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

1. Babu, P. P. Suresh; Reddy, A. K. (Central Institute of Fisheries Education, Seven Bungalows, Versova, Mumbai – 400 061 (India)). Venugopal, G. (Central Institute of Fisheries Education, Kakinada Centre, Kakinada - 533 007, Andhra Pradesh (India)). **Production potential of early segregated all-male population of *Macrobrachium rosenbergii* (de Man) in tropical earthen pond condition.** Indian Journal of Fisheries (2009) v. 56(3) p. 195-198.

Production potential of all-male culture of *Macrobrachium rosenbergii* was evaluated by comparing the yield obtained from an early segregated all-male population (post-larvae of average size = 50 mm) with a mixed population comprising males and females in 1:1 ratio. Nursery reared prawns were size graded, sexes, segregated manually by observing the presence or absence of appendix masculine, stocked in four replicates in earthen ponds of 200 m² area at a density of 1 m⁻² and reared for a period for weight of 42.2 g with 62.3% of marketable prawns whereas in mixed population, a production of 23.65 g m⁻² 90 days⁻¹ with an average individual weight of 30.7 g with 47.14% of marketable prawns were obtained. The production of all-male population was 30% higher than that of mixed population.

2. Bahuguna, S. N.; Khatri, Suman; Bahuguna, Garima; Bahuguna, D. N. (Post Box-70, H.N.B. Garhwal University, Srinagar Garhwal – 246 174, Uttarakhand, (India). Department of Zoology). **On the morphology of the alimentary tract of three fishes of genus *Noemacheilus* (Family:Cobitidae) from Garhwal Himalaya.** Aquacult (India). (2009) v. 10(2) p. 209-215.

The morphology of alimentary tract of three hill-stream fishes namely *Noemacheilus montanus* (McClelland), *N. rupicola* (McClelland), *N. bevani* (Gunther) of Garhwal Himalaya region has been described in the present investigation. All the three species are bottom feeders. In them, the maxillary and pharyngeal teeth are present. The gill rakers are short and pointed. The mastication of food takes place with the help of strong mucosal folds of pharynx, oesophagus, stomach etc. The stomach in these loaches is well developed with cardiac and pyloric regions. Intestine is short without loops. All the digestive structures show ecological adaptation according to their feeding habits.

3. Barde, Ravi (S.G.B. College, Purna (Jn.) District – Parbhani (M. S.) – 431 511 (India). Department of Zoology). **Organophosphate pesticides alters enzyme activities in fresh water crab *Barytelphusa guerini*.** Aquacult (India). (2009) v. 10(2) p. 321-324.

The freshwater crab *Barytelphusa guerini* has a great economic importance, which in terms of nutritive values. The pesticides, Sumidon and Acephate causing pollution of Godavari basin, therefore the efforts were made to study the effect of pesticides on enzyme activity in the various tissues like hepatopancrease, stomach and intestine of the crab *Barytelphusa guerini*. The treatment of pesticides showed that lipase, and protease enzyme activity in the tissues are severely affected by the pesticides. Effects of these pesticides showed variation of enzyme activity in digestive system of the crab.

4. Basade, Yasmeeen (Coldwater Fisheries Research, Bhimtal, Nainital, Uttarakhand – 263 136 (India)) Kohli, M. P. S. (Central Institute of Fisheries Education (Deemed University) Mumbai – 400 061 (India)). Ogale, S. N. (Tata Power Company Limited, Lonavale, Pune (India)). **Effect of selected dietary supplements on growth performance and production of pond reared deccan mahseer, *Tor khudree* (Sykes, 1839).** Indian Journal of Fisheries. (2009) v. 56(4) p. 277-282.

The effect of selected dietary supplements on the growth performance, survival, production, body composition and digestive enzyme activity in deccan mahseer reared under pond conditions was studied. Cholecalciferol (CC), soylecithin (SL), thyroxine (TH) and betaine (BT) were added to the basal diet (BD) as supplements at concentrations of 1800 IU kg⁻¹, 3.5%, 0.05 ppm and 0.5% respectively. After a rearing period of 180 days on experimental diets, soylecithin supplemented diet (SL) resulted in significantly higher ($p < 0.05$) growth performance in terms of live weight, specific growth rate (SGR), fish biomass and fish production when compared with other diets. Feed conversion ratio (FCR) was significantly better ($p < 0.05$) in the fish fed with the SL diet compared to fish fed on other diets. Carcass composition and energy content were significantly higher ($p < 0.05$) in treated groups compared to the control group. Among all the treatments, body protein, lipid, ash and energy contents were highest in fish fed with the SL diet. Digestive enzyme activities in both the intestinal and liver tissues were significantly higher ($p < 0.05$) in fish fed fortified diets compared to fish fed BD, with the highest values in fish fed SL diet. However, lipase activity, was not significantly different ($p > 0.05$) from that of BD diet in the intestinal tissue of fish fed TH diet and in the liver of fish fed on CC, TH and BT diets. Soylecithin (3.5%) was found to be a better dietary supplement among the treatments for rearing deccan mahseer.

5. Beevi, M. Razia; Radhakrishnan, K. V.; Kumar, S. Suresh (M. E. S. College, Ponnani, Kerala (India). Department of Aquaculture and Fishery Microbiology). **Species diversity and abundance of ichthyofauna of Biyyam Kayal – A developing brackishwater tourist centre in Kerala with special reference to threats and conservation measures.** Journal of the Inland Society of India. (2009) v. 41(2) p. 26-30.

Species diversity and abundance of ichthyofauna of Biyyam kayal has been investigated for a period of one year. This water body has high biological, ecological and socio economic relevance as far as the Malabar region of Kerela is concerned. Thirty six fish species were recorded from the lake which indicated the rich faunal biodiversity. Majority have high commercial importance as food and ornamental fishes. The fishes are endangered due to anthropogenic reasons which include unethical fishing practices, pollution, habitat destruction etc. The proposed conversion of the lake as a tourist centre would likely to worsen the situation. Strict management measure with large scale public awareness would be essential to save the ichthyodiversity of Biyyam Kayal.

6. Bhaumik, Utpal; Singh, U. P.; Paria, T. (Central Inland Fisheries Research Institute, Barrackpore, Kolkata - 700 120, West Bengal (India)). **Ecology and management of the Dhaura reservoir, Uttaranchal for enhancing fish production.** Indian Journal of Fisheries. (2009) v. 56(3) p. 189-193.

India possesses over 3.15 million ha area of reservoirs. In reservoirs, the available culture-based fisheries technologies offer possibilities for achieving fish yields of 100-200 kg ha⁻¹ against the present national average of about 50 kg ha⁻¹. With a view to

enhance fish production from the reservoir through scientific management techniques, an investigation was carried out in Dhaura Reservoir of Terai region of Uttaranchal. The reservoir is alkanotropic in nature. The population of planktonic organisms was moderate. Macro-zoobenthos population was of medium order. Fish production potential was estimated at 290 kg ha⁻¹yr⁻¹. The reservoir was stocked @ 413 numbers ha⁻¹. The fish production during the study period was 106.6 kg ha⁻¹ against pre-adoption production of 32 kg ha⁻¹.

7. Bhuyan, K. C.; Kalita, B. (Morigaon College, Morigaon, Assam (India). Department of Zoology). Dutta, A. (Gauhati University, Guwahati, Assam (India). Department of Zoology). **Hydrobiology and fishery status of Sondoba beel, Morigaon, Assam.** Journal of the Indian Fisheries Society of India. (2009) v. 41(2) p. 48-53.

Physico-chemical variables of water and soil, and diversity and abundance of phytoplankton and zooplankton with the fishery status of the Sondoba beel of Morigaon, Assam have been studied during September 2005 and August 2007. A total of 36 phytoplankton Genera, 14 belonging to Chlorophyceae, 11 to Bacillariophyceae, 9 to Myxophyceae and 2 to Euglenophyceae, and 23 zooplankton Genera, 5 belonging to Copepoda, 10 to Rotifera, 7 to Cladocera and 3 to protozoa were recorded. The beel water was permanently alkaline in nature. Physico-chemical parameters of the beel were favourable for fishery. Of the 76 species of fish recorded, 05 were endangered, 13 vulnerable, 18 lower risk not threatened and 3 lower risk least concerned. Total catch was dominated by miscellaneous group (40.19%) followed by catfishes (21.94%), major carps (16.94%), feather back (11.23%), live fishes (5.62%) and minor carps (4.09%).

8. Bondre, R. D.; Sawant, S. S.; Joshi, V. P. (Marine Biological Research Station, Dr. B. S. Konkan Krishi Vidyapeeth, Pethkilla, Ratnagiri – 415 612 (India)). **Fish culture in polyethylene-lined farm ponds of Konkan, Maharashtra.** Fishing Chimes (India). (2009) v. 29(9) p. 39-40.

The porous nature of soils in several parts of the country prevents the utilization of such lands for fish farming. The reason is that the ponds excavated in such soil do not retain water. What is highlighted in this context is that there is a developed technology of lining of ponds excavated in porous soils to prevent water seepage and to enable purposeful fertilization of such ponds for fish production. The authors undertook fish culture in polyethylene-lined farm ponds at Matrumandir Sanstha, Devrukh, Ratnagiri with encouraging results.

9. Chavan, S. P. (S. B. Science College, Aurangabad - 431 001 (MS) (India) Department of Zoology) Deshai, R. B.; Jadhav, S. S. (Indira Gandhi Sr. College, CIDCO, Nanded – 431 603 (MS) (India). Department of Zoology). Radhakrishnan, M. V. (Annamalai University, Annamalaiagar – 608 002 (TN) (India). Department of Zoology). **Effect of copper sulphate on glycogen in the fresh water fish, *Garra mullya*.** Aquacult (India). (2009) v. 10(2) p. 309-311.

