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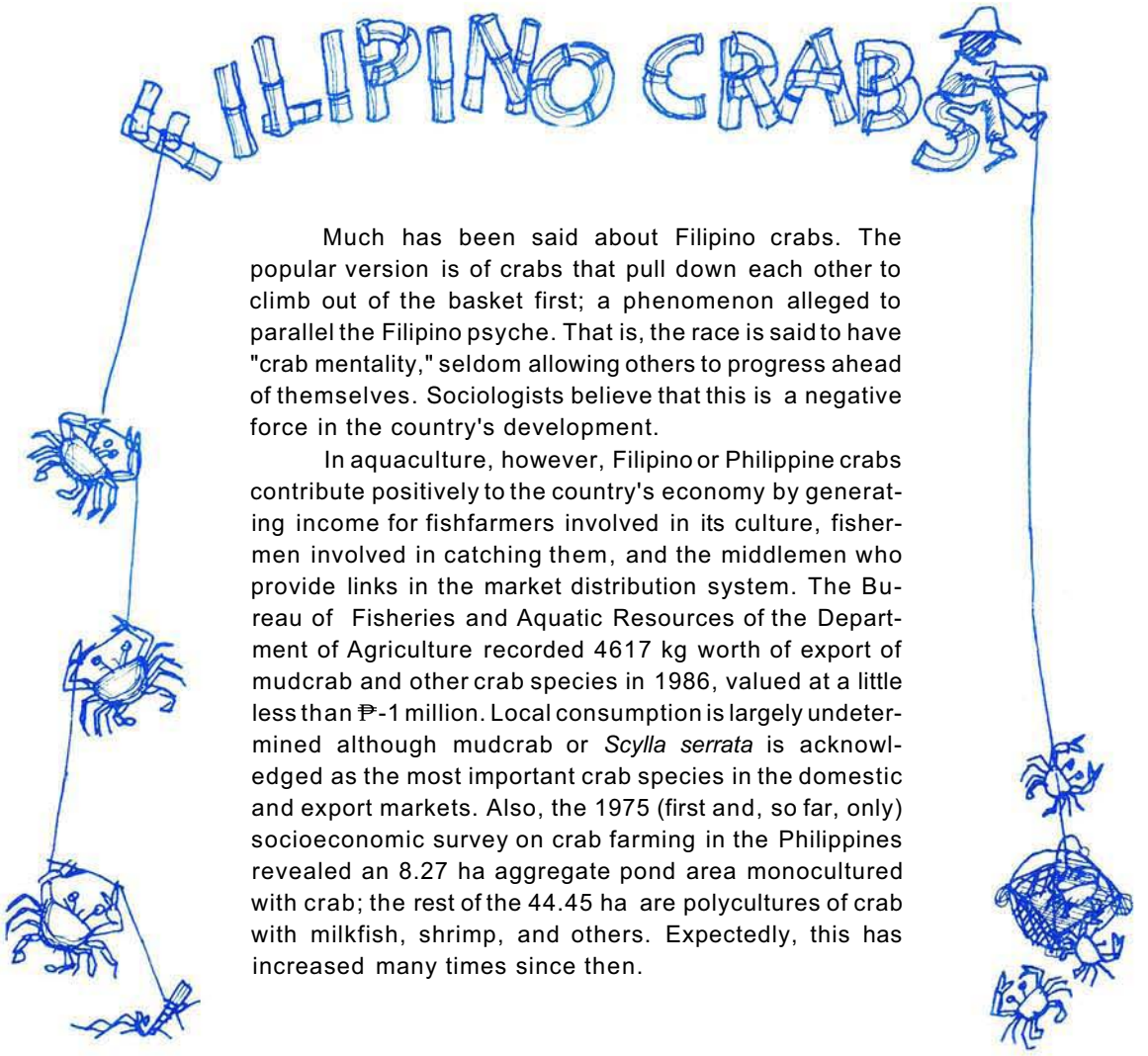
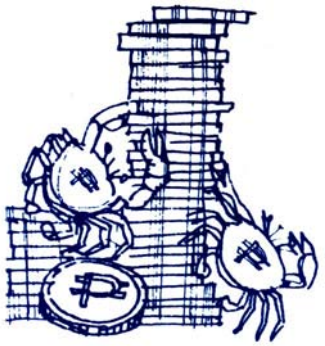


Much has been said about Filipino crabs. The popular version is of crabs that pull down each other to climb out of the basket first; a phenomenon alleged to parallel the Filipino psyche. That is, the race is said to have "crab mentality," seldom allowing others to progress ahead of themselves. Sociologists believe that this is a negative force in the country's development.

In aquaculture, however, Filipino or Philippine crabs contribute positively to the country's economy by generating income for fishfarmers involved in its culture, fishermen involved in catching them, and the middlemen who provide links in the market distribution system. The Bureau of Fisheries and Aquatic Resources of the Department of Agriculture recorded 4617 kg worth of export of mudcrab and other crab species in 1986, valued at a little less than ₱-1 million. Local consumption is largely undetermined although mudcrab or *Scylla serrata* is acknowledged as the most important crab species in the domestic and export markets. Also, the 1975 (first and, so far, only) socioeconomic survey on crab farming in the Philippines revealed an 8.27 ha aggregate pond area monocultured with crab; the rest of the 44.45 ha are polycultures of crab with milkfish, shrimp, and others. Expectedly, this has increased many times since then.

This issue considers the feasibility of culturing mudcrabs, taken largely from research studies of SEAFDEC Aquaculture Department. Considering the large economic returns, methods of culture are then discussed including fattening. Cultures of Thai and Malay crabs are also noted, these minus the cultural connotations. For those interested in crab capture, traditional devices in catching crabs are presented; and for those whose palates are into gourmet, crab preparation and cooking are discussed.

(to page 2)



The economics of mudcrab monoculture

Mudcrab monoculture is a viable venture in the Philippines.

This was revealed by a study made by SEAFDEC Aquaculture Department researchers Renato Agbayani, Dan Baliao (now resigned), Giselle Samonte, Reuel Tumaliuan, and Romeo Caturao on the economic feasibility of monoculture of mudcrab (*Scylla serrata*).

The researchers noted the capital investment and annual depreciation of a 1-ha crab monoculture farm as ₱23 833 and ₱8 017, respectively. This is detailed in Table 1.

This farm outlay was projected based on the experimental pond yields at the Leganes Brackishwater Station of SEAFDEC/AQD (now closed) in Leganes, Iloilo. The experimental 0.12-ha pond was subdivided into 12 100-m^2 compartments, using bamboo screens as dividers. The bamboo screens, installed in an upright position, were 3-m high and woven with monofilament at 1-cm intervals between slats. The bamboo was driven 70-cm deep into the pond bottom. A 40-cm wide bamboo overhang was installed perpendicular to the wall to pre-

Table 1. Capital investment and annual depreciation for a 1-ha crab monoculture farm

Capital outlay	Quantity	Unit cost (₱)	Total cost (₱)	Economic life (yr)	Annual depreciation (₱)
Pond development			10 000	5	2000
Perimeter fencing					
Bamboo poles (no.)	150	20	3000	2	1500
Banata fabrication (no.)	110	18	1980	2	990
Nylon monofilament (kg)	17	95	1615	2	808
Nails (kg)	4	15	60	2	30
Plastic sheet (rolls)	5	160	800	2	400
Construction of mounds (units)	100	40	4000	2	2000
Caretaker's hut[1]			1000	5	200
Tools and equipment[1]					
Digging blade	2	150	60	5	12
Bolo	2	60	24	5	5
Spade	1	185	37	5	7
Scoop net	2	50	20	2	10
Traps, bamboo	8	20	32	2	16
Basins, 201	2	95	38	3	13
Pails, 101	3	35	21	3	7
601	2	145	58	3	19
Total			**23 833**		**8017**

[1]Allocated per 5 ha.

