amount of clam meat in the dish. The chef indicated A\$7-8 per serve as reasonable if the amount of meat in this trial was used and A\$10-15 if about fifty per cent more clam meat was used.

Tasters were asked that if they had any suggestions about how this particular dish might be improved (Q.10). Three tasters did not make any suggestion. This possibly indicates that the tasters were satisfied by the *sunomono* dish in this second trial. These results contrast with those in the first trial for the same dish. The other Japanese taster commented that presentation was excellent with seaweed and cucumber, and he suggested that it would probably be better if more clam meat was served in each dish. The texture of the clam meat in this *sunomono* dish was rated as 'very good' by two tasters and as good by the other two tasters (Q.11). The flavour of this *sunomono* dish was rated as 'very good' by three tasters and good by the chef (Q.12).. Three tasters preferred the flavour of *T. maxima* to *T. crocea* because of its less pronounced sea flavour. The chef preferred *T. crocea* because of its strong sea flavour. Three tasters rated the colour/appearance of the clam meat in this *sunomono* dish as 'good' and the Australian female taster rated it as 'very good'. Although the same species and sizes of giant clams were used in both the first and the second trial, the responses of the tasters were quite different on the different occasions. This may be partially because of differences in the presentation and the type of sweet vinegar dressing used. Overall, comments on the second trial *sunomono* dish were: enjoyed the sweet taste; good potential as a side dish; very tasty served with seaweed, cucumber and chilli, as in this trial.

**GRILLED GIANT CLAM WITH SALT** (photograph 11)



**Photograph 11**

Grilled clam meat prepared by the chef of restaurant B

As can be observed from Table 5, grilled giant clams (*T. crocea*, *T. maxima*) was rated as a ‘Very good’ dish for eating on special occasions (Q.7) by all tasters except one Japanese who rated grilled *T. crocea* only as acceptable. The chef commented that this dish may suit Japanese customers because it is similar to a top shell (*Turbo [Batillus] cornutus*) cooked in its own shell with sake and soy sauce (*Tsuboyaki* in Japanese). All tasters were interested to try grilled giant clam with salt again in the future (Q.8) although two tasters mentioned that they would prefer bigger pieces of giant clam meat. All tasters indicated that they would buy this dish as a special item. Three tasters (one Australian and two Japanese) indicated that a maximum reasonable price for this trial dish (grilled giant clam with salt) as an entree would be around \$10 and the other Australian taster indicated that a reasonable price for an entree would be around \$6.00.

Tasters were asked if they had any suggestions about how this particular dish might be improved (Q.10). Two tasters including the chef mentioned that larger pieces of giant clam meat would be needed for this dish (about three times larger than the size of the giant clams provided for this trial). One taster mentioned that he would like to try giant clam grilled meat prepared in different ways, e.g. grilled with butter, grilled in its own shell with soy sauce and sake (i.e. *tsuboyaki*). The texture of the clam meat in this grilled dish was rated by different testers from ‘Very good’ to ‘not so good’ (Q.11). Two tasters indicated ‘very good’ one answered ‘good’ and the other rated it as ‘not so good’. The taster who said ‘not so good’ mentioned that there is a small problem because of a slightly stringy texture. This probably came from the mantle of the giant clam.

Two tasters rated the flavour of this dish as ‘good’ and one said it was ‘very good’. Another rated the flavour as ‘very good’ for *T. maxima* and as good for *T. crocea* (Q.12). Three tasters indicated the colour/appearance of the clam meat in this dish to be ‘very good’ and one said that it was ‘not a problem’. One taster commented that its brownish colour indicated that it was well grilled. General comments about this dish were: beautifully presented; preferred *T. maxima* to *T. crocea* (all tasters); good potential as a side dish.

#### 2.4 Observations from the two trials

The first trial was less successful than the second one. On the basis of the *sunomono* prepared on the first trial, the prospects for using giant clam meat did not appear to be very promising. However, the second trial gave a much more favourable impression of the prospects of using giant clam meat in Japanese cuisine. The results indicated that it can be successfully used in *sushi*, *sunomono* and also in grilled form.