The lethal effect of copper sulphate on the muscle glycogen, liver, kidney were estimated in the fresh water fish, *Garra mullya*. Fishes were exposed to the lethal concentration of copper sulphate. Fluctuation observed in the metabolites of glycogen indicates the possible arrival of anaerobic condition of the exposed fishes.

10. Chavan, S. P. (S. B. Science College, Aurangabad – 431 001 (M S) (India). Department of Zoology). Deshai, R. B.; Jadhav, S. S. (Indira Gandhi Sr. College, CIDCO, Nanded – 431 603 (M S) (India). Department of Zoology). Radhakrishnan M. V. (D D E, Annamalai University, Annamalai Nagar – 608 002 (T N) (India). Department of Zoology). **Toxic effect of copper sulphate on lipid of a fresh water teleost *Garra mullya***. Aquacult (India). (2009) v. 10(2) p. 191-193.

Heavy metals are continuously released into the terrestrial environment by natural sources and human activities. One of them copper sulphate effects on the aquatic animals. In this study the lethal effect of copper sulphate on the lipid in muscle, liver and kidney were estimated in fresh water fish, *Garra mullya*. Fishes were exposed to the lethal concentration of copper sulphate, fluctuation observed in the metabolites of lipid.

11. Chesti, Anayitullah (Email: drferozshah@yahoo.com, mobile No.-09622400) Qureshi, T.A. (Barkatullah University (M P) Bhopal – 462 026 (India). Department of Applied Aquaculture). Balkhi, M. H.; Shah, Feroz A. (S K U A T - K Rangil Ganderbal J & K – 190 006 (India). Faculty of Fisheries). Banday, M. T. (F V Sc & A H. SKUAST - K Shuahama Alusteng, Srinagar (J & K) (India). Division of L P M). **Growth response and carcass composition of common carp (*Cyprinus carpio* var. *communis*) fed with varying protein and energy ratio**. Aquacult (India). (2009) v. 10(2) p. 161-166.

An experiment was conducted on growing stage of common carps under laboratory conditions fed with formulated feeds and a commercial diet with a varying protein and energy ratio reared for a period of 8 weeks. The feed was dispensed @ 4% body weight. The water stability of different formulated diet containing highest fish meal ingredient (diet-C) remained appreciably water stable up to 1 hour. The growth rate was highest in the group of fishes fed diet C containing protein energy ratio of 25.27 and lowest in the group of fishes fed with diet D containing P/E ratio of 22.23. The net weight gain, specific growth rate and feed conversion ratios were also highest in the fishes fed diet-C and lowest in fishes fed diet D. However, the protein efficiency ratio and protein retention efficiency were highest in the groups of fishes fed with diet-A. The alkaline and acid phosphatase activity in liver, gills and intestines were highest with diet-C. Similarly highest RNA: DNA levels of fish muscle was recorded with the diet C and lowest in the group of fishes fed with diet D. Suggesting that the fishes fed dietary protein level of 45.6% and P/F ratio of 25.27 showed more synthesis and accumulation of protein. Similarly RNA:DNA ratios were also better in the same group of fishes which correlates closely with growth and protein synthesis. It may be concluded that the formulated diet with higher P/F ratio exhibited better growth corroborating with similar trends with regards to RNA:DNA ratio which might have occurred due to higher protein utilization and better amino acid and protein synthesis.

12. Das, P. (A 8/4 Indralok Estate, Paikpara, Kolkata - 700 002 (India)). **Fisheries and aquaculture in India [Indigenous Technological Knowledge (I T K)]**. Fishing Chimes (India). (2009) v. 29(6) p. 10-14.

In this outstanding contribution, the author takes us into the realm of historic hues of the past technological knowledge of fisheries and aquaculture in India. The details presented trace back to 3000 BC and these are of profound and absorbing interest, inculcating a well deserved pride on the fisheries and aquaculture past of India, while at the same time exhortative to move ahead.

13. Das, Pronob; Bhagabati S. K.; Mandal, S. C.; Singh, S. K.; Akhtar, M. S. (Central Institute of Fisheries Education, Seven Bungalow, Versova, Mumbai – 400 061 (India)). Kalita, K. (College of Fisheries, Assam Agriculture University, Raha – 782 103 (India)). **Professional fisheries education in India, present status and strategies for improvement.** Fishing Chimes (India). (2009) v. 29(6) p. 17-20.

Professional fisheries education, a vital input for the purposeful, quality oriented and progressive increase in fish production has registered a cognisable status in India that is an envy even to developed countries. The authors at Central Institute of Fisheries put together several aspects of the subject in a historic perspective. While telling us that there are 17 fisheries colleges/ universities in the country that were established from 1961 to 2006, they explain that the nation now has an intake capacity of 452 candidates for fishery degree course, 179 candidates for MFSc course, besides an inviting capacity at a level of 78 seats for providing research facilities to scholars for acquiring Ph.D degree.

14. Deo, Ashutosh D. (College of Fisheries, Central Agricultural University, Lembucherra - 799 210, Tripura (W) (India). Department of Fish Diseases and Environmental Monitoring). Venkateshvaran, K. (Biotoxinology Laboratory, Central Institute of Fisheries Education, Seven Bungalows, Versova, Mumbai - 400061. (India)). Raghuram, Ram (Central Drug Research Institute, P.B. No. 173, Lucknow – 22 6001, Uttar Pradesh, (India). Department of Pharmacology). Devaraj, M. (68/3, Greems Road, Chennai - 600006, Tamil Nadu, (India)). **Wound healing activity in crude mucus extract of marine catfish, *Osteogeneiosus militaris* (Linnaeus) of Mumbai coast.** Indian Journal of Fisheries. (2009) v.56(4) p. 297-300.

Marine organisms represent a valuable source of new pharmacologically important compounds. The wound healing activity of crude mucus extract of the marine catfish *Osteogeneiosus militaris* of Mumbai waters has been studied using both *in vivo* and *in vitro* models. The mucus extract of *O. militaris* at doses of 0.25% and 0.50% were found to have a higher wound contractile activity of 30% and 14.25% respectively, when compared to the control. Wounds treated with the same dose of mucus extract for seven days had the highest level of hydroxyproline, a marker of collagen synthesis, with values of 25.52 and 16.14 mg⁻¹g⁻¹ tissue, respectively. The collagen crosslinking enzyme, lysyl oxidase exhibited an increasing trend with increase in dose i.e. the lysyl oxidase activity was found to be dose dependent. Chick Chorioallantoic Model (CAM) studies showed angiogenic activity of the mucus from slight to marked levels at different doses. Neovascularization at a dose of 80 g was marked in comparison to control. This study confirms the promising wound healing activity of crude mucus extract of the catfish *O. militaris* which warrants more detailed experimental and clinical studies with purified extract.

15. Devi, J. Achyutha; Piska, Ravi Shankar (University College of Science, Osmania University, Hyderabad - 500007 (India). Department of Zoology). **Alterations in enzyme activities in the tissues of freshwater cat fish, *Clarias batrachus* (Linn) due to fluoride toxicity.** Aquacult (India). (2009) v. 10(2) p. 301-308.

Studies on fluoride induced alterations in enzymes like Succinate Dehydrogenase (SDH) and Malate Dehydrogenase (MDH) activities in the tissues such as liver, muscle, kidney, gill and brain of freshwater cat fish, *Clarias batrachus* (Linn) were carried out. The effect

of fluoride was observed in different concentrations like 1, 10, 20 and 30 ppm on 130 and 60 days of exposure. SDH and MDH activities were measured. The SDH and MDH activities were found decreased in all the tissues, throughout the exposure span. Maximum depletion was observed on 60th day of exposure in 30 ppm of fluoride concentration. In most of the cases the depletion of SDH and MDH activities significantly differed from the controls. Muscle showed maximum SDH activity followed by kidney, brain, liver and gill. Brain showed maximum MDH activity followed by kidney, liver, muscle and gill. The depletion of SDH and MDH may be due to fluoride toxicity and damage caused to the mitochondrial elements.

16. Dhawan, Asha; Kaur, Vaneet Inder (Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana -141 004 (India) Fisheries Unit). **Effect of feeding rate and feeding frequency on the growth performance of *Clarias batrachus*.** Journal of Inland Fisheries Society of India. (2009) v. 41(2) p. 54-58.

The study was conducted to assess the impact of different feeding rates and feeding frequencies on the growth and survival of fingerlings of Indian catfish, *Clarias batrachus*. Fish were fed with supplementary diet composed of rice bran, mustard meal, meat cum bone meal and soybean meal (in equal proportions) @ 10% (FR₁), 20% (FR₂), 30% (FR₃), 40% (FR₄), 50% (FR₅) and 60% (FR₆) body weight. The experiment was conducted for 90 days where 20% feeding rate (FR₂) resulted in maximum body weight gain of fish, when reared indoor. Likewise, SGR as well as PER was also significantly ($P < 0.05$) highest in FR₂. In another experiment, the fish were fed at three feeding frequencies viz. once a day (FF₁), twice a day (FF₂) and thrice a week (FF₃) for 60 days. The maximum increase in body weight was observed in FF₁. No significant differences were observed for water quality parameters with respect to different feeding rates and feeding frequencies. It was concluded that feeding rate @ 20% body weight once a day is appropriate for indoor rearing of fingerlings of *Clarias batrachus*.

17. Dwivedi, Amitabh Chandra (Central Inland Fisheries Research Institute (ICAR), 24 Panna Lal Road, Allahabad – 211 002 (India). Riverine Division). **Ecological assessment of fishes and population dynamics of *Labeo rohita* (Hamilton), *Tor tor* (Hamilton) and *Labeo calbasu* (Hamilton) in the Paisuni river.** Aquacult (India). (2009) v. 10(2) p. 249-259.