Table 2. Stocking density, survival, and production data for mudcrab monocultured in 100-m² ponds

Stocking density (100/m²)	Working capital (₱/run)	Harvest/100m² No. recovered	Harvest/100m² Ave. wt. (g)	% survival	Relative growth increment (g/day/crab)	*Feed conversion	Gross production (kg/ha/crop)
50	19 480	44	231.60	88	2.28	1.72	1019.04
100	24 262	52	196.63	52	1.89	2.16	1022.48
150	34 440	57	171.11	38	1.61	3.85	975.33
200	40 608	62	178.11	31	1.69	4.04	1104.28

*Feed was trashfish, mainly chopped tilapia at 10%, 8%, and 6% of body weight per day, adjusted after 0, 30, and 60 days, respectively.

vent the escape of crabs, especially the berried females which try to migrate into the sea to hatch their eggs. A 5-cm² earthen mound was built in the middle of each compartment for the crabs to stay on during low oxygen tension. The mounds were made high enough such that their peaks remained above water even when the desired maximum depth of 50 cm had been reached. Pond preparation followed the *lablab* method.

Production data from these ponds which were stocked with 25.3 g mudcrab juveniles and reared for 90 days are given on Table 2.

Again, projecting these figures to a 1-ha farm (Table 3), the costs and returns given four stocking densities (5000, 10 000, 15 000, 20 000) show profit for the two lowest stocking densities.

Their comparative cost indicators of production are given in Table 4.

The researchers also noted that the lowest stocking density (5000/ha) produced the highest average weight (231 g), registered the highest survival rate (88%), and had the lowest feed conversion ratio (1.72).

A ₱23 833 capital outlay is constant regardless of stocking density. However, net income/ha/yr was highest (₱53 626) at lowest stocking density. Return on investment (124%) and return on equity (248%) were also highest in this density; average cost of production (46%) is also lowest.

Further economic analyses using partial budgetting and sensitivity analysis showed that (1) increasing stocking density to the next level tested or 10 000/ha resulted in a P4 611 decrease in net benefit, indicating further that 5000 crabs/ha is the most viable; and (2) if wholesale price were to drop 28% orto 16% for 5000 and 10 000/ha, respectively, return on investment will drop 60%. This shows that at 5000/ha, 28% drop in wholesale price is still attractive.

Table 3. Costs and returns for a 1-ha crab monoculture at various stocking densities

Stocking density (crab/ha):	5000			10 000			15 000			20 000		
Item	Quantity (kg)	Unit cost (₱)	Total value (₱)	Quantity (kg)	Unit cost	Total value (₱)	Quantity (kg)	Unit cost (₱)	Total value (₱)	Quantity (kg)	Unit cost (₱)	Total value (₱)
Revenue (per kg)	1019	50.00	50 952	1022	50.00	51 124	975	50.00	48 766	1104	50.00	55 214
Variable costs												
Chicken manure (kg)	1000	0.60	600	1000	0.60	600	1000	0.60	600	1000	0.60	600
Crab juveniles (no.)	5000	0.50	2500	10 000	0.50	5000	15 000	0.50	7500	20 000	0.50	10 000
Trash fish (kg)	1753	5.00	8764	2209	5.00	11043	3755	5.00	18 775	4461	5.00	22 306
Labor (man h)	1000	5.00	5000	1000	5.00	5800	1000	5.00	5000	1000	5.00	5000
Marketing expenses (2%)			1019			1022			975			1104
Sub-total			17883			22 665			32850			39011
Fixed costs												
Repairs and maintenance			397			397			397			397
Interest			1299			1443			1748			1933
Depreciation			2672			2672			2672			2672
Caretaker's salary			1200			1200			1200			1200
Sub-total			5569			5712			6018			6203
Total costs			23 452			28 378			38 868			45 213
Net income before tax (per run)			27 500			22 746			9898			10 001
Net income before tax (3 runs/yr)			82 501			68 239			29 694			30 002
Tax (35%)			28 875			23 884			10393			10501
Net income after tax (3 runs/yr)			53 626			44 355			19 301			19 501
Return on investment (%)			124			92			33			30
Return on equity (%)			248			184			66			61
Payback period (yr)			0.70			0.92			3.02			3.30

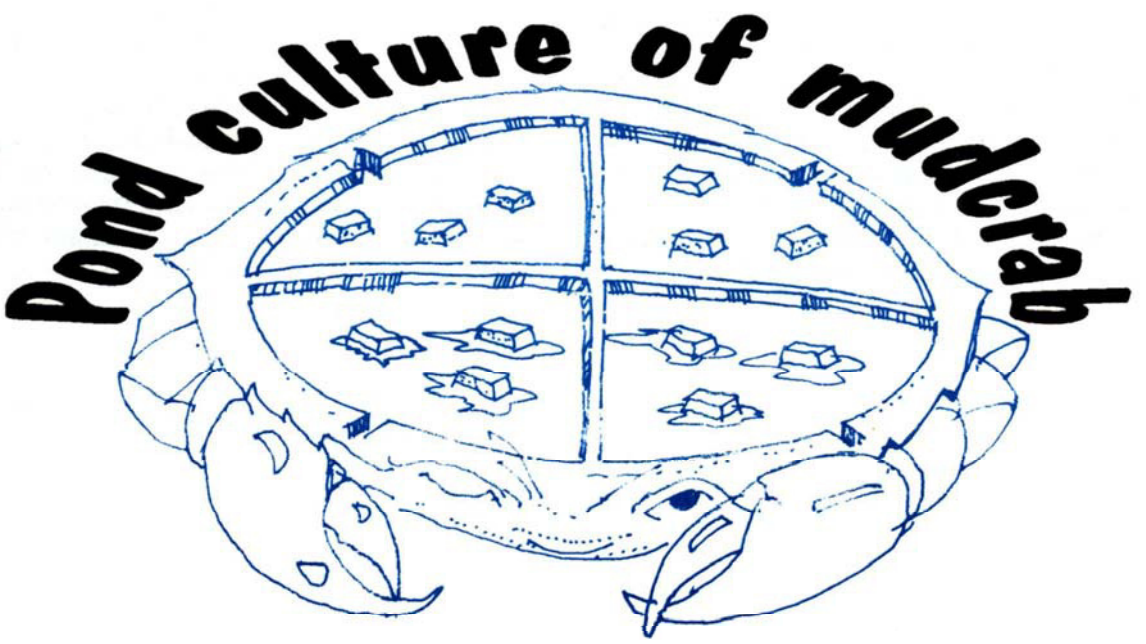
Table 4. Comparative cost indicators of production for a 1-ha crab monoculture (1 run)

Average cost (₱/kg)	Stocking density (crab/ha)			
	5000	10 000	15 000	20 000
Feed	8.60	10.80	19.25	20.20
Juvenile	2.45	4.89	7.69	9.06
Labor	4.91	4.89	5.13	4.53
Marketing	1.00	1.00	1.00	1.00
Debt	1.28	1.41	1.79	1.75
Variable cost	17.55	22.17	33.68	35.33
Total	**23.01**	**27.75**	**39.85**	**40.94**

The researchers concluded that 5000-10 000 crabs/ha stocking densities are most profitable. They urged traditional milkfish growers to allocate a portion of their ponds for mudcrab culture to take advantage of the higher returns on investment and to diversify their crops.

Source: RF Agbayani, DD Baliao, GPB Samonte, RE Tumaliuan, RD Caturao. 1990. *Economic feasibility analysis of the monoculture of mud crab (Scylla serrata) Forsskal.* **Aquaculture** 91:223-231.

Pond culture of mudcrab



The crab *Scylla serrata* Forsskal, locally known as *alimango,* is one of the highly esteemed and most expensive edible crab in the Philippines. The female, when the gonads are well developed, commands nearly double the price of males.

The crab pond

Pond is preferably located in estuarine areas where tidal difference is great to facilitate water change. Salinity should be within 15-30 ppt. Sandy bottoms are preferred.

The size of the pond is usually small, about 350-500 m^2. One good layout is to divide a square pond into four smaller compartments with a 1.5 m^2 water inlet tank in the center. When water enters, the crabs congregate in the tank and can be caught there.

Pond walls made of mud blocks are fenced with bamboo mattings 1.5-2 m high. These are staked vertically 1 m from the inside edge of the dike's crown and 30 cm or more into the soil to prevent the crabs from escaping either by climbing over the bamboo matting or by burrowing through the dikes during low tide.

