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ADSEA'87 Opens

As part of the 20th Anniversary Celebration of the Southeast Asian Fisheries Development Center (SEAFDEC), the Aquaculture Department (AQD) is hosting a seminar-workshop for senior aquaculturists on September 8-12, 1987 at Amigo Terrace Hotel, Iloilo City, Philippines. The seminar's theme is "Aquaculture Development in Southeast Asia" (ADSEA '87) and has the following objectives.

1) to assess the current aquaculture technology for major species in Southeast Asia;

2) to evaluate the contribution of AQD on these technologies; and

3) to identify future research directions for aquaculture in the Southeast Asian Region.

Senior aquaculturists from Japan (2), Malaysia (4), Singapore (1), Thailand (4), the Philippines (4), and AQD (10) will participate in the seminar. Country papers will be presented including a review of AQD research activities over the years particularly on prawns, milkfish, seabass, siganids, carps, tilapia, mussels and oysters.

SEAFDEC AQD, established in 1973 has contributed significantly to the development of the aquaculture industry in the Philippines and in the region. These contributions brought about a rapid turn

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AQD observes 14th year

The Aquaculture Department (AQD) of SEAFDEC observed its 14th anniversary last July 9 with simple ceremonies held at its three stations. The main program was held at its main station in Tigbauan.

The anniversary was highlighted by the employees' tree-planting activities near the staff houses, apartment and the nearby laboratories.

In the afternoon the Chief, thru a convocation exhorted all employees to work hard, sacrifice and dedicate themselves to the

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inside

It is imperative that fish culture in Laguna de Bay emphasizes the development of ecologically sound fishpen technology to ensure sustained productivity of the lake ecosystem, and must be compatible with traditional capture fisheries. (See article on page 3).

Guerrero wins award

Dr. Rafael Guerrero III, former AQD Training and Extension Division Head (1983) was conferred the prestigious IBM Science and Technology Award last July 13, 1986. The recognition came with a P100,000 cash award.

Guerrero, 42 is currently the Director of the Fisheries Research Department of the Philippine Council for Agriculture and Resources Research and Development (PCARRD) and consultant to many aquaculture firms. The highlight of Guerrero's achievements is the development of SRT-95, a high quality tilapia fry feed containing a synthetic male hormone for inducement of sex reversal — the conversion of genetic females into functional males. When applied properly, it can produce 95-99 per cent male tilapia fry in 21 days.

SRT-95 addresses the main problem in tilapia culture which is the breeding habit of the fish. They breed prolifically and crowd themselves, resulting in less food, space and growth. The stunted fish command a low market price making it difficult to commercialize tilapia culture.

Dr. Guerrero's tilapia fry feed hopes to build tilapia culture as a major entity in Philippine aquaculture industry. □

ADSEA '87 .... *(from page 1)*
over of scientific publications on commodities such as prawns, milkfish, tilapia, seabass, carp, rabbit fish, mussel and oyster. Technology innovations and refinement in mollusc culture improved its quality and increased the demand for its production. Works on the culture and hatchery of prawn spawned a multi-million industry in the Philippines. Research achievements in finfishes (notably on induced spawning of milkfish, and breeding/seed production of rabbitfish, sea bass, carp and tilapia) have been envisioned to solve the problem of food shortage in the region.

Despite these achievements, aquaculture development in Southeast Asia is slow. This led to the recommendation of the SEAFDEC Program Committee during its 7th Meeting held in Singapore on 14-17 August 1984, to put a seminar/workshop on the research activities of the Aquaculture Department. Such seminar/workshop will assess AQD's research results and identify areas for collaboration with member countries. Progress of aquaculture development in the region made in the last two decades will also be presented to assess present status and future need for aquaculture research, and the role of AQD in its development. The implementation of the seminar was approved during the 19th Meeting of the SEAFDEC Council held in Tokyo, Japan on November 18-21, 1986, with funding support from the Government of Japan. □

AQD OBSERVES. . . . *(from page 1)*
survival of AQD. He also gave credit to all those who defended AQD in the take over fiasco in November 1987. Likewise he also commended all those responsible for the success of AQD's participation in the PHILCITE Agri-Aqua Fair in which the Department won all the top prize in a grand slam manner.

Awards and certificates were also given by the Chief in recognition of various contribution to aquaculture research and development in general, and to SEAFDEC AQD in particular. Among the awards given were: the Pioneer Service Award given to 30 AQD staff in recognition of the continuous services rendered to AQD since 1973. Twenty-one employees received the Recognition Award for dedicated service to the Department.

Thirteen researchers also received certificates of appreciation in recognition of their invaluable contribution to aquaculture research through scientific/journal publications from 1976 to 1986, thereby contributing to the further development and continued existence of AQD in particular.

Certificates of appreciation also were given to C.L. Baticados, R. Coloso and R. Fernandez for winning the ELVIRA TAN Memorial Award.

Certificates of appreciation were also given to R. Cuevas and V. Sulit, in recognition of their leadership during the aborted illegal take-over of AQD last November, and leadership and dedicated service for the PHILCITE Agri-Aqua Fair '87, respectively.

AQD was established in July 1973. The establishment of AQD was based on a proposal submitted by the Philippine government and its approval at the Fourth Meeting of the SEAFDEC Council held in Manila on January 18-22, 1971.

On September 13, 1973, former Pres. Marcos issued Presidential Decree No. 292 granting AQD international status.

Under the revised plan of operation and program of work approved by the SEAFDEC Council in 1986 AQD shall have the following functions:

(1) promote and undertake aquaculture research that is relevant and appropriate for the region

(2) develop human resources for aquaculture development

(3) disseminate and exchange information on aquaculture

(4) undertake such other activities as maybe determined by the Council of the Center.

To date, AQD maintains three stations, the Tigbauan Research Station, Leganes Brackishwater Station and the Binangonan Freshwater Station and one substation in Igang.

