

SEAFDEC Asian Aquaculture



Volume XXV Number 3 July-September 2003

ISSN 0115-4974

Abalone culture - a new business opportunity

Wenresti G. Gallardo and Nerissa D. Salayo
SEAFDEC/AQD, Iloilo, Philippines
<gallardo@aqd.seafdec.org.ph>
<ndsalyo@aqd.seafdec.org.ph>

Abalone is a marine gastropod (single shelled mollusk) that has a big foot muscle, inhabits rocky and coral reefs, and feeds mainly on seaweeds. There are about 100 species of abalone in the world but only 20 are of high commercial importance.

In the Philippines, the abalone species are *Haliotis asinina*, *H. varia*, *H. ovina*, and *H. glabra* but it is *H. asinina* which has high commercial value. Live abalones command a high price of P250-300 per kg (15-20 pieces; P55 = US\$1). Middlemen or processors blanch these to remove the shell and gut. The blanched meat is sold at P450-550 per kg. These semi-processed abalone are then frozen, dried or canned for export to many countries such as Hong Kong, Japan, Korea, Taiwan, Singapore, China, Australia, USA, Canada, Spain, Netherlands. In China, abalone is believed to have aphrodisiac and medicinal value, and canned abalone is a prized gift.

☞ page 25

The abalone Haliotis asinina (photos by J. Altamirano); netcage culture at AQD's Igang Marine Substation (rightmost, photo by R. Buendia). In floating net cages, it is easy to monitor, feed, and harvest abalone. Seaweeds that grow naturally on nets can serve as additional food



Training schedule, survey, p31 and p4

Learn about seven business opportunities in aquaculture, p19

Ecological issues in aquaculture discussed by British Ecological Society, p14

Mangrove survey in Carles, Iloilo, p2

ASEAN-SEAFDEC 5-YEAR PROGRAM
Integrated Regional Aquaculture Program

Inspiring aquaculture development in rural Cambodia

Wilfredo G. Yap and Virgilia T. Sulit
SEAFDEC/AQD
<wgyap@seafdec.org.ph>



Family of Khiev Sam, fish breeder, in front of their new house

Sam and Som

Mention Cambodia and most likely the horror of the 'killing fields' comes to mind. If you go to the province of Takeo and meet Khiev Sam and Som Hekk, most likely you will have a new "first thing that comes to mind" when you hear Cambodia mentioned. Not only that, unless you are a dyed-in-the-wool cynic, you will likely leave inspired and your faith in aquaculture for rural development strengthened. But that's going ahead of the story.

Takeo province was the first stop in Cambodia for the SEAFDEC/AQD Site Visitation Mission to get the Integrated Regional Aquaculture Program going as a component of the ASEAN-SEAFDEC Five-Year Special Program. Its capital town also called Takeo is located a little over 100 km southwest of Phnom Penh.

☞ page 12

www.seafdec.org.ph

A publication of the Aquaculture Department of the Southeast Asian Fisheries Development Center [SEAFDEC/AQD] Tigbauan 5021, Iloilo, Philippines

**Abalone- new business ...
from page 1**

Abalone Juveniles are fed an artificial diet at the hatchery (photos courtesy of W Gallardo)



Locally, abalone dishes are served in some seafood specialty restaurants and commands a high price of PhP 120-150 per serving which consists of only one abalone cut into thin slices. The abalone shell also used for ornamental shellcrafts which are sold locally and abroad.

SEAFDEC Aquaculture Department (SEAFDEC/AQD) started its research on abalone in 1994 with the objective of developing technologies for hatchery and grow-out culture in order to provide continuous supply of abalone in case the wild populations are over-harvested due to unregulated gathering. As a result of almost 10 years of research, technologies for hatchery and grow-out culture have been developed but continuing research are still being undertaken to further improve and refine the technologies for adoption by the industry.