The present study was carried out between December 2003 to June 2004 in the Paisuni river. The Paisuni is a tributary of the Yamuna river. The average pooled catch was 14.8% for *Labeo calbasu*, 4.88% for *L. rohita* and 1.27% for *Tor tor*. *Aorichthys* spp. 8.53% formed a sizeable part of the total catch. *Cyprinus carpio* and miscellaneous group was contributing only 6.43% and 12.3% respectively. Major carps constituted 31.2% in the total landing. The population dynamics of *L. rohita*, *T. tor* and *L. calbasu* collected from the Paisuni river at Karwi and Chitrakoot were analyzed using length-frequency based FiSAT software. The L_{∞} and K were 833 mm and 0.56 yr⁻¹ for *L. rohita*, 787 mm and 0.61 yr⁻¹ for *T. tor* and 612 mm and 0.28 yr⁻¹ for *L. calbasu*, respectively. The rate of total mortality (Z), fishing mortality (F) and natural mortality (M) was computed to be 3.67 yr⁻¹, 2.73 yr⁻¹ and 0.94 yr⁻¹ in case of *L. rohita*, 5.57 yr⁻¹, 4.57 yr⁻¹ and 1.0 yr⁻¹ in *T. tor* and 1.86 yr⁻¹, 1.21 yr⁻¹ and 0.65 yr⁻¹ in *L. calbasu* respectively. The exploitation rate was maximum in *T. tor* and minimum in *L. calbasu*. The present study indicates over exploitation ($E > 0.50$) of *L. rohita*, *T. tor* and *L. calbasu* stocks in the Paisuni river.

18. Gautam, R. K.; Parvin Aysha; Irshad, Shaikh (School of Life Sciences, Dr. B.R. Ambedkar University, Khandari Campus, Agra – 282 002 (India). Department of Zoology). **Biochemical responses in the blood plasma of freshwater catfish, *Clarias batrachus* (Linn.) after exposed to Nuvan.** Aquacult (India). (2009) v. 10(2) p. 235-240.

The present study has been undertaken to investigate the responses of certain blood biochemical parameters of walking catfish, *Clarias batrachus* (Linn.) after exposed to sub lethal concentration, .22 ml (1/10 of LC₅₀) of Nuvan (Dichlorvos) at different time intervals 24 hrs, 48 hrs, 72 hrs and 96 hrs. The present study showed statistically significant increase value in plasma glucose level and significant decrease value in plasma cholesterol level.

19. Gawde, M. M.; Sawant, G. P.; Mhatre, V. D. (College of Fisheries, Ratnagiri, Maharashtra, Dr. Balasaheb Sawant Konkan Agricultural University, Dapoli (India)). **Sea bass (*Lates calcarifer*) : Pond-based cage culture.** Fishing Chimes (India). (2009) v. 29(4) p. 12.

The authors highlight in this contribution the potential of ‘Seabass farming’ for which a supporting, hatchery technology has been developed. Pointing out that Sea bass serves as a valuable species for diversification from shrimp farming, they explain that not only seabass farming would benefit the farmers but would also be useful for them in overcoming the present disease problems faced in shrimp farming.

20. Gawde, Mangesh Mohan; Shirdhankar, Mangesh Madhukar (College of Fisheries, Shirgaon, Taluka Ratnagiri District Ratnagiri, Maharashtra (India)). Chandge, Manohar Shivram (College of Fisheries, Seminary Hills, Nagpur, Maharashtra (India)). **Efficacy of adoption of improved shrimp farming techniques by shrimp farmers operating along South Konkan region, Maharashtra, India.** Aquacult (India). (2009) v. 10(2) p. 265-271.

To achieve eco-friendly and sustainable development of shrimp farming, adoption of improved shrimp farming practices is necessary. An attempt has been made in this study to collect data from shrimp farmers along the south Konkan region of Maharashtra to judge the level of adoption of improved aquaculture practices. The data was collected by personally interviewing the farmers with the help of questionnaire. Descriptive score sheets for each of the recommended practice was constructed with zero, one and two scores. The adoption quotient obtained by the shrimp farmers ranged from 50 to 96.88 with the mean of 76.18. It was observed that there was quite high extent of adoption of bloom in colour range of brownish of yellowish before stocking (92.5%). It was also seen that there was quite high partial adoption among the shrimp farmers w.r.t. frequent checking of water parameters (82.5%), checking of healthiness of seed before packing (72.5%)

21. Ghosh, Shubhadeep; Mohanraj, G.; Asokan, P. K.; Dhokia, H. K.; Zala, M. S.; Bhint, H. M. (Veraval Regional Centre of Marine Fisheries Research Institute, Matsya Bhavan, Bhidiya, Veraval, Gujrat – 362 269 (India)). **Fishery and stock estimates of the silver pomfret, *Pampus argenteus* (Euphrasen), landed by gill netters at Veraval.** Indian Journal of Fisheries. (2009) v. 56(3) p. 177-182.

The fishery and population characteristics of silver pomfret *Pampus argenteus* (Euphrasen) caught by gillnetters off Veraval were studied for the period from 2003 to 2007. The average annual landing of *P. argenteus* was 114.5 t which contributed 4.5 % to the total gill net catches. The period from July to September was the most productive in terms of catch and catch rate. The length-weight relationship showed that the growth was isometric. The sex ratio was 1.75 in favour of females. Mature females occurred throughout the year, with maximum during June – November. The length at first maturity of female was 27.5 cm. The von Bertalanffy growth equation was $L_t = 41.57 [1 - e^{-0.64(t+0.0315)}]$. The length at first capture (L_c) was 8.2 cm with recruitment taking place throughout the year with two peaks during February-March and in August. The natural mortality (M), fishing mortality (F) and total mortality (Z) were 1.20, 2.11 and 3.31 respectively. The exploitation ratio (E) was 0.64. The Maximum Sustainable Yield (MSY: 90 t) was lower than the average annual catch indicating over-exploitation of the species. The yield per recruit (Y/R) and biomass per recruit (B/R) was 38.31 g and 18.16 g respectively. An increase in relative yield by 17.18% would be obtained by decreasing the present level of fishing by 60%.

22. Ghosh, Shubhadeep; Pillai, N. G. K.; Dhokia, H. K. (Veraval Regional Centre of Central Marine Fisheries Research Institute, Matsya Bhavan, Bhidiya, Veraval – 362 269 (India)). **Fishery, population dynamics and stock assessment of the spotted seer in gill net fishery at Veraval.** Indian Journal of Fisheries. (2009) v. 56(3) p. 157-161.

The fishery and population characteristics of *Scomberomorus guttatus* (Bloch & Schneider) from Veraval was studied for the period 2003-2006. The average annual catch was 378 t, forming 14.4% of the total gill net catches at Veraval. The post-monsoon and winter seasons (September to January) were the most productive seasons in terms of catch and catch rate. The length - weight relationship showed that growth was isometric for the species. The von Bertalanffy growth equation was: $L_t = 61.27[1 - e^{-1.4(t+0.0046)}]$ and length attained at the end of 1 and 2 years were 46.3 cm and 57.6 cm respectively. The growth performance index was 3.721 and longevity was 2.318 years. Recruitment pattern was unimodal with peak recruitment from February-July and the length at first capture was 21.2 cm. The natural mortality, fishing mortality and total mortality were 1.79, 2.92 and 4.71 respectively and exploitation ratio was 0.62. The maximum sustainable yield was 305 t, which was lower than the average annual catch indicating over-exploitation of the species. The yield per recruit and biomass per recruit was 198.9 g and 66.9 g respectively. An increase in relative yield to 101.8% would be obtained by decreasing the present level of fishing by 20%.

23. Ghosh, Shubhadeep; Mohanraj G.; Asokan, P. K.; Dhokia, H. K.; Zala, M. S.; Bhint, H. M. (Veraval Regional Centre of Central Marine Fisheries Research Institute, Bhidiya, Veraval – 362 269, Gujrat (India)). **Trophodynamics and reproductive biology of *Otolithoides biauritus* (Cantor) landed by trawlers at Vanakbara, Diu along the west coast of India.** Indian Journal of Fisheries. (2009) v. 56(4) p. 262-265.

The trophodynamics and reproductive biology of Koth *Otolithoides biauritus* caught by trawlers at Vanakbara, Diu was studied for the period from September 2005 to May 2008. The length - weight relationship showed that growth was allometric and there was no significant difference between the sexes. The overall sex ratio was 1:1:09 with mature females occurring throughout the year. The peak breeding season was in the monsoon season from May to August as evidenced by maturity stages, gonado-somatic index and

the size progression of yolked ova. The length at first maturity of the female was 110.15 cm. The absolute fecundity ranged from 1,82020 to 1,941400. The mature ovaries of *O. biauritus* contained two batches of mature ova measuring from 0.75 to 0.79 mm and 0.65 to 0.69 mm in diameter. *O. biauritus* was found to feed more intensely during the post-monsoon months. The most important food item was *Acetes* spp. Followed by finfishes. Fishes possessing empty stomachs were frequently encountered in the commercial catch. Young ones of *O. biauritus* fed more abundantly than adults with penaeid prawns dominating the gut contents while adults preferred finfishes as their diet.

24. Ghosh, Shubhadeep; Pillai, N. G. K.; Dhokia, H. K. (Veraval Regional Centre of Central Marine Fisheries Research Institute, Matsya Bhavan, Bhidiya, Veraval – 362 269, Gujrat (India)). **Fishery and population dynamics of *Trichiurus lepturus* (Linnaeus) off Veraval, north-west coast of India.** Indian Journal of Fisheries. (2009) v. 56(4) p. 241-247

The fishery and population dynamics of *Trichiurus lepturus* (Linnaeus) from Veraval was studied for the period 2003-2006. The average annual catch was 18813 t, forming 27.63% of the total trawl catches at Veraval. September to December was the most productive period in terms of catch and catch rate. The length-weight relationship showed that growth was allometric and there was no significant variation between the sexes. The growth parameters L_{∞} and K were 134.1 cm and 0.29 respectively and the length attained at the end of 1, 2, 3, 4 and 5 years were 35.28, 60.16, 78.77, 92.70 and 103.12 cm respectively. The growth performance index (Φ) was 3.717 and longevity was 10.29 years. Recruitment pattern was trimodal with two major peaks during May-June and August-October and one minor peak during January-March and the length at first capture was 14.11 cm. The natural mortality, fishing mortality and total mortality were 0.51, 0.93 and 1.14 respectively and exploitation ratio was 0.64. The maximum sustainable yield was 14565 t which was lower than the average annual catch indicating over-exploitation of the species. The yield per recruit and biomass per recruit was 43.34 g and 46.6 g respectively and increase in relative yield by 142.41% would be obtained by decreasing the present level of fishing by 60%.