There was a general view that the clams supplied were too small for the dishes prepared. Opinion seemed to be that clams of two to three times larger would be preferable. Overall, *T. maxima* was preferred to *T. crocea*. This is interesting because per unit of meat it is cheaper.

Both chefs commented on the amount of labour involved in separating the clam meat from the shells. In small clams the meat yield in relation to effort is low. A similar observation was made by Shang, Leung and Brown from their restaurant trials with giant clams (poster at the 7th International Coral Reef Symposium, Guam, 1992). For some of the dishes, e.g. *sunomono*, it may be preferable to complete the initial process at or near the giant clam farm and freight the chilled meat. Chilled or frozen meat should also be suitable for the grilled dishes. Aesthetically, however, it does seem desirable to serve giant clam dishes in clam shells. For this purpose, however, a restaurant could reuse its stocks of clam shell. For some dishes, e.g. *sunomono*, species of clam such as *T. derasa* and *T. gigas*, which grow larger and more quickly than *T. maxima* and *T. crocea*, may be suitable especially if the meat is chilled at or near the farm. Taste tests with these species would be desirable for comparative purposes. In the light of the above, it is useful to consider the use of giant clams in the Ryukyus for food, recipes used there for their preparation and the local trade in giant clam meat.

### 3. Use of Giant Clams for Food in the Ryukyus and Selected Ryukyuan Recipes for Giant Clam Meat.

According to Murakoshi (1991), both mantle lobes and adductor muscles of *T. crocea* and *T. maxima* are eaten raw (i.e., *sushi*, *sashimi*) in the Ryukyus (Okinawa prefecture). Raw adductor muscles of *H. hippopus* and *T. squamosa* are also eaten raw while the mantle lobes are salted for processing. Murakoshi (1991) also mentions that frozen mantles of large species such as *T. gigas* and *T. derasa* have been imported from the Philippines<sup>5</sup> because the materials for salted giant clam meat are in short supply in Okinawa. According to Mr. Tamaki, Research Associate of Okinawa Prefectural Sea Farming Center, giant clams are generally used in a form of *sushi*, *sashimi* and *sunomono* in Okinawa. However, in some areas of Nansei Shoto such as the Yaeyama Group including Ishigaki Island, the meat of *T. crocea* and *T. squamosa* are used in ordinary home cooking in *Chanpulū* (meaning ‘to fry’ in the Ryukyuan language). This meat is fried with white radish, onion and other vegetables. This method is similar to that used in some Taiwanese recipes reported in Tisdell and Chen (1992). Shell ligaments of *T. squamosa* and *H. hippopus* are used for *Agemono* (a deep-fried dish with flour/cornflour) as a special item in Chinese cuisine in the Ryukyus. On Ishigaki Island, giant clam meat is used for miso-soup. According to Tamaki, the consumption of giant clam meat is closely related to local availability of giant clams and they are therefore mostly consumed in the Yaeyama Group and on Miyake Island, and in the northern part of the main island of Okinawa. Traditionally, giant clams are not used for food in the central and southern parts of the main island of Okinawa. However, salted giant clam meat is produced mainly for consumption in the prefecture, especially on Ishigaki Island.

The following are some of the selected recipes for Ajike (general term for giant clam in the Okinawan language) which are provided by Mr. Tamaki, Research Associate of Okinawa Prefectural Sea Farming Centre.

#### RECIPE 1. *SUNOMONO*

Ingredients:	giant clam meat (all parts)	300g
	Japanese cucumber	2-3
Dressing:	rice vinegar	90 ml (6 tablespoons)

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<sup>5</sup> According to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), these two species are listed as endangered species and can only be traded if it is authorised in exceptional circumstances (CITES, article II).