AQD is one of the three SEAFDEC departments organized under the six-nation SEAFDEC Agreement to which the Republic of the Philippines is a signatory, along with Japan, Malaysia, Singapore, Thailand and Vietnam. The two others are the Training Department in Bangkok, Thailand and the Marine Fisheries Research Department in Singapore. □

Managing Laguna Lake for the Small Fishermen*

Flor Lacanilao

The conflict of interests between small fishermen and commercial fishpen owners in Laguna Lake has spawned serious ecological, social, economic, and political problems. Fighting over the fishery resources of the lake are the community of poor fisherfolk numbering more than 15,000 families and the group composed of a few hundred rich fishpen operators.

This seems to be an unequal confrontation in terms of the camp size of the protagonists. But the fishpen owners are a potent and very influential bloc. In a report published in the newspapers recently, the Laguna Lake Development Authority (LLDA) identified an elite group of operators owning 10 of the largest fishpen areas on the lake totalling more than 4,000 hectares. The list showed members of prominent families, including politicians and ranking military officers.

The law says that no person or corporation can own more than 50 hectares of fishpen concessions. According to the LLDA, however, influential investors managed to circumvent the regulation by putting up interlocking corporations actually controlled by the same people.

The LLDA report said that close to 14,000 hectares of the illegal fishpens have been dismantled since 1986, and that the demolition of the remaining questioned structures on 4,000 hectares is now under way. This is undoubtedly a positive regulatory measure to arrest the dominating presence of commercial fishpens in the lake. However, the issues involved have still many facets and implications to be resolved.

Central to these issues is fisheries. Thus, focus should be given to scientific data, management techniques, and other relevant information on the subject.

Fisheries in Laguna de Bay

Proper management of the lake's natural resources should ultimately redound to improved livelihood for the small fishermen. Corollary to this is the maintenance of a water quality acceptable for irrigation and water supply purposes.

The economic plight of more than 15,000 lakeshore families dependent on fishery is mainly attributable to the unregulated proliferation of commercial fishpens. Data show that in 1982 fishpond operators produced 62,000 tons of fish from their total concession area of 31,000 hectares, while the open waters yielded only 19,000 tons for the small fishermen.

Way back in 1961-1964, or during those years when there were no fishpens, the annual catch amounted from 80,000 to 82,000 tons. In terms of production, therefore, the lake yielded virtually the same harvest over time. What the introduction of fishpens did was rob the municipal fishermen of their traditional catch by limiting both the area where they can fish and the volume of wild species that thrived in the lake.

This discrepancy wherein the small fishermen had to settle for a fourth of their former catch was inevitable because the milkfish in pens must feed on natural food in the lake and so compete with native fishes in the open waters. Thus, the natural stocks became less and less through the years and the fishermen have to put more effort in catching them.

The fishpens have also deprived the shrimps and molluscs in the lake of their food budget. This adversely affected the small-scale industries which use these products and provide livelihood for many lakeshore families. In addition, the fishpens contributed to the deterioration of the lake's water quality and obstructed the navigation channels.

Capture Fishery

Prior to 1970, fisheries in the lake consisted only of open-water fishing. Sometime that year, however, fishpens were introduced and later became the dominant fishery activity.

As earlier mentioned, the annual production of finfishes was 80,000-82,000 tons in 1961-1964. For shrimps and molluscs, it was about 240,000 tons. The bulk of this catch was used for animal feeds, mainly by the duck-raising industry.

There were 23 species of fish caught in Laguna Lake, with the goby *(Biyang-puti)* and perch (*ayungin*) as the dominant species. These fishes, however, have a relatively low market value. Carp

(Continued next page)

* Based on a study (Laguna de Bay: Problems and Options) by Jon Davis, Flor Lacanilao and Alejandro Santiago published by the Haribon Foundation as "White Paper No. 2", April 1986. Dr. Lacanilao is the Chief of the Aquaculture Department of SEAFDEC.

(*karpa*), catfishes (*hito* and *kanduli*), snakehead (*dalag*) and tilapia were also found in the lake in addition to migratory species from Manila Bay which came via the backflow of the once unpolluted Pasig River.

In 1968, a survey showed that some 8,000 full-time and 2,000 part-time fishermen used the lake as a communal fishing ground. They employed 43 different types of fishing gear, the most common of which were the traps (*baklad*), gill nets (*pante*), and push nets (*sakag*).

Fish Culture

A United Nations-sponsored fishery study in 1968-1970 took note of the low market price of the dominant fish species in Laguna de Bay and recommended the introduction of quality fish for propagation. Following this recommendation, LLDA in 1970 initiated fishpen culture in a 38-hectare pilot project at Looc in Central Bay.

Milkfish (*bangus*) was chosen as the cultured species because of its popularity and good market value. *Bangus* was also an ideal fish for another practical reason. This is the fact that it feeds directly on phytoplankton which was plentiful in the lake.

The pilot project yielded very encouraging results, particularly the finding that fish production can be increased 3.5 times over that in open waters. It proved that *bangus* culture in Laguna Lake was a profitable enterprise that can be sustained purely with the use of the natural food (phytoplankton) present in the lake. This prompted businessmen and entrepreneurs to go into fishpen culture which then spread out rapidly.

By 1982, 31,000 hectares of the lake, or one-third of its total area, have been converted into fishpen sites. This excessive growth of the industry proved counterproductive as the milkfish then took more time to mature because of the increased competition for food. The four-month rearing period had stretched to 8-15 months. Meanwhile, the catch from the remaining two-thirds of the lake open to the small fishermen dwindled to one-fourth of the 1961-1964 production.

Two misconceptions have to be pointed out with respect to fishpen culture. First, that milkfish feeds on phytoplankton which is not utilized by the native fishes. This is not entirely true. The native species actually depend on the phytoplankton indirectly by feeding on the organisms that consume phytoplankton.

Secondly, to emphasize the increased yield in fishpens compared to open-water fishing is misleading. Water circulates in and out the fishpens, bringing in food and at the same time taking out wastes to the detriment of the open-water fishes. Even then, the fish production data in 1982 placed the catch from the fishpens at 62,000 tons and from the communal fishery at 19,000 tons, or a total yield of 81,000 tons. This was clearly equivalent to the yearly catch in 1961-1964 when there were no fishpens in the lake.

