

Oral Presentations

Advances in Shrimp Culture in China

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Shrimp experimental ecology studies and the shrimp farming industry in China developed rapidly in the 1970's, and great strides have been made in the mass production of shrimp fry and the growing-out of marketable size shrimp since 1978. The total production of artificially reared shrimp fry and cultivated shrimp increased dramatically in the last few years.

The improvement of water quality management and feed supply in larval rearing have resulted in increased production of shrimp fry up to 100,000-200,000 or even 300,000 fry/m³. Advances in the nutritional physiology and biochemistry of the digestive enzymes of juvenile and adolescent shrimp have enabled us to develop different kinds of formulated feeds with high efficiency and low cost. Techniques for the transplantation and propagation of small benthic crustaceans (e.g. *Corophium* spp.) or polychaetes (e.g. *Nereis* spp.) to increase the benthos biomass for natural food of juvenile shrimp in nursery ponds have been developed and successfully practised. Improvement of culture techniques including shrimp pond management, has decreased the mortality of juvenile and young shrimp and increased yields of cultivated shrimp in the country. Highest production of 9,000 kg/ha has been achieved in the semi-intensive culture pond.

Culture of the Blue Shrimp, *Penaeus stylirostris* in Sonora, Mexico

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The Centro de Investigaciones Cientificas y Tecnologicas de la Universidad de Sonora has been conducting research on the culture of the blue shrimp *Penaeus stylirostris* since

1972. Most of the programs carried out are related to intensive culture in the Puerto Peñasco facilities. However, some experiments on semi-intensive and extensive culture have been conducted since 1975.

This paper describes the principal aspects of the technology developed; spawners, larval culture, nursery, growth, feed, environmental parameters, water supply and others. While in intensive culture it is possible to attain over 5 kg shrimp/m², in semi-intensive systems about 1 kg/m² is obtained. The intensive system uses raceways for the grow-out of shrimp, the semi-intensive and extensive systems use ponds.

Brackishwater Shrimp Culture in India and its Impact on Socio-Economics

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Utilization of potential area for shrimp culture in the traditional system was very meager — just 1.8% of total estimated available area of 1.45 million ha. The traditional paddy and fish culture and paddy cum fish culture systems and the return on investment (ROI) are explained. To adopt intensive culture, there is adequate scientific information based on many successful achievements through experimental trials indicating body weight of 16.7 g in 45 days for *P. indicus* with more than 80% survival rate proving economic viability. Basic studies were also made to find out the seasonal seed availability in different regions. Shrimp production to the extent of 500-700 kg/ha was achieved in many demonstration ponds organized by the Marine Products Export Development Authority indicating commercial reality of shrimp culture in India. As vast potential areas are available, shrimp culture will minimize the present 75% idle capacity of the Indian seafood processing industry which is over-dependent on shrimp as its major product for export.

Furthermore, adding more areas to culture has direct impact on the socio-economic status of the rural population. Three thousand self-employed people are now known to be directly engaged in seed collection. In addition, the shrimp farmer realizes returns two to three times more than his

counterpart in paddy cultivation, in the same field and for more or less the same period of time. In West Bengal, of total export value of 43 crores, up to 25 crores is realized by farmers for their production of shrimp through culture reflecting better unit return for their raw material than that realized by the processor/exporter of the end-product. Therefore, bringing additional areas under shrimp culture will directly affect the socio-economic status of the rural people employing an average of 5 persons/ha, and indirectly affect no less than 15,000 casual workers in the seafood processing industry by additional utilization of manpower and working hours.

As productivity from capture appears bleak, brackish-water shrimp culture has been accorded top priority in India's national developmental programmes for more harvest from aquatic sources otherwise termed the "Blue Revolution."

Larval Growth and Survival Optima for Four Species of Penaeids from Australia, as Indicated by their Distribution and Abundance in the Field

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Prawn catches from tropical northern Australia are dominated by four species of prawns: *Penaeus merguensis*, *P. semisulcatus*, *P. esculentus* and *P. latisulcatus*. Three of the species (*P. merguensis*, *P. semisulcatus* and *P. latisulcatus*) are widespread throughout the Indo-Pacific, while *P. esculentus* is endemic to northern and eastern Australia. The species appear, however, to have well defined and limited distribution on a smaller scale. Surveys of the larvae in the Gulf of Carpentaria, northern Australia, have shown both spatial and temporal heterogeneity in the abundance of all four of these species.

Assessing the temperatures and salinities in which the larvae were caught may be a realistic indicator of conditions suitable for reproduction, as well as growth and survival of the larvae. Means of these distributions may be deemed optima and ranges indicate tolerances.

Most of the larvae of all four species are found in water above 26°C and 31 ppt. However, the mean temperatures and salinities vary significantly between species. *P. merguensis* has the lowest salinity optimum (31.8 ppt) and the highest temperature optimum (29.0°C). The other three species are similar for both temperature and salinity optima. *P. latisulcatus* has the lowest temperature optimum of 27.4°C compared with *P. semisulcatus* at 27.9°C and *P. esculentus* at 28.5°C. The salinity optima for these three species are almost identical at approximately 33.2 ppt.

While the ranges of temperatures of all four species are similar (21.5-30.6°C), the ranges of salinities in which the lar-

vae are found coincide with the size of the biogeographic distribution of the species. The three widespread species have large salinity ranges: *P. merguensis*, 26.2-34.9 ppt; *P. semisulcatus*, 27.8-34.9 ppt; and *P. latisulcatus*, 28.6-34.9 ppt. The Australian endemic, *P. esculentus*, has the smallest and highest range, 30.1-34.6 ppt. This apparent inability of *P. esculentus* to tolerate low salinity water may restrict dispersal during the larval stages.

Description of the Embryonic Stages of *Penaeus notialis* and the Influence of Some Abiotic Factors on the Species

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The embryonic development of the shrimp *Penaeus notialis* Farfante, 1967 is studied. The duration from spawning to hatching of the nauplii was 14-16 hr. As soon as spawning occurs, a sequence of transformations is observed in the characteristic cell mitosis up to the formation of the embryo which breaks the membrane and emerges as the first naupliar stage. The process of development is very similar to other penaeids and the duration of each stage is characteristic of the species. The influence of salinity and pH on spawning, hatching rate and survival, and the optimal values for each factor were determined.

Thermal Tolerance of Larval Greentail Prawn *Metapenaeus bennettiae* (Racek and Dall) — A Comparison with School Prawn *Metapenaeus macleayi*

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The thermal tolerance of four larval stages of *Metapenaeus bennettiae* was studied in the laboratory. Critical Thermal Maximum (CTM), One hour Median Lethal Temperature (1hLT50), and Median Resistance Time (MRT) were measured. Moulting rate of larvae and hatching rate of embryos were also monitored to study the delayed effect of thermal stress.

Thermal tolerance was shown to be strongly dependent on acclimation temperature (TA) at all larval stages, which