

THE WARMWATER CRAB FISHERY IN ASIA

*Implications for the Chesapeake Bay
Blue Crab Industry*

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and
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Maryland Sea Grant Extension Program
Virginia Sea Grant Marine Advisory Program

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INTRODUCTION

The Chesapeake Region of the United States is one of the main blue crab producing regions in the world. In 1992, the blue crab harvest was 52 million pounds with an ex-vessel value of nearly \$24 million. This represents 27% of the total U.S. landings and value, though it was the lowest harvest from this region since 1978. In 1991, the Chesapeake region's harvest was 43% of U.S. landings. Landings in 1993 will probably be closer to the 1991 levels than 1992 landings. While the Chesapeake harvest can fluctuate largely from year to year, it does not display the dramatic increasing trend of the other U.S. producing regions, the Mid-Atlantic, the South Atlantic and Gulf of Mexico. Production from these areas has increased steadily in the last decade. The prospects for increased harvests from the Chesapeake Region appear dim unless management actions are undertaken to increase yields.

In addition to increased competition from domestic producers, Chesapeake producers have also experienced increased competition from abroad. The competition is not only from other blue crab producers, but from countries producing crab products that are close substitutes for blue crab.

The production and marketing of crab and crab products have become a significant factor in the world's fisheries market. During the 1980s, total landings of crab have increased by some 40%. International trade in crab and value-added crab products has risen significantly in quantity and in value. Exports of fresh, chilled, or frozen crabs alone are worth more than \$870 million annually (FAO 1993).

This report on worldwide crab production is an overview of the recent trends in crab landings, output of crab products, harvesting methods and export markets of the Asian brackish and warmwater marine crab species. Its objective is to assess the international activity of the Asian warmwater marine crab industry and its potential impact on the Chesapeake Bay crab industry. The findings are based on an April-May 1992 field survey of several crab producing countries, in particular, Hong Kong, China, Malaysia and Thailand. Political instability at travel time prevented a trip to the Philippines and time constraints affected travelling to Indonesia. Site visits were

conducted at resource habitats, landing sites, processing plants and wholesale and retail markets. Meetings and interviews were held with fishermen, processors, distributors, buyers and brokers. Two seafood trades shows — the Thailand Food Fair in Bangkok and Sea Fare in Long Beach, California — provided additional information on import marketing strategies and retail packaging.

WORLD CRAB RESOURCES

All crabs are decapod crustaceans, a large order of invertebrates which also includes lobsters and shrimp. Though there are hundreds of crab species, only a small number are of commercial importance; these include the king crab, tanner (snow) crab, dungeness crab and blue crab.

Production

While the king crab currently commands the highest prices, *Portunus* spp. and blue crabs are the most important in terms of volume, each accounting for approximately 40% of world production (Table 1). The primary region for crab harvests is the northern Pacific, though crab resources provide fisherman an important source of income in most of the world's oceans, as the following summary indicates:

NW Atlantic: most stocks fully exploited

NE Atlantic: status unknown, but catches fairly stable

WC Atlantic: moderately exploited by United States and Mexico; potential in some areas

NE Pacific: king crabs overharvested to depleted; tanner crabs fully-to-heavily exploited

Table 1. Yearly crab landings by species, 1982-1991 (1,000 mt).

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Tanner	89.2	77.6	71.7	92.5	106.3	88.0	103.8	106.0	127.6	205.0
Blue	99.9	94.9	100.1	93.8	90.1	96.6	107.5	102.0	100.5	111.7
King	40.3	36.6	38.4	40.1	49.8	53.1	54.6	54.5	57.9	53.7
<i>Portunus</i> spp.	56.4	58.3	64.4	64.8	79.8	193.5	189.8	228.1	216.1	227.1
Edible	23.4	27.0	28.3	29.8	26.2	29.0	29.3	27.0	28.2	26.2
Dungeness	15.8	14.0	12.5	14.0	11.5	15.0	23.1	19.8	16.4	12.0
Others*	466.4	480.5	554.5	553.0	535.6	499.0	546.7	629.3	596.5	712.6
Total	791.4	789.0	870.0	888.0	899.3	974.1	1054.7	1166.6	1143.2	1348.3

*Includes those whose species is not specified in the national statistics.

World crab production is concentrated in a few countries. At nearly 660,000 metric tons in 1991, China now accounts for almost half the world's crab catch, while the United States and Japan make up another quarter (Table 2). Though little is known about the composition of species harvested in China, a large majority of harvested crabs are for domestic consumption. The U.S. continues to retain its central commercial position in crab production: it is the world's second largest harvester, the most important exporter and the second largest importer. U.S. crab landings have risen steadily, with blue crab harvests remaining at sustained levels and snow crab harvests rising to make up for the decline in king crab resources (Globefish 1990).

With the increasingly heavy exploitation of popular crab resources throughout the world (Table 3), and their potential declines, the industry has been examining techniques for maintaining growth. One consideration is the development of crab aquaculture, particularly in Asia, with China and Thailand taking the lead; some interests are targeted at spawning commercial species while others are implementing the grow-out of wild caught animals. A second consideration is the export of underutilized Asiatic crab species to Europe and the United States. Indications that crab has become an increasingly important seafood commodity is reflected in a recent report that

Table 2. Crab landings by main catching nations, 1981-1989 (1,000 mt).

	1983	1984	1985	1986	1987	1988	1989	1990	1991
China	270.4	344.3	339.5	328.3	413.2	449.9	582.1	538.4	659.6
USA	143.8	141.9	153.1	161.3	173.4	206.7	207.9	226.5	294.3
Japan	100.9	97.7	99.6	94.8	78.1	70.2	65.7	60.6	64.9
Canada	43.2	44.5	45.2	44.4	29.5	33.0	25.0	79.9	53.5
Korea Rep	25.5	36.9	37.7	46.8	45.8	51.9	53.8	38.2	44.4
USSR	24.6	30.5	32.7	37.9	39.7	44.8	41.9	41.7	39.8
Thailand	28.6	27.1	26.8	35.6	31.2	33.9	25.0	28.8	38.0
Brazil	18.6	18.6	23.1	19.0	19.7	21.0	17.7	17.6	18.0
Philippines	27.7	20.1	17.7	18.2	15.1	18.8	16.9	15.1	17.6
UK	14.4	17.2	16.1	14.5	16.6	17.0	14.3	16.2	17.4
France	16.7	14.6	15.2	12.3	14.5	11.7	11.7	14.8	15.0
Vietnam	13.1	14.1	14.40	14.8	15.0	15.0	15.0	11.5	10.2
Rest of World	57.8	57.3	66.8	68.2	71.4	74.4	57.1	53.9	75.5
Total	785.3	864.8	888.0	899.5	963.2	1048.3	1146.4	1143.2	1348.3

shrimp sales in supermarkets have weakened because of increased sales by cost competitive crab products (Globefish 1992). It is likely that this competition will continue to increase.

In general, crabmeat is low in fat, high in protein and is an excellent source of minerals and vitamins. In many developed countries, it is considered a quality luxury food and brings a relatively high price. In the United States, crab is served more in restaurants and hotels than at home; consumption is heaviest among higher income and well educated groups in the mid-Atlantic and west coast areas (FAO 1990).

Crabmeat is an extremely versatile and adaptable commodity and can now be found in a number of value-added products worldwide. Examples include several dishes using crab as an "au gratin" in France, stuffed snapper fillets and crabcakes in the United States, fish soup with crab in Chile, and the new crabmeat paella of Spain.

WORLD TRADE

Japan is the leading importer of crab; accounting for over \$692 million in crab products in 1991 (Table 3) (FAO 1991). The United States accounts for half the balance of world crab imports while France, Spain and Canada are the other major importers of crabmeat commodities (FAO 1992).

Table 3. Major importers of crab (fresh, chilled or frozen).