Based on SEAFDEC/AQD experience on breeding and culture of the abalone *Haliotis asinina*, the major activities and duration of breeding and culture are:

1. Broodstock conditioning (1-2 months)
2. Spawning, egg collection, larval rearing and stocking
3. Primary nursery rearing (2-3 months) - diatom feeding
4. Secondary nursery rearing (1-2 months) - seaweed feeding
5. Grow-out culture (9-12 months)

Abalone hatchery production

Hatchery production is outlined as follows:

Broodstock management

- Flow-through seawater supply
- Continuous feeding of seaweeds
- Dark environment
- Temperature: 27-29°C
- Salinity: 32-35 ppt
- 50-100 spawners per ton at a ratio of 1 male to 4 females

Spawning and egg collection

- Well-conditioned broodstock can naturally spawn every other week, at midnight to early morning
- Water sample from tank bottom is taken every morning (6-7 AM) to check any spawning

Larval rearing, stocking, and settlement

- Eggs or trocophores are collected from spawning tanks and stocked in incubation tanks
- Veliger larvae that swim up are collected by siphoning into buckets and stocked (100-250 larvae per liter) into larval settlement tanks with diatom-filmed corrugated plastic sheets; static water condition but with mild aeration
- Larvae settle on the diatom plates within 3-4 days and water flow may be started on day 4 or 5.
- Larval settlement is a major problem in hatchery production because this depends on the availability of coralline algae and diatom species on the settlement plates.

Primary nursery

- After one week in indoor tanks, corrugated plastic plates with settled post-larvae are transferred to outdoor tanks for better growth of diatoms which post-larvae and juveniles feed on for 2-3 months until they reach 1 cm shell length
- Outdoor tanks should have transparent roof (to allow maximum sunlight penetration but prevent rain which could lower salinity), flow-through seawater and continuous aeration.

Secondary nursery

- Juveniles more than 1 cm shell length are harvested from the diatom plates and fed seaweeds (*Gracilaria*) in trays or cages in indoor tanks with flow-through seawater and continuous aeration. To save on pumping costs, primary and secondary nursery may be carried out in the sea without strong waves and siltation.
- For sea ranching or stock enhancement purposes, juveniles are fed artificial diet for 3-4 weeks to produce the bluish-green shell band which will serve as marker of hatchery-produced abalones
- Juveniles with shell length of 1.5 cm or more can be used for grow-out culture.

➡ next page

business opportunities in aquaculture, part 1 of 2

Below are details of the hatchery economics:

Assumptions and givens

Total no. of spawners in 4 tanks (160 females: 40 males)	200
No. of females spawning every other week	80
No. of eggs spawned per female	100,000
Percent survival from eggs to larvae	5-7
Total no. of larvae every other week	500,000
No. rearing runs per year (excl. rainy months)	20
No. of rearing days to reach 1.5 cm juveniles	120-150
No. of juveniles produced per year	80,000
Project duration (years)	15

Investment items and operating costs (in pesos)

<i>Investment items</i>	386,450
Spawning tanks (4 units, 600-liter capacity, fiberglass)	
Incubation tanks (2 units, 250-liter capacity, plexiglass)	
Larval settlement tanks (2 units, 1-ton capacity, oval fiberglass)	
Primary nursery rearing tanks (2 units, 12-ton capacity, concrete)	
Secondary nursery rearing tanks (2 units, 6-ton capacity, concrete)	
Reservoir (30 tons, with sand-filter)	
Pump (5.5 Hp), Blower (1 Hp), Generator set	
Piping system, trays and cages	
Filter bags, plankton nets, pails, basins, etc.	
<i>Variable cost per run</i>	3,517
<i>Fixed cost per run</i>	6,705

Incomes and economic indicators

Revenue per rearing run (3,600 pcs at P5 per pc)	P 18,000
Income/run	7,778
Income/year	155,568
Return on investment (%)	40
Payback period (year)	2
Break-even price (PhP) per 1.5 cm juvenile	2.84
Break-even production (pcs.)	2,044
Net present value at 12% interest (PhP)	513,343
Internal rate of return (%)	37
Discounted benefit-cost ratio	2.5

Grow-out culture

The grow-out culture of abalone can be land or sea-based. Land-based cultures are in tanks, raceways or on-shore ponds. Sea-based cultures are in cages, pens, barrels, enclosed pile of rocks, inter-tidal ponds or by sea ranching.

Each type of culture method has its advantages and disadvantages. The land-based culture method allows greater control over the culture process and it simplifies animal maintenance (i.e. no need for diving), but it requires large initial investment in land, facilities and equipment, and involves high pumping and operation costs. On the other hand, the sea-based culture method generally requires lower capital investment and capital costs but allows little control over environmental conditions (e.g. typhoons, strong waves). The choice of culture method to use would therefore depend on budget, technology and site suitability.



