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New research thrust for Aquaculture Department

The SEAFDEC Aquaculture Department has overhauled its research program and, starting 1980, is embarking into a new direction. Essentially, the new thrust has a ten-year horizon although its formulation was basically influenced by a 20-year scenario of the fisheries and aquaculture industries of the world and the Asian region in general and the Southeast Asian region in particular.

The research program consolidates the existing commodity-oriented programs — milkfish, prawn, seafarming, freshwater, and aquaculture engineering — into three aquaculture systems-oriented R & D research areas which give primary consideration to the environment and the production systems deriving from such environment. These three are: *brackishwater, freshwater* and *mariculture.* Henceforth, they shall be the three research programs of the Department.

In its 2nd meeting held in Bangkok from 27 to 30 August 1979, the SEAFDEC Program Committee was appraised of this research program re-orientation by Aquaculture Department chief, Dean R. O. Juliano. The committee accordingly acted favorably on the plan. In addition, Dean Juliano presented to the committee, which reviews and endorses to the SEAFDEC Council of Directors the administrative policies, program directions, and operational orientations of the three SEAFDEC departments, the fundamental changes in the administration and training and extension strategies being planned to be adopted by the Aquaculture Department.

Research Program

Brackishwater. For brackishwater, the 10 priority research areas that have been identified include culture techniques, seed production and broodstock development, feed and nutrition, soil and water management, fry collection, socio-economics, aquaculture engineering, pest, predators and diseases, selection of new species, and selective breeding.

(Continued on page 2)

Int'l training on aquaculture management underway

Twenty-nine participants representing 7 countries are now attending this year's second aquaculture management course. This two-month program is focused on shrimps, particularly *Penaeus monodon,* and is being attended by representatives from Nigeria, Panama, Cuba, Indonesia, Malaysia, Thailand and the Philippines.

The course covers fundamentals of broodstock development, hatchery operations, design and construction of ponds and other enclosures, nursery and grow-out pond management and operations.

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Some of the 29 aquaculture management trainees at work in the Aquaculture Department's hatchery. Seven countries from 3 third world regions are represented.

New research thrust . . .

These priority areas for R & D are meant to solve the following industry problems: not enough supply of seeds, lack of low-cost feed, high cost of materials, equipment and energy source, high cost of inorganic fertilizer, injudicious use of pesticides and other chemical agents, lack of refined hatchery techniques for major finfishes, insufficient market information system, inadequate extension, and unsound pond engineering.

Freshwater. A two-tiered priority was set for freshwater aquaculture research: the farming systems on one hand i.e. cage and pen farming and agro-fishery and pond systems, and the species.

Cage and pen farming priorities are nursery, improvement of production systems, feed, engineering, and hatchery while the priorities for freshwater pond system research include polyculture and stock manipulation, utilization of agricultural wastes, development of low-cost efficient and locally available feeds, and the improvement of life support systems.

As to freshwater species, the priorities for research — in descending order — are milkfish, tilapia, carps, and shrimps.

The identified research areas are meant to solve the following industry problems: dearth of fish seed, high cost of feed, parasites and diseases, pollution, inadequate extension program, consumer preference and marketing and distribution problems, credit and financing, low output production systems, and engineering constraints.

The role of the Department's freshwater aquaculture program in the Southeast Asian region will be to intensify research on cage and pen farming and conduct collaborative studies on agro-fishery and pond systems. For the Philippines, freshwater research will aim at intensifying studies on milkfish, tilapia, carps and shrimps in pens, cages and ponds and to do collaborative studies on agro-fishery systems with other national agencies particularly the Central Luzon State University which has a freshwater aquaculture center as well as a college of inland fisheries.

Mariculture. A relatively new area of research in the Aquaculture Department, mariculture will focus on molluscs and seaweeds. The priorities for mariculture R & D are therefore heavily-oriented towards molluscs although finfishes are also considered in the formulated program. These include studies on seed supply, culture techniques, feeds, design of holding structures, parasites, pests and diseases, suitability criteria for farm sites, water quality requirements for mariculture, post harvest handling and marketing, choice of species for culture, feed and fertilizer development, and credit.

