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Central Inland Fisheries Research Institute
(Indian Council of Agricultural Research)
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ENTRIES

1. Abdussamad, E. M.; Mohamed, Kasim H.; Achayya, P. (Central Marine Fisheries Research Institute, Kochi-682018 (India)). **Fishery and population characteristics of Indian mackerel, *Rastrelliger kanagurta* (Cuvier) at Kakinada.** Indian Journal of Fisheries. (2006) v. 53(1) p. 77-83.

Indian mackerel, *Rastrelliger kanagurta* is exploited by trawls and gillnets along Kakinada coast. Its production increased from 67 t in 1988 '99 to 3,493 t in 1997 '98. Period of peak abundance and fishery was February-March while recruitment was high during December-January. Length weight relationship showed that females were slightly heavier than males of the same size. Growth parameters, L_{∞} and K were estimated as 286.3 mm and 1.89/year respectively. Natural mortality of the stock was 2.61. Total mortality varied between 4.69 and 9.29 and fishing mortality between 2.08 and 6.68. Stock varied during the period between 1,814 and 5,255 t and biomass between 268 and 902 t. Maximum sustainable yield is 2,239 t. E_{max} is 0.77, whereas exploitation rate varied between 0.44 and 0.72. These indicated that the resource is currently under moderate fishing pressure especially from trawls and has only marginal scope for further increase in production. Since further increase in effort by trawls would be detrimental for the resource it is recommended to reduce their effort marginally or to maintain at the present level, whereas effort by gillnets can be increased.

2. Ayyappan, S. (Indian Council of Agricultural Research (ICAR), Krishi Anusandhan Bhavan II, Pusa, New Delhi -110012 (India)). Gopalakrishnan, A. (National Bureau of fish Genetics Resources, Cochin Unit, CMFRI Campus, P. B. No. 1603, Cochin-682018, Kerala (India)). **Transgenics in fisheries: Perspectives, priorities and preparedness for India.** Indian Journal of Fisheries. (2006) v. 53(2) p.127-152.

Transgenic technique provides a rapid and efficient method for fish improvement across a wide range of species by direct gene manipulation. Gene transfer studies in fishes have been initiated for developing some superior strains useful in aquaculture. The most popular gene used in aquatic species is the growth hormone (GH) with an aim to enhance the growth rate of cultivable species. Transgenic ornamental fish popularly called as "glow fish", harbouring fluorescent genes isolated from jelly fish has recently opened new possibilities for producing new multi-coloured fluorescent fish. Transgenic fishes may also be used as "bio-reactors" to produce pharmaceuticals. Although this potential is being realized in crops, there has been no commercial use of genetically modified organisms (GMOs) in aquaculture. Even though, the bio-safety framework in India surrounding the

GMOs has been fabricated mainly to include agriculturally important transgenic plants and hygienically important transgenic pathogens, the guidelines and rules emphasize the need for adequate safety measures.

3. Babu, Ramesh K. V.; Benakappa, S.; Chandra, Mohan K; Naik, Ramachandra, A. T. (University of Agricultural Sciences, College of Fisheries, Mangalore - 575 002 (India)). **Breeding biology of *Charybdis (Charybdis) feriatus (Linnaeus) from Mangalore.*** Indian Journal of Fisheries (2006) v. 53(2) p.181-184.

The computed Chi-square values indicated that male and female ratio in population was not significant ($P < 0.05$) during all the months of the year except November, whereas among different size groups a significance was observed. Dominance of male was noticed in almost all the size groups. Significant chisquare values were observed in 61-65, 66-70 and 101-105 mm carapace width (CW) ranges. The fecundity varied from 35,635 to 3,49,939 with an average of 1,42,012. The correlation value was found to be significant at $p \leq 0.001$ between the parameters studied. The productivity index was found to increase from a low of 0.35 in 80 - 90 mm CW to a maximum of 2.78 in 110 -120 mm CW.

4. Bhatnagar, D. D.; Edward, L. Loveson (Central Institute of Freshwater Aquaculture, Bhubaneswar, Orissa (India)). Joseph, Imelda (Central Marine Fisheries Research Institute, Cochin (India)). **Nutritional quality of food ingredients upgradation by solid state fermentation (SSF).** Fishing Chimes (India). (2006) v. 25(11) p. 22-23.

The authors enlighten us in this contribution on their work on upgradation of nutritional quality of aquafeed ingredients through the application of SSF technology. The authors explain that this technology enables bioconversion of low quality agricultural by-products that may have certain nutritional deficiencies in them to be used in aqua feed as ingredients to meet the health requirement of fishes/ crustaceans under farming. The authors also tell us that SSF technology has the feature well suited for its transference to rural farmers.

5. Biswas, S. N. (Freshwater Aquaculture and Research, Govt. of West Bengal, Kalyani, Nadia, West Bengal (India)). Basu, D. (Freshwater Fisheries Research Station, Govt. of West Bengal, Kalyani, Nadia, West Bengal (India)). **Emission of ultrasonic sound in fish ponds has a positive effect on fish growth.** Fishing Chimes (India). (2006) v. 25(10) p. 14-15.

Study reveals on effect on ultrasonic sound produced by Tele Net Fish Chaser on fish growth and breeding prowess of fishes in the ponds. An account of the studies and outcome have been presented in this paper. The results which are encouraging, deserve a study with a view of adopting the technique.

6. Borthakur, Mridul Kr.; Mahanta, Rita; Goswami, Umesh C. (Guwhati University, Guwahati - 781014, Assam (India). Department of Zoology). **Cytochrome p450, arylhydrocarbon hydroxylase and xanthine oxidase activity during sublethal malathion exposure in freshwater catfish *Heteropneustes fossilis***. Journal of the Inland Fisheries Society of India. (2006) v. 38(1) p. 9-14.

Bio-accumulation and environmental persistence of organochlorine pesticides have led to progressive increase in the use of organophosphorus (OP) pesticides like malathion. Effect of OP pesticide, malathion on three hepatic mixed function oxygenase (MFO) enzymes - cytochrome P450, arylhydrocarbon hydroxylase (AHH) and xanthine oxidase (XOD) of *Heteropneustes fossilis* were studied in laboratory condition. Fishes were exposed to malathion in two sub lethal concentrations. Activity of three MFO enzymes were estimated in experimental and control groups from the day of treatment upto one month. Cytochrome P450 and xanthine oxidase (XOD) activities were consistently and significantly higher in malathion exposed group at different time exposures compared to control group. Arylhydrocarbon hydroxylase activity in response to malathion exposure was minimal relative to the other two enzymes. It has been found that malathion at sub-lethal concentration can act as inducer of hepatic MFO enzymes in *Heteropneustes fossilis*.

7. Chandra, Sudhish (B. S. N. V. College, Lucknow - 226 001.(India). P. G. Department of Zoology). Kumar, Praveen (D. A. V. P. G. College, Lucknow – 226 004 (India)). **Sex related trends in blood urea levels of freshwater fishes**. Aquacult (India). (2006) v. 7 (1) p. 123-127.

Sexual variations in blood urea levels of freshwater fishes were observed. Out of 21 species sixteen revealed higher levels in females than their respective males. The difference between the urea levels of the two sexes was maximal (40.95%) in carp *Cirrhinus mrigala* and minimal (7.52%) in climbing perch *Anabas testudineus*. Fish belonging to same order indicated a definite trend in their blood urea levels.

8. Chezhan, A.; (CAS in Marine Biology, Annamalai Univeristy, Parangipettai (Porto Novo) - 608 502, Tamil Nadu (India)). Sivakumari, K. (Bharati Women College, Chennai-60018, Tamil Nadu (India). Department of Zoology). **Influence of external calcium on the toxicity of low pH and Phosphamidon in relation to ionic regulation of *Cyprinus carpio* var. *communis* (Linnaeus, 1758)**. Indian Journal of Fisheries. (2006) v. 53(1) p. 59-65.