Pond preparation and management

Construct, install, or repair dikes, walls, gates, and water inlet tank. In ponds with mud dikes, install bamboo mattings. Check leakages, if there are any. When the pond is ready, let the water enter up to 1 m or more. According to field reports, the incidence of crab holes can be minimized or prevented by maintaining the water at least 1 m deep. Water maintained at this depth can provide sufficient coolness to the pond bottom. Thus, crabs will no longer look for a much cooler refuge, like burrowing into the dikes.

Change about two-thirds of the water daily; also maintain the average 1 m depth. Install soil seal after each change of water. One fishery aide can oversee a 500-m^2 crab pond.

Stocking

Stock the crabs from April to September. This is done two days after pond preparation at 7-8 am. Both male and female crabs may be stocked. The stocking rate is generally 3-5 crabs/m^2, depending on the water exchange capacity of the pond. The size of the young crabs stocked varies from 1.5-3 cm or some may be larger but less than 60 g in weight. Record the weight of the crabs before stocking.

Feeding

The feed usually given are snails, trash fishes (tilapia, slipmouth, tenpounder, shark), fish viscera, kitchen left-overs, and almost any kind of animal food. Chop these and broadcast or place on the bricks (if there is any) on the bottom of the pond. Soft-shelled snails, mostly freshwater species, are preferred. If hard snails are given, crack it first. According to experienced crab farmers, snails are the most important feed for the maturation of the crabs, thus, plenty of it must be given.

The quantity of feeds given daily is 10% of the total weight of crabs. Feed the crabs once a day specifically in late afternoon because crabs usually eat after dark. Give more feeds if the crabs are actively searching for food. Also, give enough food to prevent cannibalism.

Conduct sampling every 15days. Collect 15 samples per thousand of stocked crabs. Record the average weight, length, and width.

Harvesting

In 5-6 months, the crabs can be harvested. Market-sized crab has a carapace width of 12-15 cm or weighs 220-250 g. Survival rate is 70%.

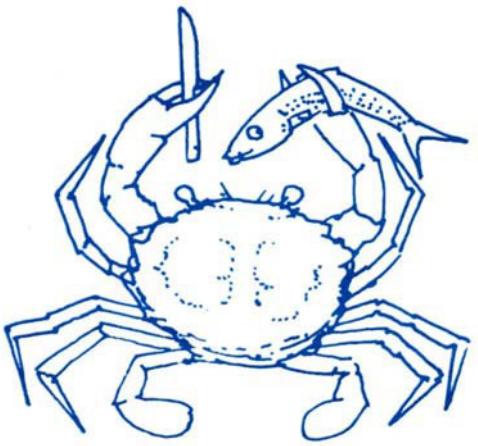
Male crabs which have many copulations have very little meat and demand low price. This happens very often after September. To avoid this, farmers usually harvest before September.

Harvest by hand with the help of a small dip net, large dip net, or crab lift net baited with trash fish. If needed, place plastic cement pipes on the bottom. Lift it from time to time to empty the crabs that hide there. But the most effective method is to catch the crabs in the water inlet tank as mentioned earlier.

Marketing

Cultured crabs, male or female, with or without ovaries, may be sold. To determine the fullness of the ovaries, experienced farmers examine the crabs against the light or press the shell to determine if it is firm. When transporting, bind each crab with wet heavy straw rope to facilitate handling and to keep it moist. Crabs are sold either by number or by kilo.

Source: SV Seville, LA Barcenas, RP Graboso. 1987. *The Mud Crab Culture.* **Reachout** 6(1), Oct-Dec.

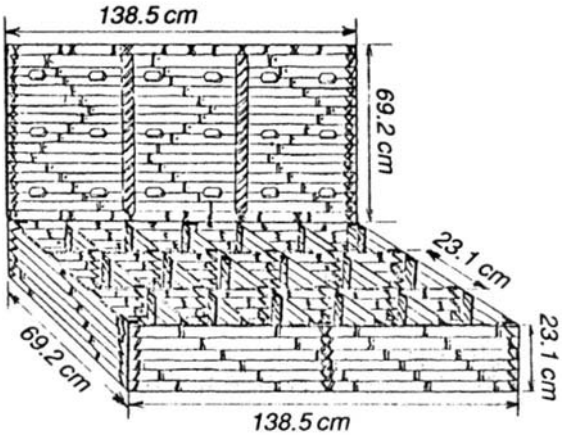


Fattening of mudcrab in cages

The Department of Agriculture (DA) in Region VI conducted a study on fattening of mud crabs in bamboo cages. This technology was tested in Barangay Manapao, Pontevedra in Capiz.

Marketable thin crabs were stocked in bamboo cages (figure below) for an average 10-15 days. These cages have 18 compartments stocked with one crab per compartment. The crabs were then fed brown mussel meat every morning and afternoon. Trash fish, soft-shelled snails, kitchen left-overs, animal entrails, and other food materials were also used as crab feed.

Results reveal that this technology can generate a return of investment (ROI) of 154%. The 150-200 g unfattened crabs stocked in ten bamboo cages, which were purchased at ₱10 each were sold at an average of ₱150/kg after 15 days of fattening. The average weight obtained was 250 g each. This gave a gross income of ₱6525.00 with a net income of ₱3956.96 (Table 1).



Design of bamboo cages. Size can be modified depending on production target, manageability, and availability of capital.

These figures indicate that upon adoption of technology, a 100% ROI can be attained if proper care and handling of crabs are observed.

Table 1. Cost-and-return analysis

Item	Cost
Operational cost	
Seed stock (180 pc of 150-200 g mud crabs at ₱10/ pc)	₱1800.00
Feed (30 kg brown mussel meat at ₱5/kg)	150.00
Labor (one person at ₱20/day for 15 days)	300.00
Depreciation	84.58
Contingencies (10%)	233,46
TOTAL	₱2568.04
Gross income (174 pc fattened mud crabs at 250 g/pc with an average price of ₱150/kg)	6525.00
Net income	**₱3956.96**

On the other hand, a demonstration-trial farm in Sasmuan, Pampanga has been set up by the science and technology department in Region III to showcase the cage fattening technology. Some 200 cages were constructed.

These cages can be installed along river channels which have been silted by lahar or in fishponds stocked with other species.

Source: *Let's fatten mud crabs.* **Farming Update,** Vol. 3, No. 2, April-June, 1991; **Philippine Daily Inquirer,** 27 Feb. 1992.

Live crab - a Malaysian favorite

Malaysia's per capita consumption of seafood is 35 kg, one of the highest in the world. Malaysians love seafood and they also enjoy dining out frequently in seafood restaurants where live mudcrab is a popular item.

Hence, it is not surprising that the country has become a flourishing market for the live crab in Southeast Asia. The Malaysian market channel for live mudcrab is given on p.9.

Mangrove mudcrab, the trade name of the species *Scylla serrata,* is known as Sri Lankan crab to local Malaysians. Although Sri Lankan supplies still dominate the market, mudcrabs are also imported from neighboring Indonesia, Vietnam, India, and Bangladesh as well as from far off sources such as Fiji and Papua New Guinea.

Live mudcrabs are air-freighted from various supply sources. These are packed in knitted bamboo baskets, stacked one above another. Their pincers are tied up with straw to prevent them from damaging each other. The basket bottom is covered with polythene sheeting to avoid leakage. Mudcrabs can survive out of water for a week if kept cool and moist, especially with seawater.

The mortality rate is usually 10-15% in non-stop air freighting.

The supply of mudcrab in the producing countries is becoming less due to over-exploitation and importers constantly look for alternate sources. Apparently, the supply is never enough to meet the increasing demand for this popular seafood. Almost all seafood restaurants in Kuala Lumpur serve mudcrab.

It is difficult to quantify the market volume due to lack of statistics but certain examples might help. The biggest seafood restaurant in Kuala Lumpur located near the airport sells 20 baskets of live crab a day. Each basket contains 40 kg of crabs. This particular restaurant caters to about 1000 customers a day during weekdays; even more people, of course, eat here during the weekends. There are hundreds of medium and small seafood restaurants in the city and surrounding areas with most of them stocking live crabs.