Moreover, the following problems that accompanied the proliferation of fishpens should be considered:

— Aside from the reduced catch that prejudiced over 15,000 families of small fishermen, others engaged in shellfish collection and duck-raising also suffered.

— In 1985, supplemental feeding for cultured fish added about 22 tons of nitrogen into the lake which degraded its water quality.

— Congestion of fishpens obstructed water circulation and favored the growth of water hyacinth which thrives in calm water; such hindered navigation, especially on the part of the fishermen.

— Access to open waters became difficult for the small fishermen, which led to open antagonism between the fisherfolk and the pen operators that on several occasions resulted in the death of a number of fishermen.

Fish cultured in Laguna de Bay thus requires the development or emphasis on ecologically sound fishpen technology. This technology should ensure the longevity and sustained productivity of the lake ecosystem. It must be compatible with traditional capture fisheries. Unless these conditions are met, the imperatives of ecological stability and social equity compel the alternative of phasing out the fishpens from the lake.

Physical and Biological Features of the Lake

The characteristic food chain in the lake is made up of phytoplankton, zooplankton, snails, shrimps, and fishes. Phytoplankton, composed of microscopic plants, is the basic component and whose amount determines the level of the lake's food production.

These minute plants multiply only in the presence of light and nutrients such as nitrogen and phosphorus. Under turbid conditions, light cannot penetrate the water and so even with large amount of nutrients, phytoplankton production would be low.

Thus, the production of phytoplankton varies during the year, depending on the weather. When the wind is strong during the months of December to February, turbidity is high. The wind induces the suspension of bottom sediments which limit sunlight penetration (mean depth is 2.5 meters).

From March to May, lower wind velocity decreases turbidity. This promotes light penetration that stimulates phytoplankton growth. The limiting factor is nutrient (nitrogen). Also, when temperature rises at this time of the year and due to lack of rainfall, lake evaporation exceeds inflow, putting the lake level at its lowest by the end of the season. The lake waters may fall below sea level,

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Last of a series

An introduction to Lapu-lapu (Epinephelus) of the Philippines

Hiroshi Kohno

Lapu-lapu species of Groups V-VIII is characterized by not having distinct body spots (sometimes spots smaller than its scale appear). Presence of bands/stripes on body distinguishes Groups V and VI from VII and VIII.

Group V

Lapu-lapu with broad, vertical dark bands on the body is categorized under Group V. Three species of this group, all of which are important for fisheries/aquaculture, are described below.

Key to Species of Group V

A. Body red-tinted with dark red bands — *Epinephelus fasciatus*
B. Body pale to whitish brown with dark brown bands
   a. Six dark brown bands present; small black spots scattered on dorsal, anal and caudal fins — *Epinephelus sexfasciatus*
   b. Seven dark brown bands present; no spot on fins — *Epinephelus amblycephalus*

Epinephelus fasciatus (Forsskal)
(Fig. 1, TL = 24.6 cm)

English name: Redbarred rock-cod; banded reef-cod; black-tipped grouper

Diagnosis: Dorsal rays XI, 15-17; anal rays III, 8; pectoral rays 18-20; gill rakers 6-8 + 14-17.

Color when fresh: Body red-tinted with five-six dark red bands; distal part of interspinous membrane of dorsal fin black.

Remarks: Common size 20 cm TL; very common in market.

Epinephelus sexfasciatus
(Valenciennes)
(Fig. 2, TL = 14.0 cm)

English name: Six-banded rock-cod; six-banded grouper.

Diagnosis: Dorsal rays XI, 14-15; anal rays III, 8; pectoral rays 18; gill rakers 7+13-14.

Color when fresh: Body pale brown with six dark brown bands, one on nape, two each under spinous and soft dorsal fins and one on caudal peduncle; dorsal, anal and caudal fins covered by small black spots; in small specimens, body bands tend to bifurcate in both dorsal and ventral sides, and pale brown spots appear along the edges of body bands.

Remarks: Common size 15 cm TL but the maximum reaches to more than 30 cm TL; very common in market.

Epinephelus sexfasciatus is abundant in Philippine waters and plays an important role in trawl fishery. A study on the fishery resources of the species was conducted by Ingles and Pauly (1984) in the Visayan Sea. In Roxas City this species is caught for culture but is unfavorable because of its poor growth rate.

Epinephelus amblycephalus
(Bleeker)
(Fig. 3, TL = 23.8 cm)

English name: Clearly-banded rock-cod; black-spotted grouper; dotted grouper.

Diagnosis: Dorsal rays XI, 15-16; anal rays III, 8; pectoral rays 17-19; gill rakers 7-8+14-15.

Color when fresh: Body pale/whitish brown with seven dark brown bands, one on preopercular region under eye, one on nape, two each under spinous and soft dorsal fins and one on caudal peduncle; dark bands extend to dorsal and anal fins; dark bands edged by small black spots (in small specimens black spots relatively large); no black spots on fins.

Remarks: Common size 30-35 cm TL; not so popular in market.

Epinephelus sexfasciatus
(Valenciennes)
(Fig. 2, TL = 14.0 cm)

English name: Six-banded rock-cod; six-banded grouper.

Diagnosis: Dorsal rays XI, 14-15; anal rays III, 8; pectoral rays 18; gill rakers 7 + 13-14.

Color when fresh: Body pale brown with six dark brown bands, one on nape, two each under spinous and soft dorsal fins and one on caudal peduncle; dorsal, anal and caudal fins covered by small black spots; in small specimens, body bands tend to bifurcate in both dorsal and ventral sides, and pale brown spots appear along the edges of body bands.

Remarks: Common size 15 cm TL but the maximum reaches to more than 30 cm TL; very common in market.

Epinephelus sexfasciatus is abundant in Philippine waters and plays an important role in trawl

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Dr. Kohno is a visiting JICA expert on finfish aquaculture at AQD.