Fingerlings of *Cyprinus carpio* were exposed to low pH (Treatment I), low pH with high calcium (Treatment II), phosphamidon (Treatment III) and phosphamidon with high calcium (Treatment IV) for a period of 24 h. At the end of 24 h, plasma sodium, potassium and chloride levels were estimated. In

Treatment I and II, sodium and chloride levels decreased. A similar decrease in sodium and chloride levels were observed in treatment III and IV also. Plasma potassium levels increased in all the treatments. The alteration in the above said parameters were minimum in acid plus calcium treatment and phosphamidon with calcium treatment. The significant alteration in the electrolyte levels serve as a biomarker of pollutant exposure and effects. The probable reasons are interpreted and discussed.

9. Das, Manas Kr.; Samanta, Srikanta (Central Inland Fisheries Research Institute (ICAR), Barrackpore - 700 120, West Bengal (India)). **Application of an index of biotic integrity (IBI) to fish assemblage of the tropical Hooghly estuary.** Indian Journal of Fisheries. (2006) v. 53(1) p. 47-57.

The index of biotic integrity (IBI) was applied in 117 km stretch of the fresh water zone of Hooghly estuary in India and the effect of anthropogenic stress on fish assemblage integrity was evaluated. Seven new metrics viz., native species richness, native family richness, benthic species richness, water column species richness, % non-native individuals, % tolerant individuals and % herbivorous individuals were added retaining five original metrics. The number of native species and families, number of water column species, number of benthic species, number of intolerant species and percent individual as herbivores decreased significantly ($P < 0.01$) whereas the percentage of tolerant species, percent individual as omnivores and percent individual as carnivores increased significantly ($P < 0.01$) in the anthropogenically stressed sites. The index of biotic integrity (IBI) is significantly lower at the stressed sites downstream. Based on the modification of IBI only 3 or 50% of the sample sites supported fishery in acceptable condition.

10. Datta, Soumendra Kishore; Ghosh, Apurba Ratan; Kundu, Ruma (University of Burdwan, Burdwan – 713 104 (India). Department of Environmental Sciences). **Trade off between economic environmental management of two fish production units in Burdwan districts of west Bengal.** Environment and Ecology (India). (2006) v. 24 (1) p. 237-241.

Inland fish production units in west Bengal often suffer from lack of financial resources, absence of motivation and knowledge about ideal combination of inputs, improper monitoring of water quality, inordinate stress on economic aspects at the cost of environmental dimensions and maximum suitable yield. While the importance of economic benefits can not be belittled, this should not arise at the neglect of pond water quality and fish health. It is found that water quality and other environmental dimensions and maximum suitable aspects are relegated aside the generate quick returns. The authors suggested that Govt. and local authorities should make provision for supply of adequate credit to economically weak fish production units, while ensuring control of the damaging impact on pond

water quality leading to deterioration in fish health and negative impact on society in general.

11. Edwin, Leela (Central Institute of Fisheries Technology, Matsyapuri P.O. Cochin – 682 029 (India)). Hridayanathan, C. (School of Industrial Fisheries, Cochin University of Science and Technology, Cochin -682016 (India)). **Optimisation of ring seine using large mesh sections - a theoretical approach.** Indian Journal of Fisheries. (2006) v. 53(3) p. 291-296.

The introduction of the ring seine in the mid eighties in the artisanal marine fisheries sector of Kerala helped the traditional fishermen to counter the marginalisation felt due to the emergence of the large mechanized sector to a certain extent. This communication is based on the theoretical consideration to reduce the weight of this huge gear by introducing large mesh section in the wing region. The reduction brought about in the total weight of webbing by substituting with large mesh knotless webbing and the cost of fabrication of the ring seine was estimated. Two hypothetical cases were taken for calculation. In the first case when three panels from both wings were substituted effecting a 14% reduction in weight and 2.6% reduction in cost and in the second case where the last eight panels were substituted with large mesh effecting 14% reduction in weight and 7.3% reduction in cost.

12. Felix, N.; Jayaseelan, M. J. Prince (Fisheries College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Thoothukudi - 628 008, Tamil Nadu (India)). **Effects of different protein diets on growth and food conversion ratio of postlarvae of *Macrobrachium rosenbergii* (deMan).** Indian Journal of Fisheries. (2006) v. 53(2) p. 175-180.

The experiment was designed to study the effect of different protein levels on the survival and growth of *Macrobrachium rosenbergii* in nursery phase. The experiment was conducted for 45 days in plastic tubs of 20 L capacity by stocking ten post larvae weighing 0.015 to 0.018 g. Seven diets were formulated at different protein levels of 15, 20, 25, 30, 35, 40 and 45% using the same ingredients. The prawn reared on 40% protein diet exhibited best performance in terms of growth followed by those on 45 and 35% protein diets. However, the high protein efficiency ratio (PER) was recorded in the diet that contained 15% protein.

13. Goswami, M. M.; Borthakur, Arunav; Pathak, Janardan (Fish Biology and Fishery Science Laboratory, UGC SAP (DRS), Gauhati University, Guwahati – 781 014, Assam, (India). Department of Zoology). **Comparative biometry, habitat structure and distribution of four endemic snakehead (Teleostei: Channidae) species of Assam, India.** Journal of the Inland Fisheries Society of India. (2006) v. 38(1) p. 1-8.

Snakeheads of the family Channidae viz. *Channa barca*, *C. aurantimaculata*, *C. stewartii* and *C. bleheri* are of restricted distribution in some areas of Assam.

Biometry, habitat and distribution of the four species were carried out. The microhabitat characteristics of all the four species are of burrowing type. The rare and dwindling status of *C. barca* is of great concern. The declining occurrence of the fish in relation to human interference has been discussed. A key to identification of the fishes of the Genus *Channa* of Assam is provided.

14. Husain, S. Afsar (Chhattisgarh State, Raipur (India). Department of Fisheries). **Riverine collection of fertilized eggs of *Chitala chitala*; hatching and rearing them to brooder stage and spawning them in ponds.** Fishing Chimes (India). (2006) v. 25(11) p. 29-31.

In this study the author gives an account of collection of fertilized eggs of *Chitala chitala*. From a pond in which walls of temple are partly submerged and his successful efforts, not only rearing and growing them to brooder size but also in breeding the gravids and raising their seed. His work acquires importance in the context of observations that *Chitala* now stands listed as a species moving towards a threatened category.

15. Jagadish, I; Victor, A. C. C.; Ilangovan, K. (Tuticorin Research Centre of CMFRI, Tuticorin (India)). Ignatius, Boby (CMFRI, Kochi (India)). **Production of mother oysters of *Pinctada fucata* (Gould) by manipulation of stocking density.** Indian Journal of fisheries. (2006) v. 53(3) p. 297-305.

Marine pearl culture is a multifaceted technique involving three different kind of works namely i) seed production, ii) farming and mother oyster development and iii) nucleation and pearl production. To make the technique more viable and economically feasible it is imperative to make critical analysis of the various technicalities involved in the culture strategy. Critical analysis of the data revealed that a definite upgradation of the pearl culture technology is required in many components coupled with policy decision by the state Government. The present paper focuses a single problem that is production of mother oyster at commercial level. The culture method, appropriate farm management, stock density, growth and survival, culling and their effect on the production of mother oyster suitable for nucleation are presented in the paper.

16. James, R.; Sampath, K. (Chidambaram College, Tuticorin - 628008, Tamilnadu (India).Department of Zoology). **Effect of dietary administration of methyltestosterone on the growth and sex reversal of two ornamental fish species.** Indian Journal of Fisheries. (2006) v. 53(3) p. 283-290.

Efficacy of androgenic hormone, methyltestosterone (MT) on growth, sex reversal and reproductive performance of two ornamental fishes, red swordtail *Xiphophorus helleri* and siamese fighting fish *Betta splendens* were investigated. 30 days old juveniles were fed *ad libitum* on diets containing different levels of MT (0, 10, 20, 40 and 60 mg kg⁻¹ diet) during the experimental period. The mean

body weight and length and specific growth rate of *X. helleri* and *B. splendens* were higher in the MT 10 mg kg⁻¹ treated groups than other levels of MT treated groups, and hence 10 mg kg⁻¹ is considered as optimum dose for attaining higher growth rate. Sex determination of the fishes based on the secondary sexual characteristics showed increased percentage of males with higher dose levels of MT-treated groups. *B. splendens* treated with 20, 40, 60 mg kg⁻¹ produced 100% male population on day 84, 56 and 56 respectively, while *X. helleri* treated with 40 and 60 mg kg⁻¹ produced 100% male population on day 70 and 56.