<i>dashi</i> -soup	60 ml (4 tablespoons)
soy sauce	30 ml (2 tablespoons)
chilli 1	

Method:

- a) wash giant clam meat in fresh water
- b) dice the clam meat
- c) pour a little bit of rice vinegar over the meat and take off the moisture.
- d) rub salt into the cucumber then wash it with fresh water
- e) slice the washed cucumber
- f) place the diced giant clam meat on top of the sliced cucumber
- g) combine ingredients for the dressing

**RECIPE 2:** *MISOAE* (giant clam meat with miso dressing)

Ingredients:	giant clam meat	300g
	kidney of giant clam	one kidney
	rice vinegar	proper quantity
	<i>miso</i>	proper quantity
	sweetened <i>sake</i>	a little

Method:

- a) wash giant clam meat under fresh water b) separate the kidney from the giant clam
- c) dice the giant clam
- d) place the kidney in a *suribachi* (an earthenware mortar) and grind it with rice vinegar and miso, then add the clam meat
- e) garlic and ginger can be added depending upon preference.

**RECIPE 3:** *AJIKE-NASHIMUN* (*Tsukemono* dish)

Ingredients:	giant clam meat	6kg
	Salt	300g
	crystal sugar	1kg
	red chilli	10-15
	<i>Awamori</i> (Ryukyu spirits)	proper quantity

Method:

- a) remove kidney from the giant clam
- b) wash the giant clam meat under fresh water
- c) dice the clam meat
- d) rub salt into the clam meat and leave it in a refrigerator for around two days

- e) mix giant clam meat with crystal sugar and the red chilli in an appropriate container
- f) store in a cool, dark place
- g) when bubbles appear, add an appropriate amount of *Awamori*
- h) store for around six months

#### 4. Trade and Availability of Giant Clam Meat

According to Murakoshi (1991), most giant clams in the Ryukyus are sold directly from fishermen to consumers without being auctioned through a fisheries cooperative association because the volume of giant clams harvested has declined drastically since the early 1970s. Hence it is difficult to estimate harvest levels of giant clams in Okinawa for recent years. Murakoshi (1991) provides estimates of catches of giant clams in Okinawa during the period 1973 to 1982 and Shang et al. (1991, p. 6) those for 1975-1987. The figures using both sources are shown in Table 6.

**Table 6 Catches of Giant Clam in Okinawa, 1973 – 1987<sup>a</sup>**

Year	Quantity (in tons)	Value (millions of yen)	Average Price (¥/kg)
1973	481	40	83
1974	432	94	218
1975	578	232	401
1976	227	96	423
1977	215	101	470
1978	222	107	482
1979	187	99	529
1980	187	107	572
1981	92	58	630
1982	112	61	545
1983	116	67	578
1984	154	68	442
1985	172	96	558
1986	154	103	669
1987	91	70	769

Source: Agriculture, Forestry and Fisheries statistics, Okinawa General Bureau, Okinawa Development Agency.

<sup>a</sup> Catches from January to October are shown for 1973 and 1979, and figures for 1974 and 1980 include catches in November and December in the previous year.

Murakoshi (1985) indicated that in Yaeyama Group, six species of giant clams can be found:

*T. crocea*, *T. squamosa*, *H. hippopus*, *T. maxima*, *T. derasa* and *T. gigas*. However, as Murakoshi (1985) points out, the harvest other than for *T. crocea* is very low. Thus, the figures shown in Table 6 are mainly for *T. crocea*.

Table 7 is reproduced from Murakoshi (1985, 1991) which shows the price of giant clams at Ishigaki Island in the Yaeyama Group in April 1985. As can be observed from Table 7, the price of *T. crocea* in Naha is twenty to thirty percent higher than in Yaeyama (Ishigaki Island) in 1985. This trend was still the case in 1991 when Tisdell visited Okinawa.