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Epinephelus amblycephalus (Bleeker)
(Fig. 3, TL = 23.8 cm)

English name: Clearly-banded rock-cod; black-spotted grouper; dotted grouper.

Diagnosis: Dorsal rays XI, 15-16; anal rays III, 8; pectoral rays 17-19; gill rakers 7-8+14-15.

Color when fresh: Body pale/whitish brown with seven dark brown bands, one on preopercular region under eye, one on nape, two each under spinous and soft dorsal fins and one on caudal peduncle; dark bands extend to dorsal and anal fins; dark bands edged by small black spots (in small specimens black spots relatively large); no black spots on fins.

Remarks: Common size 30-35 cm TL; not so popular in market.

Epinephelus amblycephalus was found by the author in a pond of a fingerling supplier near Manila, but the supply is scarce and unstable. In Taiwan, this species is an important fish for coastal fisheries (Yang and Chen, 1971).

Group VI

Group VI *lapu-lapu* is characterized by having horizontal bands/stripes on body.

Key to Species of Group VI

A. Caudal fin truncate; wavy, narrow dark stripes running horizontally on head and upper part of body — *Epinephelus undulosus*
B. Caudal fin round; wide dark bands (sometimes pale and stripes formed by dots) present horizontally on body
   a. Dark body bands running forward from spinous and soft dorsal fins
      1. A dark body band running from eye to caudal peduncle through upper base of pectoral fin — *Epinephelus cometae*
      2. No dark band running from eye to caudal peduncle — *Epinephelus morrhua*
   b. No dark band running forward from dorsal fins — *Epinephelus poecilonotus*

Epinephelus undulosus (Quoy and Gaimard)
(Fig. 4, TL = 38.1 cm)

English name: Brown-lined rock-cod.

Diagnosis: Dorsal rays XI, 18-19; anal rays III, 8; pectoral rays 17-18; gill rakers 14+20; caudal fin truncate.

Color when fresh: Body olive or greyish with narrow, horizontal dark brown wavy lines on head and on upper part of body.

Remarks: Common size 35 cm TL; very rare in market.

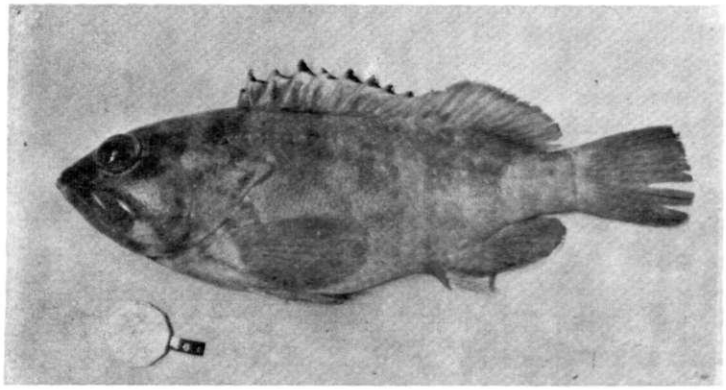

Fig. 1. *Epinephelus fasciatus*, TL = 24.6 cm.

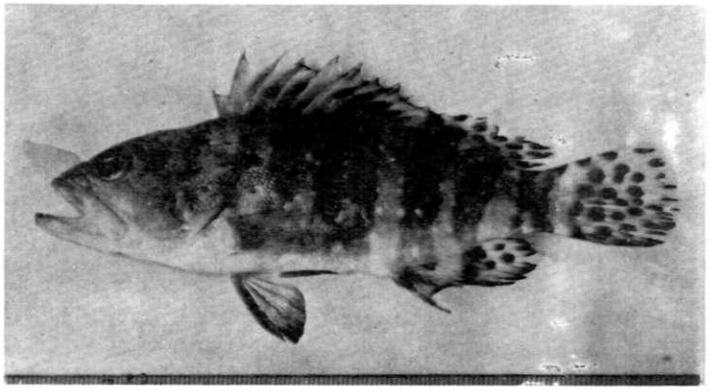

Fig. 2. *Epinephelus sexfasciatus*, TL = 14.0 cm.

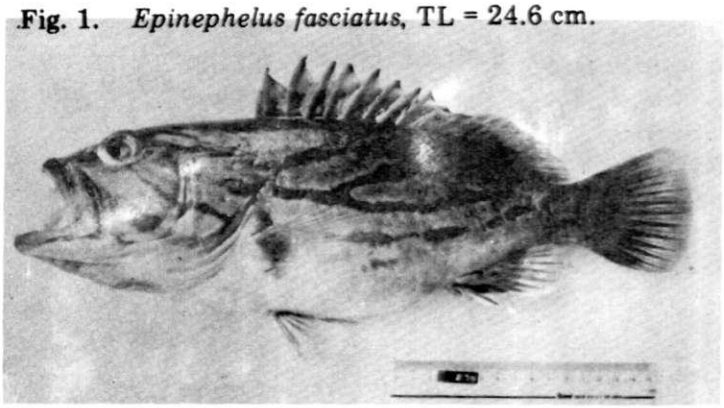

Fig. 5. *Epinephelus cometae*, TL = 42.1 cm.

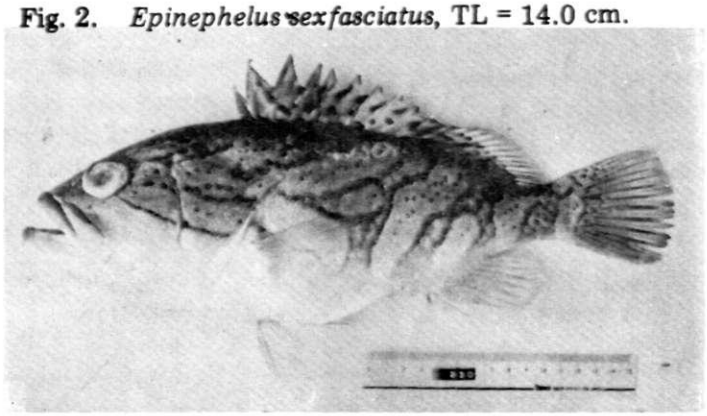

Fig. 6. *Epinephelus morrhua*, TL = 43.6 cm.