17. Jayasankar, P. (Central Marine Fisheries Research Institute, PB No. 1603, Cochin-682018, Kerala (India)). **Survival of trawl-caught fish in experimental fishing in the Gulf of Mannar and Palk Bay off southeast coast of India.** Indian Journal of Fisheries. (2006) v. 53(2) p. 211-217.

Survival of injured fish caught in a series of experimental trawl hauls conducted in the Gulf of Mannar and Palk Bay (8°55' - 9°20'N; 79° - 79° 40'E) in the southeast coast of India has been examined. Larger size groups of trawl-caught finfish survived longer, while inedible organisms showed shorter duration of survival. Among the target groups, the blue crab, *Portunus pelagicus* had the greatest survival ratio. Among the non-target groups, molluscs and stomatopods survived better than others. Generally, inedible taxa were relatively more resilient to trawling pressures, showing better survival and reduced injury.

18. Kailasam, M.; Sundaray, J. K.; Mathew, Abraham; Subburaj, R; Thiagarajan, G.; Karaiyan, K. (Central Institute of Brackishwater Aquaculture, No.75, Santhome High Road, R. A. Puram, Chennai - 600028, (India)). **Evaluation of different feeds for nursery rearing of Asian seabass *Lates calcarifer* (Bloch).** Indian Journal of Fisheries. (2006) v. 53(2) p. 185-190.

Asian seabass, *Lates calcarifer* (Bloch) fry were reared with *Artemia* biomass, PUFA enriched *Artemia*, *Moina*, PUFA enriched *Moina*, egg custard and fish meat as feeds. Survival and growth rates were recorded after 45 days of rearing. Maximum survival (88.7 ± 4.1%) was observed in PUFA enriched *Artemia*, followed by non-enriched *Artemia* (85.33 ± 8.2 %), PUFA enriched *Moina* (84.0 ± 6.5%), non-enriched *Moina* (82.0 ± 1.6%), egg custard (71.3±6.6%) and fish meat (60.3 ± 5.7%). Mean length increment was 41.2 ± 4.0 mm in fry fed with PUFA enriched *Artemia* biomass, followed by non-enriched *Artemia* (41.0 ± 6.1 mm), non-enriched *Moina* (29.0 ± 3.0 mm), egg custard (28.6 ± 3.7 mm), enriched *Moina* (26.8 ± 2.8 mm) and fish meat (22.3 ± 3.0 mm). However wet weight gain was in the order of non-enriched *Artemia* (0.90 ± 0.03 g), followed by enriched *Artemia* (0.86 ± 0.23 g), egg custard (0.35 ± 0.1 g), non-enriched *Moina* (0.31 ± 0.06 g), enriched *Moina* (0.23 ± 0.09 g) and fish meat (0.14 ± 0.05 g). Results have indicated that *Artemia* biomass enriched with PUFA is a better feed for rearing seabass fry.

19. Kannupandi, T; Veera, Ravi A.; Soundarapandian, P. (Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai – 608 502 (India)). **Biochemical changes in relation to larval development of the portunid crab *Charybdis lucifera* (Fabricius)**. Indian Journal of Fisheries. (2006) v. 53(2) p. 225-230.

All the biochemical constituents in *Charybdis lucifera* increased with the stages of development from first zoea to first crab. A total increase of 3.70, 4.76, 3.51, 5.92, 4.82, 3.82 and 3.56 folds in dry weight, water, protein, lipid, carbohydrate, chitin, ash and energy respectively were observed during larval development. In general, the maximum rate of accumulation in dry weight and proximate composition was found during the transition period between zoeal and megalopal stages. However, the accumulation of carbohydrate was higher during the stage between the megalopa and first crab. The fatty acid composition did not show any linear relationship with the stages of larval development. The fatty acids like 16:0, 18:0, 18:1 n-9, 20:4 n-6, 20:5 n-3 and 22:6 n-3 constituted the major percentages. The saturated fatty acids showed a minimum of 30.19% in 1st zoea and a maximum of 38.28% in IIIrd zoea. The mono unsaturated fatty acids showed a minimum of 23.49% in 1st zoea and maximum of 33.08% in IIrd zoea. The polyunsaturated fatty acids showed a maximum of 46.49% in 1st zoea and minimum of 30.29% in IIIrd zoea.

20. Kapila, Rajeev (National Research Centre on Coldwater Fisheries, Bhimtal-263 136, Nainital, Uttara Anchal (India)). Mishra, D. P. (G.B. Pant University of Agriculture and Technology, Pantnagar-263 145, Uttara Anchal (India)). Department of Biochemistry). **Randomly amplified polymorphic DNA (RAPD) fingerprinting of *Schizothorax richardsonii* (Gray)**. Indian Journal of Fisheries. (2006) v. 53(2) p. 219-224.

Randomly amplified polymorphic DNA (RAPD) fingerprinting was used to assess the genetic variation/similarity among snow trout (*Schizothorax richardsonii*) collected from four wild locations. RAPD profiles were generated using ten oligonucleotide primers which produced repeatable and consistent results. Ninety eight RAPD loci were detected with average of 9.8 bands per primer. Sixty nine of these loci were polymorphic exhibiting location specific as well as individual specific bands. Twenty nine of the loci exhibited species specific monomorphism. Dendrograms prepared using unweighted pair group method with arithmetic averages (UPGMA) using Jaccard's similarity coefficient revealed fishes from neighboring locations were more genetically similar than the distant ones.

21. Kaushal, D. K. (ICAR-RCER, WALMI Complex, Phulwari Sharif, Patna – 801 505 (India)). Kumar, S. (Karnal Research Centre of Central Inland Fisheries Research Institute, Karnal-132001 (India)). **Ecosystem oriented approach towards development of fisheries in Pong reservoir, Himachal Pradesh**. Journal of the Inland Fisheries Society of India. (2006) v. 38(1) p. 28-34.

Pong reservoir limno-chemical features and productivity status were assessed from 1991 to 1995. The range of total alkalinity (48 to 110 mg Γ^{-1}), temperature (13 to 33°C), pH (6.8 to 8.3) and specific conductivity (96.4 to 266.8 $\mu\text{mhos cm}^{-1}$) exhibited medium productivity of the reservoir. The reservoir has both thermal and chemical stratification. Annual yield of the reservoir has gradually decreased from 53 kg/ha⁻¹ in 1987-88 to 24.7 kg/ha⁻¹ in 1994-95. Average production potential of the reservoir is 118 kg/ha⁻¹. The analysis of catch statistics in the light of prevailing ecological conditions suggest the need for eco-friendly fishery management to augment fish production.

22. Khan, Mohammad Zafar (Central Marine Fisheries Research Institute, Cochin-682018 (India)). **Fishery resource characteristics and stock assessment of ribbonfish, *Trichiurus lepturus* (Linnaeus).** Indian Journal of fisheries. (2006) v. 53(1) p. 1-12.

Ribbonfish, *Trichiurus lepturus* (Linnaeus) has become one of the most important exploited resources in the northwest coast of India. It was landed as bycatch of shrimp trawler earlier but on account of emerging export demand it is now increasingly targeted. The resource has been monitored for more than ten years. The landings of ribbon fishes varied between 16,000 t (1995) and 63,000 t (2000) with an average catch of 33,000 t. The trawl contributed about 93% of the total landing. Peak catch rates were observed in September and November-December. *T. lepturus* is a carnivorous predator feeding on crustaceans, fishes and cephalopods. Spawning season is prolonged from October-May. Individual fish spawns once in a year and the minimum size at maturity is 75 cm. The fecundity varied between 4,900 and 81,000 with a relative fecundity of 65 ova/gm of the body weight.

It grows faster rate and attains 65.1 cm., 98.0 and 114.7 cm. at the end of first, second and third years respectively. The average total mortality coefficient (z) for the period 1992 and 1997 was 3.3 whereas it was 3.64 during 1998-2001. The estimated fishing mortality (F) was 2.49 with exploitation ratio (F/Z) 0.756 and F 2.96 with F/Z 0.815 during the same quinquial periods respectively. During the last two years of 2000-2001 the rate of exploitation was very high and average Z was 3.97 with F/Z 0.814. The average F was 3.232, the yield was about 60,000 t and the biomass was 46, 391t. The yield can be optimized at 70% of the current fishing effort.

