

## **Study of reproductive biology and stock variability of *bele* (*Glossogobius giuris*) with a view to establishing its induced breeding technique**

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### **Abstract**

A study was conducted to ascertain the stock variability of pond, *haor* and estuarine *bele* (*Glossogobius giuris*) and to know its breeding biology so that a dependable induced breeding protocol can be developed. Accordingly, samples of *G. giuris* from pond of Mymensingh, *haor* of Mithamoin, Kishoreganj and estuary of Barisal were collected. On the basis of the morphometric and meristic characteristics the *haor* stock of Kishoreganj was found better than other two stocks. So, *G. giuris* from *haor* were collected and domesticated in the ponds to use subsequently for induced breeding trials. *Bele* fed chicken viscera and trash fish at 2-5% of body weight showed significantly better growth and survival rates compared to those provided with formulated feed. Samples of *G. giuris* from *haor* were collected for 12 consecutive months for gathering information relevant to reproductive biology and for histological observation of gonads to identify its breeding season. From the reproductive biology and histological study it was found that *G. giuris* is a highly fecund (3,53,946) fish and breeds during June to September with the peak in the month of August. Several breeding trials using PG extract as inducing agent were given during the months of June to September to find a suitable dose and time for induction of breeding of *G. giuris*. Subsequently a dose of 8 mg PGkg<sup>-1</sup> body weight of female was found suitable so far as the ovulation (94.67 %) fertilization (92.33 %) and hatching (91.67 %) rates of eggs are concerned, in the month of August. The incubation period of fertilized eggs ranged from 35-48 h at a temperature of 27°C. Different stages of embryonic and larval development upto 48 h post-hatching were observed and described accordingly.

## **Gene banking of improved broodstocks of Indian major carps (catla, rohu and mrigal) and development of breeding technique of three threatened species (mohashol, bagair and baim)**

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### **Abstract**

Six dinucleotide microsatellites (*Ccat A12*, *Ccat C3*, *Ccat C6*, *Ccat C8*, *Ccat G1*, and *Ccat G2*) were analysed to test the genetic structure of three different wild stocks of catla (Halda, Jamuna and Padma). The average observed heterozygosity (*Ho*) and the average expected heterozygosity (*He*) was highest in the Halda population (0.6250 and 0.7156, respectively). The genetic differentiation ( $F_{ST}$ ) and the gene flow ( $N_m$ ) over all three populations was 0.04727 and 5.3883, respectively. Relatively high level (0.0653) of  $F_{ST}$  and low level (3.5811)

of gene flow ( $N_m$ ) was detected between the Halda and the Padma populations. UPGMA dendrogram based on Nei's genetic distance resulted in two clusters: the Halda population alone in one cluster whereas the Jamuna and the Padma populations made another cluster. Experiments were conducted to develop the protocols for cryopreservation of sperm of rohu and mrigal and to assess the effect of cryopreserved sperm on fertilization and hatching. Two extenders Alsever's solution, egg-yolk citrate and two cryoprotectants, DMSO and methanol were used for preservation of sperm of the two experiments. The toxicity of cryoprotectant (DMSO and methanol) to sperm showed better motility with 5 and 10% concentrations during 5 and 10 min incubation and 15% concentration seemed toxic to sperm in both rohu and mrigal. Alsever's solution with 10% DMSO showed best performance in equilibration and post-thaw motility for both species. The fertilization and hatching rates were  $62.03 \pm 0.8\%$  and  $45.5 \pm 1.78\%$  for Alsever's solution with DMSO whereas  $50.93 \pm 0.73\%$  and  $16 \pm 5.1\%$  respectively for egg-yolk citrate with methanol in rohu. In mrigal the fertilization and hatching rates were  $62.37 \pm 0.68\%$  and  $45.83 \pm 1.53\%$  for Alsever's solution with DMSO whereas  $46.13 \pm 0.83\%$  and  $3.3 \pm 0.4\%$  for Alsever's solution with methanol respectively. Between the two diluents a significant variation was found for fertilization ( $P < 0.05$ ) and hatching ( $P < 0.05$ ) for both species. Two induced breeding trials were conducted with baim, *Mastacembelus armatus* using PG extract. Four different doses of PG viz. 20, 40, 60 and 80mg PGkg<sup>-1</sup> body weight of females were used and best result was obtained from 40mg PGkg<sup>-1</sup> body weight in respect of ovulation rate (100%), fertilization ( $93.00 \pm 2.00\%$ ) and hatching rates ( $58.30 \pm 3.50\%$ ) of eggs. Successive embryonic and larval development stages were also observed. A reasonable number of fry of baim have been produced which are being reared in ponds and in the laboratory condition under different experimental protocols.