Epinephelus cometae **Tanaka**
(Fig. 5, TL = 42.1 cm)

English name: Broom grouper; narrow curve-banded grouper.

Diagnosis: Dorsal rays XI, 14-15; anal rays III, 8; pectoral rays 17-18; gill rakers 9-10+15-16; caudal round.

Color when fresh: A dark brown body band running from eye to caudal peduncle, parallel to which one dark band present on lower part of head and trunk; two bands running forward from soft dorsal portion, both of which unite together at upper part of pectoral fin to form one band that reaches to eye; one band present under spinous dorsal portion and on nape.

Remarks: Common size 30 cm TL; common in market.

Epinephelus morrhua
(Valenciennes)
(Fig. 6, TL = 43.6 cm)

English name: Broad curve-banded grouper

Diagnosis: Dorsal rays XI, 14-15; anal rays III, 8; pectoral rays 17-18; gill rakers 9-10+14-17; caudal round.

Color when fresh: Five dark brown bands present; one running from eye to occipital region; one under spinous dorsal fin; two under soft dorsal portion, both of which bifurcate at ventral side, and the anterior one running forwardly; one on caudal peduncle.

Remarks: Common size 30 cm TL; rare in market.

Epinephelus poecilonotus
(Temminck et Schlegel)
(Fig. 7, TL = 32.4 cm)

English name: Spot-lined grouper; linearspot grouper.

Diagnosis: Dorsal rays XI, 14-15; anal rays III, 8; pectoral rays 17-18; gill rakers 8-10+13-14; caudal fin round.

Color when fresh: A large dark patch present on spinous dorsal portion (sometimes this patch is pale and composed of many spots); narrow dotted lines present concentrically with the patch on spinous dorsal portion (sometimes these lines are not clear).

Remarks: Common size 30 cm TL; rare in market.

Group VII, which is represented by *Epinephelus epistictus* (Temminck et Schlegel), is omitted in this study.

So far only one species of Group VIII, *Epinephelus heniochus*, had been collected.

Epinephelus heniochus **Fowler**
(Fig. 8, TL = 31.5 cm)

English name: Barcheek grouper.

Diagnosis: Dorsal rays XI, 14-15; anal rays III, 8; pectoral rays 17; gill rakers 9-11+13-16; caudal round.

Color when fresh: Body light brown without any body spots (sometimes tiny dark spots present); two brown stripes running from

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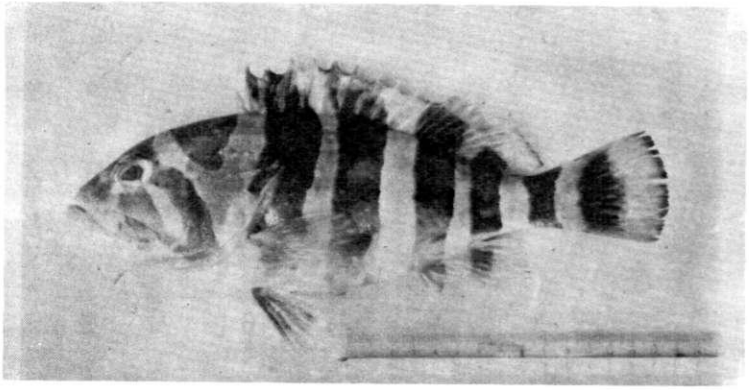

Fig. 3. *Epinephelus amblycephalus*, TL = 23.8 cm.

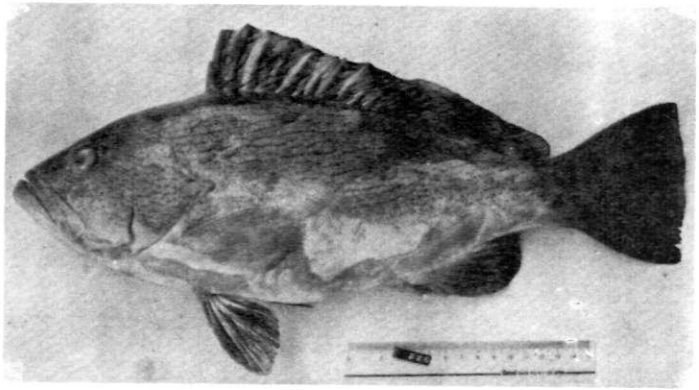

Fig. 4. *Epinephelus undulosus*, TL = 38.1 cm.

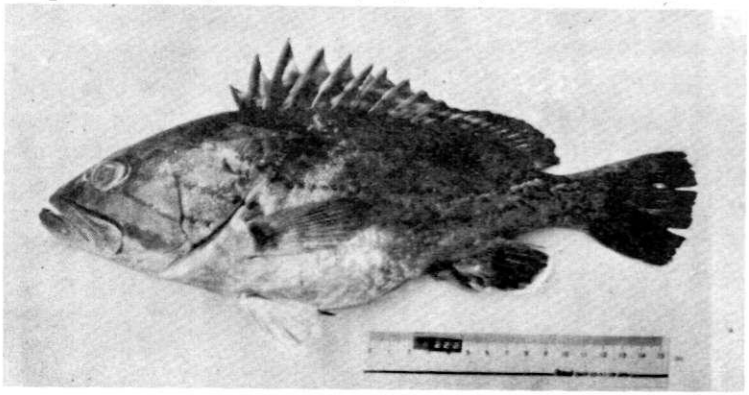

Fig. 7. *Epinephelus poecilonotus*, TL = 32.4 cm.