23. Krishna, P. V. (Acharya Nagarjuna University, Nagarjuna Nagar - 522510, Andhra Pradesh (India). Department of Aquaculture and Centre for Aquaculture Research and Education). **Production of *Penaeus monodon* using modified extensive systems in Repalle area, Guntur District, Andhra Pradesh.** Aquacult (India). (2006) v. 7(1) p. 37-41.

The present experiment was conducted to study the shrimp production in relation to water parameters. Correlation of different water parameters of the

pond with growth of *Penaeus monodon* was observed in modified extensive systems. A significant positive correlation was found between average growth and quality of feed used. The temperature and salinity show a negative correlation with growth whereas pH of water shows positive correlation with the growth. Frequent water exchange towards later part of shrimp production induced more growth. The survival rate was 55.6 - 75.6% and the production 1,090 - 1,220 kg / ha of 110-126 days culture period.

24. Kumar, Sudheer D. J.; John, Sushma N.; Sivaiah, U.; Rao, S. Madhava; Rao, K. Jayantha (Sri Venkateswara University, Tirupati - 517 502 (India)). **Effect of chlorpyrifos and azadirachtin on Ach and AchE of Fish *Tilapia mossambica***. Aquacult (India). (2006) v. 7 (1) p. 87-91.

In the present investigation, chlorpyrifos and azadirachtin toxicity on *Tilapia mosambica* were evaluated. And also the effect of chlorpyrifos and azadirachtin on Ach and AchE were determined. The AchE levels were inhibited by chlorpyrifos and azadirachtin in all tissues of 7 and 15 days exposed fish. The inhibition is significant in all tissues except in brain and gill of 7 days azadirachtin exposed fish. The Ach content was more in brain followed by muscle, gill and liver in control animals. The organophosphates are protein inhibitors of the enzyme acetyl cholinesterase. They bind the active site and prevent breakdown of Ach resulting in blocking of synaptic transmission in cholinergic nerves. In consonance with the decrease in the AchE level, there is a corresponding increase in the Ach content of the tissues suggesting decreasing in the cholinergic transmission and; consequent accumulation of Ach in the tissues. In the present study, when the individual effects of chlorpyrifos and azadirachtin were compared on the inhibition of AchE, the effect of chlorpyrifos is greater than the azadirachtin in all the tissues of pesticide exposed fish, with suggests higher affinity of the enzyme, AchE towards chlorpyrifos than towards azadirachtin.

25. Laskar, Boni Amin; Pujen, Azen (NRCCWF (ICAR) Project station, Fisheries Experimental Farm, Iduli – 792 110 (India)). Das, D. N. (110, Lower Dibang Valley, Arunachal Pradesh, Rajiv Gandhi University, Rono Hills -791112; Arunachal Pradesh (India). Department of Zoology. Nath, Pronob (Govt. of Arunachal Pradesh, Itanagar-791111, Arunachal Pradesh (India). Department of Fisheries. **Neolissocheilus hexagonolepis (McClelland) or chocolate mahseer conservation in Arunachal Pradesh, India**. Aquacult (India). (2006) v.7 (1) p. 105 - 110.

Seed collection sites in different streams / lakes of chocolate mahseer in Dibang Valley District (N 28° 10' 29' 40", E 95°20' 96'40", Alt 150 to 5300 m msl) of Arunachal Pradesh have been surveyed and identified. Density of fry collected from the various streams ranged between 25-175 fry / m². The experimental fishing with drag net (very small meshes) in the Shally lake

(420 m asl) encountered fingerlings and adults of chocolate mahseer and the present day population structure of the chocolate mahseer in Shally lake is found to be expanding, which was inferred from observation on the occurrence of different size groups of this species belong to a wide length ranged from 70 mm to 280 mm (fries, adults and brooders). Rearing of fingerlings (3.0- 4.0 g weight) of Chocolate mahseer in earthen ponds conducted for 364 days revealed that fry have gained a length of 110.41 mm and weight of 104.33 gm.

26. Laxmilatha, P.; Thomas, Sujitha; Sivadasan, M. P.; Ramachandran, N. P.; Surendranathan, V. G. (Central Marine Fisheries Research Institute, West Hill P.O., Calicut- 673005, Kerala, (India)). **The fishery and biology of *Meretrix casta* (Chemnitz) in the Moorad estuary, Kerala.** Indian Journal of Fisheries. (2006) v. 53(1) p. 109-113.

Meretrix casta forms an important fishery in the Moorad estuary. The average annual landing for the period 2000-2004 was 426 t, the average catch per effort was 573 kg and total effort was 3182. Clams ranging from 28 to 32 mm size contributed to the fishery. *M. casta* is a continuous breeder with two peaks in March-April and August-September. The percentage edibility ranged between 8 and 16. The standing stock biomass in the Moorad estuary was estimated at 2073 t with an average density of 1096 numbers per sq. m. The present status and management options for this important fishery are discussed.

27. Maji, S.; Mali, P.; Joardar, S. N. (West Bengal University of Animal and Fishery Sciences, Mohanpur Campus, P.O. - B.C.K.V, Pin. - 741252, West Bengal (India). Department of Fishery Pathology and Microbiology). **Diagnostic potentiality of fractionated antigen of *Aeromonas hydrophila* isolated from gold fish, *Carassius auratus* (Linn.)** Indian Journal of Fisheries. (2006) v. 53(1) p.13-17.

With the aim of isolating purified antigens of extra cellular products (ECP) of *A. hydrophila* that might be exploited for early sero-diagnosis, bacteria was isolated from ulcerative lesions of gold fish. Polypeptide profile of ECP of *A. hydrophila* showed 12 bands having molecular weight in the range of 22 - 55 kDa in SDS-PAGE analysis. Fractionation (by DEAE-cellulose) and serological characterization of ECP were subsequently performed. One of the fractionated antigen (DI) possessing mainly of 45 kDa polypeptide revealed sero-reactivity with *A. hydrophila* antiserum having no cross-reactive component(s) with related bacterial antigens, viz. *Vibrio harbeyi*, *V. alginolyticus* and *Pseudomonas fluorescense*. Hence, 45 kDa polypeptide of ECP of *A. hydrophila* showing potentiality of sero-diagnosis should be given due attention.

28. Mallik, Sumanta K.; Landge, A. T. (Central Institute of Fisheries Education, (Deemed University –I C A R, Bungalows, Versova, Mumbai-400061 (India)). Venugopal, G. (Central Institute of Fisheries Education, Kakinada Centre, Beach Road, Kakinada- 533 007 (India)). **Growth and survival of fry to fingerling production of Indian Magur, *Clarius batrachus* (Linnaeus, 1758) in cemented nurseries.** Aquacult (India). (2006) v. 7 (1) p. 99-104.

An experiment of four weeks duration was conducted to determine the growth and survival of fry to fingerling production of Indian magur *Clarius batrachus* in 4 cemented nurseries obeying a uniform stocking density of 100 no.fry/m². The results of growth analysis clearly indicate that the highest apparent growth of 1.472 gm was recorded in nursery pond - 4 after four weeks of rearing. Similarly nursery pond 1 and 2 attained a growth of about 19 m while nursery pond -3 a least growth of 0.666 gm. Although the SGR of 14.07% is found in nursery pond -3, but the final apparent growth seen in this nursery is minimum. The lowest growth in nursery pond -3 may be. It attributed to the initial stocking size of fry (0.013 gm). The maximum fry survival of 72% was obtained in nursery pond 2, while in nursery pond 4 it was 70% and nursery pond 1 and 3-recorded 58% and 63% respectively, with an average of 65% fry survival in all 4 cemented nurseries indicating suitability of cemented nursery in rearing of fry to fingerling production, which serves as a stocking material for magur culture.

29. Manna, S. K.; Som, A. B.; Samanta, S. (Central Inland Fisheries Research Institute (ICAR), Barrackpore, Kolkata - 700120, (India)). **Water alkaline phosphatase activity and phosphorus availability during summer in inland water bodies.** Indian Journal of Fisheries. (2006) v. 53(2) p. 167-173.

