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Market Conditions of the Spotted Shrimp Fishery in the Suruga Bay Area

－A Study on Recent Changes and Relevant Factors－

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Summary

Spotted shrimp (*Sergia lucens*) is most important fisheries product in Suruga Bay area. In this area, landing price of spotted shrimp inclined steeply, though the catch quantity was stable on and after 2003. In other words, the market condition of spotted shrimp fishery was obviously improved.

In this study, we tried to elucidate the main factor of inclining of spotted shrimp price during this period, from the 2 viewpoints ――" technological improvements on this fishery ", and" finding a new market condition ".

Therefore, 3 points（v.i.）about spotted shrimp fishery in this area were elucidated.

1. **After 2002, various kinds of innovation for the improvement of freshness and quality advanced in this fishery.**
2. **With the improvement of freshness and quality on spotted shrimp, the use as dried shrimp reduced remarkably, and the use as" Kamaage "(freezing boiled shrimp) and" Fresh product " (freezing fresh shrimp) greatly enlarged.**
3. **The demand for Kamaage and fresh Product was excellent and let the market size spread in the whole country.**

The price of spotted shrimp greatly rose as a factor with above-mentioned 3 points.

1. Introduction

The spotted shrimp fishery in the Suruga Bay area is famous for its advanced fishery management. This area issues restrictions on daily catches and ensures equal catch distribution for price maintenance with the help of the pool system and participation of all ships involved. Numerous studies on economic effects of spotted shrimp fishery have been conducted on the two measures.[1] However, few studies have been conducted recently regarding the market conditions for spotted shrimp (on which fishery management is based).[2]

Catches of spotted shrimp remained stable at slightly below 2,000 tons per year between 2002 and 2008, but the local prices of spotted shrimp rose during this period. In fact, prices were at an unprecedentedly high level in 2009 and 2010 when catches of spotted shrimp decreased. Thus, the spotted shrimp market in the Suruga Bay area clearly began to expand in 2002.

What factors caused these changes in market conditions? This research has clarified the factors that influenced the increase in local prices of spotted shrimp with a focus on (1) improvement of the technology required to manage freshness of catches, (2) change of the structure of processed spotted shrimp products, and (3) trends in demand for spotted shrimp products. Our findings were based on an analysis of interviews with members of the Yuiko Fisherman's Cooperative Association and Ooigawa Fisherman's Cooperative Association, as well as materials provided by these groups, and the results of a survey that was distributed to

several process manufacturers in the production area.

2．Production and price trends of spotted shrimp

First, trends regarding catches and prices of spotted shrimp in area were confirmed. As Figure 1 shows, annual catches of spotted shrimp remained between 2,500 and 3,000 tons until 2001, except in 1997 and 1998 when catches dropped temporarily. During this period, the real price of spotted shrimp was \1,000～\1,500/kg, except in 1997 and 1998.

In 2002, however, the real price rose to \2,000/kg; it continued to rise until 2008 despite the fact that catches remained stable at a level below 2,000 tons until 2008. Subsequently, the real price of spotted shrimp exceeded \3,000/kg in 2009 and 2010 when catches decreased, and it reached about \4,300/kg in 2010. As a reaction to the steep rise, the real price began to fall in 2011. Nonetheless, the price level after 2002 was unprecedentedly high.

To confirm the above trends, the correlation between catches and real prices was examined. The spotted shrimp fishing seasons in the Suruga Bay area are spring (between late March and early June) and autumn (between late October and late December). The price of catches in the autumn season varies greatly because" spotted shrimps caught in the autumn season are [a] mixture of small ones born in the current year and big ones born in the previous year. "[3] For this reason, the relationship between catches and prices during the spring season was examined. Figure 2 shows the results.

As the figure shows, negative correlations exist between catches and prices. There are clear differences between the situation before 2001 and that after 2002. The regression line shifted to a higher level after 2002, which was indicative of the growing demand for spotted shrimp and commercialization of new products. Therefore, the research covered recent activities associated with product commercialization of spotted shrimp by fisheries and process manufacturers.