Implementation

For implementation, these three research programs will be identified with three substations: the Leganes substation in Iloilo Province in Panay Island for brackishwater; the Freshwater Fisheries station in Binangonan, which is situated along the shores of Laguna Lake, for freshwater; and a yet-to-be-selected substation for mariculture. The Department's main station in Tigbauan, Iloilo will be the base of most laboratory studies and support activities related to the three programs.

Workshop

The new research thrusts and priorities were evolved in a 3-day (Aug. 8-10) workshop among the Department's research staff, administrators, selected support personnel, and resource persons from other institutions. For the workshop, the participants developed a scenario of the aquaculture industry, from 1980 to the year 2000, of Asia, Southeast Asia and the Philippines. The research and development outputs and activities were identified that would support the scenario. It is on these identified activities and priority research areas that the Department based its new research direction.

Five-fold Increase

In drafting the scenario, the participants gave primary consideration to the continuing energy problem, decreasing fish catch, pollution, the new regime of the seas, the expansion of the areas for aquaculture, and the population pressure. They agreed that a five-fold increase in aquaculture output (base year 1975) may be attained in 20 years' time.

Outreach Strategy

In other developments, the Aquaculture Department will be adopting a new outreach strategy. Instead of the Department engaging in actual extension activities, a mechanism is being developed in which the private progressive fish-farmers will play more active role in assisting less productive traditional fish culturists. Also, priority will be given to the publication of research journals and extension-type publications. Finally, plans are underway to consolidate the various training courses with the view of judicious utilization of resources. ●

Coastal aquaculture . . .

(From page 8)

Finance

The Marine Biological Association will finance the organization and conduct of the symposium, printing of abstracts of papers, and publication of the proceedings. However, the participants or their sponsoring organizations will have to shoulder the cost of travel, accommodation, board, tourist excursions and other expenditures.

Language

English is the official language of the Symposium but papers in French, German, and Spanish with summaries in English are accepted.

For details address communications to:

The General Convener
Symposium on Coastal Aquaculture
The Marine Biological Association
of India
P.O. Box 1244 Cochin 682 011
Kerala, India

Manual on mussel farming off the press

A *Manual on Mussel Farming* is now available at the SEAFDEC Aquaculture Department in Tigbauan, Iloilo. It sells for P7.50 a copy plus postage charge of P1.50, or US$3.00 a copy for those ordering from other countries.

The manual deals with the improved techniques of growing green mussels *(tahong)* using floating structures such as bamboo rafts. It describes in detail the biology of the mussel, reviews the evolution of mussel farming in the Philippines, provides basic principles, cost and return analysis, and steps in mussel farming including construction of rafts, spat collection, management, and harvesting. Illustrations, pictures, and diagrams are provided.

The improved techniques mentioned in the manual are the results of three years of research made possible with the assistance of the Government of New Zealand.

The authors are Mr. W. G. Yap, head of the SEAFDEC mollusc project, A. L. Young, C. E. F. Orano and Ma. T. de Castro, research personnel of the SEAFDEC Aquaculture Department.

Address your orders and remittance to:
The Director
SEAFDEC Institute of Aquaculture
SEAFDEC Aquaculture Department
P. O. Box 256, Iloilo City, Philippines

Int'l training . . . *(From page 1)*

stocking, feeds and feeding, pest and disease control, water management, farm recording, harvesting and post-harvest operations and marketing.

Aquaculture management is a live-in course for farm managers, pond owners, operators and technicians, government technologists, extension workers, and production technicians. Especially offered to participants from SEAFDEC member-countries, the course is open as well to trainees from other developing countries.