**Table 7 Prices (yen/kg) of Giant Clams at Ishigaki Island in the Yaeyama Group in April, 1985**

	<i>T. crocea</i>	<i>T. squamosa</i>	<i>T. maxima</i>	<i>H. hippopus</i>
<b>For food</b>				
Within Yaeyama Group				
Wholesale price	6,000–7,000	(1,500–2,000) <sup>1</sup>	3,500–4,000	ca. 1,000 <sup>1</sup>
Retail price	7,000–8,000	--	--	1,500–2,000
Shipped to Okinawa I.				
Wholesale price	8,000–10,000	(3,000–4,000) <sup>2</sup>	--	(2,500–3,000) <sup>2</sup>
<b>For other uses</b>				
Within Yaeyama Group				
Live shell	--	2,000	--	1,500
Shell valves				
(Small)	--	500	--	--
(Large)	--	250	--	--

<sup>1</sup> Small quantity is landed

<sup>2</sup> High prices at the time of typhoon

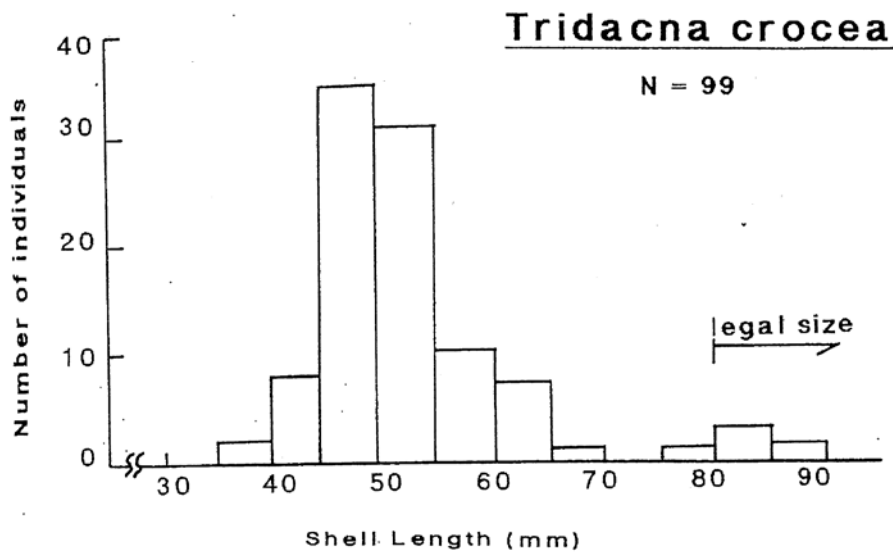
Shang et al. (1991, p.6) reported that the wholesale price per kilogram in Okinawa of giant clam meat from the various species was as set out in Table B. These are the same prices as reported. by Murakoshi for April 1985.

**Table 8 Wholesale Price of Giant Clam Meat in Okinawa**

Species	Price per kilogram (muscle and mantle only)
<i>Tridacna crocea</i>	¥8,000 – ¥10,000 (US\$57.14 – \$71.43)*
<i>Tridacna squamosa</i>	¥3,000 – ¥4,000 (US\$21.43 – \$28.57)
<i>Hippopus hippopus</i>	¥8,000 – ¥10,000 (US\$17.86 – \$21.43)

\* Exchange rate of US\$1 = 4,12

As mentioned earlier, nearly all of the local trade in the Ryukyus is in *T. crocea*. It is therefore interesting to consider the size of *T. crocea* traded. Trading at Naha fish market in *T. crocea* provides a guide. On 29 February 1988, the size distribution of *T. crocea* at this market was as indicated in Figure 1. As can be seen; the majority of the *T. crocea* for sale had a shell width of 45-55 mm. This meant that they were about the same size as those provided by the Cairns farm for our trials. It is also true that most *T. crocea* traded at the Naha market were below the legal limit of 80 mm shell width. It is reported that most of the *T. crocea* of around 50 mm traded in the Naha market are used for *sushi* (pers. comm. by Mr. Tamaki, Jan., 1993). Giant clam meat appears to be able to be used very economically in *sushi* and the strong (fresh) sea-flavour taste of *T. crocea* may be an advantage rather than a disadvantage. Our taste tests in Brisbane indicated that all tasters liked giant clam served in *sushi*.