	1989		1990		1991	
	1,000 mt	\$ mil.	1,000 mt	\$ mil.	1,000 mt	\$ mil.
Japan	73.2	487.8	86.1	634.4	115.0	692.4
France	10.4	28.6	12.7	34.8	13.3	34.6
Spain	7.6	26.6	9.0	30.4	9.8	32.0
Hong Kong	6.8	20.7	7.5	24.0	8.6	31.4
USA	6.2	51.0	5.9	44.0	3.8	25.3
Canada	1.7	14.2	1.4	11.1	1.6	11.3
Portugal	1.6	3.5	1.9	6.0	2.2	8.0
China	0.1	0.1	0.1	0.2	1.5	7.7
Malaysia	3.7	4.3	4.7	6.0	6.4	6.2
Korea Rep.	0.8	5.0	2.0	6.8	1.4	5.8
Italy	0.8	3.8	0.8	4.3	1.0	4.7
Germany	0.4	2.0	0.7	4.4	0.6	3.6
Sweden	0.5	2.3	0.5	3.0	0.5	2.8
Belgium	0.2	0.6	0.2	1.7	0.3	2.3
UK	0.5	2.1	0.3	1.5	0.3	1.3
Thailand	0.5	2.1	0.3	1.5	0.3	1.3
Netherlands	0.1	0.8	0.1	0.8	0.2	1.0
Other Asia	0.3	1.1	0.3	1.0	0.4	0.9
Others	1.7	7.3	3.0	11.1	4.1	18.7
Total	117.1	664.0	137.4	827.1	171.4	891.4

The United States is the chief source of crab for the Japanese, with China and Russia close behind. Alaskan king crab is the premium product, though live snow crabs are packed in sawdust and flown from Alaska to Japan with prices of more than \$12 a pound. Japan imports small quantities of soft crab from the U.S. east coast and Gulf of Mexico; these crabs are primarily for seafood specialty restaurants rather than for retail markets. Cooked frozen whole blue crab is also beginning to make an appearance in Japanese markets.

Despite huge crab landings, the United States still imports great quantities of crabmeats and products: in 1993, imports of fresh and frozen crab were over \$150 million (Table 4; NMFS, unpublished data). Canada and Chile are currently the major sources of whole crab and crabmeats; Thailand and Indonesia provide the largest portion of canned crab (NMFS unpublished data).

France is another important market for crab, with imports having grown to 9,000 metric tons – the United Kingdom provides nearly 80% of these imports. France also imports sizeable quantities of canned crabmeat from Thailand. In recent years, Spain and the Federal Republic of Germany have also dramatically increased their crab imports, largely from the United Kingdom and Thailand; Turkey is the main supplier of live crab.

In 1990, 46% of crabmeat imports by the European Economic Community (EEC) were from Asian countries; the two primary sources were Thailand (39%) and China (6%) (Infofish). EEC imports of Asian crab products including value-added products should continue to increase over the next decade.

Table 4. Value of U.S. crab imports by species and country, 1993.*

		\$ mil.
Dungeness Crab	Canada	.69
	Chile	.01
	Thailand	.01
	<i>Subtotal</i>	.71
<hr/>		
Crab	Chile	.51
	Canada	1.76
	Russia	12.49
	Other	.35
	<i>Subtotal</i>	15.11
<hr/>		
Tanner Crab	Canada	25.37
	Korea Rep	2.15
	Other	.97
	<i>Subtotal</i>	28.49
<hr/>		
Not Specified	Canada	52.45
	Russia	3.97
	Thailand	9.76
	China	3.38
	Chile	18.38
	Korea Rep	2.87
	Mexico	4.96
	Venezuela	9.85
	Other	7.80
<i>Subtotal</i>	106.41	
<hr/>		
Total		150.72

*National Marine Fisheries Service (unpublished data).

MARINE SPECIES OF COMMERCIAL IMPORTANCE IN ASIA

Scylla serrata (Forsk.)

Common names: Mud crab, serrated swimming crab, mangrove crab, Samoan crab, green crab.

Distribution: Throughout the Indo-Pacific region, from Hawaii, southern Japan, Taiwan and the Philippines to Australia, the Red Sea and South Africa.

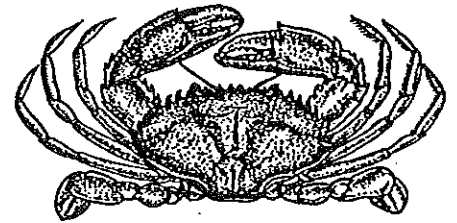
Habitat: Muddy bottoms in the brackish water along the shoreline, mangrove areas, river mouths, estuaries and shallow bays.

Harvesting: Commonly caught with gill nets or traps (pots) baited with fish scrap and set on bottoms in brackish water.

Technology: Current culture projects can be found throughout Asia. Practice involves growout in brackish water or tidally-fed ponds. Sometimes found as polyculture with milk fish (*Chanos chanos*). A cottage industry, with some movement towards large-scale operations.

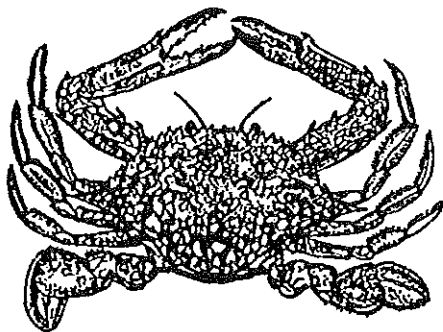
Marketing: Currently a product that is high in demand and price. Primarily an indigenous market favorite, accelerated export movement to Japan as whole live or frozen halves. Females are preferred. Aggressive culture may create new marketing opportunities worldwide.

Biology: *Scylla serrata* appears to be the largest known crab species from the nearshore and brackish water habitats. The carapace breadth is reported to reach over 200 mm (8 inches), with the cheliped span at 800 mm (31.5 inches). One distinguishing feature is the nine sharp acuminate teeth on each side of the anterolateral borders. The chelipeds are very large with powerful chelae; the second to fourth pairs of legs are normal with the fifth pair serving as the



Scylla serrata (Forsk.)

paddle legs. The carapace and appendages are greenish gray. It tolerates salinity fluctuations and is found in abundance in brackish water areas. *Scylla serrata's* fast growth it has stimulated the recent development in cultivation.



Portunus pelagicus (Linnaeus)

Portunus pelagicus (Linnaeus)

Common names: Blue swimmer, swimming crab.

Distribution: Throughout the Indo-Pacific waters from southern Japan, China, Tahiti, Australia and westward to Africa.

Habitat: Lives on sandy or sand/mud bottoms from shallow brackish water to depths beyond 40 m (13 feet). Commonly found on sand flats bordering grassy areas.

Harvesting: Captured with crab traps (pots), gill nets and trawlers from interior portions of the bay to well offshore. Seines, trot lines and lift nets are also commonly used in some countries. A frequent by-catch product.

Technology: Some companies are just beginning to experiment with shedding systems. Also new harvesting techniques and quality control (refrigeration) are being implemented.

Marketing: Currently enjoying a receptive domestic market where it is sold live or dead. Export markets are increasing rapidly to the U.S., Japan and Europe. Export products are sold as frozen halves, pasteurized, canned or frozen block meats.

Biology: *Portunus pelagicus* is one of the larger species of crab, next to *Scylla serrata*, growing to about 180 mm (7 inches) across the carapace. The last pair of legs are the paddles, while the three pair in front are normal — this positioning is shared by all members of the family Portunidae. It has a spine at the far end of the arm border of the cheliped. The anterior pair of the abdominal appendages of the male are straight, with no bend at the tip. The carapace is pinkish/blue in males with the females having a sand color. Both have extensive white spots spread throughout with a deep purple on the legs. The breeding period is September to March in the Indian Ocean and China Sea.

Portunus (Neptunus) sanguinolentus (Herbst)

Common names: Sand crab, blood spotted swimming crab, blue swimming crab, red spotted swimmer.

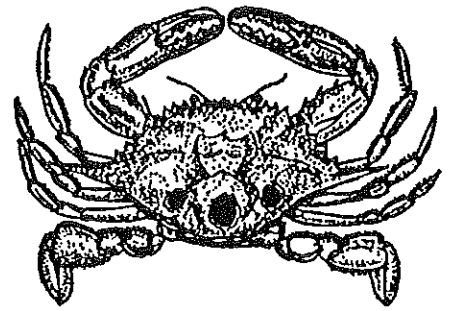
Distribution: Range is from Hawaii southward to Polynesia, west towards Micronesia, Japan, China, Philippines and into the Indian Ocean towards the coast of Africa.

Habitat: Lives on a sandy or sand/mud bottom mostly along coastal shorelines.