For this program, which runs October 1 to November 30, the participants and their respective countries are: Nigeria – Nnachebe Ojike, Jacob Anota, Femi Ebie Tomiye and Olusegon Dosunmu; Cuba – Isabel Castellanos, Elvira Hernandez, Josefa Capote, Ines Maria Monte, David Perez, and Jose Sergio; Indonesia – Asmin Ismail, Supriyono Tayib Mustafa and Suwantoro; Malaysia – Hassan b. Cheh Leh, Mohammad Salleh b. Yeop Rani, Abdul Rahim b. Md. Rashid, and P'ng Tiang Hock; Thailand – Pimporn Boonyagard and Chairat Penpibulratana; Philippines – Agnes Gervacio, Saturnino Lappay, Wilma Ladra, Joy Vicencio and Pepito Hofileña, Henry Ng, and Alexander San Diego. In addition, the Panama ministry of agriculture has sent Sr. Luis Hooper, chief of the government's shrimp program, as observer. Another observer is Mr. Busman Saleh of the FAO/UNDP office in Indonesia. ●

IDRC HEAD VISITS SEAFDEC AQD

Dr. Jesus Juario, (left) head of the Department's milkfish research program, briefs Dr. Ivan Head (right), President of the International Development Research Centre (IDRC) of Canada, on the Department's milkfish R & D program in which IDRC has consistently granted financial support. Dr. Head visited the Department on October 21 along with Dr. Jingjai Hanchanlash, director of the IDRC office in Singapore.

The IDRC-funded milkfish project, now on its second phase, aims to (a) standardize the technology of milkfish breeding; (b) improve the collection, transport, handling and storage of fry; (c) develop economically viable and nutritionally effective feeds; (d) improve management and culture methods; (e) provide demonstration and outreach programs and short-term training for fishpond operators, technicians and extension workers; and (f) transfer technology on milkfish aquaculture on a national and subsequently regional level.

Some general guides and cost estimates for a small-scale prawn culture project

Second Part in a Series

In the September issue of Asian Aquaculture, the three components of the prawn culture system, namely, broodstock/hatchery, nursery, and grow-out pond, were described. The cost estimates for the broodstock hatchery component were presented. This issue presents the estimates for the nursery system.

Nursery System

Capital outlay and equipment is estimated at ₱168,000; operational expenses at ₱38,000/year with six operations in one year. The nursery area is one hectare which includes the space taken up by reservoir, dikes, canals, etc. The capital outlay and cost of equipment includes the construction of the nursery pond, CHB supply canal system, stocking/harvest/acclimation facilities, water and aeration facilities, and other equipment. The details of the cost estimates are provided in the following tables:

Cost of Physical Facilities and Equipment for Nursery System

a. Cost of pond development and its facilities

1. Pond construction (dikes, canals, excavation/levelling, reservoir, etc.) . . . . . ₱40,000
2. CHB supply canal system — 40 cm x 70 cm x 180 m 24,000
3. Stocking/harvest/acclimation facilities: shelter 1 unit . . . . . 7,000 fiberglass tanks* 4 units @ P2,500 . . . . . 10,000 wooden filter tank 1 unit 1,000
4. Water facilities (PVC pipes, fittings, hoses, air regulators) 16,000

₱128,000

b. Cost of equipment

1. Two units water pump at 500 gpm each . . . . . ₱40,000

TOTAL . . . . . ₱168,000

Cost of Operating Nursery

(per year at 6 operations a year)

1.	Labor/ services	300 per operation	₱1,800
2.	Sugpo fry	3,600,000 fry	21,600
3.	Lime	4 tons	1,300
4.	Fertilizer (C.M. and inorganic)	700/yr	700
5.	Feed		2,000
6.	Fuel/Oil	500/run	2,000
7.	Repair and maintenance	160/run	960
8.	Supplies and materials	150/run	900
9.	Depreciation (Equipment 3 yrs; pond 5 yrs)		3,000
10.	Land lease		1,000
11.	Miscellaneous		1,000
12.	Overhead		1,500
			₱37,760
			say 38,000

* use of cheaper substitutes like marine plywood and other local materials would reduce costs by 30-40%.