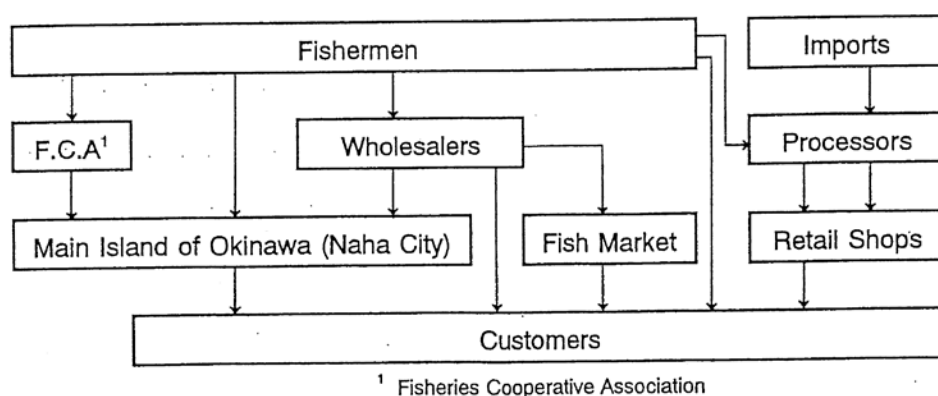


**Figure-1. Size distribution of *T. crocea* at Naha Markets on 29 February, 1988**

The *T. crocea* supplied by Reefarm for our Brisbane taste tests were clearly comparable in size to most of those traded in the Naha markets (at the most, they might have been *slightly* smaller on average).

Mr. Tamaki of the Okinawa Prefectural Sea Farming Center informed us that in Okinawa, *T. crocea* takes 3-5 years to reach a shell width size of around 5 cm. Under culture at Fitzroy Island near Cairns, *T. crocea* reaches a similar size when about two years old. This may be due to the advantages of land-based aquaculture at Fitzroy Island and a more suitable temperature regime for the growth of this species, than in Okinawa. From an economic point of view, such speedy growth would be an advantage.

As mentioned earlier, most harvested giant clams are now supplied directly to customers by harvesters. Figure 2 shows channels used for marketing giant clams in Okinawa and is adapted from Murakoshi (1985). Note that imports do not usually go through the same marketing channels as local clams. Furthermore, it can be very difficult for foreign firms to get access to distribution channels (see Anderson and Riethmuller, 1992).



**Figure 2. Marketing Channels for Giant Clams in Okinawa for Meat**

## 5. Concluding Comments

The trials undertaken at Japanese restaurants in Brisbane indicate that giant clam meat has definite potential for Japanese cuisine. Indeed, responses to the second trial involving the serving of giant clams in *sushi*, *sunomono* and grilled are very encouraging. This indicates that presentation and method of preparation would be very important in using these shellfish

in the Japanese restaurant trade.

While Brisbane tasters thought that the small size of the clams was a problem, this was probably less of a problem for *sushi* than for other dishes tested. In the case of *sushi*, vinegared rice makes up a substantial component of the dish. Furthermore, when *sunomono* is served with seaweed, chilli and other ingredients as on the second trial, use of the meat 'can be extended'.

From an economics point of view, the cost of farmed clams in Australia is a problem. If a serve of *sushi* (using two small clams) were to sell at A\$12-15, this would just repay the cost of the landed clams. However, if the farmgate price of these clams could be halved (and if distribution costs could be reduced), the use of such clams could be worthwhile from a restaurant's point of view as a speciality item. Farmgate prices of clams can be reduced substantially with increases in volume of throughput because strong economies of scale in production exist.

At the present time, most of the production of giant clam farms is used to supply specimens for the aquarium trade. However, if sales to restaurants could be achieved on a regular basis in volume, scope exists for substantially reducing farmgate prices.

On the two trials conducted in Brisbane, both chefs pointed out that considerable effort is involved in preparing clam meat when clams are supplied in the shell, and that meat yield in relation to effort is low when the giant clams are small. Larger-sized clams would have an advantage from this point of view. It may be that ingredients for some of these dishes could be supplied by other species of clams which grow more quickly to a larger size than *T. crocea*. In the Brisbane trials, *T. maxima* was found to give greater meat yield than *T. crocea* and on the whole to be preferred by tasters. There was no opportunity to test other species e.g. *T. gigas*. It seems likely that different species would be appropriate for different types of dishes, e.g. the larger-sized species of clams might be more suitable for grilling.