25. Goswami, Biswajit (Dakshin Dinajpur Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Majhian, Patiram, D. Dinajpur – 733 133, West Bengal (India)). **Involvement of rural women in coastal fishery sector of West Bengal, India.** Journal of the Inland Fisheries Society of India. (2009) v. 41(2) p. 44-47.

The study was conducted in South 24 Parganas district of West Bengal. From the district two blocks namely Kakdwip and Namkhana were selected. The data were collected from the selected 120 fisher women administering a specially constructed interview schedule. From the nine independent variables, only two variables namely annual income and decision making process were found to be significantly and positively correlated with the amount of seed collection. Amount of net weaving was positively and significantly correlated with annual income, utilization of information sources and decision making process. Education, annual income and decision making process were positively and significantly associated with amount of fish sale by fisher women. In case of fish harvesting only annual income was significantly and positively associated with amount of fish harvested by fisher women. Annual income, utilization of information sources were positively and significantly associated, whereas, family size, family type and land areas

were negatively and significantly associated with decision making process by fisher women.

26. Goyal, Mini; Saran, Sukhjeet K. (Punjab Agricultural University, Ludhiana (India). Department of Economics and Sociology). **Economics of fish farming – a zone wise study of Punjab.** Journal of the Inland Fisheries Society of India. (2009) v. 41(2) p. 38-43.

The utmost attention to increase agricultural production to attain self sufficiency in food grains resulted in green revolution in the state of Punjab. But with the predominance of wheat and paddy rotation, decrease in the size of the holdings, over-use of fertilizers and pesticides, Punjab agriculture has become stagnant. The need of the hour seems to diversity in favour of non crop enterprises. Subsidiary occupations like fish farming may lead to increase in income generation to the farmers, increase in employment opportunities and improve ecological status of the state as well as economic welfare of the farmers.

27. Hazarika, Rabindra; Goswami M. M. (Gauhati University, Guwahati – 781 014 (India). Department of Zoology). **Aquatic insects association with macrophytes – A study in two fish ponds of Guwahati, Assam, India.** Aquacult (India) v. 10(2) p. 167-177.

An ecological study has been conducted to relate the abundance, diversity and seasonal occurrence of aquatic insects associated with free floating, submerged and rooted emergent vegetation in two ponds named as Pond A and Pond B at Gauhati University Campus, Guwahati, Assam, India. Pond A is man made and manually maintained water body while Pond B is a naturally managed reclaimed swamp. Altogether 27 species of aquatic insects belonging to 5 orders and 14 families and 23 genera have been recorded in association with 15 species of aquatic macrophytes. Hemiptera tops the list with highest number of associated taxa followed by Coleoptera, Odonata, Ephemeroptera and Diptera. The Pond B harbors 14 species while Pond A only 9 species of macrophytes. Highest density of insects in association with the plants is recorded during pre-monsoon in Pond B. Seasonal population density varied between 466 m⁻² and 307 m⁻² with a mean of 370 m⁻² ± 89.66 in Pond A and between 696 m⁻² and 450 m⁻² in Pond B with a mean value of 554.99 m⁻² ± 129.1. *Eichhornia crassipes* is recorded to be the most abundant species harbouring highest number of insects throughout the study period followed by the submerged plant species *Hydrilla verticillata*.

28. Jagpat, H. S. (Majalgaon Arts, Science & Commerce College, Majalgaon, District - Beed – 431131 Maharashtra (India). Department of Zoology). **Fish Diversity of Majalgaon Dam, District Beed, Maharashtra, India.** Aquacult (India). (2009) v. 10(2) p. 217-228.

Majalgaon Dam is one of the largest water reservoir in Marathwada region. It is perennial water resource for human consumption and agriculture. Biodiversity as an emerging economic resource of great promise. There is no report on the biodiversity of Majalgaon Dam with special reference to the fisheries. In the present work attempts were made to study the diversity of fish. About 31 species of fish were identified. Among them 20 species are in abundant quantity, 8 species moderate and 3 species are rear. Some fish

species fecundity was recorded. The important physico-chemical parameters were also studied.

29. Joshi, Hemant K.; Dobriyal Anoop K. (H.N.B. Garhwal University (Central University), Pauri campus, Pauri Garhwal – 246 001 (India). Department of Zoology). Bahuguna, Pankaj (L.S.M. Government P.G. College, Pithoragarh (Uttarakhand) (India). Department of Zoology). **Length-weight relationship between brain and body of a hillstream fish *Nemacheilus botia* (Ham-Buch).** Aquacult (India). (2009) v. 10(2) p. 317-319.

The paper deals with the quantitative analysis of fish brain in relation to body length and body weight in *Nemacheilus botia*. There was a constant growth of all dependent variables in relation to the selected independent variables.

30. Joshi, K. D. (Directorate of Coldwater Fisheries Research, Bhimtal – 263 136, Nainital, Uttarakhand (India)). **Brood stock maturity and artificial breeding of rainbow trout, *Oncorhynchus mykiss* (Walbaum).** Indian Journal of Fisheries. (2009) v. 56(3) p. 219-222.

The Norwegian rainbow trout, *Oncorhynchus mykiss* (Walbaum) was successfully reared and bred at the Experimental fish farm, Chhirapani, Champawat (Uttarakhand). The stock attained sexual maturity during peak winter (December to February). The male attained maturity after completion of 2 years (average body weight: 18-182 g) and female after 3 years (average body weight: 900-1850 g). Potential male and female brooders were segregated in separate ponds in November 2001 and stripping was conducted during February 2002 and December 2002, by dry method. Fecundity recorded was between 547-1402 eggs kg⁻¹ body weight. Eyed – egg stage was noticed after 23-46 days post - fertilization at ambient water temperature between 4.5 to 8.5⁰C. Incubation period was complete within 51-58 days (water temperature 6.5 -12.0⁰C) and 86 -100 days (water temperature 4.5 - 7.5⁰C). The cumulative survival recorded was between 42.2 to 88.9%. The resultant yolk-laden hatchlings were of 14 -17 mm size range.

31. Kathirval, M. (MIG 10F, Kalki Krishnasurthy Road, Thiruvanniyur, Chennai - 600 041 (India)). **Marine poisonous brachyuran crabs of India.** Fishing Chimes (India). (2009) v. 29(9) p. 24 -29.

Marine crabs being a delicacy, there is a general trend towards their farming. In this background, the author tells us in this contribution that there are 24 poisonous crabs in Indian waters. He has also given detailed and illustrated descriptions of these crabs.

32. Kitto, M. R. (Fulaisi organic foods, Box No. 18, Abu Dhabi (UAE)). ***Dunaliella* farming, its harvesting and processing.** Fishing Chimes (India). (2009) v. 29(4) p. 8-11.

The micro-alga *Dunaliella salina* is found in the oceans and other high saline aquatic environments. It is a rich source of several pigments. It forms an excellent feed item for shrimps, prawns and fishes. For the reason, there is a high demand for this micro-alga particularly for the manufacture of its powder to serve as aqua feed. Another aspect is that farmers need information on the supporting nursery set-up and the related operational details. After discussing the author mentioned that the demand for *Dunaliella* powder is as high as 1410 t/ annum. He also discussed about a model *Dunaliella* farm, its operational aspects and the attractive economics thereof. According to author production

of *Dunaliella* is an economically viable and attractive proposition that would go a long way in the production of quality shrimps, prawn and fish.

33. Kumar, A. Biju (University of Kerala, Thiruvananthapuram – 695 581 Kerala (India). Department of Aquatic Biology and Fisheries). Deepthi, G. R. (N.S.S. College, Pandalam – 689 501, Kerala (India) Department of Zoology). **Diversity of flatfishes (Order: Pleuronectiformes) along the Kerala coast of India, with notes on two rare species.** Indian Journal of Fishes. (2009) v. 56(3) p. 211-214.

A survey of trawl by-catch of Kerala, south-west coast of India recorded the presence of 34 species of flatfishes (Order: Pleuronectiformes) classified under four families and 17 genera. The Khaki flounder *Laeops natalensis* Norman included under Bothidae is reported for the first time from the Indian coast. The soleid *Aseraggodes umbratilis* (Alcock) is recorded from Indian coast after the initial reports by Alcock in 1894 and 1899.

34. Kumar, Pankaj; Ranjana; Mishra, A. P. (B. R. A. Bihar University, Muzaffarpur - 842 001 (India). P G Department of Zoology). **Oxygen uptake through water during early life of an air breathing fish *Osphronemus nobilis* (McClelland).** Environment & Ecology (India). (2009) v. 27(4) p. 1458-1463.

Oxygen uptake (mg/h) during early life of fish *Osphronemus nobilis* in relation to body size at 28 ± 1 C showed a statistically significant two component curves, one related to the fish larvae depending wholly on aquatic respiration ($b_W = 0.8449$, $b_L = 1.9497$) and the other related to the fry respiring bimodally ($b_W = 0.6018$, $b_L = 1.8608$). The point of intersection being at 18 mg body weight and 1.15 cm body length. These were the theoretical values of weight or length at which the fish acquired air-breathing habit during the period of day 20-22 after hatching, resulting about 39.5% decline in O₂ uptake through branchio-cutaneous system in water, which was made good through the newly developed air-breathing organs. The total O₂ uptake calculated during exclusively aquatic respiration of fish was 466.32 ml/kg per ha, which became 282.03 ml/kg per ha when they started relying on aerial respiration in addition to gills. One of the important causes forcing developing fry to adopt bimodal gas exchange machinery seemed to be nearly three fold increase in the water-blood diffusion distance at the secondary gill lamellae.