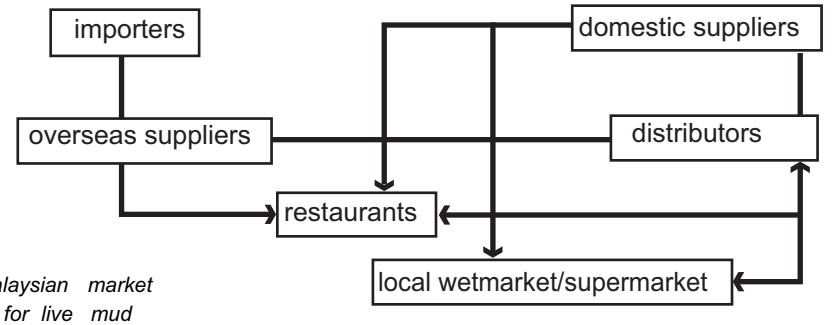
Crab sizes vary between 350 g/pc and 1 kg/pc. However, the popular size is 750 g/piece. Popular preparations are: grilled, baked, boiled, steamed, fried in sweet/sour/hot sauces and Indian spices.

The import price for Sri Lankan crab is about MR12/kg (US$4.40) whereas Indonesian prices range between MR4.50-7/kg (US$1.70-2.60) depending on size and sex. Female crab with roe are more popular and expensive than the males. Vietnamese mudcrab, which are also known as green crab fetches a slightly higher price. Sizes range from 350 g to 1 kg where prices vary from US$2.50 to 6.15/kg. The mudcrab supply increases during the new moon and tapers off during full moon.

Live mudcrabs are also sold on the local wetmarkets and supermarkets although not daily. It has always been more popular as a restaurant item than as home-cooked seafood.

Another species of live crab is also being flown in from Fiji and Papua New Guinea particularly for the local five-star hotels. This is known locally as Fijian crab. This huge creature weighs 6-8 kg/pc. Unlike mudcrab, its color is red and it looks like the coconut crab. Although the price for this species is MR35/kg (US$13), one crab costs MR1000 (US$370) at a five-star hotel's seafood restaurant although it can be served to 8-10 people.

Source: F. Ferdouse. 1990. *Live mud crab - a Malaysian favourite.* **INFOFISH International** 6/



The Malaysian market channel for live mud crab.

Crab fattening in cages

In Pulau Ketam on the western shoreline of Peninsular Malaysia, the following were observed. Crabs were cultured in cages located amidst calm mangrove estuaries. The species reared was the mudcrab (*Scylla serrata*). Cages were no further than 10 m from mangrove shorelines, ten partly submerged cages placed alongside one another. They were suspended by nylon ropes from a floating platform. Shade for the cages was provided by thatched palm leaves overhead. One person took care of the operation.

Cages were 340-cm long, 190-cm wide, and 90-cm deep. The cages were fixed on an anchored floating platform, with approximately 25 cm of the cage above water level. Cage material consisted of inflexible plastic netting of mesh size 1.25 cm.

Small to medium size and even large 'thin' crabs (7.5-12.5 cm carapace width) with low market value were purchased from fishermen, trapped from the wild, or imported from neighboring countries and stocked into cages at 0.1/ m^2. With higher stocking rates, the crabs tended to crowd together. As often as possible, crabs were regularly sorted and restocked by size.

Mortalities seem to occur among airflown imported juveniles upon arrival and initial stocking. If adequate shelter was provided with pipes and inverted pots, mortalities at molting did not occur. Injuries sustained during fights, such as loss of limbs were evident. Obviously, optimal stocking and size segregation helped reduce mortalities caused by cannibalism.

Feed consisted of chopped trash fish, molluscs, crustaceans, and small dried fish -all 'by-catch'. Feed was placed on clay plates on the floor of cages. Cages were not cleaned as the crabs picked them clean. Occasionally, horse-shoe crabs were thrown in and were made a meal of.

Crabs were marketed live at 0.5-1.0 kg size. Claws were immobilized with rubber bands, and the crabs transported in wet burlap bags.

Mudcrabs may also be cultured in coastal earthen ponds. Being euryhaline, they are tolerant of wide changes in salinity. Fattening is preferred to culture from crab larvae, since mortalities are high in the latter case and the technology is not well established.

Source: **INFOFISH International** 4/90.

Mudcrab culture in Thailand

In Thailand, mudcrab farming is carried out on a small scale compared to shrimp, fish, and bivalve farming. Due to the decline in natural populations of *Scylla serrata* and many small undersized crabs being caught, there has been considerable interest by fishermen to grow and fatten crabs. There are some 100 crab farms in Thailand.

Crab farms

Crab farms are generally small-scale, never more than 1 rai (1600 m^2) in area, using earth ponds and bamboo fences. However, some may be located in the estuary in the form of a rigid pen structure in the water, or by an estuary with a sluice gate for the water to enter. In Krabi Province, fishermen are known to raise crabs individually, feeding crabs in cages or traps in the mangrove areas, but not many crabs would be fattened at any one time. Either small crabs are fattened to medium-sized crabs, or medium-sized crabs are fattened to large crabs in the hope of producing some mature female crabs. Culture period is always short for these burrowing, cannibalistic animals to reduce the number of molts during the period, as newly molted crabs are very soft and extremely vulnerable to cannibalism by other crabs.

Today, the Kanjanadit district of Surat Thani Province is the main area for crab farms, followed by Nakon Si Thammarat and Chanthaburi. Rayong, Krabi, Satun, and Pattani Provinces all have crab farms. Total annual production of cultured mudcrab in Thailand is estimated at around 13 t. Samut Songkram province had many crab farms before shrimp farming boomed and farmers turned to shrimp.

Limitations

A major limitation to the expansion of crab farming is that there are no hatcheries producing juvenile *Scylla* in Thailand; crab farmers are dependent on natural stocks. Research is being done by some government fisheries stations. And *Scylla* can be bred but the larval stages are highly cannibalistic and therefore difficult to rear on a large scale.

Comparing crab culture techniques

Country	Stocking size (carapace width)	Grow-out	Stocking density	Feeding rate	Market size	Survival
Taiwan	7-12 cm	3-4 months (summer); 5-6 months (winter)	3/m^2	5% body wt	220 g (12-cm carapace width)	
Taiwan	1.5–3.0 cm	5-6 months	1/m^2	5% body wt	220 g(12-cm carapace width)	50%
	7-12 cm	20-50 days polyculture with seaweed & milkfish	1/m^2	5% body wt	220 g (12-cm carapace width)	70%
Thailand	100 g	1-2 months	2/m^2	8% body wt	200-300 g	50-70%
Philippines	2-3 cm	3-6 months; 4-8 months polyculture with prawns, milkfish	1/10m^2	No strict feeding regime	8-9 cm; 200-500 g	40-70%

Source: **INFOFISH International** 2/91.

Mud crabs support a year-round local fishery in coastal mangrove areas, being found throughout the tropics in mangrove regions, estuaries, and coastal waters, living both intertidally and subtidally. Young crabs are found throughout the year; medium-sized crabs appear more abundant in the rainy season. They are caught entirely by artisanal fishermen and over the past ten years, there has been a noticeable decline in its population and now the catch consists of many undersized crabs.

Nowadays, with the destruction of mangrove areas and the declining population of *Scylla* there has been renewed interest among fishermen to grow small crabs and if a pond is well managed, crab fattening can frequently generate income. Stocking rates of ponds depend on the supply and availability of young crabs; if no crabs are available, then none can be fattened. Mud crabs are easy to sell and transport live. An added feature is that they can be air- or sea-freighted, being a popular delicacy in the Indo-Pacific region.

Until hatchery techniques have been fully researched to rear large numbers of small *Scylla,* crab farming will remain small-scale. Research into other areas such as feeding, molting, and biology is the key to its large scale culture. Meanwhile, small-scale crab farming will continue in Thailand as long as there are natural stocks of young *Scylla* available.

Source: M. Harvey. 1990. *Mud crab culture in Thailand.* **INFOFISH International** 6/90.