## Development of breeding and fry rearing techniques of endangered Tengra, *Mystus vittatus* and Gulsha, *Mystus cavasius*

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### Abstract

Experiments were conducted to develop breeding and fry rearing techniques of two threatened catfish, tengra, *Mystus vittatus* and gulsha, *Mystus cavasius*. The live fish were collected from natural water bodies and stocked in ponds in the Faculty of Fisheries, Bangladesh Agricultural University campus and reared with farm-made and commercial supplemental feeds. Both the fish species were successfully domesticated in captive condition and growth and breeding related parameters such as gonado-somatic index (GSI), fecundity etc. were studied. The fecundity of tengra ranged from 8346 to 42253 in May and 9073 to 22705 in June, while the fecundity of gulsha ranged from 4752 to 7776 in May and from 7413 to 16331 in June. Partial GSI study revealed that both the species breeds in monsoon season i.e. starts from April and breeding season can be extended to next few months. Six month GSI values revealed that April is the pick time for tengra and June for gulsha for breeding. Artificial breeding trials were conducted using carp PG extract with three different dosages (2 & 6, 4 & 8, 6 & 10 mg/kg body wt. for male and female respectively) and 2 & 6 mg/kg body wt. produced the best result. About 62-85% fertilization and 55-70% hatching were obtained from tengra, while 64-80% and 57-71% fertilization and hatching were recorded from gulsha respectively. Hatchlings of tengra and gulsha are being reared in

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aquarium and tray with supplemental feed such as hard boiled egg-yolk, tubifex, and plankton and their rearing techniques will be developed through experimental trials.

## **Study of bamboo charcoal added feed on elimination of nitrogenous waste and growth of *Pangasius hypophthalmus***

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### **Abstract**

A 50-day feeding trial was conducted to determine the effects of dietary bamboo charcoal (BC) on ammonia-nitrogen excretion and growth performances of *Pangasius hypophthalmus*. Four levels of BC (0%, 0.5%, 1% and 2%) were supplemented to the diet composition and fed to fish (initial body weight  $1.18 \pm 0.04$ g) twice a day. At the end of the trial, mean of final weight (g), final length (cm), weight gain (g), length gain (cm), percent weight gain, percent length gain, specific growth rate (% per day), feed conversion ratio, survival rates and water quality parameters i.e, ammonia, pH, and dissolved oxygen were measured and found that fish fed 2% BC diet showed significantly ( $P < 0.05$ ) higher growth enhancement than those of fish fed the control diet (0%BC). Ammonia concentration over the experimental period decreased with increasing dietary BC. Moreover, in histological observation it was found that the villus height and villus area in all intestinal segments tended to increase with increasing dietary BC supplementation. The present results indicate stimulating effects of dietary BC on intestinal villi and the diet supplemented with 2% BC was found to have a suitable level to fulfill the maximum growth performances of *P. hypophthalmus* and to decrease the ammonia concentration.

## **Investigation into the disease condition of cultured silver carp *Hypophthalmichthys molitrix* and its control trial**

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### **Abstract**

The silver carp, *Hypophthalmichthys molitrix* is an exotic fish introduced to Bangladesh waters for aquaculture and algal control of ponds. Its production is high and can be cultured without supplementary feeding. It has therefore, become a very important cultural species of Bangladeshi farmers. Unfortunately, this fish is known to be infected by bacterial pathogen and causes mortalities in many farms of Mymensingh region. Though *Pseudomonas* and *Aeromonas* are the important bacterial pathogen isolated from this fish throughout the world. Several workers reported such pathogenic bacteria from this fish sporadically from Bangladesh also. The investigator (Project Director) has therefore undertaken an investigation on the disease condition of this silver carp to identify the disease causing agent by morphological, physiological and biochemical characters to confirm its pathogenicity to understand its sensitivity to different drugs (antibiotics) and its control measures. For working on this investigation the plan of work was good and scientific. The investigator has reviewed