35. Majumdar, R. K (College of Fisheries, Central Agricultural University, Lembucherra, Agartale, Tripura – 799 210 (India)). Basu, S. (Central Institute of Fisheries Education, Versova, Mumbai – 400 061 (India)). **Studies on seasonal variation in the biochemical composition of the Indian shad, *Tenualosa ilisha* (Hamilton, 1822).** Indian Journal of Fisheries. (2009) v. 56(3) p. 205-209.

An year round study on the macro and micro-nutrient constituents of the Indian Shad (*Tenualosa ilisha*) was carried out. The average values of the proximate composition recorded were: moisture – 68.16%, ash –1.42%, protein – 6.27%, fat –12.04%, calcium – 55.09%, phosphorous – 184.58%, sodium –66.10% and potassium – 179.95%. The summation of moisture and fat content was 80%. The correlation coefficients between moisture and fat content obtained was – 0.987 indicating an inverse relationship. The correlation coefficient between weight and moisture and weight and fat content recorded were 0.670 and 0.781 respectively. The maximum moisture content was observed in January (74.22%) when the average weight of the sample was 357.83 g and the minimum

was found in September (58.82%) when the average weight of the sample was 788.35 g. The lowest fat content was recorded during January to April, whereas, the maximum fat content was found during July to September. In the rest of the period, the average fat content was 11.45%. The proportion of calcium and phosphorous in the flesh of hilsa was found to increase with increase in size of the fish. On the other hand, sodium, the most vital tissue component of fish, decreased considerably with growth of the fish, whereas no definite trend of variation was observed in potassium content of the fish.

36. Mishra, Bibhudatta; Jena, J. K.; Patri, Priyambada; Behera, P. K.; Aravindakshan P. K.; Purushothaman, C. S. (Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar – 751 002 (India)). Ayyappan, S. (Indian Council of Agricultural Research, New Delhi, (India)). **Carp polyculture in aquaculture sewage treatment plant and its impact on soil and water characteristics.** Indian Journal of Fisheries (2009) v. 56(4) p. 271-276.

The hydrobiological conditions of carp polyculture ponds in an aquaculture sewage treatment plant (ASTP) at Matgajpur, Cuttack, Orissa with reference to sewage input and production were studied. The water quality of fish culture pond, receiving partially treated effluent from a duckweed pond complex was evaluated for different physico-chemical and biotic parameters. Water quality parameters such as pH, total alkalinity, hardness and dissolved oxygen were found to be conducive for fish culture. Wide variations in nutrients, ammonium-N, nitrate-N, nitrite-N and phosphate-P in water and organic carbon, total nitrogen and available phosphorus in soil showed increasing trend with time. The C/N ratio (4.2 -16.7) in soil, organic matter (5.4 - 9.8 ppm) and plankton (652-33, 280 nos.l⁻¹) in culture water suggest productive status of the pond. Carp polyculture was carried out in two ponds using five species combination of rohu, catla, mrigal, silver carp and common carp resulting in production of 3451 kg ha⁻¹ and 3975 kg ha⁻¹ annually. Silver carp registered maximum growth and survival rate where as catla showed poor performance. The water released from the carp culture pond meets the water quality criteria specified for irrigation water and swimming water. This type of carp culture in ASTP showed progressive trend in terms of safe biomass production (fish) and are comparable to the results obtained in other wastewater culture studies.

37. Mishra, Pushpita; Samanta, Mrinal; Maiti, Nikhil Kumar; Sarangi, Niranjana (Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar – 751 002, Orissa (India). Fish Health Management Division). **Characterization of extracellular cytotoxic protein of *Vibrio* spp. isolated from freshwater carps and prawns.** Indian Journal of Fisheries. (2009) v. 56(4) p. 307-311.

Several *Vibrio* species which are part of the microflora in the coastal, brackish and freshwater environments cause vibriosis in economically important fishes. In this study, *Vibrio parahaemolyticus*, *Vibrio harveyi* and *Vibrio fluvialis* were isolated from the gastrointestinal tract of *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala* and also from *Macrobrachium rosenbergii* and *Macrobrachium malcolmsonii*. The extra cellular products of these bacteria produced cytopathic effect in MDBK cell but they did not damage DNA of MDBK cells as detected by RAPD-PCR. A 43 KD protein was precipitated from the extra cellular products with 70% ammonium sulphate saturation which was found to be antigenic by immunoblotting.

38. Mishra, R. (Krishi Vigyan Kendra, Kakatpur District, Puri – 752 108 (India)). Dora, K. C. (5 Budherhat Road, Panchasayar, P. O. Kolkata – 700 094 (India). Faculty of Fishery Sciences). **Observations on the dynamics of soil, water and biotic communities as influenced by *Penaeus monodon* Fabricius in brackishwater ponds along Chilika Lake.** Indian Journal of Fisheries. (2009) v. 56(4) p. 267-270.

The fringe areas of western sector of the Chilika lagoon which were brought under monoculture of *Penaeus monodon* was examined for the chemical and biological qualities of soil and water to suggest improvement in shrimp yield. In the pond soils, the pH ranged from 7.86 to 8.25, organic carbon from 0.297 to 0.412%, available nitrogen from 12.88 to 19.28 mg 100g⁻¹ soil and available phosphorus from 3.13 to 4.08 mg 100g⁻¹ soil, indicating nutrient limitations. The total iron content ranged from 0.22 to 0.28%. The physico-chemical parameters of the pond water recorded were in the ranges of 8.35-8.55, dissolved oxygen 4.42-5.11 ppm, total alkalinity : 58.4 -100.8 ppm, salinity : 20.1-23.15 ppm, dissolved nitrogen: 0.22-0.28 ppm and dissolved phosphorus:0.05-0.09 ppm, indicating low nutrient turnover. Poor plankton and benthos is a clear indication of nutrient limitation. The reported moderate yield of shrimp from 148.5 to 212.5 kgha⁻¹crop⁻¹ suggest a poor fertility status and need for supplementary fertilization.

39. Monterio, Sharmila (Govt. of Fisheries, Goa, Panjim (India)). **Farming of catla and rohu in brackishwater ponds: A success story.** Fishing Chimes (India). v. 29(4) p. 13.

The author discussed in this contribution her remarkable experiences and the encouraging results she obtained in the farming of catla and rohu in a brackishwater pond, in the background while water conditions in monsoon months are not well suited for shrimp farming.

40. Musa, A. S. M.; Bhuiyan, Abdus Salam (University of Rajshahi, Rajshahi - 6205 (Bangladesh). Department of Zoology). **Spawning periodicity of *Mystus bleekeri* (Day) from the river Padma of Bangladesh.** Indian Journal of Fisheries. (2009) v. 56(4) p. 257-259.

Studies were conducted on the spawning periodicity of *Mystus bleekeri* (Day) from the river Padma of Bangladesh. A total of 550 specimens (240 males and 309 females) of *M. bleekeri* (Day) were collected from different fish landing centres of Rajshahi during the period from April, 2004 to March, 2005. Five maturity stages of ovary viz. immature, maturing, mature, ripe and spent were observed. The high values of GSI during June, July and August indicated that these months were the main spawning period of the species and the fish breeds only once a year.

41. Nagarajan, R.; Indira, Y. S. Santhi Pon; James, R. (V. O. Chidambaram College, Tuticorin – 628 008, Tamilnadu (India). Department of Zoology). **Effect of ration levels on growth and gonad weight in red swordtail, *Xiphophorus helleri* (Poeciliidae).** Aquacult (India) v. 10(2) p. 229-234.

Effect of ration levels (25, 50, 75 and 100%) on food intake, growth and gonad weight were studied in sexually immatured (SIM) and matured (SM) female red swordtail, *Xiphophorus helleri*. Maturity was determined based on the development of ova in the brood pouch. Rates of consumption and conversion and gonad weight of *X. helleri* were increased with an increase of ration in both SIM and SM groups. Consumption rate of

SIM group was high as compared to SM group; however the rate and efficiency of conversion and gonad weight showed the reversed trend. The optimum ration for SIM and SM female *X. helleri* was 122 and 80 mg g⁻¹ live fish day⁻¹ respectively. The energy allocation for growth and reproduction in relation to ration is discussed.

42. Nandi, Ashim; Rout, S. K.; Dasgupta, Amlan; Abraham, T. Jawahar (West Bengal University of Animal and Fishery Sciences, 5 - Budherhat Road, Panchasayar, Kolkata – 700 094 West Bengal (India). Faculty of Fishery Sciences). **Water quality characteristics in controlled production of ornamental fishes as influenced by feeding a probiotic bacterium, *Lactobacillus* sp. bioencapsulated in *Artemia* sp.** Indian Journal of Fisheries. (2009) v. 56(4) p. 283-286.

The water quality characteristics in the controlled production of ornamental fishes such as *Carassius auratus* and *Xiphophorus helleri* and the effect of feeding a probiotic bacterium *Lactobacillus* sp. Bioencapsulated in live food organism *Artemia* sp. on fish production were assessed. The addition of *Lactobacillus* sp. into the ornamental fish culture systems did not affect the water quality characteristics except for the eventual significant changes in dissolved organic matter, chemical oxygen demand and phosphate-phosphorus of the rearing water. The differences in bacteriological parameters of rearing waters of probiotic fed and control groups were insignificant. The bioencapsulated probiont fed *C. auratus* and *X. helleri* fry showed significant improvement in wet weight gain, food conversion ratio and specific growth rate compared to the respective control groups.

43. Nath, Rabindra (Hematology Laboratory, Patna Science College, Patna University, Patna – 800 005 (India) Department of Zoology). **Influence of pesticide decis on hematology of air-breathing fish *Channa punctatus* (Bloch.)** Environment and Ecology (India). v. 27(4) p. 1530-1531.

