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showed ontogenetic development of thermal resistance. Moulting of larvae was hindered at temperatures (37.2°C for nauplius when TA=25°C) well below lhLT50 (38.1°C for nauplius when TA=25°C). The embryonic stages were more susceptible to thermal stress than the larval stages. The salinity effects were also significant. Nauplius and protozoea stages showed their highest CTM values at the salinity in which they were spawned.

When compared with another penaeid *M. macleayi* (offshore breeder), *M. bennettae* (estuarine breeder) was found to have higher thermal resistance, but was less adaptive to changes in acclimation temperature.

## Growth and Productivity of Juvenile Banana Prawns, *Penaeus merguiensis* in Natural and Laboratory Systems

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Growth and survival of *Penaeus merguiensis* juveniles were measured over four years in the Norman River estuary, south-eastern Gulf of Carpentaria. Growth in carapace length for the first 8-9 weeks after settlement was essentially linear and averaged 1.2 mm/week in summer at 29.5°C and 0.45 mm/week in winter at 19.5°C. A comparison of different cohorts under varying temperatures and salinities indicated that growth was temperature- but not salinity-dependent. Survival of newly settled postlarvae varied seasonally and was highest in spring (October-November).

In the laboratory, a study of moulting rate and moult increment at 15, 20, 25, 30 and 35°C demonstrated that the optimal temperature for growth was 25-30°C. Survival of juveniles was also highest at intermediate temperatures. Effects of salinity and food ration amounts are discussed.

## Water Quality Criteria for Farming the Grass Shrimp, *Penaeus monodon*

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Physiological and growth effects of pH, salinity, temperature, heavy metals, pesticides and others on juvenile grass shrimp *Penaeus monodon* have been investigated to determine the biologically safe concentrations. Optimal pH, salinity and temperature are found to be in the range of 8.0-8.5, 15-25 ppt, and 28-33°C, respectively. A dissolved oxygen concentration of 3.7 ppm seems to be the critical oxygen pressure to support the normal life of grass shrimp. To avoid poor survival and retarded growth, the recommended level for each pollutant are: heavy metals, 0.0025 ppm Hg, 0.1 ppm Cu, 0.15 ppm Cd, 0.25 ppm Zn; pesticides, 0.0004 ppb parathion, 0.001 ppb malathion, 0.008 ppb rotenone, 0.01 ppb Azodrin, 0.033 ppb Saturn, 0.01 ppb paraquat, 0.01 ppb Endosulfan, 1 ppb Butachlor; surfactants, 0.1 ppm Dunall OSE, 0.2 ppm BP 1100, 0.5 ppm Seagreen 805; and others, 0.033 ppm $H_2S$, 0.1 ppm $NH_3$.

## Genetic Changes During Development of Penaeid Shrimp

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As penaeid shrimp grow from the earliest naupliar stages, through protozoeal and mysis stages, to postlarvae, they develop greater morphological and behavioral resemblance to the adults. Electrophoretic analysis of cytoplasmic enzymes from nauplii, protozoea, mysis, postlarvae, and adults show that each stage has a unique pattern of gene activity. Thirteen enzyme stains and a general protein stain have been used on larval samples from *Penaeus stylirostris, P. vannamei* and *P. aztecus.* Some enzymes, such as phosphoglucose isomerase, are produced in the same isozymic form during all of the stages. Other enzymes exhibit changes in the number and position of isozymic bands during development, e.g. glutamate dehydrogenase. Some of these differences among developmental stages can only be explained by changes in the number and/or identity of the genes that are active at each stage. This finding suggests larval and adult responses to selection may be relatively independent.

## Osmotic, Total Protein and Chloride Regulation in *Penaeus monodon*

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The osmotic, total protein and chloride ion regulation in two size groups (10 and 30 g) of *Penaeus monodon* Fabricius was investigated. Preliminary experiments showed that osmolality, total protein and chloride concentrations tend to