3．Producers 'responses to the market

(1) Technology improvements in the fishery production process to maintain freshness of catches

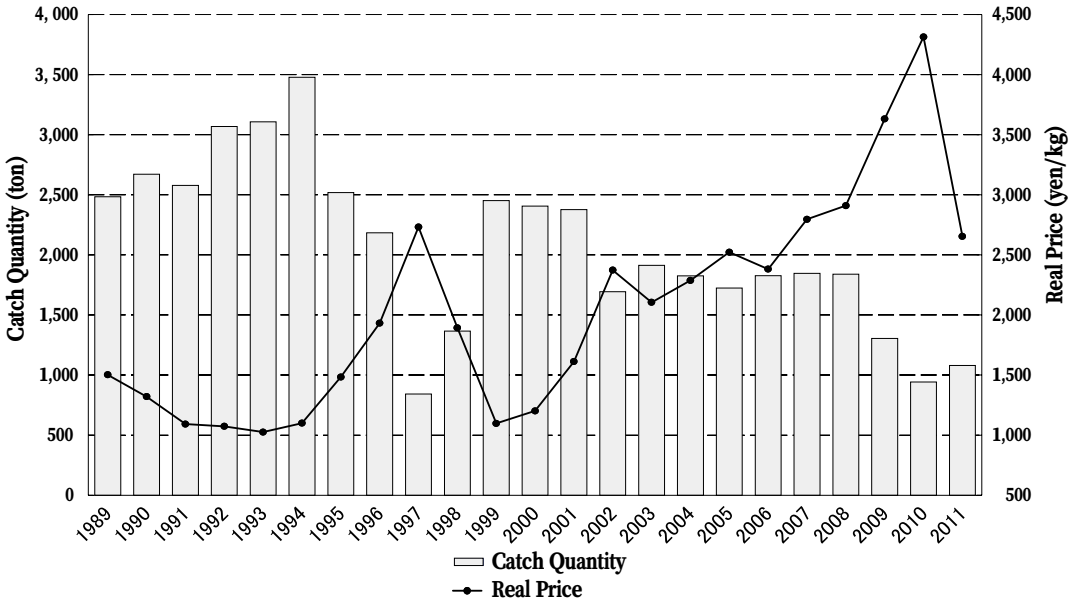

Fig1； Catch quantity and real landing price of spotted shrimp in Suruga bay area

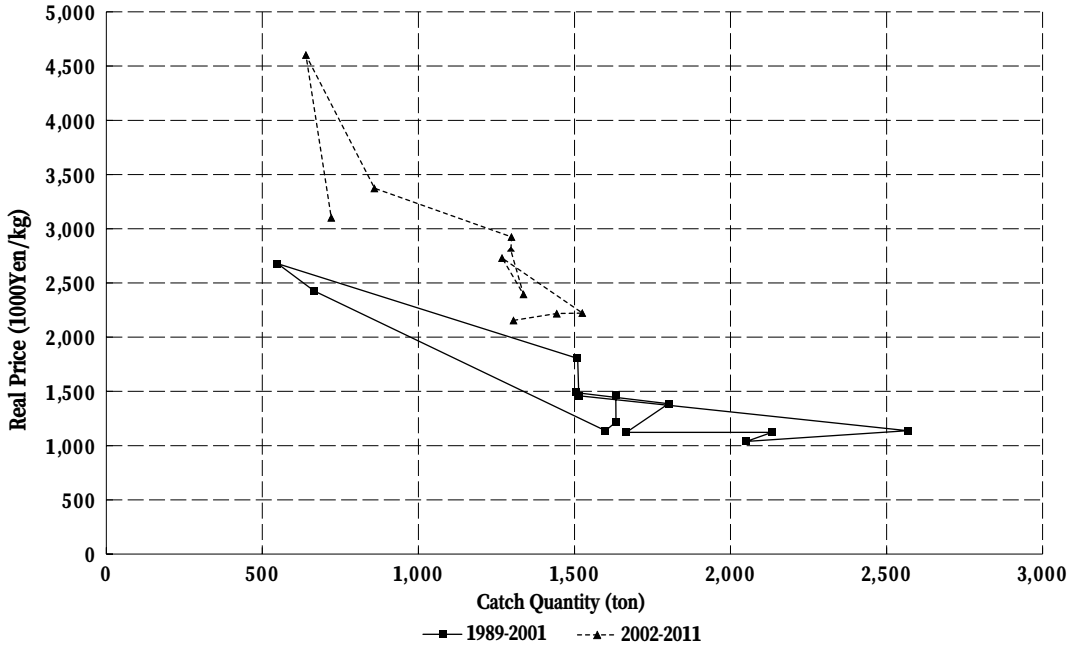

Fig2；catter diagram about the relations of catbh quantity and the real price about Spotted shrimp in Suruga Bay area Source；Note; Op.cit

Timing for the typical spotted shrimp fishery operation is as follows: 1) leave port at 17:00, 2) operate at sea for 4-5 hours, 3) return to port at 22:00, 4) land the catch, and 5) prepare for bids to sell catches, starting at 6:00 the next morning. In the past, landed shrimp were left on ice for several hours in fish boxes covered with sheets until sales began. However, decreased quality and loss of freshness led to a certain degree of criticism, even when the shrimp were dried in the shade. It grew more serious when raw diets of spotted shrimp began to attract attention.[4)]

Consequently, the Yuiko Fisherman's Cooperative Association began the"evening sales system"in 1988, permitting fisheries to sell catches that had landed earlier by designated fishing ships to designated process manufacturers at night. This system is suitable for producing Kamaage products (freezing boiled shrimp) and fresh products (freezing fresh shrimp) obtained while shrimp is still fresh. In fact, the system has resulted in an increase in bid prices, but it has triggered the objections that only a small amount of shrimp has been available for sales and only a few process manufacturers have been allowed to participate in the bidding.

In 1990, Yuiko Fisherman's Cooperative Association installed a refrigerator to store spotted shrimp; a greater level of freshness was maintained until the next morning and the raw material of Kamaage products and fresh products was still suitable for consumption. However, the refrigerator could store a maximum of 200 boxes (15 kg per box), representing merely 10% of daily landed catches. Of course, expanding refrigerator capacity and increasing the number of refrigerators were discussed, but neither improvement was realized because the area of the fishing port was too small to provide sufficient space adjacent to the pier.