It is also clear that it may be unnecessary to ship giant clams alive to supply meat suitable for Japanese cuisine. Chilled meat can be suitable for *sushi*. In the case of *sunomono* the meat may actually 'improve' if it is salted or vinegared and chilled and held for a couple of days. A clam farm or facilities associated with it could do the necessary initial processing thereby reducing transport costs and possibly, obtaining some scale economies. There needs to be liaison between clam producers and Japanese restaurants to ensure that this is done correctly.

Such a situation could be attractive to a large Japanese restaurant chain which might find integration worthwhile with clam production. However, it should be pointed out that most Japanese are not familiar with giant clams. On the whole familiarity is limited to the far south of Japan in the Ryukyus. Nevertheless, given the suitability of giant clam meat for inclusion in Japanese cuisine, sales of giant clam meat could be extended to Japanese restaurants generally both in Japan and abroad, if adequate promotion and supply of giant clam meat were forthcoming. At least, there seems to be a good prospect of this happening as a speciality item in relation to Japanese cuisine.

The question might be asked if there would be a market for Australian farmed giant clams for meat in Japan. Clearly a market exists in Okinawa but as yet there are not direct flights from Cairns to Naha. Also, the Ryukyu market is rather small, according to Shang et. al. (1992). But actual consumption of giant clam meat exceeds this figure since large quantities of giant clams are sold directly by fishermen to customers in the Ryukyus. Other than in the Ryukyus, no ready market exists in Japan but a potential would appear to exist for development of the use of giant clams in Japanese restaurant cuisine in other parts of Japan. As pointed out by Riethmuller (1993), Japanese are consuming an increasing proportion of their food outside their homes.

In order for Australian producers to supply the Okinawa market, the farmgate price of their clams would have to be much lower than at present. In 1989, for example, *sushi* bars in Okinawa paid about A\$2.10-3.60 for each 5-6 cm. *T. crocea* in the shell. (Cf. Shang et al., 1991, p. 6). The Australian farmgate price for such clams was A\$4.50 each. It seems that this price would have to be at least halved if sales were to be realised in Okinawa, especially because shipment costs have to be added to the farmgate price. It is feasible because of economies of scale (Cf. Tisdell et al., 1990, 1993) for production costs to be halved for *T. crocea* if volume of production can be substantially raised on clam farms, but the possibility of doing so involves a 'chicken-and-egg' problem in that expansion of production depends on expanded demand which in turn may hinge on enhanced levels of production.

## **6. Acknowledgments**

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which Professor Y.C. Shang is the team leader. The authors would like to thank both Mr. Murakoshi and Mr. Tamaki at the Okinawa Prefectural Sea Farming Center, Okinawa., Japan for providing valuable information.

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**APPENDIX 1      Questions for Chefs**

**Department of Economics,  
The University of Queensland,  
Information Sheet re Potential for Giant Clam Meat in Cuisine**

- 1. Date .....
- 2. Restaurant .....
- 3. Respondent .....
- 4. Dish .....
- 5. Species of giant clam used .....
- 6. Have you prepared this dish before using seafood other than giant clam?

Yes     

No     

If yes, what other seafood did you use? .....

.....

Was it    Harder     

          Easier     

          About Same   

to prepare this dish using giant clam?

Comment .....

- 7. Would you be interested to use giant clams for this dish again?

Yes     

No     

Comment .....

8. If you were to use giant clams to prepare this dish again, would you modify its ingredients or method of preparation?

Yes

No

Comment .....

9. Was the size of the clam suitable for this dish?

Yes

No

Explain .....

10. What would you expect a small serve of this dish to sell at retail? \$.....

Number of persons likely to be involved in eating a small serve? .....

Do you have in mind a main course, subsidiary course, e.g. entree, accompaniment?

.....

.....