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previous literature on the relevant works specially of our country, gained field experience through field visits in different farms in Mymensingh region and prepared the plan of work concerned to the work identified. The methodology followed for the working protocol was also scientific and technically sound. Fish sample was regularly collected from the Rocky Fish Farm, Vabukhali, Mymensingh with diseased fish having abnormal appearance, external ulcerative lesions and reddened fin bases. Liver, kidney and intestine of fish was studied after plated into TSA for total bacterial count and onto *Aeromonas* isolation medium (AIM) plates for isolation of *Aeromonas* bacteria. Five drugs were tested for sensitivity of bacterial colony. Treatment trials were then undertaken with those antibiotics (drugs). The investigator has paid considerable effort to fulfill the objective of the works as proposed in the project proposal and achieved satisfactory results in the project work. Investigator identified the pathogen *Aeromonas hydrophila* might cause serious losses to the intensive culture system of silver carp. The disease might be Motile Aeromonas Septicaemia (MAS) for which fish culturists must adopt proper management practices to avoid *Aeromonas* like infections. The culturists are also suggested to apply Captor (60g/100 kg fish for 7 days) or Oxy D Vet (1g/4kg body weight for 10 days) for such ubiquitous bacterial infection. In fine, it is recommended that the work of the project has been scientifically conducted in the light of the project proposal and achieved satisfactory results which would be useful for silver carp culturists.

## **Studies on caryophyllaeisis in freshwater catfishes *Clarias batrachus* and *Heteropneustes fossilis* of Bangladesh**

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### **Abstract**

A study on effects of parasitism on the growth of *Heteropneustes fossilis* was conducted during the period from July 2012 to June 2012. Fish samples were collected from various water bodies like haor, beel and ponds of Sylhet region. Sex, total length, standard length, head length, weight and gonad weight of hosts were recorded. Blood was also collected from each fish. Six different species of parasites were identified from the hosts examined as i). *Euclinostomum multicaecum*, ii) *Allocreadium handiai*, iii). *Lytocestus indicus*, iv). *Pseudocaryophyllaeus heteropneustus*, v). *Procamallanus heteropneustus* and vi). *Paracamallanus equispiculus*. Moderate infestations were found in *H. fossilis* with different groups of helminth parasites. Prevalence was different in different months. The highest prevalence (69.57%) was observed in November and the lowest (33.33%) in July. Changes in the nature of growth and loss of weight as the result of parasitic infestation were noticed. Accordingly length, weight and condition factors were found greatly affected. Loss of total length was 1.75% and the highest gain of mean head length was 7.50% found in low level infested larger length group fish. The highest loss of weight 18.34% was found in larger length group fish. The highest condition factor, 0.59, was found in uninfested fish and the lowest, 0.45, in infested fish. Changes in the percent of haemoglobin and erythrocyte sedimentation rate (ESR) were also investigated. Percent loss of haemoglobin was 0.43 and erythrocyte sedimentation rate (ESR) was 5.19 mm/h.

## **Study on impact of aqua-drugs and chemicals on fish/shrimp health and production**

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### **Abstract**

An investigation was carried out to know the aqua drugs used and their effect on health and production of shrimp in the coastal belt of Bangladesh. Twenty seven types of aqua drugs was recorded from Khulna region and 17 types from Cox'sBazar regions. Bleaching powder, potash and lion brand aqua solution had positive impact against white spot diseases in most of the investigated areas. However, basudin, Oxytetracycline and methylene blue had no effect on the recovery of white spot disease investigated areas. Geolite gold, aqua Z poder, gasonex plus, megageo and ammonil had positive impact on gas removal in shrimp ghers of all the investigated areas. Aqua nurish, megavit, aquavost, aqua vit, rabbit C had positive impact as growth promoter in the studied areas. Lion brand aqua solution, megavit, aqua boost, aqua vit and GPC 8 had positive impact as disinfectants recorded from the investigated areas. Shrimp production was 100 kg each in Chakaria and Cox'sBazar region, 80 kg in Paikgacha, 150 kg in Bagerhat and 200 kg per acre in Assasuni, Khulna. In Assasuni farmers used more aqua drugs. Thus aqua drugs played some role in production of shrimp in the coastal belt of Bangladesh. Some shrimp of Cox'sBazar regions were yellowish, brownish or darker than normal appearance. Clinically health condition of shrimp of Khulna regions was better than those of Cox'sBazar regions.