Harvesting: Lift nets, seines and some trapping (pots). A frequent by-catch product.

Marketing: Sold in local markets live and dead. Receiving some commercial attention in many countries as an export product. China has good resource populations in the south and packs the meat in frozen blocks. May be an important product.

Biology: *Portunus sanguinolentus* is a small crab averaging about 130 mm (5 inches) with a maximum of 150 mm (6 inches) across the carpace. Its antero-lateral border has nine spines with the posterior the longest. There is no spine on the posterior end of the arm of the cheliped. Behind the chelipeds, the three legs are normal, with the last pair the paddles. The colors are dark grey with three red round spots on the posterior of the carapace. Each spot is circled by a white ring giving it a distinguished color.



Portunus (Neptunus) sanguinolentus
(Herbst)

Charybdis feriata (Linnaeus) *cruciata* (Herbst)

Common names: Mask crab, coral crab, christian crab, crucifix crab.

Distribution: Ranges from Hawaii, Japan, China, Philippines, India, Madagascar to the east coast of Africa.

Habitat: Inhabits sandy shores during young-of-year stage, but prefers offshore sand/mud bottoms.

Harvesting: Primarily a by-catch product from offshore trawlers with some increased activity towards seining and trapping.



Charybdis feriata (Linnaeus) *cruciata*
(Herbst)

Marketing: Local market value but commercial value still needs further development.

Biology: *Charbydis cruciata* will grow to 150 mm (6 inches) across the carapace. The length of the carapace is not as long as its width. The anterior abdominal appendage in the male is almost as straight with a blunt tip and hairs on the outer margin. The color of the carapace is brownish/red with a purplish tinge and conspicuous yellow markings of which the central one is a cross, thus the name christian crab. The appendages of both the male and female are brown.

Thalamita crenata (Latreille)

Common name: Crenate swimming crab.

Distribution: The entire tropical Indo-Pacific area from Hawaii, western Pacific, Indian Ocean, Red Sea to the coast of Africa.

Habitat: Mud flats, muddy beaches, river mouths, mangrove areas and brackish waters.

Harvesting: Mostly caught by small trawlers, seiners and some trapping (pots).

Marketing: Sold alive or dead in local markets.

Varuna litterata (Faricius)

Common name: Shore crab.

Distribution: From Japan to India, Madagascar and the east coast of Africa.

Habitat: Sometimes clings to floating debris (i.e., coconut shell, timber). Usually inhabits brackish water areas, mangrove creeks and canals. Megalopa can be seen swimming upstream through river mouths.

Harvesting: Mainly caught with baby trawlers, seines or weirs.

Marketing: A small crab with little commercial value; females with eggs are preferred. Sold live or dead in local markets.

Birgus latro (Linnaeus)

Common names: Coconut crab, robber crab.

Distribution: Indo-Pacific region

Habitat: A hermit crab that has left the sea and inhabits terrestrial areas; can climb coconut trees. Females migrate to sea for spawning.

Marketing: Seldom seen in local markets as overharvesting has caused serious depletion. In danger of extinction.

Ranina ranina (Linnaeus)

Common names: Kona crab, red frog crab, spanner crab.

Distribution: Indo-Pacific region, from Hawaii, Japan, Philippines through the Indonesian archipelago, to eastern Africa.

Habitat: Sandy bottoms, from shallow water to over 30 m (10 feet).

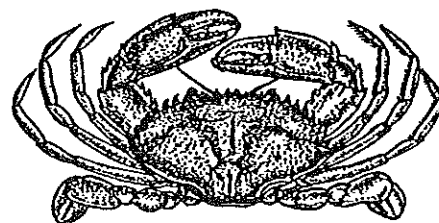
Harvesting: Caught by gill net or crab trap.

Marketing: A high priced crab with heavy demand; commonly served in restaurants. Export is increasing in some countries.

Importance of *Scylla serrata* (Mud Crab)

Small numbers of *Scylla serrata* (also referred to as green crab, mangrove crab) product actually reach the United States, among all the edible and commercially important Portunidae crabs it is currently the most important commercial species. The reasons are several: its large size, good meat quality, high price and export potential. Traditionally a favorite throughout Asia, demand has been increasing for this crab in both domestic and export markets. Traditionally, mud crabs are sold live; some product is also sold cooked, chilled and in frozen halves. While Japan is the largest consumer of export product and pays the highest prices, Singapore and Hong Kong are also important markets.

There is a great deal of harvesting pressure on wild stocks of *S. serrata* and the future does not look promising if this pressure is allowed to continue. The fishery areas tend to be dispersed, often



Scylla serrata (Forsk.)

located in remote areas with poor accessibility. The primary harvest season is April through October. Gear includes baited long lines, nets, dragners, crab pots and traps; some mud crabs are also caught as by-catch. Since there are wide seasonal variations in mud crab fishing, most harvesters generally do not depend on this fishery alone for sustenance. The majority depend on other resources such as fish and prawns along the estuaries and brackish waters where they live.

An accelerated development of mud crab culture operations has been occurring throughout Asia, including India, and quite a few progressive operations have been established in Thailand, Indonesia, China and Malaysia. The objective is to "fatten out" small captured wild crabs. While some attempts have been made in hatching and raising larval mud crabs, low survival rates have been discouraging for culturists. Disease and cannibalism remain a problem and have frustrated some new farmers. Polyculture with fish and seaweeds is now being implemented. Because of substantial interest in this popular delicacy, culturing techniques will likely improve and move forward; already the Japanese have begun to invest in expanded growout operations in several countries. Growout methodology includes ponds, pens and tidal enclosures for retainment; growout times vary with each location, depending on tides, water quality and seasons. The crabs are fed fish scraps and crushed molluscs. Currently, mud crab culture is a small cottage industry though it is growing: a number of government extension programs have targeted improvements as a goal in the industry.

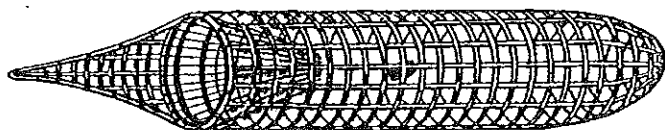
With all this attention on the mud crab, a great deal of information and research is needed in areas such as biology, habitat and resource management. Culturing techniques may take the pressure off wild stocks; if not, then we may see a species in jeopardy. Overharvesting, pollution and habitat destruction need to be monitored. In addition, to relieve pressure from the wild stocks, accelerated culturing techniques should not only target the fattening out process but should also the possibilities of rearing mud crab larvae.

HARVESTING TECHNIQUES

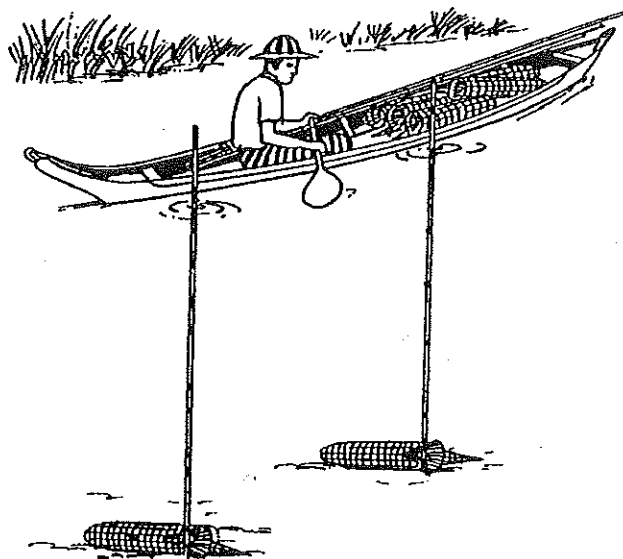
Crab harvesting methodology and techniques vary by country, culture, species and resource availability. Seven basic types of crab harvesting methods are predominant in Asia; gear is usually simple in construction and operation, and is well suited for the artisan fisherman in this expanding cottage industry.

Wire/Bamboo Pots

Used generally in mud flats and tidal areas along the coasts, crab pots are either tethered or staked out. Made of wire, framed netting or split bamboo, pots are rectangular or cylindrical in shape. Bait consists of fish scrap and are tied inside the pot. Pots are fished and rebaited.