Phosphorus is a limiting nutrient in most freshwater environments. Alkaline phosphatase enzyme plays an important role in phosphorus cycling and may be decisive in primary and secondary production. In the present investigation total water alkaline phosphatase activity was high during summer in all the water bodies. Relative contributions of algal, bacterial and dissolved fractions to total water phosphatase activity were 11-50, 3-8 and 41-83% respectively. Unlike cell free and bacterial phosphatases, phytoplankton specific enzyme activity was positively correlated to orthophosphate concentration. Algal specific enzyme activity was low suggesting P-uptake to be a more important process than P regeneration in hyper-eutrophic sewage fed ponds.

30. Manoharan, S.; Murugesan, V. K.; Palaniswamy, Rani (Central Inland Fisheries Research Institute, Coimbatore Centre, 68, Raju Naidu Road, Tatabad, Coimbatore - 641012, Tamil Nadu (India)). **Numerical abundance of benthic macroinvertebrates in selected reservoirs of Tamil Nadu.** Journal of the Inland Fisheries Society of India. (2006)v. 38(1) p. 54-59.

Richness and diversity of benthic macroinvertebrates in nineteen reservoirs located at different river basins of Tamil Nadu were investigated. Krishnagiri reservoir recorded the highest macrobenthic population (4290 um^{-2}) followed by Wellington (4170 um^{-2}). Gunderipallam, Varattupallam, Amaravathy, Uppar, Vaigai, Pechiparai and Vidur reservoirs also recorded large quantity of macrobenthos (1926 to 2338 um^{-2}). Palar-Poranthalar, Pilloor, Vembakottai, Manimuthar and Orathupalayam exhibited a moderate quantity of macrobenthos (952 to 1458 um^{-2}). A low level of bottom fauna was encountered at Parambikulam (502 um^{-2}), Thoonakadavu (838 um^{-2}), Peruvaripallam (329 um^{-2}), Uppar (411 um^{-2}) and Odathurai (364 um^{-2}). While *Chironomus* larvae formed the major portion of the macrobenthos (2835 um^{-2}) at Krishnagiri, molluscan forms dominated (3939 um^{-2}) at Wellington reservoir.

31. Mathews, Jehosheba P.; Philip, Babu (S.N.M. College, Maliankara – 683 516 Kerala (India). Department of Biochemistry). **Metabolic responses in *Oreochromis mossambicus* (Peters) exposed to water accommodated fractions (WAF) of Bombay High Crude Oil.** Indian Journal of Fisheries. (2006) v. 53(1) p. 23-31.

Oreochromis mossambicus (Peters) was exposed to 1.5, 3.0 and 5.0 ppm concentrations of water-accommodated fractions (WAF) of Bombay High Crude oil for 21 days and different parameters like total carbohydrate, glycogen, blood glucose, lactate, pyruvate, lactate dehydrogenase, glycogen phosphorylase 'a' and glycogen phosphorylase 'b' were estimated. A significant dose-dependent change ($P < 0.001$) was observed in liver, gill, heart and muscle tissues which suggest a severe respiratory stress in the WAF exposed fish and its tendency of shift in the carbohydrate metabolism more towards anaerobic dependence than aerobic oxidation.

32. Mishra, D. K. (Deogarh College, Deogarh-768 119 (India). Department of Zoology). Bohidar, K. (Utkal University, Bhubaneswar-751004 (India). Department of Zoology). Pandey, A. K. (Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar-751 002 (India)). **Occurrence of trematode parasitic cysts in liver and blood vessel of *Channa punctatus* (Bloch).** Aquacult (India). (2006) v.7(1) p.129-131.

Liver of about 200 specimens of *Channa punctatus* were examined for experimental studies. In three individuals, encysted metacercarial larvae of digenean trematode were encountered among the hepatocytes as well as in the artery supplying blood to liver.

33. Mohanty, S. K.; Mohapatra, A.; Bhatta, K. S.; Pattnaik, A. K. (Chilika Development Authority, C-II, BJB Nagar, Bhubaneswar-751014 (India)). Mohanty, K. S. (Water Technology Centre for Eastern Region (ICAR), Chandrasekharapur, Bhubaneswar-751023, (India)). **Occurrence and biological outlines of two species of *Scylla* (De Haan) in Chilika**

lagoon, India. Indian Journal of Fisheries. (2006) v. 53(2) p. 191-202.

The mud crab population in Chilika lagoon was hitherto considered as belonging to a single species of *Scylla serrata*. The present study, after examining colouration, reticulation on limbs, size range, minimum size at first maturity, habitat preference, fishery season, breeding and morphological traits, confirmed the co-existence of two species, *Scylla tranquebarica* (Fabricius, 1798) and *Scylla serrata* (Forsskal, 1755) in Chilka lagoon. The maximum size of *Scylla tranquebarica* (240mm / 2.8 kg) and *Scylla serrata* (181 mm / 0.83 kg) recorded during the study were considered as the largest sizes so far recorded from Indian waters. Collection and estimation of landing statistics separately for two mud crab species from a single water body seemed to be the first attempt in the country. *Scylla serrata* and *Scylla tranquebarica* accounted for 81.52 and 18.48% share respectively in the average annual landing. Strategic conservation regulation need to be formulated for mud crab fishery in Chika lagoon based on species-wise landings and biological information to prevent unregulated exploitation.

34. Mohapatra, Pradeep Kumar (Chandrabhanga Prawn Hatchery, At / PO-Konark, Dist: Puri, Orissa (India)). **Successful scampi seed production at Chandrabhanga shrimp hatchery.** Fishing Chimes (India). (2006) v. 25(11) p. 19-21.

In this study it is found that there have been stray efforts at utilization of shrimp hatcheries for production of scampi seed, with varying degree of success. In this background the author narrates the success story of production scampi seed at Chandrabhanga shrimp hatchery in Orissa through incorporation of the needed innovations to the shrimp hatchery.

35. Mondal, Debjit Kumar; Kaviraj, Anilava (University of Kalyani, Kalyani-741235, West Bengal (India). Department of Zoology). Das, Bipul Kumar (West Bengal University of Animal and Fishery Sciences, Chakgaria, Kolkata -700 094, West Bengal (India).Department of Fisheries Environment). **Ichthyofaunal diversity and aquaculture potential of some floodplain wetlands in the district of north 24 Parganas, West Bengal.** Journal of the Inland Fisheries Society of India. (2006) v. 38(1) p. 23-27.

Five floodplain wetlands, locally called 'baor', located in West Bengal were studied in the year 2003. Sixty species (including five exotic species) belonging to twenty-four families were recorded in the baors. Stocking and harvesting of carps is practiced in the baors on annual basis. Maximum yield (901.9 kg/ha) of carps was recorded from Gopalnagar baor during 2000-2001. The major carps are harvested during a specified season while the small fish are harvested throughout the year without any regulation. *Gudusia chapra*, *Amblypharyngodon mola*, *Mystus* sp. and *Puntius* sp. constitute a significant percentage of the total catch. A detailed account of ichthyofaunal diversity and aquaculture potential of the baors

have been discussed.

36. Mondal, Sandip Kumar (Madras Research Centre of Central Marine Fisheries Research Institute. 75, Santhome High Road, Chennai-600 025 (India)). **Effect of temperature and body size on food utilization in the marine pearl oyster *Pinctada fucata* (Bivalvia: Pteridae).** Indian Journal Marine Sciences. (2006) v. 35(1) p. 43-49.

Physiological parameters such as clearance rates, absorption efficiency, oxygen consumption and ammonia excretion were estimated for four size groups ranging from 16 to 60 mm in Dorso Ventral Measurements (DVM) of the marine pearl oyster *Pinctada fucata* at different water temperatures and the results were integrated by means of two physiological indices, namely Scope For Growth (SFG) and Net Growth Efficiency (K_2). The rates of clearance, oxygen consumption and ammonia excretion were found strongly correlated ($p \leq 0.01$) with size groups (as tissue dry weight) at water temperature from 18⁰ to 31⁰C. Absorption efficiency ranged from 43.2 to 56.9 % and was not related to body size in the tested temperature range. Oxygen consumption and ammonia excretion increased with temperature within the same size group from 18⁰ to 31⁰C. Clearance rate increased with temperature from 18⁰ to 28⁰C, but declined with further increase of temperature to 31⁰C. Excreted energy contributed 2.4 to 4.0% to the total absorbed energy for different size groups and water temperatures. The SFG and K_2 were higher at 26⁰ and 28⁰C and were minimum at 18⁰C or all the size groups. The result showed that the optimum physiological conditions for survival and growth of *P. fucata* were in the temperature range of 26⁰ to 28⁰C.