In the present study the variation in hematological parameters of freshwater fish *Channa punctatus* on exposure to lethal 96 h LC₅₀ and sublethal concentration of decis (organophosphorus) for 48, 72, 96 and 120 h were observed. The pesticide decis caused significant decrease in TEC, Hb and PCV% in exposure of found to be significantly increased in exposed fish.

44. Nayak, Ashok K; Kumar, Prem; Mahanta, P. C.; Halder R. S.; Saxena A. K. (Directorate of Coldwater Fisheries Research (ICAR), Bhimtal – 263 136, Nainital, Uttarakhand, (India)). **Development of user-friendly database software for Indian upland fishes.** Journal of the Inland Fisheries Society of India. (2009) v. 41(2) p. 1-5.

A database software for easy and effective exploration of highland fishes of India has been developed for the first time. The upland regions of the Himalaya and peninsular India are endowed with plentiful and varied fish wealth. More than 250 fishes belonging to Schizothoracinae, Cyprininae, Cobitidae, Sisoridae etc. are quite important from the commercial and biodiversity point of view as well. Though the magnitude of the hill fishery resource is small as compared to tropical, but it forms a subsistence fishery for the weaker sections of people in the hills. Though the pertinent information on the subject was available but remained scattered in different work. This has been scanned and compiled in a form of database software for future use to researches, planners and other agencies presently engaged in coldwater fishery sector for further resource management. Based on the available information on various physical and biological characteristics of

highland fishes including their photographs, several informative computerized modules/formats have also been designed in the database and properly discussed in the present communication.

45. Palavai, Vijay; Davidar, Priya (Pondicherry University, Pondicherry – 605 014 (India). Department of Ecology and Environmental Science). **A survey of freshwater fishes of Andaman Islands.** Journal of the Bombay Natural History Society (India). (2009) v. 106(1) p. 11-14.

A survey of the freshwater fish community was conducted in five large islands of the Andaman archipelago. The objective of the study was to make a complete inventory of freshwater fishes and ascertain the status of fish species reported by Herre (1039). We have collected with cast nets and other fishing traps 2,403 fishes belonging to 33 species in 77 perennial streams and 1 perennial river. 17 species (11 native) were freshwater fishes. *Acentrogobius caninus* is reported here for the first time from the Andaman Islands and it is also a first reporting from Indian inland waters. Five species of freshwater fish have been introduced from mainland India deliberately or accidentally since Herre's survey. The new findings have indicated that more new species can be found in undisturbed regions particularly, the tribal reserves and areas that are inaccessible. However, many of the native species are threatened due to habitat loss and invasive species.

46. Panikkar, Preetha; Ayyar, S. P. (Central Inland Fisheries Research Institute, Hessarghatta Lake Post, Bangalore - 560089, Karnataka (India). Reservoir Division). Khatre, Shakuntala (Bangalore University, Bangalore, (India). Department of Zoology). **Effect of feeds and feeding levels over different time periods on the rate of ammonia excretion in *Macrobrachium rosenbergii* (de Man)** Indian Journal of Fisheries. (2009) v. 56(4) p. 325-327.

The rate of ammonia excretion in *Macrobrachium rosenbergii* at 2, 4 and 6 h, when fed three commercial feeds and two control feeds at 1%, 5% and 10% of body weight, were investigated. The rate of ammonia excretion was significantly influenced by the quality of feed offered. A higher rate of ammonia excretion by the prawns fed on control feeds as compared to the commercial feeds appears to be correlated with the protein content in the feeds offered. The quantity of food consumed had significant influence on the ammonia excretion and it was found to increase with feed levels.

47. Pathan, T. S.; Shinde, S. E.; Thete, P. B.; Paithane, K. T.; Sonawane, D. L.; Khillare, Y. K. (Dr. Babasaheb Ambedkar Marathwada University, Aurangabad – 431 004 (M. S.) (India). Department of Zoology). **Sublethal effect of paper mill effluent on food consumption and growth of freshwater fish, *Rasbora daniconius*.** Aquacult (India). (2009) v. 10(2) p. 273-277.

The effect of sublethal concentrations 1.9% (1/5) and 0.95% (1/10) of the paper mill effluent on food consumption and growth of the fish, *Rasbora daniconius* were studied in the laboratory for 4 week. It was observed that the control fish showed normal food intake and growth. The food intake and growth reduced in fishes exposed to sublethal concentrations of paper mill effluent as compared to control. The study shows that paper mill effluent brings out various physiology disorders in the fish, *Rasbora daniconius*. Thus, the release of this effluent around water bodies should be monitored and controlled.

48. Peyami, F. Y; Afser, M. R. (ICLE's M. J. College, Vashi, Navi Mumbai – 400 703 (India). Department of Zoology). **Population structure and bioenergetics of a gangetic catfish *Eutropiichthys vacha* (Ham.) at Patna.** Aquacult (India). (2009) v. 10(2) p.-241-247.

Eutropiichthys vacha (Ham.) is an omnivore carfish extracting energy from phytoplankton, macrophytes, small fishes and detritus. The number of fishes per m²/y² were 11 and the estimated weight and energy were 680 gm and 212.32 kcal respectively. The food items were comprised of 24.94% macrophytes 33.89% fishes and 41.13% detritus. The energy obtained from supra mentioned food items were in order of 782.83, 1062.11 and 1289.01 kcal/m²/y² respectively. The total fish weight of *Eutropiichthys vacha* (Ham.) at Patna was estimated 16996.80 kg in 2000 in terms of energy it comes to 5308100.60 kcal/yr. The fishing area was operated in approximately 25000 m². The per annum catch in terms of energy per unit area was found to be 100.53 kcal/m²/yr.

49. Ponnusamy, K. (Central Institute of Brackishwater Aquaculture, Chennai – 600 028, Tamil Nadu (India)). Gupta, Jancy (National Dairy Research Institute, Karnal – 132 001, Haryana (India)). **Livelihood contribution, problems and prospects of aquaculture in integrated coastal farming systems.** Indian Journal of Fisheries. (2009) v. 56(4) p. 317-322.

Integrating different enterprises for maximizing farm productivity is the tradition of Indian farmers. Aquaculture in combination with other farm enterprises in the coastal regions of the country significantly contributes to the livelihood security of farm families in a system's perspective. The review of previous studies showed that aquaculture significantly contributed for the generation of additional income and employment and resource utilization in aquaculture based farming systems. However, high investment in the initial stage, encroachment of village commons and marketing of different produces are some of the constraints to be addressed through appropriate technological and policy interventions to make it more complimentary to the coastal farming systems.

50. Pradhan, C; Giri, S. S; Rath, S. C.; Mohanty, S .N. (Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar – 751 002 (India)). **Use of vegetable oil in fish feed.** Fishing Chimes (India). (2009) v.29 (6) p. 39-41.

Fish oil is generally used as a component in fish feed. A constraint in this usages is the mounting demand for it, having the effect of shortage of its supplies on one hand and the addition of pollutants like dioxins and furans because of fish oil, on the other, which are harmful to fishes. Giving this background, the authors explain in details the distinct advantages of replacing fish oil with vegetable oils.

51. Quasin, S.; Ganguly K.; Roy, S. (Vidyasagar College, Kolkata – 700 006 (India) Postgraduate Department of Zoology). Nath, A. (Research Centre for Makhana, ICAR-RCER, Darbhanga, Bihar (India)). **Diversity of macro benthic fauna of two freshwater pisciculture ponds of West Bengal.** Environment and ecology (India). (2009) v. 27(3) p. 1017-1021.

Macro benthos diversity of one managed and one unmanaged freshwater fish pond was studied. Frequency distribution of benthic organisms was higher in the managed pond

than the unmanaged one. The diversity of the macro benthic fauna in both the fluctuated ecosystem is calculated with the use of diversity indices, to show the variation of the abiotic and biotic factors on the species diversity. The Shannon-Wiener diversity index was higher in the managed pond, which had less organic matter. The production of benthic invertebrate population showed strong positive relation with the soil parameters like temperature, available phosphorus, available nitrogen and organic carbon. The production of benthic invertebrate population showed a strong positive correlation with the water parameters. However, there was a negative correlation between *Bellamyia* sp. and DO in the managed pond. *Tubifex* sp. Also showed a negative correlation with pH in the unmanaged pond. In the unmanaged pond, the Tubificidae were recorded more than Chironomidae. In the managed pond, Tubificidae was recorded to the relatively less in number whereas larvae of Chironomidae were recorded high. This observation suggests that unmanaged pond had high organic load, which also depicted from the soil study of unmanaged pond. Thus the ratio *Tubifex* sp. and Chironomid larvae may be a useful index of sewage pollution.

52. Rajaiah, V.; Vimala, V.; Reddy, T. Ravinder (Kakatiya University, Warangal A.P - 506 001 (India). Department of Zoology). **Tissue and species specific distribution of esterases in five perciformes fishes.** Aquacult (India). (2009) v. 10(2) p. 293-299.

Tissue and species specific distribution of esterases were studied in five perciformes fishes. Four tissues were taken viz, mucous, liver, brain and retina. Among the four tissues mucous exhibits E R esterases in majority of zones, which are not inhibited by paraxon, Eserine and pCMB, retine exhibits CE esterases in three fishes i.e. *Chandana*, *Etroplus maculatus* and *Oreochromis mossambicus* and where as *Glossogobius giurinus* exhibit ChE esterases, which are inhibited by eserine and paraxon. Remaining tissue exhibits other esterases like CHSP, ER and ARE, etc.

53. Rao, Srinivasa, P. (Central Institute of Fisheries Education, Mumbai – 400 061 (India). Division of Fish Genetics and Biotechnology). Umesha, D.; Prasad, K. Pani (Central Institute of Fisheries Education, Mumbai – 400 061 (India). Aquatic Environment and Fish Health Management). Babu, P. Hari (College of Fishery Science, Muthukur, P.O. – Nellore, A. P. (India)). **Fish vaccination for sustainable aquaculture production.** Fishing Chimes (India) (2009) v. 29(4) p. 38- 40.