Principles of and its practi

The idea of sea farming was developed from salmon releasing which has been done for more than 100 years in the north Pacific. Average recapture rates of salmon and trout have increased gradually up to 2.4% and 4.5%, respectively in the last 10 years. The methods learned from salmon releasing are now being applied to prawn, crab and seabream to maintain or increase the resources.

Before 1960, most mariculturists cultured fish and prawn from egg to adult in private farms only. In 1963, the Sea Farming Fisheries Association was established in the Seto Inland Sea as a model case of modern aquaculture supported by the Fisheries Agency of the Japanese Government. Many trials of producing and releasing the juvenile were carried out in pilot farms during 1963 and 1970. After this period the commercial catch of prawn began to increase in the Seto Inland Sea. Now the principle of sea farming is applied to other species such as scallop, abalone, blue crab and seabream all over Japan. In July, 1979, the North Japan Sea Farming Association was established at Miyako,

NEXT ISSUE: Cost of Establishing & Operating the Grow-Out Pond System.

sea farming ce in Japan *

Iwate Prefecture. By 1981, the West Japan Sea Farming Association and the Hokkaido Sea Farming Association will start operations at Goto, Nagasaki Prefecture and at Akkeshi, Hokkaido, respectively.

The methods of prawn releasing have become popular with fishermen's cooperation, because the animal thrives on the natural foods in the sea. It might be said that Japanese mariculture is going to see traditional ways out and modern sea farming in.

Principles of Sea Farming

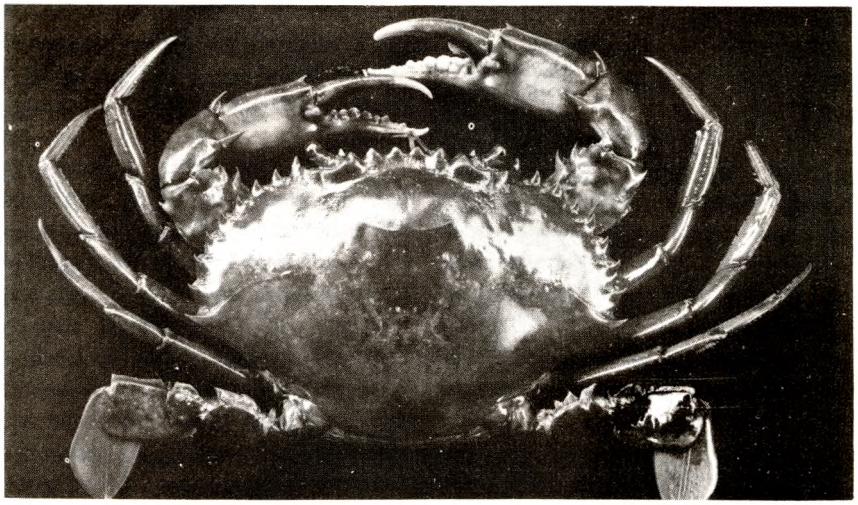
In general, lower survival rates of fish are found in larval and juvenile stages. Fig. 1 (page 7) shows the approximate mortality in animals during egg, larva, juvenile and adult stages, which was demonstrated by Allee *et al* in 1949. It is commonly recognized, as Hjort's theory, that fish mortality in the larval stage stems from the lack of plankton available (Aikawa, 1949). These theories suggest that if we need fish larvae enough food in the hatchery and release them to the sea, their resources might be restored. The principles of sea farming is based on these theories.

The biological principle of sea farming is simple, as mentioned above. Its application, however, is not easy, because the sea is too large while our hand is small; it looks impossible to increase the fish resources by our hands. But we have decreased certain commercial species already by our small hand through overfishing.

(Continued on page 6)

*From the paper, "Some Aspects of Sea Farming In Japan," by Hachiro Hirata, Faculty of Fisheries, Kagoshima University, Japan.