37. Nath, Asim Kumar (Serampore College, Serampore (India). Department of Zoology). Banerjee, Samir (University of Calcutta, Kolkata- 700019 (India). Department of Zoology). **Effect of different percentage of feeding on growth rate of *Clarias gariepinus* young.** Environment and Ecology (India). (2006).v. 24(1) p. 91-97.

Higher feeding levels with feed rates of 15% body weight / day showed significantly better result than at 20% body weight/ day when larvae are cultured for about 35 days. SGR value was found to decrease as fish body weight decrease. In *Clarias gariepinus* young, ad libitum feeding could be wasteful. The growth rate was found to differ significantly with each other at all the feeding levels from week 2 onwards of culture duration. Better results were obtained by feeding restricted rations at proper frequencies.

38. Nayak, Sukanta K. (Orissa State Office, Bhubaneswar (India)). **Egg yolk antibodies for fin and shell fish health management.** Fishing Chimes (India). (2006) v. 25(11) p.16-18.

The study reveals that imparting passive immunization to fin and shell fish through application of egg yolk antibody technologies an useful alternative to

administration of antibodies/drugs/chemotherapy and explaining that egg yolk antibody technology has enormous potential in controlling diseases in aquacultured animals. The author suggests that integration of immunodiagnosis with passive IgY immunotherapy can help to control diseases that afflict fishes and crustaceans in aquaculture.

39. Palaniswamy, Rani; Murugesan, V. K.; Manoharan, S. (Central Inland Fisheries Research Institute, Coimbatore Centre, 68, Raju Naidu Road, Tatabad, Coimbatore - 641 012, Tamil Nadu (India)). **Limnology and fisheries of an upland reservoir in Nilgiris.** Journal of Inland Fisheries Society India. (2006) v. 38(1) p. 49-53.

Sandynulla reservoir in Nilgiris was studied to understand the biotic and abiotic factors, primary production and the fishery. This reservoir was stocked with seed of Indian major carps (*C. catla*, *L. rohita* and *C. mrigala*) during seventies but since these fishes failed to establish in this reservoir, their stocking was discontinued. Instead, composite seed of *C. carpio*, *H. molitrix*, *C. idella* and *L. fimbriatus* were stocked @ 10 to 79 No ha⁻¹. Exploitation started from 1963-64 and 0.5 t of fish was caught in the same year. The fish catch improved gradually and reached a peak (7.36 t) in 1968 - 69. Subsequently, the yield declined and fluctuated between 2.0 t and 6.6 t with an average of 4.23 t (16.0 kg ha⁻¹ yr⁻¹).

40. Parthiban, F.; Christopher, I. Maria Michael; Selvaraj, S.; Surendraraj, A.; Venkataramani, V. K. (Fisheries College and Research Institute, Thoothukudi-628008, Tamilnadu (India)). **Enhancement of ovulation in goldfish (*Carassius auratus*) by a supplementary feed incorporated with polychaete worm (*Marphysa gravellyi*).** Indian Journal of Fisheries. (2006) v. 53(3) p. 307-312.

Live feeds play a vital role in the enhancement of growth, maturity in ornamental fish culture and production of brood stock. An experimental trial was conducted to study the effect of supplementary feed incorporated with locally available polychaete worm (*Marphysa graueyi*) on feed intake, conversion, coloration and fecundity of gold fish (*Carassius auratus*). Fishes were fed with polychaete worm incorporated iso-protein feed at the rate of 0%, 5%, 10%, 15% and 20%. Significant growth increment was observed between experimental feed and the control (P<0.01). Among the experimental animals fed with polychaete worm incorporated feed, more than 80% of them were observed to have matured within a period of 60 days. The fecundity was more in gold fish fed with polychaete worm incorporated in the conventional feed at 15% and 20% level.

41. Raje, Sadashiv Gopal (Mumbai Research Centre of C.M.F.R.Institute, Mumbai (India)). **Some aspects of biology of catfishes *Tachysurus caelatus* (Valenciennes) and *Osteogeneiosus militaris* (Linnaeus) from Mumbai.** Indian Journal of Fisheries. (2006) v. 53(3) p. 333-340.

The results of investigations on some aspects of the biology of *Tachysurus caelatus* and *Osteogeneiosus militaris* are presented. The fishes fed on crustaceans followed by fishes, molluscs and polychaetes. Gestating males were found starving. The occurrence of mature females and gestating male parents indicate that *T. caelatus*, spawns during February-June and *O. militaris* during August-April. *T. caelatus* attains 50% maturity at a total length of 40.8 cm and *O. militaris* at 33.0 cm. Females predominant the catch of both these species. Fecundity varied from 44 to 81 ova in *T. caelatus* and 27 to 61 ova in *O. militaris*. The maximum number of incubated eggs recorded from oro-buccal cavity of *T. caelatus* and *O. militaris* was 54 and 56 eggs respectively. The length- weight relationships of these fishes pooled for both sexes are: *T. caelatus*: $\text{Log } W = - 5.57881 + 3.24007 \text{ Log } L$. *O. militaris*: $\text{Log } W = - 4.86014 + 2.92293 \text{ Log } L$.

42. Ramanathan, N.; Padmavathy, P.; Francis, T.; Athithan, S. (Fisheries College and Research Institute, Veterinary and Animal Sciences University, Thoothukkudi - 628008 (India). Department of Aquaculture). **Growth performance of *Penaeus monodon* (Fabricius) and carps in freshwater ponds under polyculture.** Indian Journal of Fisheries. (2006) v. 53(3) p. 313-319.

The present paper deals with the polyculture of tiger shrimp, *Penaeus monodon* and carps in freshwater ponds. *P. monodon* seeds (PL 20) were stocked at the rate of 1500 and 5000 no./ 0.1 ha under extensive and semi-intensive systems respectively. The carp fingerlings (catla, rohu, mrigal, silver carp, common carp and grass carp) were stocked at the rate of 400 and 800 no./ 0.1 ha under extensive and semi- intensive culture ponds respectively. Under extensive culture, the shrimp production obtained was 162.00 kg / ha / 122 days and it was 484.00 kg / ha /123 days from semi-intensive culture. The carp production was 2409.40 and 4855.00 kg / ha / yr under extensive and semi-intensive systems respectively.

43. Rao, G. Syda (Regional Centre of CMFRI, Pandurangapuram, Visakhapatnam - 530003 (India)). Somayajulu, K. R.(Kakinada Research Centre of Central Marine Fisheries Research Institute, Kakinada, Andhra Pradesh - 533 004, (India)). **Fishery and stock assessment of the blood clam *Anadara granosa* (Linnaeus) from Kakinada Bay.** Indian Journal of Fisheries. (2006) v. 53(2) p. 203-209.

Landing and effort data of *Anadara granosa* (Linnaeus) from Kakinada Bay were collected for the years 1988 to 1991. The landings during 1988 were 802 tonnes compared to 1600 tonnes in 1991. The effort in 1988 was estimated at 32,458 man-days, which has increased by 1.7 times in 1991. However, catch rates showed a declining trend. There has been some change in the exploitation pattern. Younger size groups (<30 mm) are being exploited more, due to their higher price realization. Stock assessment attempted by Jones' Cohort analysis and Thomson and Bell analysis showed that the current level of exploitation has already reached MSY level. There is scope to increase the yields by following 1990 pattern of exploitation. However, selective

exploitation of *A. granosa* of > 30 mm, if continued may lead to declining yields over the years.

44. Rath, S. C.; Mondal, B.; Sarkar, S.K.; Gupta, S.D. (Central Institute of Freshwater Aquaculture, Kauslyaganga, Bhubaneswar (India)). **Fate of unspawned oocytes in the ovary of *Labeo rohita* (Ham.) during inter spawning period through multiple breeding.** Indian Journal of Fisheries. (2006) v. 53(1) p. 103-108.