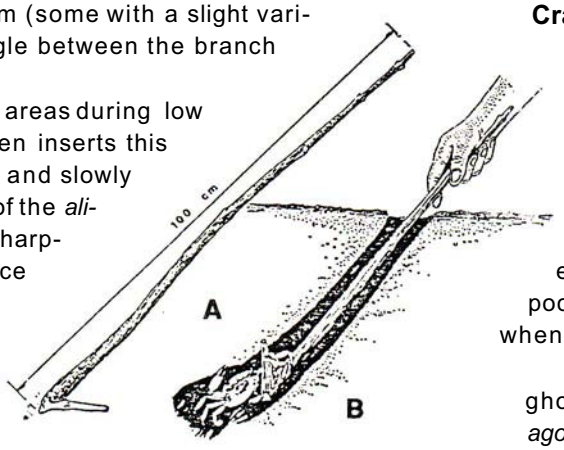
Catching crabs, crabs, crabs

Six kinds of crabbing devices in the Philippines are illustrated and described:

Crab nook

The crab hook, locally known as *panukot,* is made of the branch of mangrove tree with a hook. The branch measures 100-cm long and the hook (twig) 8 cm (some with a slight variation), and the angle between the branch and twig is 40°.

At mangrove areas during low tide, local fishermen inserts this crab hook carefully and slowly to the hole or nest of the *alimango.* When the sharpened tip of the device touched the crab usually at the end of the hole, the crab may instantaneously grasp the hook by one of its huge pincers due probably to its aggressive nature, and this response will be immediately detected by the skillful man. Then he slowly starts to withdraw the hook. He sometimes quickly blocks the hole with a sharp digging blade when the crab is about to appear at the mouth to prevent its escape towards the inner portion of the hole.



Crab hook: side view (A); method of operation (B).

Crab circular net

The crab circular net, locally known as *takiao,* consists of cotton or abaca fiber nettings (2.5 cm mesh size) and a piece of bamboo ring. The gear has enough netting material to form a pocket in which a crab is entangled when it comes out.

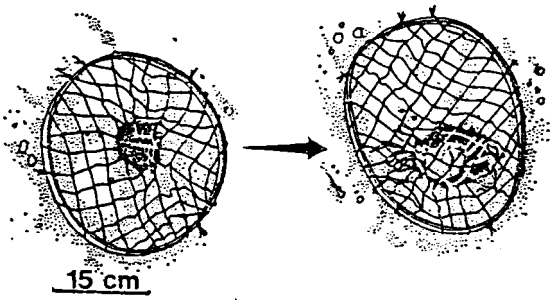
The device is used to catch ghost crabs known as *biokoy, agokoy,* or *torokoy* dwelling in sandy beaches. The fisherman covers the hole of the crab in the evening with the net, inserting its pocket into the hole. When this

this nocturnal crab comes out to search for food, it is entangled with the net and hence can be collected the following morning.

Crab tube trap

This skillfully designed trap, locally called *patibong,* consists of a large bamboo trunk (36-cm long; 10-cm outer dia.) with three pieces of bamboo slats attached by a piece of rattan string One bamboo slat slightly touches the upper end of the trunk near the open end and the other is inserted near the blind end; both have loose contact with each other. The former is tightly pulled downward by the tension of the rattan (or sometimes synthetic) String generated by the bowing of the third bamboo slat.

In the afternoon (mostly towards the evening), or sometimes during rainy days, the crab catcher sets this device at a muddy bank of fishpond or mangrove dikes. The entrance portion is inserted to the outlet of a crab hole. When crab carelessly steps into the bamboo trunk, the animal eventually touches the bamboo slat set near the end of the trunk, instantaneously pulling down another slat and trapping the crab. The next day, the crab is harvested.



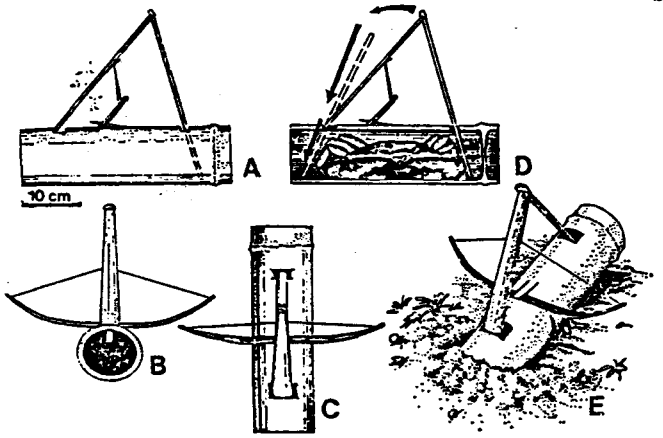
Crab circular net

As gathered from the people, the device is originally invented to trap the land crab, locally named *kagang, kuray,* or *ungkoy,* but they sometimes trap the mud lobster locally called *palatak, kolokoy, uson,* or *manla.*

Crab lift net

The crab lift net, locally known as *bintol,* is made of abaca ropes, two pieces of bamboo slats in addition to a short bamboo trunk. A kind of dipping device, the net is usually knitted by hands with the meshes varying from 3 to 6 cm^2. Stone weights are sometimes attached at each corner to make the sinking of the net quicker and to ensure the right position on the bottom. The net has a depth of about 15 cm. It is baited with a trash fish or a head of a salted fish which is replaced each time the net is lifted. It is generally dropped from a dugout (locally called *banca).* The baited trap is usually set on the sandy bottom of shallow sea for capturing swimming crabs locally called *alimasag* or *suga-suga,* or on the muddy bottoms of mangrove swamps or estuaries for capturing the mangrove crabs and other portunids known as *dawat.* After a while, the fisherman picks up the bamboo float, then suddenly lifts the net to the surface.

It is strange to hear that while the net is being hauled, the crab does not run out of the net despite its shallow and simple construction. According to fishermen, this is probably due to shock. In general, the chance to trap crab(s) might be said to be poor since the catching effort is only made periodically.



Crab tube trap: side view (A); front view (B); top view (C); inner view (D); method of operation (E).

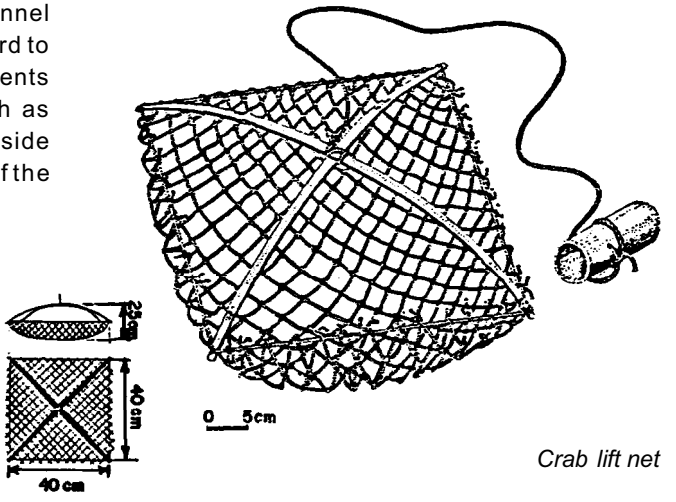
Crab basket trap

The crab basket trap, called *panggal,* is made of many pieces of bamboo slats, a rattan rope, a bamboo trunk, and stones. It is six-sided or circular in shape with one opening at the top. Commonly used crab baskets are 15-cm high, 35-cm dia. with the entrance 7-cm wide in the center of the device. The entrance is cir-

cular with a collar, sometimes with a funnel made of bamboo slats which project inward to allow crabs to enter the basket, but prevents them from escaping. Stone weights such as the sinker are usually attached to the outer side of the device for the same purpose as that of the *bintol.* It is baited with stale meat or head of salted fish.

The basket is set mostly in shallow water and sometimes in brackishwater areas, aimed to trap swimming crabs. The device is thrown out of the dugout to the bottom of the crabbing area in the evening. The following morning, the fisherman pulls the rope of the strong rattan or Manila rope through a bamboo float at its free end. Then he examines and takes out the crab trapped through the entrance.