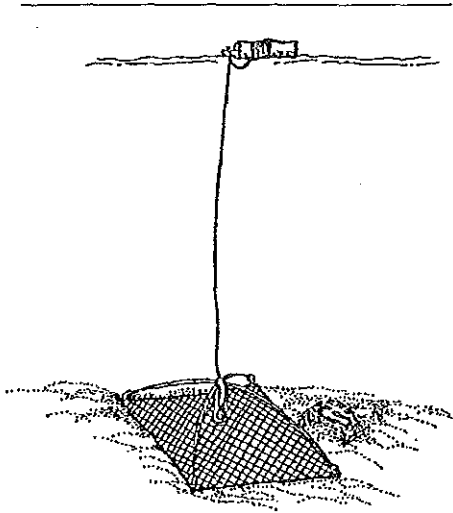
Bamboo Crab Pot



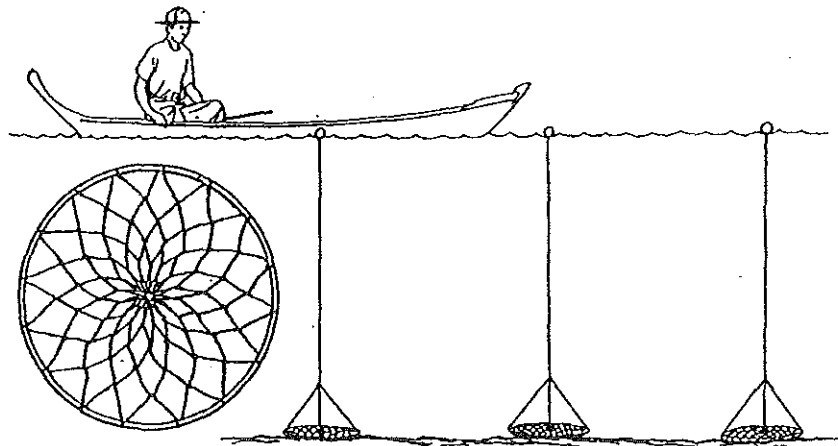
Bamboo Crab Pot in Operation

Lift Net

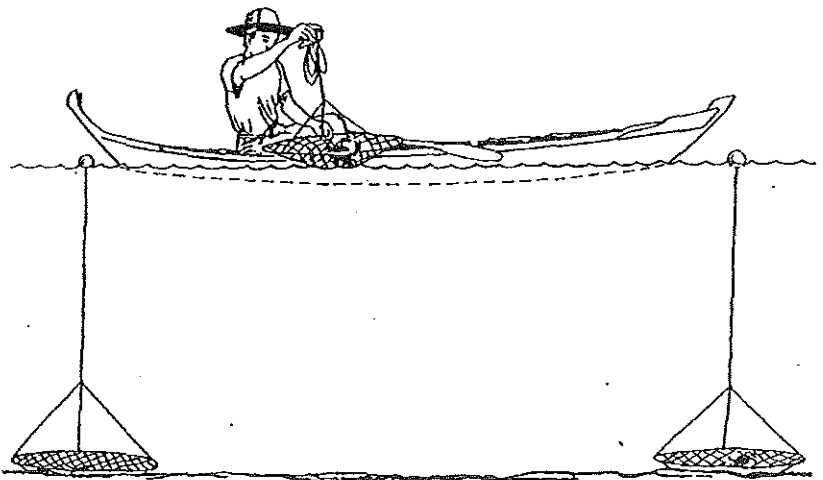
A traditional fishing method used for catching crabs, small shrimp, and fish, the lift net is a circular hoop about 1 m in width. It is made of rope or synthetic mesh net lashed to a wire or wood frame. Bait is putrefying fish heads tied to the middle of the net. A sight buoy is attached to the line and the net is periodically lifted to catch entangled crabs. The fisherman moves up and down the line of nets to work them. Lift nets can be very effective in mangrove areas.



Crab Lift Net



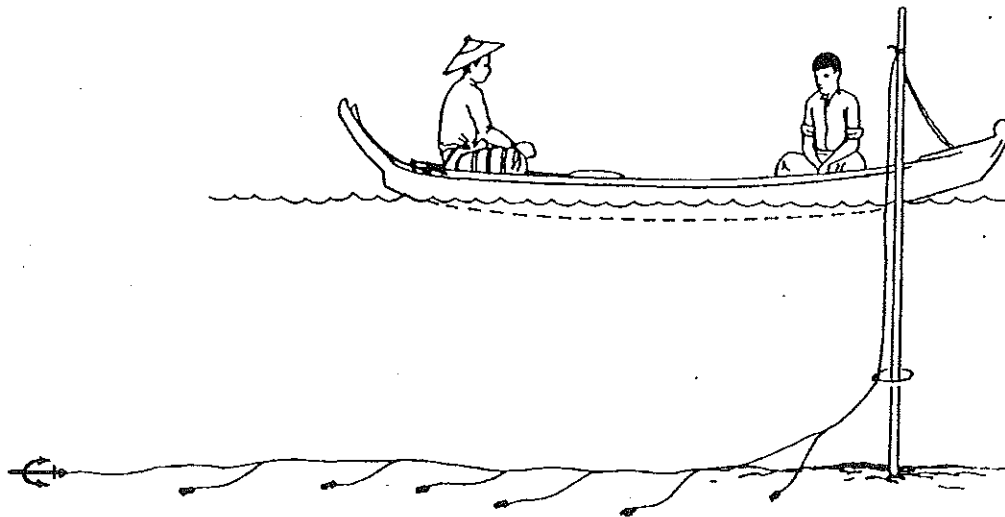
Entangled Lift Net in Operation



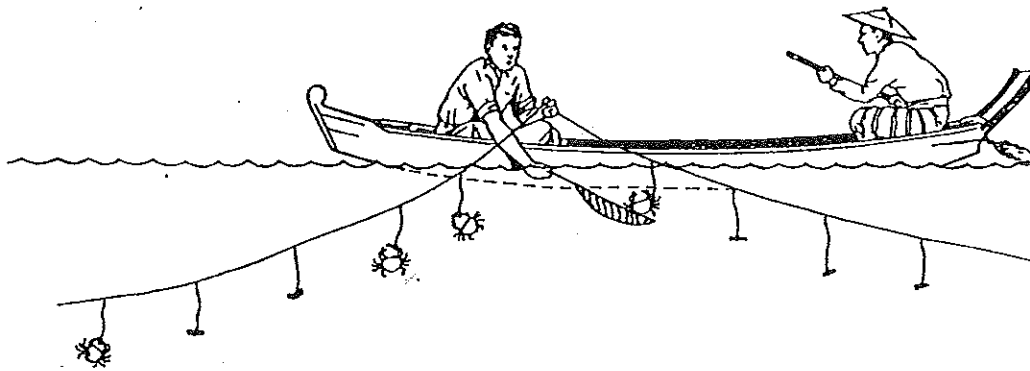
Collecting of Crabs

Hand Line

The hand line consists of a nylon rope, or main line, approximately 300 m long; hanging from the main line are small baited lines of 20 cm in length and approximately 1.5 m apart (dimensions vary by country). The main line is anchored at one end and connected to a bamboo pole at the other. Dead fish or even dead water snakes are used for bait. Crabs are lifted up on the baited lines and netted. Usually two fisherman work these lines.