In this contribution, the authors discussed that fish vaccination has emerged as an important practice in aquaculture, while also giving details that cover immune response, types of vaccines, their administration methods, responsibilities of farmers.

54. Reddy, S. Janardana; Reddy, D. C. (Sri Venkateswara University, Tirupati – 517 502 (India). Department of Aquaculture). **Effect of phosalone toxicity on detoxification enzymes and lipid peroxidation of Indian major carp.** Aquacult (India). (2009) v. 10(2) p. 147-159.

The Indian major carp fish, *Catla catla* was exposed to $\frac{1}{2}$ LC₅₀ (0.836 mgL⁻¹) and $\frac{1}{5}$ LC₅₀ (0.334 mgL⁻¹) sublethal concentration of phosalone for 1, 3, 7, 15 and 30 days. Antioxidant enzymes such as catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GPx), glutathione reductase (GR), glutathione (GSH) and glutathione S-transferase (GST) and lipid peroxidation were assayed in liver and kidney tissues of carp fish. It was observed that a gradual and significant induction in antioxidant enzymes and

lipid peroxidation except glutathione content of liver and kidney-tissues, which showed a gradual and significant diminution at all exposure days of $\frac{1}{2}$ LC₅₀ and $\frac{1}{5}$ LC₅₀ sublethal concentrations of phosalone. Increased CAT activity has indicated the importance of organic peroxide detoxification to prevent the secondary effects of peroxides. Induced GPx activity has depicted the active participation in the decomposition of superoxide anion by SOD that acts as a potent scavenger of free radicals to prevent lipid peroxidation of tissues. GR activity was increased in both tissues might be due to reduction in the levels of reduced glutathione content. Phosalone caused to decrease in GSH activity, thereby enhancing the lipid peroxidation resulting in accumulation of malonaldehydes. The induction of GST levels show an important role in the biotransformation and detoxification of xenobiotics. The present study suggested that the detoxification enzymes could be considered as potential biomarkers and subsequently used as vital tools in biomonitoring organophosphorous pesticide toxicity in the fresh water aquaculture fields.

55. Samal, S. K.; Das, B. K.; Ghosh, S.; Sahu, Swagatika (Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar – 751 002 (India)). **In vitro susceptibility of *Pseudomonas* sp. isolated from freshwater fish to antimicrobial agents.** Indian Journal of Fisheries. (2009) v. 56(3) p. 227-230.

Ten species of *Pseudomonas* isolated from healthy and diseased fish species such as catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*), goldfish (*Carassius auratus*), climbing perch (*Anabas testudineus*) and magur (*Clarias batrachus*) were evaluated for susceptibility to a battery of antimicrobial agents. The bacterial species used for testing were *Pseudomonas putida*, *P. aeruginosa*, *P. vasicularis*, *P. syringae*, *P. pickettii*, *P. compranoris*, *P. alkaligenes*, *P. fluorescens*, *P. stutzeri* and *P. carboxydoflava*. The bacteria were screened for susceptibility to 31 antimicrobial agents by the Bauer Disc diffusion method. Most of the bacteria were found susceptible to oxytetracycline, gentamycin, tobramycin, amikacin, ceftriaxone, netillin, tetracycline and amoxicillin. Majority of the *Pseudomonas* spp. tested were resistant to ceftazidime, cephalexin, cotrimoxazole, chloramphenicol, nalidixic acid, furazolidone, norfloxacin, augmentin, fluconazole, clotrimazole, cefoxitin, cephalotin, carbenicillin, ceftazidime, piperacillin, ticarcillin, amphotericin-B, Cloxacillin and cefuroxime. Testing of the bacterial pathogens belonging to the genus *Pseudomonas* against gentamycin, oxytetracycline, norfloxacin, tetracycline and amikacin gave larger zones of inhibition on agar plates indicating their usefulness against *Pseudomonas*' disease outbreak.

56. Santhosh, B. (Vizhinjam Research Centre of Central Marine Fisheries Research Institute, Trivandram – 695 521, Kerala (India)). Radhakrishnan, S. (University of Kerala, Kariavattom, Trivandrum – 695 581, Kerala (India)). Department of Aquatic Biology and Fisheries). **Host-specificity of metazoan parasites infecting mullets of Kerala, India.** Indian Journal of Fisheries. (2009) v. 56(4) p. 293-296.

Eight species of mullets occurring in the estuarine habitats of Kerala, India were examined for the presence of metazoan parasites. Of the 50 species of metazoan parasites encountered, 18 (36%) were oioxenic and 6 (12%) euryxenic; 48% of the parasites infected two to four host species and 4%, more than four host species. Among monogeneans, one species (16.7%) was restricted to a single host species and one species was seen to infect all the eight host species. Of the 12 digeneans, 3 (25%) infected a single host species and two (16.7%) were found on all the eight species of hosts. Among the 25 species of copepods, 12 (48%) were restricted to one host species and two (8%)

infected all the host species. The overall picture forthcoming from the study is that the metazone parasites of the mullets of Kerala waters showed varied levels of specificity with respect to their hosts; about 1/3 of them are highly host-specific, whereas, only 1/8 of them is distributed in all the host species.

57. Sarang, N.; Sharma, L. L.; Saini; V. P. (College of Fishereis, Maharana Pratap University of Agriculture and Technology, Udaipur – 313 001 Rajasthan (India) Department of Aquaculture). **Age, growth and harvestable size of *Cirrhinus mrigala* from the Jawahar Sagar Dam, Rajasthan, India.** Indian Journal of Fisheries. (2009) v. 56(3) p. 215-218.

Age, growth and harvestable size of *Cirrhinus mrigala* from Jawahar Sagar Dam, Rajasthan, were determined using the key scales. Maximum three annual rings were found and used to assess various growth characteristics. These growth parameters indicated higher value of index of population weight growth intensity (QCW = 7.43g) and index of species average size (Qh = 15.83 cm). The calculated weight of fish (Wg) was found to increase upto the third year of life. On the basis of growth parameters studied, a harvestable size of 66 cm has been assigned for *Cirrhinus mrigala* from the Jawahar Sagar Dam.

58. Sathianandan T. V.; Jayasankar, J. (Central Marine Fisheries Research Institute, Kochi – 682 018, Kerala (India)). **Managing marine fishery in Kerala through simulation using surplus production model, genetic algorithm and spectral methods.** Indian Journal of Fisheries. (2009) v. 56(3) p. 163-168.

Outboard ring seines and mechanized trawl nets form the two major fisheries in Kerala accounting for about 72% of the total catch in the state. A genetic algorithm was developed for simulation of trawl net and ring seine fishery using surplus production model and spectral methods. Simulations were carried out for six different levels of exploitations and the average biomass and average yield were calculated and compared with the maximum sustainable yield (MSY). The simulation results based on ring seine fishery revealed that the optimum level of exploitation is at 86.3% of the current level of exploitation to keep the annual average yields during 2005-2014 just below MSY, for both oil sardine and mackerel. Simulations based on trawl net fishery suggested maintaining the exploitation level at 87.9% of the current level to retain the average annual yields of penaeid prawns, cephalopods and threadfin breams below the MSY level during 2005-2013.

59. Shakir, M. S. Momin.; Heena, M. S. Momin; Shaikh, Nisar (G. M. Momin Women's College, Bhiwandi – 421 302, Distt - Thane (M S) (India). Department of Zoology). **Seasonal changes in haematological parameter of two fresh water fishes *Labeo rohita* and *Notopterus notopterus*.** Aquacult (India). (2009) v. 10(2) p. 329-331.

The haematological parametes of *Labeo rohita* and *Notopterus notopterus* were studied for a period of one year. The result shows significant alteration in haematological parameters of *Labeo rohita* and *Notopterus notopterus* during pre-monsoon (summer), monsoon and post-monsoon (winter) seasons.

60. Sharma, O. P.; Khajuria, Vinod (College of Fisheries, MPUAT, Udaipur (India). Department of Aquaculture). **Fish consumers and their consumption behaviour in**

Udaipur (Rajasthan). Journal of the Inland Fisheries Society of India. (2009) v. 41(2) p. 11-17.

The study indicated that maximum (44.66%) fish consumers were in service (government or private) followed by business (27%) in all the three income groups. Seventy six per cent fish consumers were Hindus followed by Muslims (12.66%). The maximum (45.66%) fish consumers belonged to general caste followed by scheduled tribes (23.33%). About 53% fish consumers had larger family size (>5 members). The consumers of higher income group consumed fish more often than the lower income groups and only 5.33% fish consumers had no knowledge about the freshness of fish. Among freshwater fishes, rohu was the most preferred, while in case of marine fish, prawns dominated over the others in the order of preference. Fish curry was the most preferred fish form. The findings clearly reflected the lack of awareness among fish consumers about its different forms such as stuffed, pickled and canned forms. Statistically, chi-square test clearly showed significant association between income of the fish consumer and their fish consumption pattern.

61. Sharma, S. R. Krupesha; Jayaprakash, Seema; Philipose, K. K. (Karwar Research Centre of Central Marine Fisheries Research Institute, Karwar - 581 301, Karnataka (India)). Radhakrishnan, E. V. (Central Marine Fisheries Research Institute, Kochi - 682 018, Kerala (India)). **Effect of salinity and pH on selected immune functions of the Indian white shrimp, *Fenneropenaeus indicus* (H. Milne Edwards, 1837)** Indian Journal of Fisheries. (2009) v. 56(3) p. 183-187.