This device is often utilized by fishermen who are engaged in handline fishing, that is, as a live box for living bait. In this case, it is called *palanan,* meaning receptacle for bait.

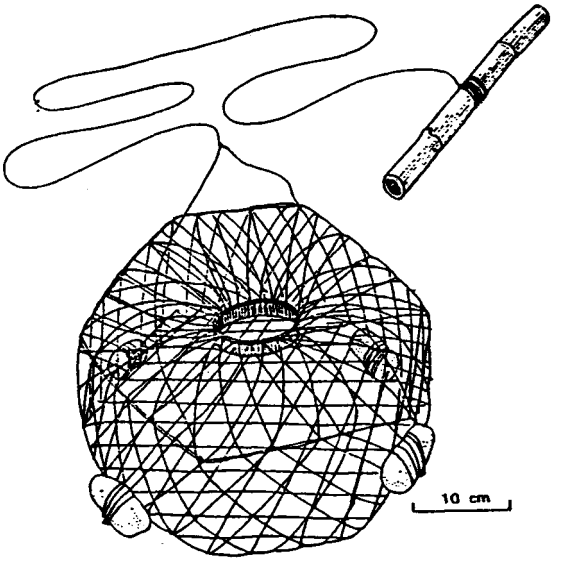


Crab lift net

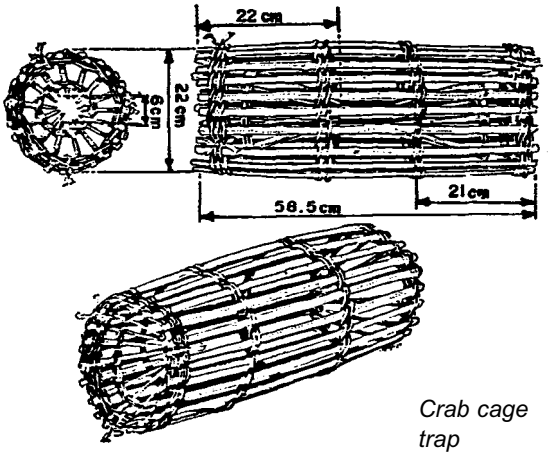
Crab cage trap

The crab cage trap, locally known as *pangay,* is rigid and is made of some 24 pieces of bamboo slats 60-cm long in addition to sharply pointed ones and several pieces of rattan. It is cylindrical (60-cm long; 22-cm dia.). Both ends of the cage are tightly capped with rattan circles which are furnished with sharp pieces of bamboo slats as a funnel, allowing crabs to enter the cage. The narrow inner end of the funnel is supported by tied rattan. Even if the trapped crab tries to escape through one of the openings from inside, it can not go out since there is a funnel or fishing head of bamboo pieces recessed.

This cage trap, sometimes baited; is used in brackishwater areas such as mangrove creeks. In the evening, fisherman sets this device forming a line at his favorite place. As crabs are generally nocturnal, he examines each trap the following morning and when he finds crab(s), he unties one of the rattan circles to remove it. After getting crab(s), he attaches the circle as before.



Crab basket trap



Crab cage trap

Source: H.Motoh. 1983. *Traditional devices for capturing crabs used in the Philippines today.* **Researches on Crustacea** No. 12. Carcinological Society of Japan.

THE LATEST

Intensive prawn pond effluent Is used to fatten mudcrab and to raise mussel

Much has been said about the social, ecological, and economic implications/impacts of intensive prawn farms in the Philippines. At last, something practical is being done about it.

Kuntiyo, a U P. in the Visayas (Miagao, Iloilo) graduate student, conceptualized construction of a mudcrab cage right at the outflow of intensive prawn ponds. He studied the survival rate, weight gain, feed conversion ratio, and economic returns of mudcrab (*Scylla serrata*) under different feeding regimes. His masteral thesis was conducted in Victorias, Negros Occidental from 14 Aug to 18 Sept 1991.

His initial results showed highest weight gain for mud crabs "fattened" with trash fish and commercial prawn pellet (10% and 2% of body weight per day, respectively); although feed conversion ratio is highest for crabs given a lower feeding level of trash fish (2%). His survival rate ranged 80-100%.

He also considered this venture (regardless of feeding treatments) profitable, which goes on to say that intensive prawn pond effluent can be used to fatten or to enhance fattening of mud crab.

For more information, write to Kuntiyo, Brackishwater Aquaculture Center, Directorate General of Fisheries at Jepara, Central Java, Indonesia.

ON THE OTHER HAND...

The pollution deriving from the shrimp ponds is mainly organic, biodegradable, and not harmful unless exceeding the threshold of what the environment can sustain. A filter has been designed and used successfully to clean the outlet water. The set-up uses filter-feeding bivalve mussels especially *Perna viridis* as the means of filtration.

The filter cleans roughly 55% of the nitrogen out of the water and produces at the same time approximately 80 kg of mussels per m^2, saving the grower from: (1) buying mussels for supplementary feed; (2) buying shrimp pellets in an amount equivalent to the feed value of the mussels.

The cost of establishing a mussel filter for 10 ha shrimp ponds is calculated to be ₱215 000 - of which the main part is used for deepening of existing ponds to create a depth of 2.5 m in the filter and for establishment of new gates for inlet and outlet to the filter.

The annual net operating result from the mussel production is calculated to PHP 75 000 based on the substitutional value of mussels for feed pellets, PHP 1.57 per kilo. The internal rate of return for the project is 27%, if the filter is operated at full capacity for 10 years. The pay back period is 3 years.

Source: Andersen, M J. Report submitted to Asian Development Bank for Western Visayas Development Master Plan Study Part III. 27 Feb 1992.

Research studies on mudcrab

• Sexual maturity in the male mud crab, *Scylla serrata,* is attained at size range 81-90 mm carapace width (CW). At 97 mm CW, 50% of males are mature. [Prasad PN, Neelakantan B. Size at maturity in the male crab *Scylla serrata* as determined by chela allometry and gonad condition. FISH. TECHNOL SOC. FISH. TECHNOL. COCHIN, Vol. 27, No. 1,1990.]

• Biochemical analysis of *Scylla serrata* muscle meat indicated higher protein and lower fat values in 51-80 mm size range. In sub-adult and adult crabs (81-130 mm carapace width), a consistent protein and decreased glycogen and fat content was observed. The percentage of moisture was more in juveniles and sub-adults than in adult crabs. [Prasad PN, Neelakantan B. Chemical composition of the edible crab, *Scylla serrata.* BEVERAGE FOOD WORLD, Vol.15, No. 3,1988.]

• A study conducted in Mahajamba Bay (Madagascar) describes the crab fishing

(to page 15, box)

Aquaculture clinic

SEAFDEC/AQD's Training and Information Division periodically receives technical inquiries from fishfarmers, students, administrators, and pond managers. For the benefit of the readers, some of these queries will be regularly featured in an *Aquaculture Clinic.* Incidentally, this *Aquaculture Clinic* is a part of AQD participations in exhibits, fairs, and others which is manned by SEAFDEC researchers. Fishfarmers are given the opportunity to interact with the Department's technical staff to help them solve problems in their farms.

Readers are encouraged to send in their technical questions on all aspects of aquaculture. Write to: The Editor, *Aqua Farm News,* P.O.Box 256, Iloilo City 5000.

QUERY

What are the water quality criteria for prawn culture in brackishwater ponds and hatcheries?

REPLY

Table 1. Water quality parameters needed to support maximum growth and feed efficiency

Parameter	Optimum level
Dissolved oxygen	>3.5 ppm
Temperature	26 - 32°C
Salinity	10 - 25ppt
Ammonia nitrogen	< 1.0 ppm
Nitrite nitrogen	< 1.0 ppm
Sulfide	< 0.003 ppm
pH	6.8 - 8.7
Carbon dioxide	< 10 ppm
Biological oxygen demand	< 10 ppm
Chemical oxygen demand	< 70 ppm
Secchi disc visibility	> 50 ppm

Table 2. Water quality criteria for hatchery

Parameter	Level
Salinity	30 - 32 ppt
Dissolved oxygen	supersaturated
Temperature	26 - 31°C
pH	7.5 - 8.5
Unionized ammonia nitrogen	< 0.1 ppm
Total ammonia nitrogen	< 1.5 ppm

The above was compiled by Ms. Precilla Subosa, SEAFDEC Research Associate and Head of the Centralized Analytical Laboratory. Ms. Subosa has published on water quality of shrimps, culture of shrimps and milkfish, and others.

from p. 14...