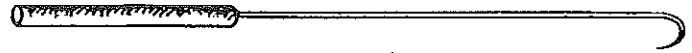
Setting the Hand Line



Collecting of Crabs

Hook

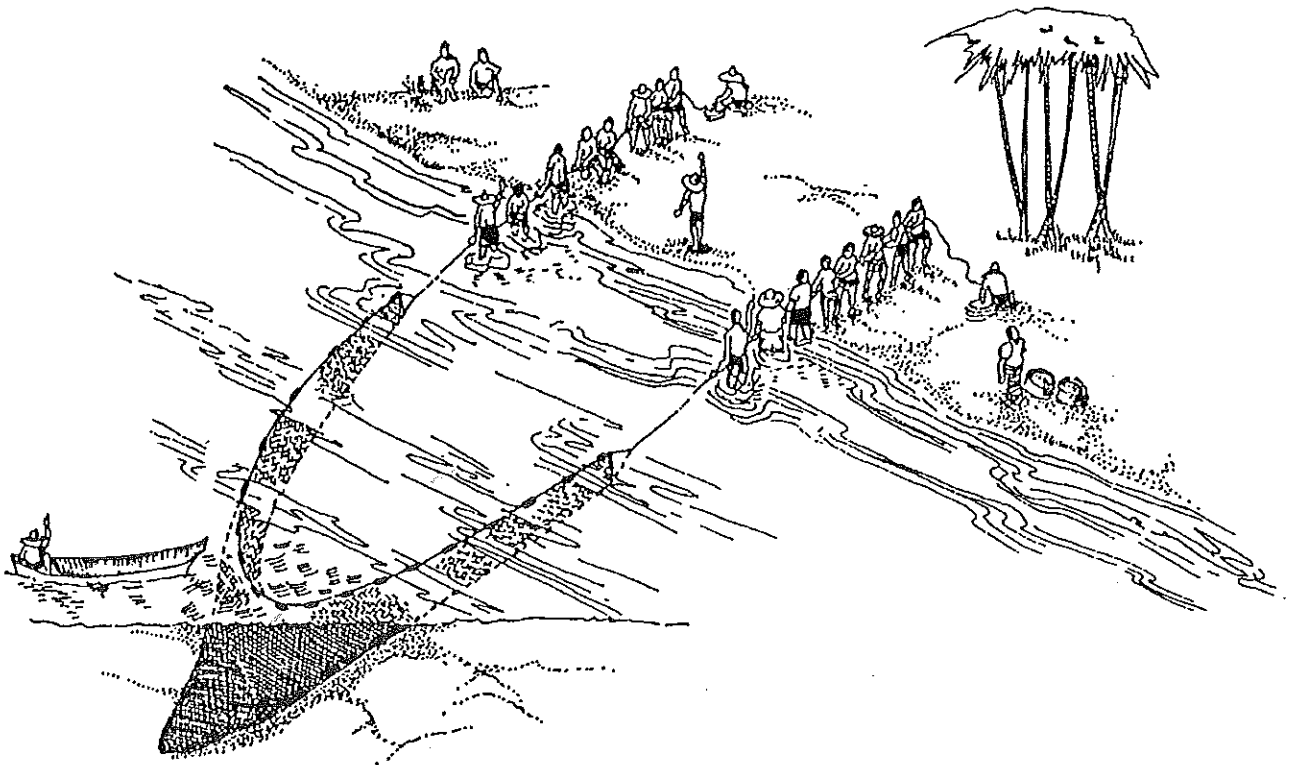
Used in mangrove or mud flat areas primarily for catching mud crabs, the crab hook is a long iron rod with a wood handle. At low tides the hook is inserted into the crab's burrowing hole and forced inside. The crab attaches itself and is drawn out. Hooks are primarily a passive method for catching only a few crabs a day; the method may be justified by the high market price mud crabs bring.



Hook

Seines

A simple method used quite often for finfish, a basic seine is made of either hemp or nylon mesh net and is stretched between two poles. Net sizes can vary in length. Usually two people will drag the net through shallow water and capture crabs as they try to escape. This is obviously a very effective way to catch small fish also. Larger beach seines can be run off the beach and pulled by hand; however, these seines are primarily for catching finfish, with crabs being harvested only as bycatch. There is also a push-net, in which the harvester pushes a bamboo-framed triangular net in shallow bay waters.



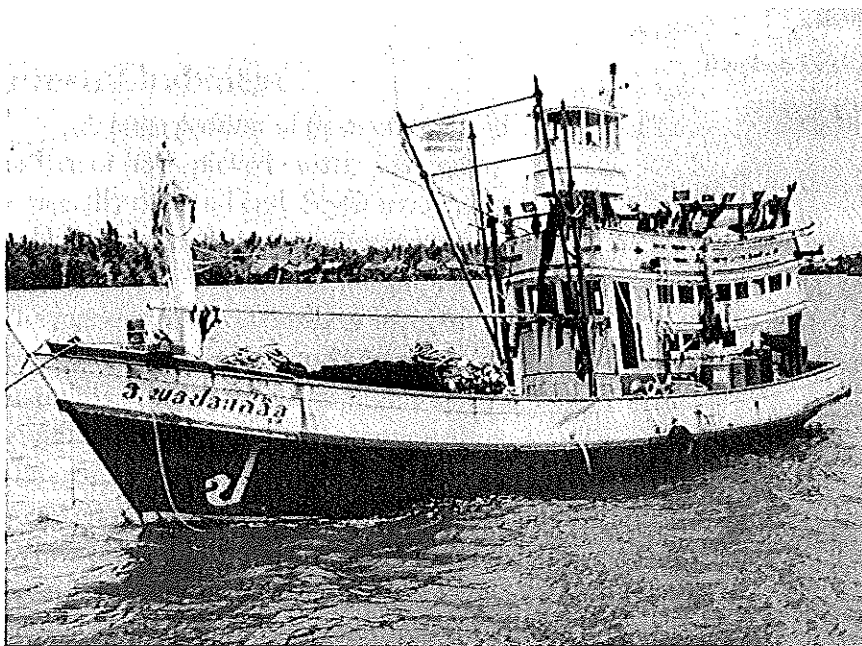
Beach Seine

Set Nets

A new simple method for capturing crabs, the set net is made of monofilament mesh. Fisherman pull them along the bottom, with buoys at each end, and harvest crabs that become entangled. No bait is used. Set nets can be very effective in areas with high concentrations of crab resources; it is used frequently in the Philippines.

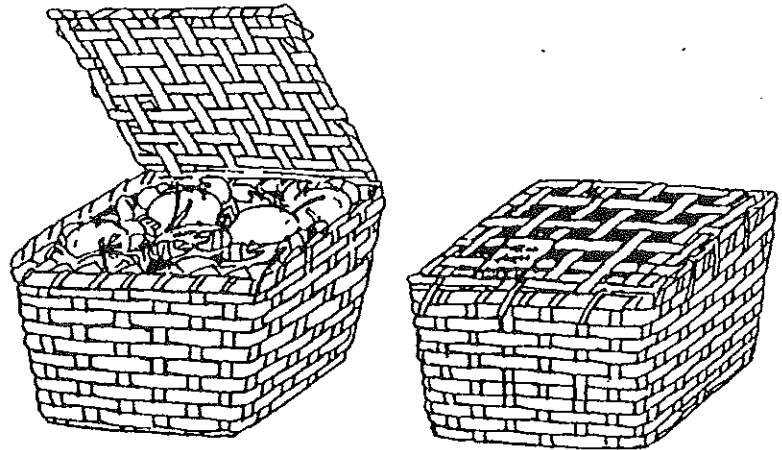
Dragger

More crabs are captured by draggers targeting other species of fish than any other method. Large trawlers and baby trawlers both are effective in harvesting crabs as a by-catch; however, since some of these boats are on the water for several days, most of the crabs do not reach the landing sites alive or in fresh condition. Smaller draggers and netters, though, are more apt to return daily with live crabs. Normally these small vessels stay out for 8 to 24 hours. Because of the lack of cold storage on board and the difficulty of obtaining cold storage, many crabs die before they reach market or processing facilities. Ice, when available, is in block form. While crabs are transported in boxes on open trucks, a growing number of closed insulated trucks are now in use in some Asian regions. Since the market for crabs is expanding, crabs caught as by-catch are receiving better attention and treatment.



CRAB PROCESSING IN ASIA

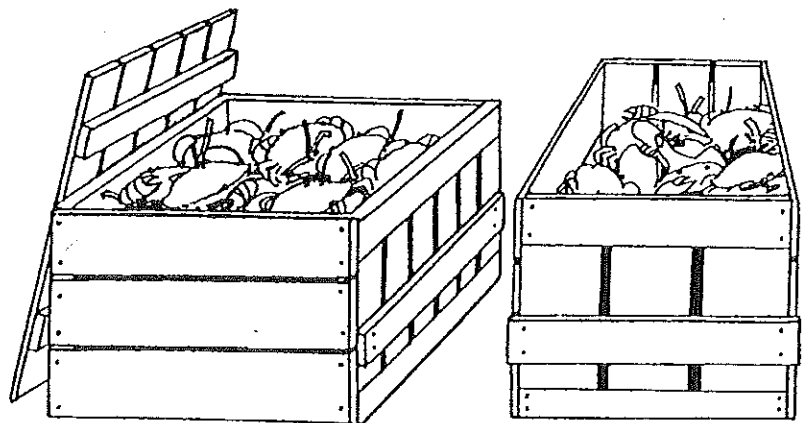
Seafood processing is important for employment and the economy in many developing countries. Crab processing like finfish processing can be divided into two components: cottage industry and commercial. Fresh, frozen and processed crab and crabmeats are becoming an important component of the export trade in several Asian countries. Some companies have been able to vertically integrate crab processing into their already existing plant operations; this is especially true of canneries engaged in packing tuna, shrimp or clams. With crab products becoming more economically valuable, specialty companies have emerged, engaged in frozen block and value added product. The focus here is on handling and processing fresh, frozen, frozen block and canned crabs.