The Indian white shrimp, *Fenneropenaeus indicus*, was subjected to environmental stresses like high (9) and low (5.5) water pH and decreasing water salinity (34% to 18%) for a period of one week and certain vital immunological functions like total hemocyte count, total hemolymph protein and phenoloxidase activity were analysed to understand the effect of the environmental stress factors on these functions. The results indicated that while stress induced by change in the salinity had no damaging effects on the immune functions, stress caused by lower water pH induced more immunological damage when compared to higher water pH. Significantly, decreased total hemocyte count and phenoloxidase activity were observed in shrimps exposed to lower pH when compared to shrimps exposed to higher pH and control shrimps. Also, lower pH significantly reduced the hemolymph protein values. It is therefore concluded that *Fenneropenaeus indicus* that are exposed to extreme pH show lowered immunological activity which would render the shrimp susceptible to infectious agents.

62. Sil, Sumantha Kumar; Amraham, T. Jawahar (West Bengal University of Animal and Fishery Sciences, 5, Budherhat Road, Chakgaria, Panchasayar, Kolkata – 700 094 West Bengal (India). Department of Fishery Pathology and Microbiology). **Occurrence of diseases and their management in carp culture systems of West Bengal, India.** Journal of the Inland Fisheries Society of India. (2009) v. 42(2) p. 31-37.

An assessment of disease problems in carp culture systems and the measures taken by the farmers to combat diseases in West Bengal was done. Ulcers, dropsy, argulosis, white spot on gills, hemorrhages, tail and fin rot, gulping air, oxygen deficiency and stunted growth were the major diseases or clinical conditions. Farmers used a variety of fertilizers, fish feeds and aquadrugs for augmenting primary productivity, fish growth and combating diseases, respectively. *Aeromonas* spp. *Pseudomonas* spp. and members of

Enterobacteriaceae were frequently isolated from diseased carps. Majority of the bacterial isolates were highly sensitive to antibiotics, indicating no antibiotic pressure in the carp culture system.

63. Singh, N. Okendro; Mahanta, P. C. (Directorate of Coldwater Fisheries Research, Bhimtal – 263 136 Uttarakhand (India)). Kumar, Surinder (DSB Cmapus, Kumaun University, Nainital, Uttarakhand (India). Department of Statistics). Singh, N. Gopimohon (Central Agricultural University, Imphal (India). Department of Statistics and Mathematics). **Evaluation of pollution sources of Narmada river by factor analysis.** Fishing Chimes (India). (2009) v. 29(6) p. 21-23

The authors have presented in this contribution an evaluation of the sources, mostly discharged of sewage, animal wastes and industrial wastes that are debouched into the crucial Hoshangabad Zone of Narmada River. The study was conducted following factor analysis. The conclusions drawn, as a result of the study, were that the sewage, animal and industrial wastes were the main causes for variations in the water quality in the Hoshangabad region of the Narmada river system that threaten to cause fish mortality.

64. Sithara, K.; Ghayathri, S.; Kamalaveni, K. (P. G. Research, Kogunadu Arts and Science College. Coimbatore – 641 029, Tamil Nadu (India). Department of Zoology). **Effects of dietary supplementation of various levels of selmos as a feed additive on growth performances and feed utilization in common carp. *Cyprinus carpio*.** Journal of the Inland Fisheries Society of India. (2009) v. 41(2) p. 6-10.

A feeding experiment was carried out to evaluate the effect of supplementary diet with selenium based feed additive selmos on growth and feed utilization in common carp, *Cyprinus carpio*. Five groups of fishes were given a basal diet (control) and supplemented diet with selmos in different concentrations such as 1g/kg (T₁), 2g/kg (T₂), 3g/kg(T₃) and 4g/kg (T₄) for 70 days. Fish grew an average weight of 8.51g at a high inclusion level of selmos. Result showed that growth performance of carp was significantly (P<0.05) increased at the higher dietary selmos diet. It is recommended that 4g/kg of selmos is the best supplemented dosage and this additive can be easily blended with common fish feed so as to exert an excellent effect in promoting the growth of fishes.

65. Sudheesan, Deepa; Jaiswar, A. K.; Chakraborty S. K.; Pazhayamadom D. G. (Central Institute of Fisheries Education, Seven Bunglows, Versova, Mumbai – 400 061 (India)). **Predatory diversity of finfish species inhabiting the same ecological niche.** Indian Journal of Fisheries. (2009) v. 56(3) p. 169-175.

A total of 211 specimens of *Nemipterus japonicus* (Bloch. 1791) and 169 specimens of *Saurida tumbil* (Bloch. 1795) were examined for different morphological traits and stomach contents. *N. japonicus* has a laterally compressed and deep body, small mouth opening and villiform teeth only on the jaws, soft gill rakers with bristles, small stomach and long intestine. These adaptations are suited for predation on small preys. *S. tumbil* has an elongated cylindrical body, with wide mouth opening, different types of sharp depressible teeth, small spine-like gill rakers, well developed stomach and short intestine, which are again the adaptations to feed on larger preys. Both the fishes are cannibalistic and asynchronous feeders. However, *N. japonicus* seems to be an opportunistic feeder, predated on crustaceans (80%), fishes, cephalopods, gastropods and polychaetes while *S. tumbil* is more like a selective feeder, predated on fishes (90%), crustaceans and

cephalopods. The study reveals that though these predators inhabit the same ecological niche of demersal waters and have the opportunity to utilize similar food resources, they are entirely different in morphology which is attributed to the difference in their diet.

66. Sugunan, V. V. (Indian Council of Agricultural Research, Krishi Anusandhan Bhavan - II, Pusa, New Delhi – 110 012 (India)). **Domestic marketing and post-harvest management in Inland fisheries.** Fishing Chimes (India). (2009) v. 29(9) p. 7.

Referring to the different regional fish consumer preferences in the country, and highlighting the infrastructural gaps thereof in respect of domestic fish marketing in relation to processing, value addition and hygienic handling, the author highlights in this contribution the need to have a national strategy for fish post-harvest operations and marketing, couples with research support for the development and commercialization of value added products, institution of national standards for processing, product development, food safety and quality control regime to certify products and to ensure quality.

67. Tembhrane, M. C.; Joshi, V. R.; Balange, A. K.; Pagarkar, A. K.; Phadke, G. G. (College of Fisheries, Shirgaon, Ratnagiri - 415629, Maharashtra (India). Department of Fish Processing Technology). **Effect of modified starch on lizard fish (*Saurida tumbil*) ball in curry.** Indian Journal of Fisheries. (2009) v. 56(3) p. 199-203.

Fish ball in curry product using the lizard fish *Saurida tumbil* was prepared by mixing fish ball with different combinations of ordinary starch (OS) and modified starch (MS) viz. 30:70, 40:60, 50:50, 60:40, 70:30, 100% MS and 100% OS. The products were frozen at -40°C , stored at -20°C and subjected to biochemical, organoleptic and physical tests at regular monthly intervals. Among the different combinations tried, it was observed that the fish ball in curry product prepared with a combination of 50% ordinary starch and 50% modified starch could be stored for six months with minimal changes in organoleptic, expressible water and folding test grades. The products were acceptable up to six months from the organoleptic and oxidative rancidity point of view.

68. Varghese, Molly; Balachandran, K. (Central Marine Fisheries Research Institute, Cochin – 682 018 Kerala (India)). Kasinathan, C. (Mandapam Regional Centre of Central Marine Fisheries Research Institute, Mandapam – 623 520 Tamil Nadu (India)). **Length-weight relationship and relative condition of *Scarus ghobban* Forsskal, 1775 from Palk Bay.** Indian Journal of Fisheries. (2009) v. 56(4) p. 323-324.

Scarus ghobban collected from the Palk Bay, south-east coast of India was subjected to studies on length-weight relationship as well as condition factor. The length-weight relationship was found to be $W = 0.022473519 L^{2.9040}$, indicating isometric growth of the fish. The relative condition factor (K_n) ranged between 0.8 and 1.5 with a mean value of 1.0.

69. Vineetha; Abraham, T. Jawahar (Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Chakgaria, Kolkata – 700 094, West Bengal (India). Department of Fishery Pathology and Microbiology). **Assessment of fish health problems in freshwater aquaculture stems of Andhra Pradesh, India.** Indian Journal of Fisheries. (2009) v. 56(4) p. 335-337.

Disease problems in carp culture systems in Andhra Pradesh and the measures taken by the farmers to combat diseases were assessed. The major health problems encountered were argulosis, oxygen deficiency, hemorrhages and ulcerated red spots, myxoboliasis, gas bubble disease, gyrodactylosis, dropsy, lerneosis, tail rot and stunted growth in *Catla catla* and *Labeo rohita*. Argulosis has been a major cause of production loss, which occurred throughout the culture period. The use of aquadrugs was found to be either unsuccessful or partially successful, Bacteria such as *Acinetobacter*, *Aeromonas caviae*, *Aeromonas hydrophila*, *Pseudomonas* spp. and members of Enterobacteriaceae were associated with diseased fish. Multiple antibiotic resistance was seen in 67% of the bacterial flora possibly due to antibiotic pressure in carp culture systems.

70. Vyas, Vipin; Parashar, Vivek; Damde, Dinesh ; Singh Satyendra (Barkatullah University, Bhopal – 462 026 (India). Department of Limnology). **Fish biodiversity of Narmada in submergence area of Indira Sagar reservoir.** Journal of the Inland Fisheries Society of India. (2009) v. 41(2) p. 18-25.

The present study has been conducted to assess the spatial and temporal variation of fish fauna in the stretch of Indira Sagar submergence area. This paper attempts to document the fish biodiversity of Indira Sagar reservoir submergence area and tributaries of river Narmada viz. Ganjal and Machak, temporal variation therein and also assess the impact of formation of reservoir on the riverine fish fauna. During the study fifty two species belonging to 28 Genera, 13 Families and 7 Orders were encountered. Twenty species were recorded in Machak River whereas twenty nine species were recorded in Ganjal River, nineteen species were recorded in Narmada River near Nemavar village and thirteen species were reported at the tail end of the reservoir near Purni. The study indicates that this region is still a hotspot of fish biodiversity and conservation measures should be followed to sustain fish biodiversity of tributaries.

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