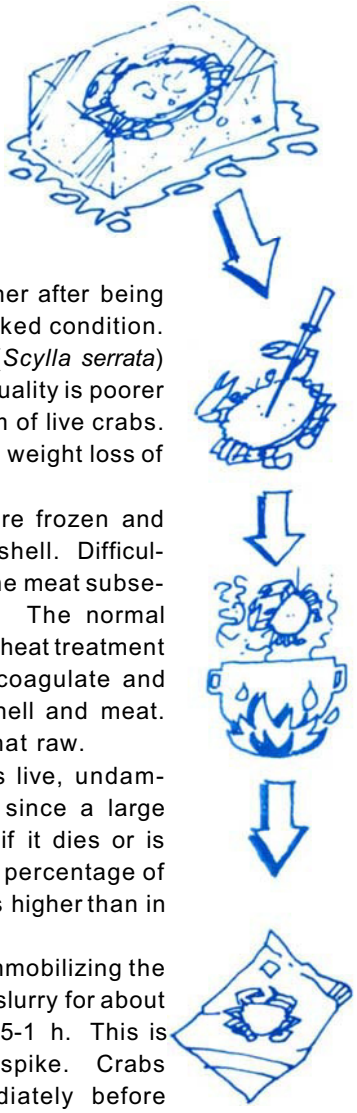
activity on the Malagasy north-west coast, region where the Refrigepeche-Ouest society operates on the mudcrab *Scylla serrata.* This society puts the product on the foreign market after processing into frozen crab meat. There are two forms of exploitation of mudcrab in the Mahajamba Bay: the traditional fishermen, using hook, racket, and line as fishing gears which catch more crabs of littler size than the groups of fisherman who use the drop dilly. The catches depend on the lunar cycle and fishing season. In 1988, the total collected catch was =475.6471. The mortality losses are linked with the quantity of mud mixed with the crabs and with transport distance. Those losses are 12.8% for the traditional fisherman and 12% for the associate one. During the 10-mo period of observation, the catch rate of the mudcrabs was found to be higher for the traditional fisherman (16.33%) than the associate fisherman (10.66%). [Razafimandimby J. Study on the crab *Scylla serrata f*isheries activities on the Malagasy north-west coast 1988. VFSH, TOLIARA (Madagascar), 92 pp, MAG/84/002. Thesis. 1989.]

Others

The Brackishwater Aquaculture Information System of SEAFDEC Aquaculture Department published the *Mud Crab Abstracts'm* 1988. This is an update of the 1986 *Mud Crab Bibliography* but now including abstracts of the entries and 91 more references. It costs-₱150, domestic; US$35, foreign. Write to: Sales/Circulation, SEAFDEC/AQD, P.O. Box 256, Iloilo City.

How do you process whole crabs for freezing? Is a different process needed for mud crabs?

Processing



Crabs may be frozen either after being cooked or in substantially uncooked condition. Cooked and frozen mudcrabs (*Scylla serrata*) are marketed, but generally the quality is poorer than the normally marketed form of live crabs. Cooking can cause a substantial weight loss of 7-24%.

When whole raw crabs are frozen and stored, the meat adheres to the shell. Difficulties are encountered in picking the meat subsequent to thawing and cooking. The normal procedure, therefore, includes a heat treatment for 4-5 min before freezing to coagulate and break the tissues connecting shell and meat. The interior meat is left somewhat raw.

It is preferable to process live, undamaged crabs starved over 24 h since a large proportion of blood drains out if it dies or is injured before processing. The percentage of blood in crabs can be 8 -10 times higher than in fish.

Processing begins with immobilizing the crabs by holding them in an ice slurry for about 1 h or cold room at -30°C for 0.5-1 h. This is followed by killing with a thin spike. Crabs should only be spiked immediately before cooking. Killing them prior to heat treatment prevents them shedding a limb or claw during the heat treatment.

In some cases where butchering is recommended, the carapace is first removed. The gills, mandibles, and viscera should all be removed to avoid discoloration of the meat. A knife or rotary brush may be used. It is absolutely essential to wash the crabs quickly. Given time, active proteolytic enzymes from the animal's digestive juices and hepatopancreas rapidly penetrate the flesh causing mushiness. Thus any disturbance of the internal organs of the crab during killing and processing leads to the release of digestive juices which cause undesirable textural changes. An air-suction applied to the mouth cavity should remove all traces of food remaining within. Butchering and keeping before blanching or cooking should not exceed 30 min. While cleaning spawning female crabs for a frozen shell-on product, the ovary should not be removed, and the eggs should be left sticking to the carapace. Depending on buyer's requirements, the carapace may be replaced on the prepared body to give a completely intact appearance. When butchering and cleaning are not carried out before boiling, a much longer cooking time is required with possibilities of discoloration of meat.

For whole raw crabs, heat-treatment by steam-blanching for 4-5 min (average product weight, 1.2kg) is recommended. For whole cooked crabs, boiling is taken from the time crabs are immersed in a boiling cauldron to the time the water returns to boiling. This can take 5-30 min.

Post-blanch chilling should follow briefly using ice or refrigerated brine. Crabs may then be packed in polyethylene bags and vacuum-packed in barrier bags before freezing to -30°C, in an air-blast freezer.

Tests carried out in the USA have demonstrated that freezing crab with nitrogen can produce a more moist, less salty product than a brine-frozen product. The crab is also claimed to have a fresh flavor. Blue crab experimentally blanched in boiling water for 3 min and quick-frozen in liquid nitrogen have been shown to be as acceptable as fresh crabs. Crabs frozen unprotected show a noticeable lack in succulence because of desiccation. Therefore, to prevent dehydration, crabs should be glazed in freshwater as soon as practical after freezing and stored in shock-proof containers. Crabs can be stored at -25°C for up to 2 months.

Source: **INFOFISH International** 6/90.

Cooking mudcrabs

Crabs can be cooked in boiling water or by steaming. Salted water should always be used for boiling crabs - ideally some of the water from which the crab was taken. Freshwater tends to make the crab meat watery and reduces its flavor, but if the water is too salty the meat will be tough and salty. If seawater is not available, add cooking salt to tapwater (25 gm/l) in a large pot and bring to the boil. Drop the crab into the pot on its back, bring to the boil again, and cook for 20-25 min. The water may be seasoned with sliced lemon, black pepper, celery, garlic, and onion, or in the 'Creole' style by adding a bag of 'crab boil' (a mixture of mustard, coriander and dil seed, cayenne pepper, bay leaves, allspice, and cloves). A couple of tablespoons of vinegar added to the water makes the cooked crab easier to pick.

To steam a crab, first kill the crab in the freezer, remove the limbs and carapace, clean out all soft parts, halve, and steam the limbs and body halves in a collander for 8-10 min.

Once cooked, the crab should be drained, cooled, and then chilled in the refrigerator. The edible meat, found in the legs and as a block along each side of the body, can now be removed and eaten as is, or incorporated into a more ambitious dish.

Jellied crab

2 envelopes unflavored gelatin
1 cup cold water
1/4 tsp salt
1 tsp grated lemon peel
1/4 cup freshly squeezed lemon juice
2 cups mayonnaise
2 tsps instant minced onion
400 g drained crab meat
1 cup finely chopped celery
lemon wedges

In a small saucepan, soften the gelatin in cold water for 5 min; heat slowly, stirring constantly, until thoroughly dissolved. Add salt, lemon peel and juice, mayonnaise, and onion. Chill until slightly thickened, but not set. Coarsely flake crab meat; fold into chilled mixture with celery. Pour into a quart jelly mold; chill until firm. Unmold onto chilled plate; garnish with lemon wedges. Serves six to eight.