## **Testing of local herbal products for Fish/Shrimp disease prevention and control**

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### **Abstract**

Experiments were conducted on preparation of fine extracts, isolation of bacteria, experimental infection and use of medicinal plant extracts on disease recovery of sarputi. (Four fine extracts prepared to observe their effect on disease recovery of fish. Diseased shing were collected from Talha Soha Fish Farm, Muktagacha and bacteria were isolated from the fishes up to genus). An experiment was conducted to observe disease recovery of affected sarpunti treated with kalojira seed fine extract, akand leaf fine extract, shoti rhizome fine extract and control for a period of 21 days. At the end of the experiment in Treatment 1, fishes were fully recovered, in Treatment 2, almost recovered, in treatment 3, recovered to some extent, but yet to be fully recovered, whereas, in Treatment 4 (Control), injury still existed at the end of 2nd week and all fishes of this treatment died at the end of experiment. Histologically, at the start of the experiment, epidermis was lost, dermis and muscle splitted necrotic having wide vacuums. In Kalojira treated treated group, skin and muscle were totally recovered except small portion of the epidermis. However, in Akand and Shoti treated groups, epidermis not yet healed, dermis still separated from muscle having vacuums.

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Whereas, in control group, skin and muscle structure had further deteriorated from that of the start of the experiment. In case of gill and kidneys, at the start of the experiment, there were pathology like loss of parts, deformities, hypertrophy, necrosis, and vacuums. However, in there were almost recovery in treatment 1, partial recovery in treatments 2 and 3 and almost no recovery in control treatment (4). It was thus observed from clinical and histological point of view that Kalojira extract was the best for injury recovery followed by Akanda and Shoti extracts. Whereas, in control treatment there was no recovery rather further deterioration was noticed.

**Diversification of carp polyculture integrating snail (*Viviparus sp.*), and shing (*Heteropneustes sp.*) culture in cage in ponds of Adivasi households**

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**Abstract**

Towards increasing the polyculture pond productivity, this experiment was conducted with 32 Adivasi farmers' ponds of various sizes where culture of *shing* (*Heteropneustes fossilis*) was done in cage in the same pond with the stocking density of 100 fingerling/cage. In each pond, two cages (each of 1m<sup>3</sup>) were set for *shing* growing and, snail culture was carried out in an area of 1-2 m<sup>2</sup> in the same pond providing with bamboo substrates and compost manure. Outside the cage, carps (*catla*, *silver carp*, *ruhu* and *mrigal*; ratio of 3:1:2:2) were stocked at the rate of 80 fingerlings/dec. During the reporting period of July 2012-June 2013, farmers level monitoring was carried out to record the data about the fish growth and production, water quality parameters and other related information of fish health. Then total harvest, both *shing* and carps was done in November 2012 and March 2013, respectively. The productivity of carps and *shing* in ponds and cages, respectively was satisfactory, but the level of production of *shing* was not up to the expected level. However, the production of *shing* was 2.5 kg/cage. The lower productivity of *shing* was due to poor quality of *shing* fingerlings supplied by the hatchery. To overcome this constraint, in the second year of production cycle, good quality *shing* fingerling collected from a reputed hatchery was stocked in cages along with carps in ponds after pond preparation applying lime 1 kg/dec. and compost 2.75 kg/dec. The average productivity of carps was 14.90 kg/dec. in the same polyculture ponds having the water quality parameters at the suitable range. This year in May 2013, at the initial stage, the fingerlings were infected by disease two times, for this reason, *shing* was stocked for third time partially. The growth of *shing* in cage has reached to 30-35g by 4 months after stocking at the middle of May 2013. The production of snail in the first cycle varied due to disturbance of household domestic ducks. In the second cycle, the snail production area has been protected by fencing with nylon net so that the domestic ducks cannot eat up them. The growth and production of snail was found encouraging during the reporting period (September 2013). Farmers started to use their produced snail for preparing feed for *shing* in cage. The monitoring process overseen by the KGF central team has given suggestions to improve knowledge level of field staff and farmers doing similar kind of experiment at the on-station level in BAU. Accordingly, an on-station experiment has been started from January 2013 in the research ponds of BAU campus to share experiences between on-station and on-farm levels. The production of snail at the on-station level was found 12 kg/dec. which is contributing to the feeding of *shing* at an expected level of 30% reduction at the end of culture

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cycle in November 2013. The growth of carps in polyculture ponds is showing encouraging trend. The project activities in terms of monitoring, sampling and data recording are going on.