11. Please indicate the advantages and disadvantages of using giant clams for this dish from your viewpoint.

<b>Advantages</b>	<b>Disadvantages</b>
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## APPENDIX 2

### Questions for Tasters

Department of Economics  
The University of Queensland  
Information Sheet re Potential for Giant Clam Meat in Cuisine

1. Date .....
2. Restaurant .....
3. Respondent .....
4. Dish .....
5. Species of giant clam used .....
6. Did you like this dish?  
Yes   
No   
Undecided
7. How would you rate this dish for eating on special occasions?  
1. Excellent   
2. Very Good   
3. Acceptable   
4. Poor   
5. Unacceptable   
Comment .....
8. Would you like to try it again in the future?  
1. Yes   
2. No   
3. Not sure

9. Would you be prepared to buy it as a specialty item?

Yes

No

If yes, what do you think would be a maximum reasonable price for a small serve?

\$.....

10. Do you have any suggestions about how this dish might be improved?

.....  
.....  
.....

11. Is the texture of the clam meat in this dish

Very Good

Good

No Problem

Poor

Please explain? .....

.....

12. Is the flavour of the clam meat in this dish

Very Good

Good

Not a Problem

Poor

Please explain? .....

.....

13. Is the colour/appearance of the clam meat in this dish

Very Good

Good

Not a Problem

Poor

Please explain? .....

.....

14. Any other comments on the dish.

.....

.....

.....

Clem Tisdell  
Department of Economics  
The University of Queensland

### **APPENDIX 3**

#### **Names and Addresses of Japanese Restaurants in Brisbane Cooperating in Testing of Giant Clam Meat in Their Cuisine.**

Mr. Hosokawa (chef)  
Oshin Japanese Restaurant  
Cnr. Adelaide and Creek Streets  
Brisbane. QLD. 4000  
Telephone: 07-229-0410

Mr. Kobayashi (owner and chef)  
Mr. Motonaga (chef)  
Sennari Japanese Restaurant  
85 Elizabeth Street  
Brisbane. QLD. 4000  
Telephone: 07-229-1551

### **APPENDIX 4**

#### **Name and Address of Commercial Producer of Giant Clam, Supplying Giant Clams for These Trials.**

Reefarm Pty. Ltd.,  
1st. Floor, Tropical Arcade,  
Abbott Street  
Cairns. QLD. 4870  
Australia  
Telephone:070-51-6193