Edible Crustaceans in the Philippines*



11. SCYLLA SERRATA **(FORSKAL)**

English name: Serrated swimming crab, Mud crab or Mangrove crab.
Philippine: Alimango (Tagalog), Alama (Pangasinan), Rasa (Ilocano), Lumayagan or Suga-suga (Cebuano), or Kangrejo (Chavacano), Malakaon Mulaka (Ilongo) or Mangilaud (Ilongo).

The carapace of large males sometimes measures over 20 cm in width, with enormously massive chelipeds; the larger males normally weigh about 1.5 kg. Carapace is fan-shaped with smooth surface and bordered along the frontal margin by six spines between the eyes and by nine spines on the antero-lateral margin. There is an H-shaped depression on the central region. Chelipeds are very strong and robust. Like the other member of the family Portunidae, the last pair of legs forming an oar shape is adapted for swimming.

It is either entirely grayish green or purplish brown in color.

This crab inhabits muddy bottoms in brackish water along the shoreline, mangrove areas, and river mouths, hence the name mud crab or mangrove crab. It is an active and aggressive species.

It is usually caught by gill nets or trap cages baited with fish heads or other trash and set on the bottom in shallow brackish water. This commercially important crab is also caught with a baited trap locally known as "Bintol".

This species is distributed throughout the Indo-Pacific region from Hawaii, southern Japan, Taiwan, Philippines, to Australia, Red Sea and East and South Africa.

An excellent and sought-after delicacy in the Philippines this crab fetches P50-60/kg in Manila or P25-45/kg in other places. Females with mature ovaries are particularly expensive and delicious but males are relatively cheaper regardless of size. This crab is usually sold live in the market all year round. Rattan fiber is used to tie the crabs.

*** by H. Motoh, 11th in a series**

Principles of sea farming . . . *(From page 5)*

The idea of "give and take" is another principle of sea farming. When we catch the fish adults, we must return their larvae or juveniles to the sea.

"Sea Farming Fisheries" is the name of the Association established at the Seto Inland Sea in 1963. The definition of sea farming is "farming the fish in the sea, then catching them from the sea" based on the idea of "give and take."

Biological Features

Selection of Species

One of the most important problems of the technology of releasing fish into the sea is to determine the suitability of species. For example, if we release snakehead *(Trichodon stellei)* in a natural pond, commercial fish like carp will disappear from being preyed upon. In the case of terrestrial ranching, no one has tried to release carnivorous animals like tigers or lions in the fields.

Elton (1927) described a "pyramid of numbers" and stated that the number of animals decreases as the trophic level increases. Another interesting note was found in "Ecology of Fishes" (Nicolsky, 1963). Nicolsky wrote that a high amount of fish landing is obtained from low trophic levels, for example, bivalve molluscs and anchovies. From these theories, we could say that herbivorous animals are the best species for releasing. Second consumers and third ones follow the first consumers in usefulness. The idea was modified by Odum (1971), as shown in Fig. 2. Odum's data on energy flow suggest that lower trophic animals should be considered for sea farming.

Succession of Feeding Habits

Succession of feeding habits through a life should be also considered for both seed production and releasing. I tried to classify the animals depending on the succession of feeding habits.

From the view point of biological evolution, the animals might be classified into 6 types from A to F. Feeding habit of the oldest type of animals show they are herbivorous through life; most shells belong to group A. Animals in type B are rather developed, are herbivorous in the larval state and omnivorous in the adult stage. Animals of the type C are herbivorous in the larval stage, omnivorous in juvenile stage and carnivorous in adult stage, like a prawn. Most marine fishes and crab are carnivorous through their life from larvae to adult, and they might be classified into type D. The most developed animals are type F and they are carnivorous as larvae, omnivorous as juveniles and herbivorous as adults. Mammals and few inland fish belong to this group. Carp and rabbit fish are typical of type E.

The feeding habits of *Penaeus japonicus* are changeable from herbivorous to carnivorous through omnivorous depending on the growth of the larval stage. They eat phytoplankton at the zoea stage and zooplankton at the postlarval stage. Mysis show omnivorous habits. As a whole, the prawn is the first or second consumer, and their migration area is restricted within a bay or gulf. Therefore, the prawn is one of the most suitable species for sea farming.