Bamboo Basket Container for Crab Export

Fresh Crabmeat

A large portion of fresh crab is sold as live or fresh-picked meats. Live crab, especially the mud crab *Scylla serrata*, are sold in local markets for indigenous consumption. These crabs are shipped to the markets in wood boxes or bamboo baskets with their claws tied for easy handling. Live mud crab is highly sought and brings the highest price among all the marine crabs. They are either steamed or cooked in a hot chili sauce. While picked fresh meats are used for local consumption in soups and stews, a sizable portion of picked meats also goes to the restaurant trade.



Wooden Box Container

Frozen Crabmeat: Whole, Halves, Block

Frozen crab is processed in whole, halves or block forms. Target species for frozen whole crab and halves are mud crab, blue swimmer and sand crabs. They generally are destined for host national markets and regional consumption and distribution centers such as Singapore or Hong Kong. Japan is the main importer of frozen whole and halves.

Block meats are composed of either sand crab or blue swimmer crabs. Freezing in Asia is done by blast freezer or plate methods; recently, however there has been a sharp increase in individually quick frozen (IQF) processing. The shrimp industry is responsible for the accelerated growth of freezer capabilities throughout the region. Primary processing occurs at the village cottage industry level. There is some movement towards established crab landing sites to facilitate access to plants; these plants usually conduct their own bacteria sampling for Salmonella and coliform. Such sites employ hundreds of women to pick crabmeats, which are separated into claw, body and lump meat.

Currently, on the southern coast of China, the target species is *Portunus (Neptunus) sanguinolentus*, (also called sand crab, blue swimming crab). Fishermen cooperatives harvest these crabs and then deliver them to a large processing plant. Meats are first separated and blocks plate frozen, either in trays or by IQF processing. They are then packed in 1 kg heat sealed plastic trays within a cardboard box. Shipping is 1 kg x 16 per master carton. Generally, they are shipped at 16 mt per 40 ft container.

Block meats are used in soups, stews and stuffings, though the meats tend to be bland in taste. If not properly handled, meats can become discolored. Shell-laced meat has also been a problem. However, because of its easy handling and large forms, block meats are a common product for immediate use or repacking. Block meats will become increasingly more popular in worldwide markets once quality control and packaging meet western standards.

Canned Crabmeat

The Asia/Pacific region of the world is responsible for over half the world's production of canned shellfish. Processing for the canned industry is dependent on the infrastructure of the local cottage industry. Increasingly, crab fishery development has included cooperatives and specific landing sites, with much of the partially-processed meats coming from small villages and dock areas. Canning of crabmeat, includes two major processes: cooking of whole animal and extracting or picking its meat. Canning is very labor intensive and well-suited to

the village artisan fishermen. Women are the primary laborers in picking meat. There are social as well as economic advantages to village level processing, for example, it gives women an opportunity to earn an income, it galvanizes the community into a cash economy and it binds the fishing family into one commercial enterprise. Such processing also serves as a business incentive, creating a barrier against drift to the larger cities (Howgate 1984).

Village level processing is not without its problems. Lack of cold storage, improper handling and poor hygiene may cause quality control problems. The primary target species is the *Portunus* (*Neptunus*) *Sanquinolentus* (blue swimming crab), which is captured by small day boats working close to shore. Quality control should begin on board, as these drift net boats work in extremely high heat conditions. Occasionally, crabs are not disentangled from the nets until they are returned to the dock.

Crabs cooked live soon after harvest make the best quality product. Crabmeat deteriorates rapidly after death because of the activity of the flesh enzymes. High heat destroys these decomposing enzymes. Some crabs are boiled on board boats in seawater, while others are cooked on shore and chilled until ready for picking. Asian crab picking is similar to U.S. methods in that crabs are banded, declawed, cleaned and the meats extracted. Separated into claw, body and backfin components, meats are either placed in plastic bags or small plastic containers. The meat yield from a blue swimmer crab averages 27-30% of the uncooked body weight. Meats are then packed in a cool place until delivery to the processing plants. Many of the large processing plants in China and Thailand are integrated so that they may begin with whole cooked crab and then process the meat themselves.

At the plant, a random sample of meats is sorted and inspected for shell and foreign matter. Black lights are used quite often during this procedure. Many plants will also reboil or blanch the meats to ensure proper cooking. Blanched meats are then placed in 170 g containers. Usually, meats are mixed in the retort cans, 75% white meats with a layer of leg and claw meat on top. Meats are topped with brine containing 0.1-0.5% citric acid, bringing the pH level to 6.3 (Howgate 1984). Cans are vacuum sealed and cooked in a retort for up to 60 minutes depending on temperature, they are then packed in a master carton of 24 each. Periodically there is "blueing or blackening" of crabmeats packed in cans — explanations include several variables, for instance, natural coppers and amino acids in crab flesh along with the retort heating process. Some crabmeats are placed in a solution of sodium metabisulphite during blanching to induce whiteness in the flesh.

Problems in canning crab begin with lack of good quality tin for the container. Lacquered cans should be used with a paper liner to inhibit iron staining. Cans must be checked for defects: they will cause black coloration in the meats. Also the meats must be checked often as blue swimming crab is very susceptible to mushiness, the result of enzymes associated with dead crabs not being properly handled. The loss of meat integrity is one of the most important factors facing handling and quality control of blue swimming crabs.

MARKETING

A large home market exists for Asian crabs and crabmeat products in households and restaurants. With the exception of mud crabs, they are an inexpensive seasonal product. Asian culinary art has its roots in the "night stalls" which are bustling with activity each evening. From the thousands of eating establishments in the larger cities to the small village-based family run eateries, crabs are consumed in great numbers at these establishments. As with most less developed countries, the community market serves as the focal point for food purchases and social gathering and interaction. Live or fresh dead crab, as well as chilled cooked halves and whole animals, can be purchased at these traditional markets. Picked meats are purchased more at restaurants and at institutional establishments. Supermarket expansion in many Asian countries will serve as another means for crab sales; in all likelihood, crab consumption in local markets will increase as quality control improves.



Regionally, the big markets for crab and crabmeat products are Hong Kong, Singapore, Taipei and Macau. Though these countries retain small fisheries themselves, they are more important as large consumer and redistribution centers for worldwide markets. A large volume of crab products is channeled through these markets daily. Some crab products are reprocessed or repackaged, such as frozen block meats from China and Vietnam. Exports will increase both to and from these regional centers as consumption levels increase, and they vie for position in growing world markets.

Internationally, a solid market remains in the European Economic Community and the United States. Both are receptive to canned products. Growth seems to be in the frozen block meat market in both areas. Currently, ethnic markets are receiving the bulk of the U.S. targeted frozen block product. Block meats are packaged in 1-pound and 5-pound containers (there are also kilo versions). Packaging is generally poor as there is quite often freezer burn and damaged cartons. Frozen meats, placed in clear plastic trays, are packaged inside light cardboard boxes. Master cartons are either packed 1 x 4 or 5 x 10. Canned meats are packaged in retort containers with destination host country language printed on each can. Europe has long been a favorite market for Thailand and Malaysian canned products. Block meats and frozen halves are making their appearance in Europe, with room for growth in the value-added sector. The United States is importing canned meats from Thailand, Malaysia and the Philippines. Frozen block meat is coming from China and Hong Kong.