Labeo rohita was induced bred repeatedly three times during May to August. GSI (ovary) was 18.2 ± 0.547 in non-bred fish which was reduced to 6.983 ± 1.004 soon after spawning and further reduced to 4.226 ± 0.603 during 1st week. GSI again slowly increased up to 17.178 ± 0.497 at the end of 6 week of initial spawning. Histology of spent ovary exhibited 70-80% empty follicle and 20-30% of un-spawned oocytes of different stages viz. previtellogenic oocytes (PO), vitellogenic oocytes (VO), non-spawned loose mature oocytes (NLMO) and non-spawned overmatured, oocytes (NOMO). The empty follicles started disintegrating within 1st week of the spawning. Some of the maturing oocytes gradually become overmatured whereas NLMO and NOMO were entered to the atretic process and were absorbed to the system. Most of the non-spawned previtellogenic eggs and early vitellogenic eggs were used to develop in the ovary as growing oocytes and entered the maturation phase towards 6th and 7th week.

45. Sarkar, Bikash; Tiwari, G.N. (Centre for Energy Studies, Indian Institute of Technology Delhi Hauz Khas, New Delhi -110 016 (India)). Ayyappan, S. (Indian Council of Agricultural Research KAB-II, Pusa, IARI Campus, New Delhi-110012(India)).**Modeling and experimental validation of water temperature in a fish rearing tank.** Indian Journal of Fisheries. (2006) v. 53(3) p. 237-243.

This study describes the modeling of a fish rearing tank. Numerical computations have been performed for a typical day in the month of January, 2005 for the composite climate of New Delhi. This model has been developed by considering the effect of heat losses e.g. conduction, convection, radiation and evaporation. The governing equations are numerically solved with Matlab-7.0 software to predict the water temperature. The model has been validated with the experimental data. It is inferred that the predicted and experimental values of water temperature exhibited fair agreement with coefficient of correlation ($r = 0.90$) and root mean square percent deviation is ($e = 1.67\%$).

46. Sarma, D. (St. Anthony's College, Shillong-793001, Meghalaya (India). Department of Pisciculture). Dutta, A. (Gauhati University, Guwahati-781014, Assam (India). Department of Zoology). **Scanning electron microscopic studies on development of *Labeo rohita* (Ham.) with reference to induced breeding at mid-altitudinal region, Shillong (Meghalaya).**

Labeo rohita was successfully induced to breed at mid altitudinal region, Shillong, at a temperature of 19-23°C. The surface microstructure of eggs and hatchlings were observed. The smaller size and rough surface architecture of the eggs and hatchling denotes incomplete development. The surface ultra structure, cellular morphology, differences in cell shape and the type of cell were observed through SEM. Unlike other teleosts some characteristic features like uniform distribution of filopodia throughout the embryonic shield, smaller diameter of filopodia and extension of embryonic axis were seen.

47. Satapathy, D. (College of Fisheries, Orissa University of Agriculture and Technology, Rangailunda, Berhampur (Gm.) – 760 007 (India)). **Maturation and spawning of the mud crab *Scylla serrata* in captive condition.** Aquacult (India). (2006) v. 7(1) p. 149-151.

The eyestalk ablation of the mud crabs, *Scylla serrata* resulted in maturation of ovary within 48 to 62 days in captive condition. The ripe ovary weighed between 12 g to 38 g bearing eggs to an extent of 4.5 lakhs at a size between 300 to 470 microns. A few crabs recorded repetitive maturation at an interval of 41 to 60 days for 2nd and 3rd time. The fecundity and carapace width (mm) showed a linear relation (Fecundity = 11703.2 CW 1195313; r = 0.87). Their spawning rate was between 32% and 55%.

48. Shankar, D. S.; Kulkarni, R. S. (Fish Endocrinology Research Unit, Gulbarga University, Gulbarga-585106 (India).Department of Zoology). **Effect of cortisol on the condition factor in *Notopterus notopterus* (Pallas) during reproductive phases.** Indian Journal of Fisheries. (2006) v. 53(3) p. 321-326.

The condition of the male *Notopterus notopterus* was studied during four phases of reproductive cycle in control and after cortisol hormone treatment. The condition of the fish including condition factor (K) and somatic condition factor (Ks) was determined based on weight of the body, length of the fish and gonad weight. The condition factors decreased during spawning and post spawning, while increased during preparatory and pre-spawning phases. The hormone cortisol level estimated by Radioimmunoassay (RIA) technique indicated that the hormone was high during pre-spawning and spawning phases as compared to other phases which may be due to the hormone involvement in metabolic activity for spermatogenesis. In 60 µg cortisol treated fish further reduction in these factors was noticed indicating that there is an active involvement of the whole body towards expenditure of energy for reproductive activity. Since cortisol is a metabolic hormone, its treatment may result in the extra expenditure of energy for progressing reproductive activity such as spermatogenesis.

49. Shanmugam, A.; Bhuvanewari, T.; Arumugam, M; Nazeer, R. A.; Sambasivam, S. (Centre of Advanced Study in Marine Biology, Annamalai University Parangipettai – 608 502 (India)). **Tissue chemistry of *Babylonia spirata* (Linnaeus)**. Indian Journal of Fisheries. (2006) v. 53(1) p. 33-39.

Biochemical composition of different body parts of *Babylonia spirata* (L) in various size groups was studied. Among the body parts, gonad and digestive gland showed highest biochemical composition and acts as a storage site followed by foot and exhibited a distinct seasonal cycle. The size groups of 40 - 45 mm and 45 - 50 mm animals showed higher values of biochemical components. Maximum protein value of 69.09% was recorded in May 1998 in the size group of 50 - 55 mm and the highest carbohydrate value of 9.20% was recorded in the 50 – 55 mm size group. The maximum lipid value of 9.5% was recorded in the 50 – 55 mm size groups animals.

50. Sharma, O. P. (College of Fisheries, M.P. University of Agriculture and Technology Udaipur–313001 (India). Department of Aquaculture). Jain, H. K. (Statistics and Computer Application, Rajasthan College of Agriculture, MPUAT, Udaipur (India). Department of Agriculture). **Effect of various cereals and pulses on the growth, digestibility and food conversion ratio of *Cirrhinus mrigala* (Ham.) fingerlings**. Indian Journal of Fisheries. (2006) v. 53(1) p. 97-102.

An investigation was conducted with various diets prepared individually with cereals and pulses viz., jowar (*Sorghum* sp.), millet (*Setaria* sp.), til oil cake (TOC), cow pea (lobia), lentil (masoor), khesari dhal and wheat bran to evaluate their effects on the growth, digestibility, food conversion ratio (FCR) and specific growth rate (SGR) of *Cirrhinus mrigala* fingerlings. The highest growth in terms of weight gain was obtained with khesari dhal, while lowest was found in wheat bran and lobia. Analysis of variance indicated the growth as highly significant but Duncan's multiple range test had shown insignificant difference between the growth of fingerlings fed with khesari dhal and jowar ($p > 0.05$).

51. Shejule, K. B.; Kharat, P.S.; Kale, R. S. (Dr Babasaheb Ambedkar Marathwada University, Aurangabad-431004 Maharashtra (India)). **Toxicity of organotin tributyltin chloride to fresh water prawn, *Macrobrachium kistnensis***. Aquacult (India). (2006) v. 7(1) p. 141-144.

Tributyltin (TBT) compounds are organic derivatives and they have been recognized as strong biological poison because of their persistent nature and cumulative activeness. The crustaceans are the suitable bioindicators of chemical contamination of water. The experiments were conducted on *Macrobrachium kistnensis* to find out the lethal concentration LC₅₀ value of

the organotin tributyltin chloride. Well-acclimatized healthy female prawns were selected for toxicity test in tap water for a period of 24, 48, 72 and 96 hours. Observed and calculated values were recorded. LC₅₀ values for tributyltin chloride were found to be 0.33, 0.26, 0.17 and 0.09 ppm for 24, 48, 72 and 96 h respectively. The results show that the LC₅₀ values decreased with increase in exposure period.