Crab and avocado

100 g crab meat
4 small avocados
lime or lemon juice
hollandaise sauce
curry powder
buttered bread crumbs

Cut avocados lengthwise, pit, and brush surfaces with lime or lemon juice. Mix crab meat with 200 ml hollandaise sauce. Stir in dash of curry powder. Heat mixture until hot and spoon into avocado halves. Top crab meat with buttered crumbs, place avocados under grill for 2-3 min until brown. Serves eight.

Crab and mushrooms in wine sauce

450 g crab meat
100 g sliced mushrooms
2 tblsp butter
2 tblsp butter to sauce fresh mushrooms
2 tblsp flour
1/2 cup milk
1/2 cup white wine
3/4 cup bread crumbs
1/2 tsp dry mustard
1/4 tsp dry tarragon
salt to taste
pepper to taste
hot sauce to taste

Saute mushrooms in butter. Make a cream sauce, blending melted butter, flour and milk, wine, mustard, tarragon, salt, pepper, and hot sauce. Cook 2-3 min, then add crab meat and mushrooms. Place in casserole; sprinkle top with bread crumbs and dot with butter. Bake 200°C for 30 min uncovered. Cover before serving. Serves four.

Source: DF Fielder and MP Heasman. (undated). *The Mud Crab.* **Queensland Museum Booklet No. 11**. Univ. of Queensland.

DR. EFREN EDUARDO C. FLORES

Change of guards

Flores is new Department Chief

SEAFDEC Aquaculture Department is pleased to announce its new Department Chief. Dr. Efren Ed. C. Flores begins a two-year term on 8 April 1992. Dr. Flores was previously Dean of the College of Fisheries of UP. in the Visayas and Professor of Marine Fisheries. He succeeds Dr. Flor Lacanilao.

During the Department Chief Induction and Turnover Ceremony held 21 April at the Tigbauan Main Station, Dr. Flores welcomed the opportunity to serve both the country and the Southeast Asian region. He noted that as Chief, he has a function of balancing the needs of SEAFDEC Member Countries and the needs of the host (Philippine) government.

For 1992, he will work for the implementation of the programs already approved by the SEAFDEC Council last year; however, plans for 1993 will be formulated in collaboration with other institutions in the country like U.P. in the Visayas, Department of Agricuiture, fishfarmer's organizations in Negros, Iloilo, and others.

He particularly noted that the concentration of fisheries researchers (80%) in UPV and AQD makes collaboration easier.

Because his success as Chief would be a result of the cooperation of the AQD staff, he urged the research and support staff to "work for the institution and not for the head, as heads come and go." He added that he would like to develop the employees' confidence in him so that all Department personnel will work to develop AQD.

He was inducted into office by DA Undersecretary for Attached Agencies Benito Bengzon, also chairman of the SEAFDEC Council (policy-making body of SEAFDEC).

In pursuit of development

People participation in R and D

Social scientists stressed the importance of user participation in R and D.

Mr. John Sollows, the first of the three scientists invited by SEAFDEC/AQD, talked about his experiences and thoughts on user participation in R and D last 20 Feb at the Tigbauan Main Station (TMS). Based on his experience in the preparation and implementation of IDRC-funded projects, he emphasized the concept of democratization, that is, sounding out the users (of technology) throughout the planning, implementation, and evaluation of research projects. This would accelerate pursuit of development.

This was further elaborated by Dr. Gary Newkirk, Coordinator of the Mollusc Culture Network and Associate Professor of Dalhousie University (Canada), who discussed his Network's involvement in coastal aquaculture in Sudan and Jamaica. He pointed out the limitations of the classic *research-extension-farmer* approach to technology transfer as inadequate since the researchers are "out of sync" with the clientele. On the other hand, the approach which was participatory and more of consensus-type of model was effective since the farmers themselves ultimately made the decision to adopt or reject the technology. His lecture was delivered last 2 Mar also at TMS.

Dr. Robert Pomeroy, Coordinator of the Asian Fisheries Social Science Research Network of ICLARM underscored the need to study why people are either resistant or amenable to social change. Social scientists must understand this in order to come up with resource management schemes that work, Dr. Pomeroy said. He spoke on the need for a participatory scheme to include the people who will use the resources so that they themselves can regulate their own use. His seminar was last 27 Mar at TMS.

The seminar series on social science as it relates to fisheries has direct bearing on the Department's seafarming/searanching project at Malalison Island, Antique which is dependent upon the cooperation of the fishermen organization in the area.

A FABLE

The Experts arrived at the fishing village. For years the natives had used primitive techniques in their work. True, they caught fish, but they had to paddle out to sea everyday, maybe even on feast days. It was a hard life, though well-tried over the years.

The new nets were rather dearer than the old, and the method of fishing was different too. But in a single net they caught a whole week's supply. Fantastic! You could work one day and be free for the rest of the week! The village folk had a great feast, several feasts...in fact so many that they had to fish two days each week to pay for the celebrations.

This is no good, thought the Experts, they should be fishing six days a week and making money out of it. We haven't come here to witness endless parties. Surely it's enough with one feast a month. This is an underdeveloped country; they must produce more protein. Fish!

But the village favored *fiesta.* Fishing two days, and free the rest of the week.

The Experts grew annoyed. They hadn't travelled from the distant North to watch natives drum, dance, and dream. They had come to fill hungry stomachs, to lessen the threat of the under nourished against the overfed. Yet the villagers danced late into the night. Why shouldn't they? They were rich now, almost as rich as the Maharaja, though he had never done a day's work in his life...

And then the Project Director had a brilliant idea. (Not for nothing had he taken an evening course back home in economics.) These lazy fisherfolk were not actually lazy; they were simply weak on motivation, motivation to work harder. They had not discovered their needs.

He bribed a villager to buy a motorbike. Bribery was distasteful, but sometimes necessary. True, there were no roads as such, but the wet sand along the water's edge was hard and smooth...

The motorcycle roared back and forth. What a toy! And soon every young man wanted one of his own. The village elders warned them: *What use is there in riding far off and back again on the sand?*

But the young men replied:

We can race. We shall see who is the fastest. And you grey-beards, you can place bets on us!

The Project Director's idea proved a brilliant success. At last the men fished almost every day. The capital city got the fresh fish it needed. (Indeed, a large part is now turned into fish meal and exported to Europe where it makes excellent pig food and helps keep down the price of bacon.)

But probably most pleased of all was the Maharaja, for it so happens that he was sole agent of the motorcycle firm in that country. He also owned the main fish market in the city, while his uncle's family built and ran the fishmeal factory. When the Experts flew home, he raised the price of a motorcycle, so that to buy one a man must work three years, instead of a single season.

And the fishermen fished on. They had discovered a need.

From this short story, one thing at least seems clear: change does not always mean progress. Source: G.Roberts. 1979. **Questioning development.** The Alver Press, Hampshire: p. 5.

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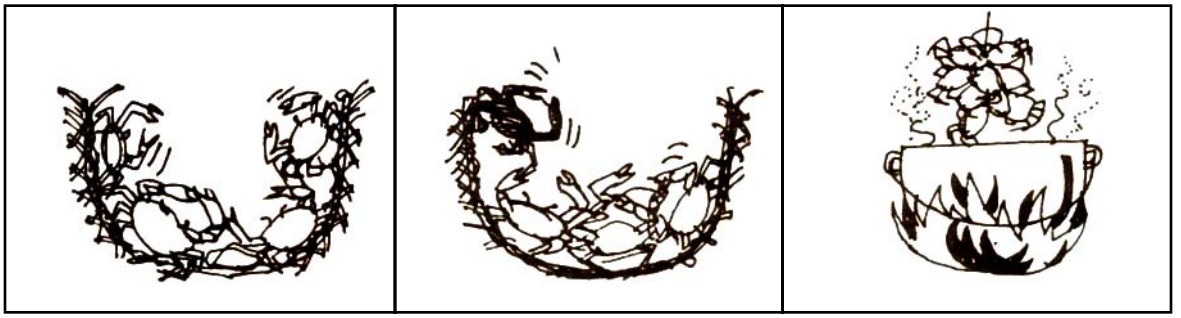
The greatest escape that failed in history



by I. Tendencia

Better life through aquaculture