Continued growth of Asian crab products imported by Europe and the United States will depend on service, quality and price. As indigenous stocks fluctuate in both these regions, along with prices, imported products will look more enticing. The market is driven by price and quality. Dedication to indigenous products in the United States is waning as the market moves forward. China will be the country to watch, as they begin to meet western quality packaging and standards; aggressive marketing will follow. Canned products will remain steady, filling the void created by product seasonality and irregular prices. Marketing by all Asian countries to both Europe and the United States will increase at a slow but steady rate.

Crabmeat prices in Asia vary from country to country and depend on the specific product, on seasonality and on demand. Canned meat and block meats are the most inexpensive products. China produces the most inexpensive block meats, averaging around \$3.00 a kilogram. Turn-around prices for this product on the U.S. west coast is approximately \$4.00 a kilogram. Shipments (whole

container) usually are set at 25% for leg meats, 50% for body meats and 25% for lump meat. Leg meat is the most difficult to sell in the United States as it tends to be stringy and red in color. Some producers are mixing the meat components as is done with canned products.

Soft crabs are virtually new to Asia. Like all crustaceans, the warmwater marine crabs of Asia also shed their exoskeleton to attain growth, though currently a soft crab in local markets brings a cheaper price than the hard crab. Lack of cultural receptiveness has resulted in little industry development; however, rapid changes are likely to occur with improved technology transfer and joint ventures that are beginning to surface. Japan has proved to the U.S. blue crab industry that there is great growth potential in this area.

LONG-RANGE PROJECTIONS

Asia will continue to be of international importance in crab harvesting and productivity. With the exception of the mud crab, the warm water marine crab still remains underutilized. As market development increases, niche areas such as United States and European ethnic enclaves will respond. Currently, the U.S. imported block frozen meat goes primarily to ethnic markets along the West Coast, with areas such as Los Angeles, San Francisco, Seattle and Vancouver, Canada absorbing much of the product. Other factors such as rising surimi prices and possibly fluctuating shrimp prices will drive dealers to crab processors. Historically, U.S. blue crab processors and distributors did not have to contend with much competition from imported crab products. Stability of the U.S. market is now being tested as increased foreign exports begin to arrive from Asia as well as from South America and Europe. Asia, though, will be the major competitor because of the number of countries involved, the large resource availability, the cost-efficient labor and the years of expertise in fisheries exploitation and development.

China will be the major country to watch as it moves towards exports to free markets. Its methodical approach may be slow, but it will continue to accelerate. Watch for the growth of integrated projects as shrimp markets become saturated. Even with one billion mouths to feed, the need for hard currency may be the impetus for export development. Currently, China needs to move forward with better packaging and quality control with block meats to significantly penetrate Western markets.

The future success of the Asian crab industry will depend on meeting several challenges. These include the following.

Packaging

Innovation is needed here. The Japanese axiom "one tastes with his eyes, before his mouth" should hold true. Better quality boxes and interior trays are needed, especially for frozen block meats.

Quality Control

Both at the harvest and processing levels, improvements are critical. The integrity of crabmeat is often compromised by poor handling; the result is poor texture and bland taste. Environmental conditions of Southeast Asia should dictate stringent monitoring along the entire processing line.

Technology Transfer

Here lies a key problem in overcoming out-of-date equipment and familiarity with the species. Western ideas of processing and packaging, together with harvest methods, allow room for improvement. State of the art processing equipment is needed in some areas. Technology transfer will also develop the soft crab industry.

Marketing

Accessing middle income markets will be the true test in acceptability. Positioned now in the ethnic markets, accelerated crabmeat product development and quality control can push Asian processors into new opportunities.

ASIAN CRAB INDUSTRY: COUNTRY SYNOPSES

Thailand

Increasingly, Thailand is becoming one of the most important seafood processing and export countries in Asia: between 1989 and 1991 the country's seafood exports grew 68.5% in volume and 71.3% in value (Table 5). The Thai seafood industry has access to affordable skilled manual labor and state-of-the-art processing plants. Shrimp have the greatest economic value. The crab species with the greatest economic values are the blue swimmer (*Portunus pelagicus*) and mud crab (*Scylla serrata*): in 1988, blue swimmers accounted for 41,900 tons, with mud crab adding 4,500 tons of product to the market.

Table 5. Major exporters of crab (fresh, chilled or frozen), 1989-1991.

	1989		1990		1991	
	1,000 mt	\$ mil.	1,000 mt	\$ mil.	1,000 mt	\$ mil.
USA	37.3	248.6	48.8	352.3	81.6	426.5
China	18.2	44.5	19.8	51.7	18.6	56.4
Canada	6.7	53.3	7.2	57.5	7.1	51.0
UK	11.9	38.6	14.0	48.5	15.1	46.9
Korea Rep	5.9	36.7	4.3	32.1	4.3	29.4
France	4.1	16.9	4.6	20.5	5.0	20.4
Hong Kong	2.5	6.2	2.8	8.3	4.6	16.0
Korea D P rp	9.9	17.0	6.8	13.0	7.4	14.0
Ireland	2.8	8.8	2.5	9.6	2.9	9.9
Chile	0.9	11.0	0.6	6.8	0.7	7.8
Indonesia	2.9	4.4	3.7	4.6	4.8	7.6
Japan	0.2	1.9	0.5	2.2	0.8	4.4
Viet Nam	0.1	0.2	0.3	1.1	1.2	3.7
Netherlands	0.2	1.5	0.2	1.6	0.3	2.0
Thailand	0.7	1.9	0.4	1.3	0.5	1.8
India	0.4	0.8	1.0	2.1	0.7	1.5
Sri Lanka	0.4	1.0	0.3	0.7	0.3	0.8
Portugal	1.2	0.7	1.1	0.9	1.1	0.8
Others	4.7	17.0	4.9	17.4	5.1	15.7
Total	111.1	511.2	124.0	632.0	162.1	716.7

Most crabmeat in Thailand is canned; in fact, Thailand is the world's principal supplier of canned crabmeat. Some 25 canneries are currently engaged in crabmeat processing, many of them large operations employing hundreds of workers.

To open new markets and to accelerate its export strength, the government and private enterprise have implemented a program of product development, product adaptation, quality control and new packaging development. Thailand will continue to be a major world exporter of crab products.

Primary crab harvest areas are located near Krabi, Surat Thani and Songkhla. Major landing sites are Surat Thani and Songkhla. Current stocks of the blue swimmer remain stable, though some crabmeat is being imported from Vietnam and China for reprocessing. Mud crab resources remain pressed, though hopes are that culturing these crabs will add significantly to supplies. *Watch for an increase of value added crab products in the future.*

China

Over the past decade, China has developed its seafood industry of finfish, shrimp and crab faster than any other country in Asia. Although only a small portion of certain species are targeted for export development, these seafood exports have increased tremendously in the last several years. While a sizeable amount of seafood is consumed domestically, government incentives have created a climate conducive to establishing international trade agreements. Europe, Japan and the United States for example are all important importers.

Crab products include block frozen meats, frozen halves, canned, fresh and frozen whole crab. Evidently, there is a quite a bit of movement between Vietnam and China for crabmeats: most of this meat is reprocessed and repackaged. Hong Kong has diminished as a major redistribution center because buyers now go directly to the Chinese source.

Warmwater crab species currently being harvested are the blue swimmer (*Portunus pelagicus*), sand crab (*Portunus sanquinolentus*), mud crab (*Scylla serrata*) and mask crab (*Charybdis feriata*), though figures for crab production and processing remain sketchy at best. No one really knows exactly how much crab is being harvested by Chinese fisherman. Harvest areas include the Gulf of Tonkin and the South China Sea. Landing sites include the Guangxi, Guangdong, Fujian and the Zhejiang province.

A number of seafood companies export large amounts of crabmeat products either as canned or frozen blocks. Presently the fresh and frozen processors are faced with several problems in quality control management and product handling. Though a crab pot fishery is developing, a large amount of the crab comes in as by-catch from draggers; thus, a lot of dead crabs are arriving at the dock. Many processors are still unfamiliar with western processing and packaging requirements: some plants, for example have their employees pick meat from the carapace with chopsticks. From a marketing perspective, packaging remains bland.

Philippines

The Philippines, with its archipelago of over 4,000 islands, its rocky coasts, estuaries and productive mangrove areas, offers an abundance of suitable habitat for several of the commercially important brackish water marine crabs. While Philippine people have a long history of fishing, crab resources have yet to experience major exploitation.