In 2001, a drastic and original measure solved the problem. Accordingly, the handling area for catches, adjacent to the landing pier, was refurbished as a refrigeration location. As Photo 1 shows, fans circulating cold air were installed on the ceiling of the handling area. After catches are delivered to the handling area, shutters are closed

to block it off and the fans are turned on to cool it down. This measure was epic and technologically innovative; subsequently, the freshness of all landed spotted shrimp could be maintained.

At the same time, a fishing pump was provided for every fishing ship in 2001, and it contributed greatly to the spotted shrimp fishery in three ways: 1) preventing spotted shrimp from damage upon landing, 2) reducing the number of crew owing to decreased workload and operation costs, and 3) shortening the time for landing owing to improved operational efficiency and freshness of shrimp. In addition, three actions to increase freshness and quality were implemented in this period: 1) usage of special plastic fish boxes, 2) prompt warehousing of catches using fish pumps, and 3) usage of sterile rubber gloves. That is, the improvements in freshness and quality of spotted shrimp landed in this area have been drastic since 2001.

(2) Product shift by process manufacturers in the production area

In response to the new approach of fisheries (described above) , process manufacturers for the production area that purchased spotted shrimp as a raw material shifted from primarily dried products to Kamaage products and fresh products. Results of interviews with several process manufacturers indicated that consumption of spotted shrimp products changed, as shown in Table 1. In the first half of the 1990s, dried products accounted for 60%, Kamaage products for 30%, and fresh products for 10%. By 2010, however, dried products accounted for 30%, Kamaage products for 50%, and fresh products for 20%.