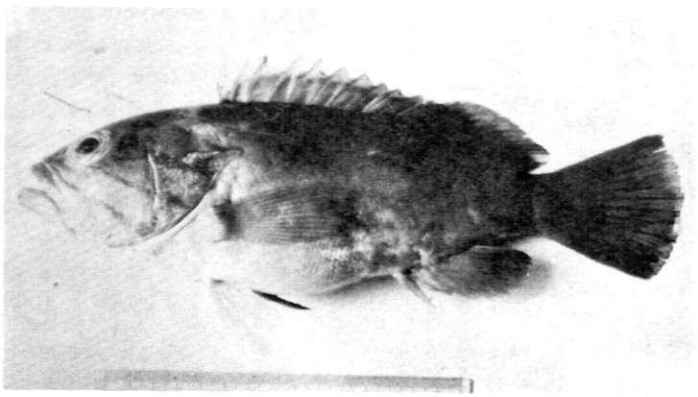

Fig. 8. *Epinephelus heniochus*, TL = 31.5 cm.

INTRODUCTION TO . . *(from page 7)*

eye to opercular edge; one brown stripe present obliquely on lower part of cheek.

Remarks: Common size 25-30 cm TL; common in market.

In four issues of this series, An Introduction to *Lapu-lapu (Epinephelus)* of the Philippines (Kohno, 1986, 1987a and b, and the present paper), a total of 18 species of *lapu-lapu* was described with photographs. Some of those species are important for fisheries and aquaculture activities. Despite the abundance of *lapu-lapu* in Philippine waters, little is known on its fishery biology because of lack of knowledge on species identification. Regarding its aquaculture, on the other hand, the present practice is to culture mixed *lapu-lapu* species. Thus there is no scientific basis on its culture. This situation is also caused by the scarce taxonomic information on *lapu-lapu*. As mentioned earlier (Kohno, 1986), the author attempted to distinguish *lapu-lapu* species by its color pattern. This report is not complete, however, because some species have not been presented here. But, hopefully, the information presented in this series would be useful to fishery/aquaculture scientists and operators. It is also hoped that this series would motivate further development in the fields of fishery and aquaculture of *lapu-lapu*. □

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MANAGING LAGUNA. *(from page 4)*

thus permitting the entry of saltwater which further reduces turbidity and causes more phytoplankton multiplication.

The period from June to November is characterized by low wind velocities, except during typhoons. Maximum lake level occurs in September-November and differs from the minimum level by about 1.7 meters.

Management Techniques

The primary objectives of managing the lake for fisheries rest on both social justice and environmental considerations. The lake must yield adequate products and services that will improve the livelihood of small fishermen and their families. At the same time, the lake's water quality must be protected against pollution so that the fresh water can be safely used for community water supply, irrigation, and other purposes.

Species Introduction and Seeding

One management technique concerns the practice of introducing species to fill up vacant niches or replace undesirable fishes. For this purpose, the species to be preferred are those that will not breed uncontrollably in the lake, such that it would be easy to prevent their establishment in case they turn out to be harmful species.

Selection of species should be done with great care, including close study of their feeding and breeding habits. The introduction of black bass in Caliraya Lake some years ago is an object lesson. This species is a voracious carnivore that practically wiped out the once abundant native fish population which served as staple food fish for the lakeshore people. Today, the black bass is only important to sportsmen who annually gather at Caliraya Lake for fishing tournaments.

Fishery management would also involve seeding in order to supplement the natural stock of desirable species that do not reproduce fast enough to stabilize regular production. In Laguna Lake, this method would be particularly needed after the excess fishpens are removed. It would restore the local fish population that has been decimated by the proliferation of fishpens.

Continued stocking with native or introduced species would require the establishment of government hatcheries around the lake. Just recently, the LLDA has inaugurated a hatchery and nursery complex in Calauan, Laguna. Research institutions, such as the Southeast Asian Fisheries Development Center (SEAFDEC) Aquaculture Department with its Binangonan Freshwater Station along Laguna de Bay, can also help develop breeding techniques for operation of fish hatcheries.

Government Regulation

By far, the most crucial system of management is government regulation. In advance countries, strict government control measures on water discharge ensure that water quality in lakes and rivers is always adequate to support fish life.

Other forms of fishery regulation are those related to controlling the type of gear used, closed fishing seasons, and prohibited areas. Large commercial ventures should be banned from fishing in the lakes. These regulations give fishes a favorable environment for completing their reproductive cycle in a sustained manner.

In the watershed areas, pollutive activities should be placed under control. Industrial effluents, municipal and agricultural wastes must be prevented from contaminating the lake waters. Logging activities in the watershed should be stopped or be subjected to very strict control.

Designed to prevent the intrusion of saline and polluted waters from the Pasig River to Laguna

(Continued on page 12)

(SECOND OF A SERIES)

An Overview of the Philippine Fishpond Industry

Arsenio Camacho

Site Selection and Pond Construction

Successful fishpond operation in coastal areas requires proper site selection which is dictated by water quality, clayey soil type, adequate elevation relative to tidal fluctuation and the availability of fry for stocking (Rabanal, 1977). The type of vegetation prevalent in the area will also affect the cost of pond construction. Meanwhile, the design or layout of the pond area is governed by the biological requirement of cultured species aside from the need to apply sound engineering principles in constructing the dikes and water supply and drainage systems especially in locations subjected to adverse weather conditions.

Acidic pond soils characteristic of mangrove ecosystems has been associated with low fish yield (Potter, 1976; Camacho, 1977). These soils exposed through pond excavation, are characterized by high content of pyrite, an iron sulfide material that produces mineral acidity upon oxidation. Fish kills would occasionally occur under this condition although chronic, sub-lethal effects like poor fertilizer response are considered the more detrimental effects in the long run. The cost of amelioration especially in large fishponds is quite prohibitive.

Environmental Pollution

Majority of the fishponds are built along the downstream portion of various rivers that are now subjected to rapid siltation and pollution. Pollution brought about by industries and human settlements has reportedly reduced milkfish production in Rizal, Bulacan and Panay provinces. The use of pesticides in agriculture threatens not only fishponds but also oyster and mussel beds in coastal estuarine areas.