Stocking abalone juveniles in the PVC pipes used for transport (top); checking for net damage and abalone mortality (photos courtesy of W Gallardo)

Suitable sites for abalone culture:

For land and sea-based culture

- Far from rivers or freshwaters sources
- Clean, clear, high salinity (32-35 ppt) seawater
- Rocky or sandy bottom (not muddy)
- Availability of the seaweed *Gracilaria* ("gulaman dagat") and abalone juveniles. These are the two major factors that determine the feasibility of abalone culture.

For sea-based culture

- Good water circulation
- Protection from typhoons and poaching
- Water depth; at least 2 m at lowest tide (for floating net cage culture)

Recommended conservation measures for abalone

Abalone (*Haliotis asinina*) locally known as "lapas", "sobra-sobra", or "kapinan" is a marine gastropod with very high commercial value. It commands a high price of P250-300/kg (live) or P450/kg (blanched, without shell) and is served as a specialty in some seafood restaurants in the country but is mostly exported to many countries in frozen, dried or canned form. Due to its high commercial value, wild stocks are over-exploited to near depletion as there are no existing laws specifically for abalone. To prevent the depletion of wild stocks, the following conservation measures are recommended:

(1) Minimum size of abalone to be collected from the wild should be 5 cm shell length. Based on a research finding (Capinpin et al., 1998, Aquaculture vol. 166, pp. 141-150), wild abalone (*Haliotis asinina*) attains sexual maturity at 3.5 cm shell length. By collect-

ing only those bigger than 5 cm shell length, the abalone is allowed to spawn at least three times before being collected from the wild. The offsprings produced are expected to sustain the fishery.

- (2) Marine sanctuaries or protected areas where there are natural populations of abalone should be established and implemented by local government units. There is a need to maintain breeding populations which will provide juveniles even to areas outside the marine sanctuary.
- (3) Corals should not be destroyed in the process of collecting abalones. Corals take years to grow and they serve as abalone habitat and shelter from predators. Fishermen should use spatulas or hooks designed for abalone gathering, instead of destroying the corals.
- (4) In depleted or almost depleted areas which are still suitable for abalone, stock enhancement or the release of hatchery-produced seeds may be carried out to rehabilitate the population

but the release site should be protected. The establishment and operation of a hatchery would be necessary for this.

These conservation measures should be implemented as soon as possible or the abalone fishery will collapse like the multi-million peso sea urchin fishery in the early 1990s [Juinio-Meñez et al., 1998, Canadian Special Publication on Fisheries and Aquatic Sciences vol. 125, pp 393-399]. There is now a very big demand for abalone in Korea and China and if measures are not undertaken, our abalone resources will be depleted. Seed production and grow-out culture techniques have been developed and being refined by SEAFDEC/AQD for adoption by the government and private sectors.

(Sgd) *Wenresti G. Gallardo, PhD*
Program Leader for Stock Enhancement
(Noted) *Clarissa L. Marte, PhD*
Head, Research Division
SEAFDEC/AQD

SEAFDEC/AQD has tried abalone culture in tanks and sea cages. The culture trials have shown technical feasibility but economic viability may be poor because of high capital investment and long culture duration (10-12 months). In consideration of economics, SEAFDEC/AQD is recommending the modular system of abalone culture in floating cages.

The modular system is based on the principle of increasing space for increasing size of abalone to maximize abalone growth. Every three months, the stocks are halved and transferred to twice the number of cages, or a ratio of 1:2:4. Depending on the capital available, an operator may have only one module consisting of 7 columns and 7 rows of net cages or seven modules which is in a ratio of 1:2:4. After each transfer, a new batch of juveniles is also stocked, thus, nine months after stocking the first batch of 1.5-2.0 cm juveniles, harvests will be every 3 months. To optimize use of a full-time laborer, a 7-module set-up is recommended for each farm operator.

The projected economics of this modular system of abalone culture in floating cages is shown below:

Assumptions and givens

Abalone size: initial 1.5-2 cm, 1.3 g (P5/pc); final: 5.5 cm, 50 g (P275/kg, 20 pcs/kg)
Culture period: 9 months
Number of crops per year: 3-4
Survival rate: 90%
Feed: seaweed *Gracilaria* ("gulaman dagat")
Feed conversion ratio, FCR: 12-13
Project duration: 4 years

Investment items and operating costs (in pesos):

	1 module	7 modules
<i>Investment items</i>	29,378	205,646
Bamboo frame (10x10m), floats and anchors	10,000	
Mother or barrier net (9x9m)	3,000	
Net cages (1x1x1.3m), 49 units	12,250	
PVC pipes for abalone transport and shelter	3,528	
Pails and containers	600	
<i>Variable cost</i>	32,880	230,160
<i>Fixed cost</i>	10,079	70,533

A new enterprise owned by Mr Vincent Encena II is now adopting this modular system of abalone culture in floating cages.