Dried products were dominant in the past for four reasons: 1) they were traditional and basic; 2) processing was easy, requiring no special skill or experience; 3) additional equipment and investment was not required when a suitable bawn was secured; and 4) drying raw spotted shrimp was optimal for shrimp that were not particularly fresh or high in quality. Why did the share for Kamaage products and fresh products increase, while the share of dried products decreased considerably? Three reasons should be mentioned: 1) producing dried products became less profitable because of increasing prices for raw spotted shrimp; 2) raw spotted shrimp improved in freshness and quality, thus becoming usable for Kamaage products and fresh products; and 3) Kamaage products and fresh products were in great demand.

As Table 2 shows, the sales prices of dried products were about \7,000～\8,000/kg during the first half of the 1990s, whereas the price of raw material (spotted shrimp) was about \1,200/kg. Because the yield of dried products was about 23%, the total cost of raw material cost associated with production of dried products was slightly greater than \5,200/kg. The difference between the price of dried products and the raw material cost was \1,800～\2,800/kg. It brought a substantial profit to the producer despite processing costs.

However, the price of raw material has more than doubled recently. For example, the price of raw material was about \3,400/kg in 2009; thus, scarcely any difference exists between the raw material cost and the sales price shown in Table 2. In fact, the profit margin for dried prod-

Table 1 ; The Output Rate of Processed Spotted Shrimp Items n Suruga Bay Area

	The first half of 1990's	Around 2000	Around 2010
Dried Products	60%	50%	30%
Kamaage Products (Freezing Boiled Shrimp)	30%	30%	50%
Fresh Product (Freezing Fresh Shrimp)	10%	20%	20%

Sourse; By hearing to some processors

Table 2 ; The difference of Sales price from material cost in dried Products processing

(Unit;Yen/kg)

	The first half of 1990's	Around 2000	Around 2010
① Material Price (Spotted Shrimp Landing Price)	1,200	2,500	3,600
② Material Cost per kg of Dried Products (①/0.23)	5,217	10,870	15,652
③ Sales Price (Dried Products Price at Forwarding)	7,000～8,000	12,000～13,000	15,000～16,000
③ － ②	1,783～2,783	1,130～2,130	-652～348

Source;Op.cit

ucts has decreased drastically, creating a concern about the risk of a negative profit margin. Accordingly, pro-cess manufacturers had to reduce the production of dried products. In addition, dried products sales have been sluggish lately because of increased pri ces that resulted from increased raw material costs.

We became interested in the reason for increased production of Kamaage products and fresh products in light of the increases in sales prices and raw material costs. Consequently, the management and technology aspects associated with process manufacturing were examined.

As for the management aspect, Table 3 shows the sales prices of Kamaage products and fresh products as \1,500～\1,600/kg and \2,500/kg, respectively, whereas the price of raw material is shown as \1,200/kg, as mentioned above, in the early 1990s. Because the yield rate of Kamaage products is about 85%, the raw material cost of Kamaage products is \1,412/kg, resulting in a difference of \88～188/kg between the sales prices and the raw material costs. Additionally, raw material can be sold in the form of fresh products after refrigeration (i.e., yield rate of 100%), resulting in a difference between the sales prices and the raw material costs of approximately \1,300/kg. In those days, producers anticipated a certain profit margin from sales of Kamaage products, fresh products, and dried products. Cost analyses were performed in 2010 to evaluate the effect of skyrocketing raw material costs. The difference between the sales prices and the raw material costs at that time was \265/kg for Kamaage products and \600/kg for fresh products. Put simply, process manufacturers have secured a certain level of profit recently for both Kamaage products and fresh products. As a result, they have stopped producing dried products because of poor profitability and have shifted their focus primarily to Kamaage products and fresh products.