Practice of Sea Farming

Mass Culture of Marine Rotifer

In 1967, Hirata and Mori reported on the outdoor culture of marine rotifer, *Brachionus plicatilis,* fed the mixture of chlorella and baking yeast in 500 liters tanks. Many aquaculturists and fish biologists in the field of fish seed production have applied this technique for mass culture of rotifer and copepede (Kadowaki *et al* 1979, Yamasaki 1977, Fukusho *et al* 1976). The procedure of rotifer culture has been rapidly improved. Recently, Kinne (1977) and Hirata (1979) reviewed the techniques developed in Europe and Japan, e.g. by Furukawa & Hidaka (1972), Hirata & Mori (1967), Hirayama & Kusano (1972), Hirayama & Ogawa (1973), Theilacker & McMaster (1971).

Another method of mass culture of rotifer was also established by Hirata and his associates in a feedback system (Hirata 1977a, 1977b, Hirata and Yamasaki 1979, Hirata, Yamasaki, Mae, Kodama and Yamauchi 1979). The principle of the feedback culture system is simple. Baking yeast or marine yeast are fed to the rotifer, and as they grow they supply faeces into the culturing medium. Such excess nutrients in the water are re-used for cultivation of marine chlorella which is now well known as the best food for the rotifer. The chlorella are daily fed back to the rotifer. Therefore, a homeostasis of ecosystem in the culture water is maintained for a long while in the feedback system, without energy loss and with no water pollution (Hirata & Yamasaki, 1979).

A movable aerator and a stream unit are the main parts of the feedback culture system. A moving pipe of the aerator supplies strong air flow directly towards the bottom of the culture tank to prevent sedimentation of suspended substances. Oxidation of faeces or biodeposits is ensured by a relatively higher dissolved oxygen content obtained from an air supply of 0.5 to 1.0% of the water volume per minute. For removing the suspended substances like faeces, zigzag stream unit is jointed to the main cultivation tank which is operated by the movable aerator previously mentioned.

Compared with the routine culture method, this feedback system has the following advantages:

1. Growth of chlorella cultured by reuse of excess nutrients in this feedback system was better and more stable than that of inorganic nutrients such as used by Hirata (1964).

2. The chlorella reproduced by the excess nutrients was daily fed back to the rotifer, and such feedback ratio was estimated to be about 10 to 20% of total foods supplied.

3. Food conversion rate in this feedback system was calculated to be about 30 to 40% in calorie level, while it is generally less than 10% (after Fukusho *et al,* 1976).

4. Water quality in the culture tank was maintained at a stable situation for about one year. For example, PO_4-P contents in the feedback system were restricted between 0.5 and 3 or 4 ppm, while it was about 4 to 7 ppm in a batch culture method as routine one.

5. The rotifer fed the chlorella in the feedback system grew better than that in the routine method by feeding the chlorella cultured by inorganic medium.

Thus, it might be concluded that the homeostasis of ecosystem is maintained in this feedback culture system. However, the experiments carried out in our laboratory were conducted by employing a 3-ton plastic tank with 200 to 400 rotifer per mL of population density. Future trials should be done on a large-scale basis to reduce energy loss without any water pollution.

Mass Culture of Prawn Larvae

The rearing methods of *Penaeus japonicus* are briefly introduced, including a general description of the effects of releasing juvenile into natural sea water.

In Japan, three rearing methods have been basically practiced: 1) monoculture, 2) multi-species culture and 3) ecosystem culture. A monoculture method requires two culture systems, one to grow the algae and another one to rear the prawn larvae. In this method, the food is directly supplied to the zoeal larvae. In multi-species culture, only one tank is by inorganic nutrients which are supplied into the rearing tank at the beginning of nauplius stage. By the time the larva metamorphoses to zoea stage, some species of algae are already growing in the tank and consumed by the zoeal larvae. On the contrary, organic nutrients like soy-cake particles and/or biodeposits obtained from rotifer culture are provided to grow both zoea and algae or rotifer in the rearing tank. Species interaction among algae-rotifer-larvae are regulated by a movable aerator system and stream unit like the feedback culture system of rotifer mentioned previously. Special caution was taken to provide strong aeration with 0.5 or 1.0% of water volume per minute for cleaning the bottom of the rearing tank and for promoting the energy flow by the oxidation process.