The use of inputs in pond aquaculture, e.g. feeds, fertilizers and pesticides is also considered a source of pollution in coastal waters. Some fishfarmers, for instance, were known to use DDT and other chemical agents during harvest time to improve the physical appearance of the crop. Foul water from fishponds brought about by unrecycled feeds and metabolic wastes are normally released back to rivers which could upset the delicate balance of nutrients and physico-chemical conditions of the waterways. Water quality is likewise affected by a host of other harmful human activities like dredging, filling, oil spills, garbage disposal and dumping of mine tailings.

Seed Production

Broodstock, hatchery and nursery technologies are relatively more advanced for freshwater fishes, e.g. carps and tilapia than for brackishwater or marine species of commercial importance. The hatchery of milkfish is far from commercialization while prawn culture has been constrained by the limited supply of gravid spawners from the wild. The hatchery technology for two other species, namely the seabass and groupers, has shown good promise but would have to be complemented by further trials in the nursery and grow-out phases. Limited seed production results in the underutilization of existing brackishwater fishponds.

On the other hand, production of carps is limited by a low market demand apparently associated with product acceptability since Filipinos, in general, are more accustomed to marine fishes. Tilapia has gained wider acceptance in the local market but there is lesser interest among fishfarmers to expand production. The culture of either tilapia or carps in freshwater ponds would be limited by current and future land use policies of the government. Unfortunately, the culture of both species in rice paddies is adversely affected by persistent agricultural practices that require the use of chemical pesticides.

Infrastructure Requirements

Infrastructures to support the fishpond industry such as hatchery-nursery complexes, feed mills, fertilizer plants, ice-plant and cold storage facilities, training and demonstration centers, markets, roads and fishing ports while basically in place would require further expansion, a stable budget and the services of qualified and dedicated personnel for more efficient operation and integrated use of facilities. One identified problem that has been raised is the inability of fishfarmers and fishermen to pay for the cost of using these facilities at post-harvest period. *(Continued next page)*

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Lower power costs through the use of appropriate technology and substitutes for imported feeds are the two major requirements that would encourage intensive aquaculture, especially prawn culture.

Technology Transfer

A successful transfer of technology program presupposes that a technology has been verified through repeated trials in an experiment status under the tutelage of researchers at the initial stages. The impact of such technology shall have been pre-determined using technical, economic and social indicators. Out in the field, a key requirement is the role of extension workers who are well-equipped to transmit knowledge to end-users in clear and simple language. These workers must also have access to fresh research information and must be able also to transmit problems in the field to researchers.

It is sad to note that our government fisheries extension agents are not provided with the best means to maximize their contributions to the fishpond industry. It is probably because of the recognition that these workers are overworked, ill-equipped and poorly trained that progressive private fishfarmers have organized independent extension programs in recent years. The underlying cause of the problem may also be attributed to the quality of training in fishery schools, colleges and universities throughout the country.

Credit and Financing Scheme

Aquaculture projects in comparison with other sectors of the fishing industry have received preferential treatment in terms of credit allocation due to their bankability and potential impact on the economy as exemplified by prawn culture. Consistently 4% of the loans granted by the Central Bank of the Philippines to rural banks and commercial banks went to the fishing industry for the period 1982-1984 (CB, Dept. of Econ. Res. International, 1986), of which the fishpond sector obtained a significant share. The government, in response to fishfarmers' call for more subsidiaries, has also sought the assistance of foreign institutions like the Asian Development Bank and the World Bank. An on-going ADB-financed aquaculture development project provides financing for the improvement and rehabilitation of some 14,000 hectares of brackishwater fishponds in the provinces of Iloilo, Capiz and Aklan which are prime sites for growing prawns and milkfish. Unconfirmed reports, however, indicated that the delivery of credit to intended beneficiaries is rather slow on account of the stiff requirements imposed on rural banks. It also appears that small-scale fishfarmers, or those who own fishponds less than ten (10) hectares, are left out in the availment of credit facilities (BFAR-RFTC Project Staff, 1981).

Government Policies and Regulations

The rather rapid development or construction of fishponds is, by itself, the outcome of government initiatives in line with an expanded fish production (Fernandez, 1986). There was very little concern about conservation measures on mangrove resources prior to the 1950's. All that was needed then was clearance from the Bureau of Forest Development (BFD) and a fishpond permit. Following the years from the declaration of martial law in 1972, P.D. 704 required interested parties to apply for fishpond lease agreement(FLA) but basically the policy was to encourage fishpond development (Siddall *et al.*, 1985). During these years development assistance from the western world was tapped for fishpond production indirectly contributing to further mangrove conversion.

By the mid 1970's, when mangrove losses became alarming, efforts were undertaken towards conservation which involved the participation of at least four (4) agencies of the Ministry of Natural Resources. A National Mangrove Committee of the Natural Resources Management Center (NRMC) was created which prescribed guidelines for the conservation of mangrove forests. On top of this was the creation of a coastal zone task force which had some 22 member agencies. From 1983-1986, the USAID provided financial support for the first phase of the so-called Rainfed Resources Development Project which likewise, attempted to address the problem of conservation and sustainable usage of the environment.

Through the years, the government has evolved an elaborate set of laws and regulations (Camacho and Camacho, 1986) whose good objectives, however, were marred by many reported and unreported violations. It was also observed that the political will to implement the spirit of the laws was rather weak.