Regarding the technology aspect, production of dried products is characterized by two obvious problems. Production is dependent on weather conditions, and the labor cost is high. On the contrary, both Kamaage products and fresh products can be produced on rainy days, although quality is compromised by block freezing. Additionally, block freezing is time-consuming, and cell tissues of spotted shrimp are destroyed; any drips created from thawing worsen the flavor. In recent years, however, individual quick freezing (IQF) technology〈technology for freezing shrimp quickly and individually〉has been applied to spotted shrimp; consequently, the special freezer was developed. This technological development has made it possible to produce high quality Kamaage products and fresh products without spoiling the original flavor of spotted shrimp. Furthermore, mechanization has resulted in reduced personnel costs for production of Kamaage products and fresh products. Because production of these products costs less per kilogram than production of dried products, which requires a larger workforce, it is not surprising that a product shift has occurred.

4. Demand trend of spotted shrimps

As Table 3 shows, the sales prices of Kamaage products and fresh products increased in conjunction with the steep rise in raw material prices. However, interviews with process manufacturers indicated that sales of Kamaage products and fresh products did not decrease despite increased sales prices. It shows demand for Kamaage products and fresh products had grown, and the upward

Table 3 ; The difference of Sales price from material cost in Kamaage Products and Fresh Products Processing

(Unit;Yen/kg)

	The first half of 1990's	Around 2000	Around 2010
① Material Price (Spotted Shrimp Landing Price)	1,200	2,500	3,600
② Material Cost per kg of Kamaage Products (①/0.85)	1,412	2,941	4,235
③ Sales Price (Kamaage Products Price at Forwarding)	1,500～1,600	?	4,500～4,600
③ － ②	88～188	?	265～365
④ Sales Price (Fresh products Price at Forwarding)	2,500～3,000	?	4,200～4,300
④ － ①	1,300～1,800	?	600～700

Source;Op.cit

shift of the regression line (Fig.2) reflects this fact.

Dr. Masato Ikematsu once conducted a nationwide survey on spotted shrimp and clarified that the species was rather famous, even in such remote areas as Sapporo and Fukuoka.[5] However, most consumers recognized the dried product form, and the presence of Kamaage products and fresh products was rather low except in the production area. In the first place, only a small amount of spotted shrimp was allocated for Kamaage products and fresh products because the raw form was not fresh. Accordingly, Kamaage products and fresh products were distributed rarely throughout the nation.

As mentioned above, however, the quality and freshness of spotted shrimp have improved since 2002, and increased production of Kamaage products and fresh products has resulted in increased recognition of the species by consumers. Kakiage on the Beach, the restaurant founded by Yui Fishermanꞌs Association inside the fishing port, serves Kakiage-don (a bowl of deep-fried shrimp with vegetables); reportedly, the customer base has been growing substantially. Of course, media coverage of restaurants and sushi bars serving fresh spotted shrimp has contributed further to the expanding demand.

The brisk demand for Kamaage products and fresh products is closely related to the wide variety of applications and excellent taste of spotted shrimp. Dried products are often used as ingredients in such dishes as okonomiyaki (savory pancake with various ingredients), yakisoba (fried soba), and kakiage (shrimp and vegetable fritters). Kamaage products are used widely as ingredients in chirashizushi (thin strips of egg, pieces of raw fish, vegetables, and crab meat served atop vinegared rice), salads, spaghetti, other vinegared dishes, chawanmushi (savory steamed egg custard with assorted ingredients), soups, and hors d'oeuvres (appetizers usually served with drinks), in addition to dishes that use dried products. Fresh products are used primarily for sushi and sashimi, though they are used also for kakiage. Because of the wide range of applications, Kamaage products and fresh products are sold by mass retailers to general consumers for use in restaurants (e.g., Japanese food restaurants, noodle cafes, Japanese-style pubs, and revolving sushi bars).

The questionnaire distributed by Ikematsu[6] clarified that kakiage is the most popular recipe using spotted shrimp; Kamaage products and fresh products are far better than dried products as ingredients of kakiage because of their texture and flavor.