In 1969, the ecosystem culture tank, 2,500 m^3 water-volume with the movable aerator was constructed at the Shibushi Station, Seto Inland Sea Farming Fisheries Association. Several trials were made for obtaining high survival and with a high population density of prawn juvenile. In 1975, a survival rate of 90% from nauplii-1 to postlarva-15 was obtained by the ecosystem culture method. An average yield of the method in 2,500 m^3 tank was about 22 million juveniles. It was obtained in 1977.

The juvenile produced in the hatchery are usually transported by truck (11 to 15 tons) or boat (100 to 150 tons) with an excellent air supply system. Transport load is about 5 million juveniles at one time. It takes about 10 to 20 hours to get from the hatchery to the nursery culture farm.

Each prefectural government (Fisheries Department) around the Seto Inland Sea has its own nursery farm on a sandy coast.

A pilot farm project supported by the Fisheries Agency was carried out from 1968 to 1970 in the associated prefecture. According to the report of Yamaguchi Inland Sea Fisheries Experimental Station, they released 1.45 million prawn juveniles in Oomi Bay in June 1968, and fishermen caught some 0.14 million adults weighing 18.9 grams on the average from the end of August to the end of November. The rate of recapture was calculated to be about 10%. Asano (1977) reviewed all the reports related to the project and concluded that the average rate of recapture is about 5%, and average size of recaptured adults is about 20 g. A larva costs about 1.5 yen so that a profit of about 50 yen per adult can be made from the sea farming of prawn. ●

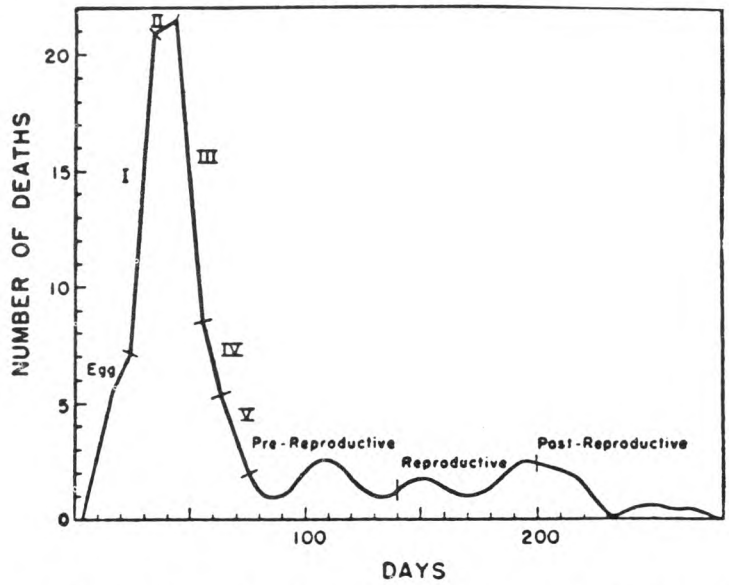


Fig. 1. Number of deaths (approximate) of Schistocerca gregaria **during egg, nymphal instars, and imaginal stages. (After Alle et al from Bodenheimer).**