52. Singh, S.; Chari, Omprakash M. S.; Vardia, H. K. (Indira Gandhi Agricultural University, Raipur 492006 (India) .Department of Fisheries). **Diversity of fish fauna in catchment of Mahanadi river in Raipur district of Chhattisgarh.** Environment and Ecology (India). (2006) v. 24 (1) p. 165-169.

Chhattisgarh is a land locked state provided with major river Mahanadi. Mahanadi has catchment area of 56% Chhattisgarh. The fish fauna were collected from seven sites of river Mahanadi in the Raipur district during January to July 2004. A total 53 species belonging to 7 orders, 17 families and 34 genera were recorded from this region. A total of 53 species *Notopterus notopterus*, *Labeo rohita*, *Puntius ticto*, and *Catla catla*. The family Cyprinidae with 19 species form the largest single group of ichthyofauna of the Mahanadi Catchment contributing 35% of total ichthyofauna, the second largest is the Bagridae sharing 11% of the total ichthyofauna. The authors concluded that Mahanadi over a period of 60 years indicates large human and other edephic factors for the change in the ecology and ichthyofauna of Mahanadi river.

53. Singh, Vijendra; Sing, C. P. Chandel (University of Rajasthan, Jaipur-302004 (India). Department of Chemistry). **Physico-chemical parameters and some heavy metals in soil from diverse farms of Jaipur, Rajasthan.** Environment amd Ecology (India). (2006) v. 24 (1) p. 28-31.

Soil samples were collected from 13 different vicinal locations of industrial sites where industrial waste water used for irrigation. The sampling and investigation of soil from diverse farms conducted during April 2004 to September 2004 from diverse farms adjacent to industrial areas of Jaipur city. The soil samples were analyzed for pH, EC, organic carbon, phosphate, potash, copper, iron, manganese and zinc. All industrial areas showed pH, EC, organic carbon, Fe, Cu and Mn were within permissible limits and showed good quality in most of the soil samples. There was lack of Zn in the soil samples but P & K in soil samples were observed in critical limits.

54. Soundarapandian, P.; Ananthan, G.; Kannupandi T. (CAS in Marine Biology, Annamalai University, Parangipettai 608 502 (India). **Mass seed production of *Macrobrachium malcolmsonii* (H. Milne Edwards) in synthetic brackishwater.** Indian Journal of Fisheries. (2006) v. 53(1) p. 91-96.

Freshwater prawn *Macrobrachium malcolmsonii*, has potential for aquaculture. Larvae of *M. malcolmsonii* were reared in synthetic brackish water using commercial salts. Live (*Artemia nauplii*, *Brachionus plicatilis* and *Moina* sp.) and artificial feeds were provided to the larvae individually and in combination. Survival was significantly higher (39.7-63%) when larvae were fed with live feeds only. Larvae fed with artificial feed showed significantly lower survival (32.3%). Survival (58 and 61%) was significantly higher when *Artemia nauplii* combined together with other feeds. Despite its limitation, synthetic brackish water can be used for freshwater prawn seed production.

55. Sunder, Jai; Jeyakumar, S.; Ahlawat, S. P. S.; Rai, R. B. ; Kundu, A. ; Senani, S. ; Chatterjee, R. N; Saha, S. K.; Yadav, S. (Central Agricultural Research Institute, Port Blair-744101, Andaman & Nicobar Islands, (India)). **Antibiotic resistance pattern of bacterial isolates from fishes of Andaman and Nicobar Islands.** Indian Journal of Fisheries. (2006) v. 53(2) p. 231-235.

A total of 131 bacteria were isolated from freshwater and marine fishes of Andaman and Nicobar Islands. The percentage of Gram -ve bacteria were 88.52%, while Gram+ve bacteria were 11.47%. The predominating genera identified from fresh water fishes were *Aeromonas* spp., *Pseudomonas* spp. and *Yersinia* spp.; while from marine fishes the predominating bacteria were *Edwardsiella* spp. and *Aeromonas* spp. The resistance pattern of Streptomycin, Cephalixin, Rifampicin and Nitrofurantoin were found to be more than 60% both by marine and fresh water bacterial isolates. A high degree of multiple drug resistance patterns has been exhibited by the bacterial isolates from fishes, however the resistance pattern against antibiotics was more in marine bacteria. The high degree of resistance to all the antibiotics by marine and fresh water bacteria may pose a threat to human population by transferring these resistant genes to other bacteria as the consumption of fish food in these islands is very high.

56. Suresh, N.; Ranganathan, L. S. (Annamalai University, Annamalainagar – 608 002 (India)). **Histogenesis of gut associated lymphoid tissues (GALT) in *Catla catla* (Hamilton).** Indian Journal of Fisheries. (2006) v. 53(3) p. 363-366.

The present study focussed on the ontogeny of gut associated lymphoid tissues (GALT) in the Indian major carp, *Catla catla* at early developmental stages. Gut appeared as a small tube on third day of post hatch and there is no evidence of lymphoid cells at this stage. Few leucocytes were detected on fifth day of post hatch and thereafter the leucocytes were increased in subsequent stages. By fifteen days of post hatch *C. catla* attains the adult component gut and there is no accumulation or aggregation of lymphoid cells along the entire length of the gut. The presence of isolated leucocytes in the gut epithelium and lamina propria indicates that GALT appeared to be of diffused nature.

57. Teji, K. T.; Thomas, John K. (Animal Behaviour and Wetland Research Laboratory, Christ College, Irinjalakuda, Thrissur, Kerala, 680125 (India). Department of Zoology). **Observations on the morphological abnormalities in induced bred larvae of some freshwater fishes.** Indian Journal of Fisheries. (2006) v. 53(3) p. 353-358.

Three different species of freshwater fishes, namely *Heteropneustes fossilis* (stinging catfish), *Anabas testudineus* (climbing perch), *Mystus vittatus* (striped dwarf catfish) were induced bred and morphological studies of the larvae were carried out. Morphological and behavioural abnormalities were noticed among larvae produced through induced breeding techniques in all the three species. Morphological abnormalities were seen in head, trunk and tail region of the larvae. Under-developed head, deformed trunk, enlarged yolk sac, underdeveloped barbel, curved tail and vertebral abnormalities were observed. Tunicate larvae (larvae with undetermined growth) were common in these species.

58. Venugopalan, R. (Indian Institute of Horticultural Research, Hessarghatta, Bangalore – 560 089 (India)). Prajneshu (Indian Agricultural Statistics Research Institute, New Delhi – 110 012 (India)). **Bootstrap estimation for non equilibrium Schaefer surplus fish production model.** Indian Journal of Fisheries. (2006) v. 53(1) p. 115-118.

The use of nonequilibrium Schaefer surplus production model in lieu of its equilibrium version was found suitable to obtain point estimates of various important biological parameters. However, policy makers while arriving at optimal management practices for a stock, may like to provide interval estimates rather than point estimates in order to take into account the sampling bias. To this end, efforts are made to employ "Bootstrap methodology". It is demonstrated that before computing various quantities of biological importance, like maximum sustainable yield (MSY) and optimum effort, bootstrap analysis should invariably be carried out for assessing reliability of estimates.

59. Vijayavel, K.; Balasubramanian, M. P. (DR. ALM Post - Graduate Institute of Basic Medical Sciences, University of Madras, Taramani, Chennai 600 113. Tamil Nadu, (India). Department of Pharmacology and Environmental Toxicology). Balasubramanian, S. E. (Ethiroj College, Chennai, Tamil Nadu (India). Department of Zoology). **Effect of urea and ammonium chloride on Aspartate and Alanine transaminases of *Oreochromis mossambicus* (Peters).** Indian Journal of Fisheries. (2006) v. 53(1) p. 19-22.

The effect of urea and ammonium chloride on transaminases was studied in serum, liver and muscle of fresh water fish *Oreochromis mossambicus*. There was an overall increase in the aspartate and alanine transaminase in serum, liver and muscle subjected to urea and ammonium chloride individually and

in combinations for 96 h. *Anabas testudineus* and *Mystus vittatus* were induced bred and morphological studies of the larvae were carried out. Morphological and behavioural abnormalities were noticed among the larvae produced through induced breeding in all three species.

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