

# CRUSTACEAN CULTURE<sup>1</sup>

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## SHRIMP, *PENAEUS JAPONICUS*

One of the most valuable marine species in Japan is the "kuruma-ebi," *Penaeus japonicus*, shrimp fishery, which commands a price of 7-30 U.S. dollars per kilogram, at the Tokyo Central Fish Market. Although this price is high compared to U.S. prices, it is due to the fact that the Japanese people demand live shrimp for the preparation of a delicacy known as tempura.

Over the years much time has been spent developing methods of holding this species in ponds and rearing it to market size. Even though the Japanese have successfully reared shrimp through several generations, they explained that it was not economical to rear shrimp to sexual maturity because it was time consuming and because the fecundity of the females was reduced. Therefore, gravid females are purchased directly from the commercial fishing fleets and then spawned.

Once the eggs have hatched, the water is fertilized to stimulate the growth of diatoms. Predetermined amounts of fertilizer and seawater are added each day to the tank until the larval shrimp have reached the last mysis stage. Brine shrimp nauplii (*Artemia* spp.) are fed from the last mysis stage through the fourth postlarval stage. The shrimp are then fed fresh meats of clams (*Venerupis philippinarum*) and mussels (*Mytilus edulis*), which are crushed and distributed throughout the ponds. Because it is too costly and time consuming to separate the crushed shell from the meats, the shell eventually covers the pond bottom, resulting in a substrate that hampers the burrowing of the shrimps. Thus, ponds must be drained or dredged periodically to remove the shell debris.

Although larval rearing techniques are primarily the same today as they were 10 yr ago, research in

shrimp culture has been expanded due to three important factors: 1) the rising demand and costs for fresh food items to be fed to the shrimp; 2) the rising wages of employees; and 3) disease problems encountered.

Of particular interest is the use of a by-product of soy sauce production, a cake which is ground into powder to fertilize the water. Not only does it stimulate the growth of diatoms, but the larval shrimp also eat it. As the shrimp grow in size, this powder is either extruded or pressed into a size suitable for eating. At the Kagoshima Prefecture Fisheries Experimental Station, the Director, K. Shigeno, remarked that although the shrimp ate this artificial food and grew to market size, the consumer was not satisfied with the quality or color of the prawns. He felt that the problem was primarily a vitamin deficiency. Artificial foods with a variety of additives are being tested at Shigeno's laboratory.

Research is also being directed toward rearing prawns to market size in a closed system. A 1,000-m<sup>3</sup> cement tank (23 m in diameter and 3 m deep) has been built at the Tarumizu Kagoshima Prefecture Fish Experimental Station. The water temperature can be controlled, and a false bottom with airlift pipes has been installed as an in-bottom filter. Twenty-day-old postlarval shrimp have been stocked in this tank and reared to market size with good results. However, during two recent experiments a number of problems occurred, resulting in poor production.

Circulation of the water mass within a rearing system was emphasized for either fish or shrimp culture. At Tarumizu Kagoshima Prefecture Fish Experimental Station the flow was maintained with water jets, while a large mechanical stirrer was being tested at Setonaikai Saibai Gyogyo Center, Tamano Jigyojo.

At the Nansei Regional Fisheries Research Laboratory, H. Kurata spoke about the natural waves of *P. japonicus* postlarvae that enter the estuaries. Monitoring of these waves now indicates

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that recruitment is presently less than in previous years. The total tonnage landed by the commercial shrimp fleet is also down. Therefore, the concept of seeding the system with ( $1.2 \times 10^8$ ) 20-day-old post-larval shrimp is being tested to see if the system is still a suitable environment, if production of shrimp can be stimulated and if new areas can be used. Some shrimp are released directly into the nursery grounds, while others are placed in a pen ( $30 \times 10 \times 10$  m) for 2 to 4 wk to acclimate them to estuarine waters.

M. Fujiya, also of the Nansei Laboratory, began physiological studies to measure the "quality" of shrimp larvae reared in different ways, by observing their reaction to anesthetics. His approach is to insert electrodes into the brain of the shrimp and record their brain waves on an oscilloscope.

H. Hirata, at Kagoshima University, has begun work on the production of single-species mass cultures of diatoms and their preservation. At present, diatoms are concentrated and later frozen at 0°C. They can be held successfully for periods of 30 days or less. Various other techniques are now being tested.

Table 1 is part of a statistical report, translated by Jiro Tanaka. Of particular interest is the number of tons of *P. japonicus* cultured. Since 1967, annual production has been about 300 tons. Although some live shrimp are imported, the tonnage is far below the market demand. The importation of frozen shrimp has no direct bearing on the live shrimp market.

### CRABS, *PORTUNUS TRIBERCULATUS*

Crabs, primarily *Portunus triberculatus*, have been reared successfully to the 5th generation at the Yamaguchi Fisheries Experimental Station. *P. triberculatus* is similar to the American blue crab, *Callinectes sapidus*. Larval crabs in the zoea I-III stages are fed rotifers, *Brachionus plicatilis*, which are maintained on freshwater cultures of *Chlorella*.

Older stages are fed *Artemia*, chopped fish, and crushed clams. Since crabs are active and difficult to maintain in a barren enclosure, a series of vertical netlike structures were placed in the rearing pond. The growth of natural filamentous algae upon these structures serves as a hiding place for the crabs.

Unfortunately, fighting over territories and food results in a high rate of mortality in the pond. Harvesting is accomplished by draining the pond and raking the crabs, a process which is time consuming. Although the price of these live crabs in United States is \$1.10 each, their culture is not yet economically profitable in Japan.

A number of prefectural laboratories rear crabs to the megalops stage and release them into estuaries.

### FRESHWATER SHRIMP, *MACROBRACHIUM* SP.

At the Tokyo University of Fisheries, Ogasawara and T. Sano discussed the culture of freshwater shrimp of the species *Macrobrachium*. Eleven different species were being studied. To rear the larval stages, they indicated that a medium of 50% fresh water and 50% seawater was necessary. A diet of *Artemia*, reared on a freshwater culture of *Chlorella*, is fed during the larval stages along with ground clam (*Tapes* sp.) meat. When the shrimp are older, pieces of chicken egg shells are added to supplement the calcium in their diets.

Juveniles of *Macrobrachium rosenbergi* have been reared on commercial trout pellets to market size in 6 mo at the Izu Branch Laboratory. Although results have been satisfactory, production costs were not made available.

### SPINY LOBSTER, *PANULIRUS JAPONICUS*

At Kanagawa Prefectural Laboratory, research on the spiny lobster, *Panulirus japonicus*, is being conducted. Of particular interest is the work of Inoue who has found that the phyllosoma larvae will

Table 1.—Annual production (in metric tons) of cultured, naturally caught, and imported *Penaeus japonicus*, 1965-69.

Source	1964	1965	1966	1967	1968	1969
	-----Metric tons-----					
Cultured	154	95	211	307	311	295
Natural catch	3,184	3,010	2,479	2,338	1,884	1,585
Imported <sup>1</sup>	17,087	21,011	36,156	44,466	32,204	48,886

<sup>1</sup> Prawns in general.

feed on the arrow worm, *Sagitta*, which is collected from the natural habitat. After a number of days, the larvae are then fed *Artemia* nauplii. Although phyllosoma larvae have been reared in 180 days, their size is smaller than those found in nature. They have not yet reared the larvae to the benthic stage.

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Their pleasant attitude, cordial response, and voluntary gesture of discussing their research clearly signified the willingness of the Japanese to cooperate on this joint venture of mariculture.