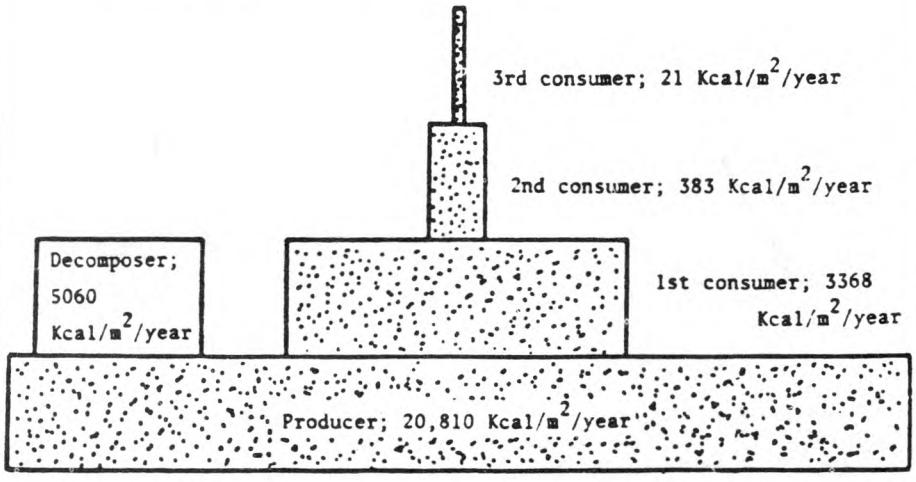


Fig. 2. Pyramidal construction of ecosystem indicated by energy-flow. (After Odum. 1971).

Coastal aquaculture symposium in India

The Marine Biological Association of India will be holding from 12 to 18 January 1980 a symposium on Coastal Aquaculture. It will be held at Cochin, Kerala State, an important center of fishing activities.

The main objective of the Symposium is to promote and develop coastal aquaculture by disseminating the knowledge and experience gained and modern technologies developed among scientists, technicians, extensionists, administrators, planners, fishfarmers and industrialists.

To attain the objective, the sponsors propose to conduct (a) a review of the present status of coastal aquaculture; (b) discussions on the culture technologies of various organisms in different types of ecosystems in the coastal zone; (c) identification of the major inputs for research, developmental, educational and training programs for the development of coastal aquaculture leading to the establishment of an organized industry; (d) discussion of means to intensity production by integrated crops-livestock-fish farming technologies; (e) assess the social, economic and legal aspects of developing coastal aquaculture; and (f) find ways to establish linkages, coordination and communication among the national and international organizations doing research, development and promotion of coastal aquaculture.

Scope

The Symposium will consider all scientific and technical aspects of ecosystems breeding, rearing, propagation and culture of finfishes, crustaceans, molluscs, seaweeds, etc, fish diseases, nutrition, farm engineering, harvesting, post-harvest technologies, and marketing. The Symposium will also deal with developmental aspects such as planning, organization, socio-economics, legal, manpower needs, training and industry relating to coastal aquaculture.

(Continued on page 2)

Agribusiness systems for crops-livestock-fish farming

The integrated farming system for crops, livestock and fish has shown great potentia's. In experiments and limited field experiences the system has shown promise as a means to optimize resources and maximize production in developing countries. The technology, as well as its interrelated components, have been demonstrated in farms in Taiwan, Malaysia, Thailand and other Asian countries. The system has been known to work well in both small and large farms. Furthermore, keen interest on the system arises from the effectivity of recycling farm waters for multiple uses.

The promise of crops-livestock-fish integrated production has prompted four agencies based in Asia to conduct a workshop along this concept. The workshop will be the first attempt at developing production and management strategies for a tri-commodity integrated farming system.

The sponsors are: the Philippine Council for Agriculture and Resources Research (PCARR), the Taiwan-based Food and Fertilizer Technology Center of ASPAC, the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), and the Philippine-based Southeast Asian Fisheries Development Center (SEAFDEC) Institute of Aquaculture.

The workshop aims to identify recycling methods on crops-livestock-fish farming, determine production inputs, problems and strategies for maximum use of resources, particularly among the participating countries, and develop case studies for analyses of problems and practices and project proposals to work out the system economically.

Scheduled for 19-25 November 1979, participants will be coming from Indonesia, Japan, Korea, Philippines, Taiwan, Thailand and Malaysia.

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