☞ next page

abalone ... from previous page

Incomes and economic indicators:	1 module	7 modules
Revenue/crop (190 kg/module at 275/kg)	52,178	365,246
Total production cost (P)	42,960	300,720
Net income/crop (P)	9,218	64,526
Net income/year (P)	27,654	193,578
Return on capital outlay (%)		94
Payback period (months)		10
Break-even price (P)		226
Break-even production (kg/module)		156
Net present value at 12% interest (P)		58,685
Internal rate of return (%)		86
Benefit-cost ratio		3.2

Prospects

Abalone culture is expected to grow and expand in the Philippines because:

- Wild populations could be over-harvested, if gathering is not regulated (see box, page 27).
- There is a high demand in the world market, with a 40% gap between supply and demand.
- Small tropical abalones like *Haliotis asinina* are preferred by the biggest market (Chinese).
- Tropical abalones have faster growth and reproduction than temperate species.
- Technology for hatchery and grow-out culture is available and economically feasible.
- The Philippines has plenty of sites suitable for abalone culture.

There are still some constraints to both hatchery and grow-out culture, however, with SEAFDEC/AQD's continuing research, these problems in abalone culture could be solved.

About the authors

Dr. Wenresti Gallardo (see also page 5) is the abalone project leader and a Scientist at AQD's Farming Systems and Ecology Section of SEAFDEC/AQD. He obtained his BS in Fisheries and Master of Aquaculture from the University of the Philippines, and his MS in Fisheries and PhD in Marine Science from Nagasaki University, Japan.



Dr. Nerissa D. Salayo is an economist and an Associate Scientist at AQD's Socio-Economics Section. She obtained her BS in Agricultural Economics from the University of the Philippines at Los Baños, MS in Fisheries Economics from Universiti Pertanian Malaysia, and PhD Economics from Griffith University, Australia.

Drs. Gallardo and Salayo thank Shelah Mae Buen for the technical assistance.

NEW!

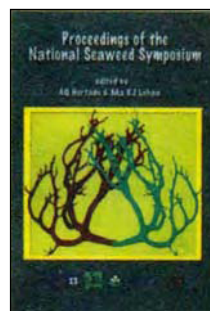


Research Output of the Fisheries Sector Program (FSP) Vol 1 Articles published in scientific journals. The volume contains 34 papers on coastal resources management and rehabilitation, aquaculture, and utilization of aquatic products. These are studies funded by FSP, a landmark national initiative which addresses issues in the fisheries sector. FSP's research agenda was coordinated by the Bureau of Agricultural Research. This report was compiled with the assistance of SEAFDEC/AQD. Email rd@bar.gov.ph



Report of the Seminar-Workshop on Integrated Regional Aquaculture Program (IRAP) is now available from the SEAFDEC Secretariat (www.seafdec.org). It may also be requested from SEAFDEC/AQD, email aqdchief@aqd.seafdec.org.ph/

IRAP is part of the aquaculture component of the ASEAN-SEAFDEC Special 5-year program on the contribution of sustainable fisheries to food security in the ASEAN region.



The **Proceedings of the National Seaweed Symposium** is published by the Seaweed Industry Association of the Philippines (SIAP). The 109-page book is edited by SEAFDEC/AQD researchers Dr. AQ Hurtado and Ms. Ma. RJ Luhan.

It contains industry cluster situationers; global overview including developments in Chile; and programs of LandBank, Quedancor, Department of Trade and Industry, Department of Agriculture, Department of Science and Technology, University of the Philippines, and SEAFDEC/AQD,

The proceedings is available from SIAP Rm 203 Jose R. Martinez Jr. Bldg, Osmeña Boulevard, 600 Cebu City, Philippines. Tel. (63-32) 253 7433, Fax (63-32) 254 8780. Email siap@digitelone.com



Diwata ng Dagat (or enchantress of the sea) is the official newsletter of the University of the Philippines College of Fisheries Alumni Association, first issued July 2003. It contains articles on the fisheries programs of UPV and newsbriefs on aquaculture. To be on the mailing list, contact upv_cfos@yahoo.com/Telefax (63-33) 315 8143. Alumni are also enjoined to attend a general homecoming in July 2004 (date to be announced later) in Iloilo.