## Research Reports and Papers in: Economics of Giant Clam Mariculture

### Previous Working Papers

1. "Market for Giant Clam Shells: Report on a Survey of Retailers and Wholesalers in Southeast Queensland, Australia." Clem Tisdell with the assistance of Rene Wittenberg, November, 1989.
2. "Seafarming as a Part of Indonesia's Economic Development Strategy - Seaweed and Giant Clam Mariculture as Cases." Carunia Firdausy and Clem Tisdell, November, 1989.
3. "Market for Giant Clams as Aquarium Specimens: Report on a Survey of Retailers of Supplies for Saltwater Aquariums, Southeast Queensland, Australia." Clem Tisdell with the assistance of Rene Wittenberg, November, 1989.
4. "Aquaculture as a Use of the Coastal Zone: Environmental and Economic Aspects, Giant Clam Farming as a Development." Clem Tisdell, December, 1989.
5. "Pacific Giant Clams and their Products: An Overview of Demand and Supply Factors." Clem Tisdell, December, 1989.
6. "Marine Property Rights in Relation to Giant Clam Mariculture in the Kingdom of Tonga." Dr T'eo I.J. Fairbairn, February, 1990.
7. "Exploring the Demand for Farmed Giant Clams and Their Components: Approaches and Problems." Clem Tisdell, February, 1990.
8. "Report on possible Demand for Giant Clam Meat by Tongan Descendants in Australia: Inferences from interviews conducted in the Brisbane Area". Clem Tisdell and Rene Wittenberg, February, 1990.
9. "Evaluation of International Trade Statistics on Giant Clams and Related Products and the Market for Giant Clam Meat." Dr John Stanton, March, 1990.
10. "Assessing Species for Mariculture in Developing Countries: A Review of Economic Considerations." Carunia Firdausy and Clem Tisdell, April, 1990.
11. "An Analysis of the Cost of Producing Giant Clam (*Tridacna gigas*) Seed in Australia." Tisdell, C.A., Lucas, J.S. and Thomas, W.R., May, 1990.
12. "Marine Property Rights Fiji: Implications for the Development of Giant Clam Mariculture." Dr T'eo I.J. Fairbairn, August, 1990.
13. "Reef and Lagoon Tenure in the Republic of Vanuatu and Prospects for Mariculture Development". Dr T'eo I.J. Fairbairn, August, 1990.
14. Progress Report No. 1 to ACIAR, Project No. 8823. Professor Clem Tisdell, August, 1990.
15. "The Potential Market for Giant Clam Meat in New Zealand: Results of Interviews with Pacific Island Immigrants." Clem Tisdell and Rene Wittenberg, October, 1990.
16. "The Potential Demand for Giant Clams in Indonesia and Their Status: A Report on a Survey of Four Coastal Villages in Bali and Java." Carunia Firdausy and Clem Tisdell, November, 1990.
17. "Traditional Reef and Lagoon Tenure in Western Samoa and Its Implications for Giant Clam Mariculture." Dr T'eo I.J. Fairbairn, February, 1991.
18. "Ocean Culture of Giant Clams (*Tridacna gigas*): An Economic Analysis." C.A. Tisdell, J.R. Barker, J.S. Lucas, L. Tacconi and W.R. Thomas, February, 1991.
19. "Aid for Village-Based Rural Projects in LDCs: Experiences, Project Appraisal and Selection, ACIAR and Giant Clam Culture as a Case". Luca Tacconi and Clem Tisdell, March, 1991.
20. "Customary Marine Tenure in the South Pacific Region and Implications for Giant Clam Mariculture". Dr T'eo I.J. Fairbairn, April, 1991.
21. "ACIAR-Supported Research on the Culture of Giant Clams (*Tridacnidae*): A Multi-Faceted Economic Assessment of Research Benefits (Draft Appraisal)". Professor Clem Tisdell, April, 1991.
22. "Economics of Ocean Culture of Giant Clams: Internal Rate of Return Analysis for *Tridacna gigas*". Tisdell, C.A., Tacconi, L., Barker, J.R. and Lucas, J.S., April, 1991.
23. "Socio-Economic Aspects of Giant Clams in The Lau Group, Fiji, and Farming Prospects: Results of Field Research". Veikila Vuki, Clem Tisdell and Luca Tacconi, June, 1991.



24. "Subsistence Economic Activities and Prospects for Clam Farming in Ono-i-Lau, Fiji: Socio-Economic Factors". Veikila Vuki, Clem Tisdell and Luca Tacconi, June, 1991.
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29. "Domestic Markets and Demand for Giant Clam Meat in the South Pacific islands - Fiji, Tonga and Western Samoa". Luca Tacconi and Clem Tisdell, January 1992.
30. Economics of Giant Clam Production in the South Pacific - Fiji, Tonga and Western Samoa". Luca Tacconi and Clem Tisdell, February 1992.
31. "Exports and Export Markets for Giant Clam Products in the South Pacific: Fiji, Tonga and Western Samoa". Luca Tacconi and Clem Tisdell, March 1992.
32. "Institutional Factors and Giant Clam Culture and Conservation in the South Pacific: Observations from Fiji, Tonga and Western Samoa". Luca Tacconi and Clem Tisdell, March 1992.
33. "Giant Clams in Wallis: Prospects for Development". Nancy J. Pollock, May 1992.
34. "Current and Potential Markets for Giant Clam Meat in Fiji - A Case Study of the Market in Suva". Vina Ram, August, 1992.
35. "Interest of Asian Restaurants in Queensland in Using Giant Clam Meat in their Cuisine and Their Knowledge of It." Clem Tisdell, September, 1992.
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40. "Final Report and ACIAR Project No. 8823 (ROU 259) 'Economics of Giant Clam (Tridacnid) Mariculture". Clem Tisdell, March, 1993.