The primary commercial species are the blue swimming crab (*Portunus pelagicus*), the sand crab (*Portunus sanquinolentus*) and the mud crab (*Scylla serrata*). Local markets account for a great deal of harvested product, though there has been a recent surge in exports. Also, in recent years, Japan and the United States have been importing an increasing volume of canned and frozen crabmeat. Phillips Seafood, a United States company headquartered in Maryland, has successfully developed a progressive fisherman cooperative and processing plant near Cebu. Pasteurized meat produced at the plant has been exported to traditional U.S. markets for blue crab (*Callinectes sapidus*) on the East Coast. Phillips has recently established a second processing plant and has plans for smaller satellite processing plants in the region.

Harvest areas include the Moro Gulf, Mindanao Sea, Visayan Sea, Sibuyan Sea and the Luzon Straits. Landing sites are numerous with the primary ones in Cebu, Davao, Zamboanga, Illoilo and Lucena.

The Philippines will continue to develop its crab fishery as new companies and joint ventures begin to exploit the product and world-wide markets. The country is attractive to investors for several different reasons, among them, the historic fishing industry, the incentives for foreign trade, the widespread use of English. Drawbacks include potential political instability and a fluctuating economy.

Malaysia

With its abundant coastlines and crab resources, Malaysia has not fully exploited its potential as a premier crab-producing country. Though a number of companies are canning crab and several others are packaging frozen block meats, the region is still virtually untapped as a source of product.

Canning plants initially did well, but have been plagued by erratic raw material supply, high labor costs and shortage of tin plate. Though Malaysian people have a history of fishery production, they are just now beginning to use that expertise to increase crab resource development. Commercial species include the mud crab (*Scylla serrata*), blue swimmer (*Portunus pelagicus*) and sand crab (*Portunus sanquinolentus*). Singapore remains a steady, reliable trade partner and pays good prices for quality products. Harvest areas are along the Terengganu and Kedah districts. Landing sites include Pinang, Lamut, Klang, Melaka, Kuantan, Belawai and Kuala Trangganu. Production should increase as the government seeks to expand this fishery; foreign joint ventures may accelerate production. Export marketing should increase as the domestic markets in this country are well established.

Indonesia

Indonesia has a huge expanse of coastline and a historic fishing industry already in place. Though not as aggressive as Thailand, the Indonesian crab fishery has a solid infrastructure. Long an exporter of canned crab to Europe, it is beginning to further develop its fresh and frozen markets elsewhere. Hong Kong, Singapore and Taiwan import a fair amount of product, especially mud crab. Primary commercial species are the blue swimmer (*Portunus pelagicus*), mud crab (*Scylla serrata*) and sand crab (*Portunus sanquinolentus*). A classic cottage industry, small clans and villages engage in harvesting and primary processing. Processing operations also can other seafood products such as tuna, shrimp and clams. Harvest areas include the Java Sea, Banda Sea, Flores Sea and the Makassar Straits. Landing areas include Medan, Padang, Surabaya, Balikpapan and Ujung Padang.

Some problems are evident with quality control and handling: the intense heat, coupled with the lack of on-board and on-shore cold storage, is the cause of a great spoilage. Nevertheless, Indonesia's crab fishery has tremendous potential for growth. The country will compete with Thailand in the cannery sector and will begin to develop frozen block meats. Foreign ventures are beginning to make serious moves in establishing crab fishing as a new growth

industry. Phillips Seafood of Maryland, Inc., for example, has recently opened a new crab processing plant in Java.

Vietnam

With its fishing industry dormant after the civil war, seafood development is now on the rise. The Mekong delta is one of the most productive estuaries in Asia. Crab harvests have been increasing each year, from 11,000 metric tons in 1981 to 15,000 metric tons in 1987. Much of this meat is consumed locally, the remainder going primarily to China and Hong Kong for reprocessing and repackaging. Some product is also exported to Europe. The Vietnam crab fishery will no doubt accelerate in the near future. Target species are the blue swimmer (*Portunus pelagicus*), mud crab (*Scylla serrata*) and sand crab (*Portunus sanguinolentus*). Many countries are beginning to look towards Vietnam, waiting for an opportunity to exploit its many resources, which have been held in check for so long.

Hong Kong, Singapore, Macau and Taipei

Though some crab is harvested from the waters of these countries, they serve primarily as consumption and distribution centers.

CONCLUSIONS AND RECOMMENDATIONS FOR THE CHESAPEAKE BAY BLUE CRAB INDUSTRY

Though marine crabs from Asian countries may never attain the status of the black tiger prawn of Asia in the world market, there is certainly the possibility that it will become the next important seafood growth industry for the region. The advent and great success of shrimp culture in Asia has proven to the people and governments that there is great opportunity for historic seafood industries. For many, crab processing holds promise as a growth industry. The success and experience gained from the shrimp industry may be applicable to crab product development, labor training, quality control and market expansion.

The Asian challenge to the United States crab industry, while not imminent, must be met over the next decade. The industry must address two areas to remain competitive: efficiency in production and improvements in marketing.

Chesapeake Bay producers of crabmeat must continue to distinguish their product as different and superior in quality and taste to all competitors, domestic and foreign. Quality assurance can only be sustained with strict and enforceable grading standards. This assurance must be accompanied by aggressive marketing of a high grade Chesapeake product. Without these standards, low quality producers will undermine the markets of high quality producers. Without the marketing effort, consumers will be unaware of product differences.

Another area needing improvement, and one that will assist marketing, is development of value-added products. Producing Chesapeake Bay crab products that customers desire will help meet the challenge posed by value-added imports. Chesapeake crabmeat producers must also pay attention to the health of the crab resource, and the cost of the raw product as it enters the processing plant. Asian product will be relatively inexpensive if the resources are abundant and not overfished, and if there is little competition for domestic consumption of whole or live crabs. Such is not the case in the Chesapeake where there is large overcapitalization in crab catching, increasing fishing pressure on the crab resource, and growing compe-

tition with the basket crab market. Some form of limited access to the crab fishery would be in the best interest of both crabbers and crab processors. For example, a trap limit could reduce the number of traps being fished, increase the productivity of the crabbers, lower the costs of crabbing and, thus, lower the cost of crabs entering the processing plant.

To date, the concern by crab processors about crab management in the Chesapeake Bay has been limited to short-run concerns about crab supplies in a season. Unless the long view is adopted, acknowledging the potential increased competition from abroad, processors may not have to be concerned about the health of the crab resource, if they are driven out of business.

FOR FURTHER READING AND REFERENCES

- Anon. 1984. Crab — A high value product. INFOFISH Trade News Fact Sheet, no. 4.
- Anon. 1986. Gazami crab pot fishing. Yamaha Fishery Journal No. 27:8.
- Dionysius, D. et al. 1988. Maintaining flesh quality in sandcrabs *Portunus pelagicus*. Australian Fisheries, Oct. 26-28.
- FAO (Food and Agricultural Organization of the United Nations) Yearbook of Fisheries Statistics. 1990. vol. 72, Rome.
- FAO (Food and Agricultural Organization of the United Nations) Yearbook of Fisheries Statistics. 1991. vol. 73, Rome.
- FAO (Food and Agricultural Organization of the United Nations) Yearbook of Fisheries Statistics. 1992. vol. 74, Rome.
- Harvey, M. 1990. Mud crab culture in Thailand. INFOFISH International No. 6:53-54.
- Hill, B.J. 1984. Mudcrab storage and transport. In the Queensland Fisheries Information Series FI 8201, The Queensland Mud Crab Industry, 23-26.
- Howgate, P. 1984. The processing of crabmeat for canning — Part I. INFOFISH Marketing Digest No. 4:48-50.
- Howgate, P. 1984. The processing of crabmeat for canning — Part II. INFOFISH Marketing Digest No. 5:39-42.
- Jaruthomsophon, B. 1986. Experiments on a suitable sanctuary for rearing blue swimming crab (*Portunus pelagicus*). Thai Fisheries Gazette 39(6):639-642.
- Schuler, G.A. 1984. Increasing picked crab meat yields through revised venting procedures. INFOFISH Marketing Digest No. 4:51-52.
- Slattery, S.L. et al. 1989. Mushiness in the blue swimmer crab, *Portunus pelagicus*. Food Australian, 698-703.