SUMMARY AND GENERAL RECOMMENDATIONS

Considering the economic viability of aquaculture enterprises, their manageability and predictability, the amount of research and development information and the existing infrastructure for sustained production, it is generally recognized that the future of aquaculture is well secured. While acknowledging the existence of several issues and problems confronting the fishpond industry, the following recommendations may be taken into account in order to maximize the industry's contribution to the current economic recovery program:

Mangrove Deforestation

1. Determine the status of government-leased fishponds by actual survey with the objective of

ameliorating technical constraints to productivity or in extreme cases, e.g. acid-sulphate soil condition, to revert the areas to permanent forests;

2. Declare a general moratorium on the conversion of mangrove areas to aquaculture and other types of non-sustainable uses;

3. Conduct cost-benefit analyses of mangrove ecosystem management for fisheries and aquaculture and disseminate the results to a large audience;

4. Restore degraded mangrove ecosystems using available technology of mangrove silviculture;

5. Plant mangrove species in clear tidal flats, outside of the mangrove forests, to provide additional sanctuaries for fishery resources (Rabanal, 1977);

6. Allow expansion of aquaculture by a) utilizing lakes, rivers, and reservoirs, however, giving due consideration to the needs of open-water fishery and b) developing inexpensive, appropriate culture systems in shallow coastal waters (Kapetsky, 1986);

7. Promote culture intensification in brackishwater fishponds by supporting research and development projects along this objective;

8. Promote conservation consciousness among the youngsters through the print media, field trips, art shows, etc.

Site Selection and Pond Construction

1. Disseminate the nature and dangers posed by acid-sulphate soil condition and the partial results of research to ameliorate such condition;

2. Minimize soil excavation in pond construction by the use of water pumps and other devices that minimize the need for conventional fuels, e.g. windmill pumps;

3. Explore the source of methane gas that could be integrated with the needs of small-scale hatchery and nursery system especially for prawns;

4. Develop strains or species of grass that could be utilized to provide cover on fishpond dikes, thus minimizing erosion and acid leaching processes;

5. Develop field kits and simple analytical procedures to detect adverse soil and water conditions affecting fishpond production;

6. Add more practical hours in courses offered in fishery schools and colleges to enable graduates to cope adequately with problems on site selection, design, and layout of aquaculture facilities;

7. Prepare a comprehensive soil map of the coastal zone as basic reference material in dealing with site selection and/or construction of fishponds.

Environmental Pollution

1. Require environmental impact assessment before initiating any infrastructure project along the coastal zone;

2. Require industrial firms located along waterways to adopt anti-pollution devices or systems with appropriate tax incentives;

3. National fishery development and management plans should emphasize the need to protect aquatic habitats from the effects of pollution and other forms of environmental degradation, including pollution originating from fisheries themselves (FAO, 1986);

4. Develop crop varieties that are tolerant to pests and predators or those requiring minimal amount of chemical pesticides;

5. Develop a substitute for the usual spray-method of pesticide applications;

6. Review and consolidate all existing laws and regulations on environmental protection and evolve new strategies in legislation and law enforcement;

7. Conduct public information campaign on the adverse effects of pollution, citing site-specific cases;

8. Deputize people in the coastal areas in the protection of fishery resources.

Seed Production

1. Minimize pollution and overexploitation of fishery in milkfish concession areas to sustain the needs of the fishpond industry for stocking materials;

2. Intensifiy hatchery production to mobilize part of the production for stocking open waters;

3. Identify and disseminate information on natural larval population found in the coastal areas which should be conserved during the gathering of wild fry;

4. Conserve and replant mangrove species in logged-over areas, tidal flats and along the perimeter dikes of fishponds facing the open sea;

5. Continue providing the highest priority to this problem in the allocation of research and development funds. Factors governing the reproduction of target species that need further research are: reproductive physiology, nutrition of broodfish, larvae and juveniles, environmental factors, behavioral responses and parasites and diseases.

Infrastructure Requirements

1. Construct feeder roads leading to fishpond areas to improve marketing of products;

2. Build additional marketing terminals to enable fishfarmers to sell their products direct to consumers;

3. Encourage the establishment of fish meal plants and small-scale feed mills, possibly via cooperatives, to service fishfarmers;

4. Develop small-scale power generating units to augment needs of hatchery and nursery operators in remote areas;

5. Evaluate rental fees for the use of government ice-plants and cold storage chains;

6. Review the fish marketing and distribution system in the country to serve the need of small-scale and large-scale fishfarmers;

7. Promote the marketing and consumption of processed products.

(To be continued next issue)

THE WORLD AQUACULTURE SOCIETY
19TH ANNUAL MEETING
JANUARY 5 - 8, 1988
SHERATON WAIKIKI, HONOLULU

The World Aquaculture Society will hold their 19th Annual Conference and Exposition on January 4-9, 1988 at the Sheraton Waikiki, Honolulu, Hawaii.

The conference is expected to draw over 1,000 participants and over 70 exhibitors from throughout the world.

For more information write:

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Shrimp WORLD III

The Third Shrimp World Market Conference
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AQD researchers win memorial award

SEAFDEC AQD researchers C. Baticados, R. Coloso and R. Fernandez won the best paper award sponsored by the Dr. Elvira Tan Memorial Awards.

The paper titled "Studies on the chronic soft-shell syndrome in the tiger prawn, *P. monodon*" was selected the best paper in the Aquaculture/Inland Fisheries Category.

The paper was cited by evaluators for its overall quality, scientific contribution and economic significance.

The awarding ceremonies was held last July 14 at the Philippine Council for Agriculture and Resources Research and Development (PCARRD) at Los Banos, Laguna.

A cash prize of P5,000 and plaque of distinction was awarded to the authors. □

MANAGING LAGUNA. . . .

(from page 8)

Lake, the Hydraulic Control Structure constructed at the confluence of the Pasig-Marikina Rivers, as well as the Mangahan Floodway, should be under an appropriate government agency that would further evaluate their relative adverse and beneficial effects.

Research Needs

The combined impact of the various uses of the lake, such as for fisheries, irrigation, water supply, and transportation, must be examined in detail. Here, government policies must be based not only on scientific facts, but should also consider the socio-economic and political factors. In view of the complex scientific evaluations that the tasks require, computer modelling could prove extremely useful.

Influencing the Fishermen

An educational campaign should be a continuing aspect of lake management. The fishermen must be taught and informed of the reasons for adopting or implementing the management techniques needed.

As a concerned management expert puts it: "Effective fishery extension is one of the most important aspects of all fisheries management, for in this way the fisherman himself can be encouraged to participate in the rational use of the stocks he exploits for his own as well as for the common good." □

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