In addition, Kamaage products and fresh products as foodstuff provide the restaurant industry with four advantages. First, they attract customers. As mentioned above, these products used to be exclusively local, but they have exhibited excellent appeal as unprecedented commodities when sold in various regions. Second, they can be used for a wide range of applications, as mentioned previously; thus, the restaurant industry prefers to utilize them for cost effectiveness. In addition, restaurants featuring spotted shrimp can design course menus featuring Kamaage products and fresh products. Third, IQF technology promotes convenience of use; it is no longer necessary to thaw frozen portions prior to cooking. In fact, IQF spotted shrimp is handled easily, and deterioration in flavor caused by thawing has been mitigated. Fourth, shrimp can be preserved for a certain period. Obviously, the product is not as suitable as dried products for long storage periods, but they can be stored in a refrigerator for about one month (suitable for storage stability of foodstuff used in the restaurant industry). Naturally, the advantages described above have expanded the demand for spotted shrimp.

5. Conclusion

The above survey results were summarized to support the objective of this paper—to analyze the factors that influenced increases in local prices of spotted shrimp.

The spotted shrimp species used to be recognized as a specialty product of the Suruga Bay area, but general consumers living in other areas associated the species with dried products. In fact, spotted shrimp were consumed mostly as dried products. After 2002, however, fishery operators improved the technology to manage freshness of harvested shrimp, and process manufacturers in the production area subsequently changed the main product line from dried products to Kamaage and fresh products. The demand for Kamaage and fresh products grew rapidly amid restrictions on catches of spotted shrimp imposed by fishery operators to maintain resources. As a result, local raw material prices of the species rose sharply. As the price of raw materials rose, production of dried products became less profitable; naturally, process manufacturers shifted their product line toward Kamaage products and fresh products.

Although I discussed the increasing demand for Kamaage and fresh products as well as the rise in raw material prices, several comments should be added regarding the future supply and demand trend of spotted shrimp. Demand for Kamaage products and fresh products has expanded geographically, and use of the products in industrial applications (e.g., restaurants) has grown as well. Accordingly, demand for these products is expected to remain steady for some time. As shown in Figure 1, however, the local price of spotted shrimp fell significantly despite the small catches in 2011. Therefore, demand is expected to be stable, but sharp price increases are expected to subside.

As for the supply prospect of spotted shrimp, estimating future catches of spotted shrimp in the Suruga Bay area is outside the scope of this paper. However, the long-term fluctuations of catches observed so far do not seem to indicate that a large increase in catches is likely in the future. At the same time, whether fishery operators in the Suruga Bay area can maintain the high prices and revenues realized by monopolizing the supply remains unclear. There is an increasing possibility that Taiwanese spotted shrimp will be imported in the form of dried products, Kamaage products, and fresh products; further, the import volume of Taiwanese spotted shrimp should increase in the future.

Interviews with process manufacturers of spotted shrimp in the Suruga Bay area revealed that many of them avoided increasingly difficult management situations owing to dwindling profit margins caused by the increase in prices of raw materials in recent years and additional investment required by the product shift. Several fishery operators indicated that they were considering withdrawing from processing spotted shrimp should the prices of raw materials remain high. Under the present circumstances, many process manufacturers have shown an interest in low-priced Taiwanese spotted shrimp, and some of them repack Kamaage products and fresh products processed in Taiwan and sell them as in-house products.

Spotted shrimp imported from Taiwan were traditionally limited to dried products because of inadequate Taiwanese management of freshness and sanitation. In recent years, however, Japanese process manufacturers have been giving technical guidance to Taiwanese manufacturers, and the quality of Kamaage products and fresh products has been improving steadily. Accordingly, it will be necessary in the future to conduct an analysis regarding the trend of importing Taiwanese spotted shrimp and its competitive impact on sales of Japanese spotted shrimp.

Notes

1) See Nakamura et al. [2], Baba et al. [4], Matsui [5], etc for management of spotted shrimp fishery in Suruga Bay
2) See Ikematsu [1], [3], for tha market and circulation of spotted shrimp
3) See Baba et al. [4], p11-12
4) Raw diet described in this paper means it as the ingestion of Kamaage and fresh product. In addition, Kamaage product freezes the boiled shrimp and fresh

product freezes the fresh shrimp.

5）See Ikematsu [3], P136-137

6）Ibid. P137-138

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