## **Good aquaculture practices in Asian aquaculture: lessons to minimize drug use and disease problems for sustainable shrimp and prawn farming in Bangladesh**

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### **Abstract**

Sustaining Ethical Aquaculture Trade (SEAT) Project ([www.seatglobal.eu](http://www.seatglobal.eu) and [www.seatbau.net](http://www.seatbau.net)) investigates various aspects to improve sustainability of seafood farming in Bangladesh being traded to developed countries. Out of different issues, the use of chemicals and veterinary drugs in seafood farming plays a critical role in sustainable seafood production and product quality for the export market. Shrimp and prawn together is the leading exportable seafood product from Bangladesh, which is often negatively criticized due to the presence of veterinary drugs in it. It may be mentioned that globally in shrimp aquaculture, massive mortality and subsequent economic losses is due to viral disease is a quite common issue. Antibiotics are not effective against viral diseases however, when rapid mortalities occur, farmers tend to use antibiotics in their desperate attempt to save the harvest which impacts the product quality negatively. Currently, this kind of farmers' practice is evidenced in Bangladesh where prawn farming has already been evident in 2009 due to the presence of nitrofurans in it. According to Rapid Alert System for Food and Feed (RASFF), the use of veterinary drugs in aquaculture reduced considerably in the world however, there is unacceptable trend of use. In this context, an investigation was carried out to assess the impacts of good aquaculture practices (GAPs) in Asian aquaculture to reduce the use of veterinary drugs which was communicated to the stakeholders in Bangladesh to understand their interest and attitudes towards adoption of GAPs. Avoiding drug use through minimizing disease prevalence in shrimp farming is the key issue of good aquaculture practices. A case study of GAPs in India that was built on the objectives of reducing risks of disease outbreak, organizing self-help groups (aquaclubs) and producing quality shrimp. The major components of the GAPs approach were cluster farming, on-farm awareness building, assisting clusters to develop voluntary guidelines, providing regular technical assistance, linking other stakeholders and participatory monitoring. The heart of the cluster developed with the interdependent ponds those were using water from same source. The major on-farm practices linked to the pond preparation, quality PL stocking, water quality and feed management, health monitoring/bio-security, pond bottom monitoring, disease monitoring, better harvest/post harvest practices, traceability and environmental awareness. The key impacts of GAPs in shrimp farming minimized disease problems, avoided drug use, maximized economic profit and enhanced extension of the practices in other areas since starting in 2001. While communicating the positive impacts of GAPs in a stakeholders' workshop, it was found that farmers in Bangladesh are interested to adopt GAPs, however it needs consistent institutional supports from the organization and technical points of view which is the critical issue for large number of farmers in wider geographical area in the Southwest and Southern regions of Bangladesh.

## **Local and global implications for use of catfish (*Pangasianodon hypophthalmus*) pond sediments in fodder grass production in peri-urban areas of Mymensingh, Bangladesh**

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### **Abstract**

Farmed fish and milk production have grown rapidly in much of Asia in recent decades to meet the needs of rapidly growing and urbanising populations. Catfish (*Pangasianodon hypophthalmus*) production in Mymensingh, Bangladesh is intensive, resulting in huge sediment deposit in the pond due to regular supplies of artificial feeds. The removal and disposal of nutrient-rich sediments creates pollution of receiving water bodies both locally and through inefficient use of energy intensive inputs, globally. Regular removal of pond sediment is time consuming and incurs high labour costs. Conversely, Mymensingh is an important region for dairying lacking of quality green fodder linked to the cost of N fertilization (urea). The use of N fertilizers is cost-intensive; the manufacture and distribution of such oil-based urea is a major part of the energy cost of food production and is highly sensitive to volatility in energy prices. In this context, the objective of the present study was to examine the potential for using catfish pond sediments to substitute for conventional N fertilizers used for green fodder grass production to support dairying. An experiment was conducted in *Pangasius* farm in Dhanikhola village under Trishal Upazila focusing the effects of *Pangasius* pond sediment on the growth and production of fodder grass (*Brachiaria mutica*). According to soil analysis, the major soil nutrients such as nitrogen (N), phosphorus (P) and potassium (K) were very high in *Pangasius* pond sediment compared to virgin soil. The fodder was cultivated with various levels of *Pangasius* pond sediment in a completely randomized designed on-farm experiment in 6 treatments, each with three replications. The size of each replication plot was 25 m<sup>2</sup> (5m × 5m) which was organized in rice-field closed to the *Pangasius* farm. The nutrient doses of the treatments 1-6 were of control (only virgin soil), 100% inorganic N, 75% inorganic N + 25% sediment N, 50% inorganic N + 50% sediment N, 25% inorganic N + 75% sediment N, and 100% sediment N, respectively. Following transplantation of cutting (25 cm in length), the fodder was harvested at the pre-flowering stage (45 days after transplantation). The results of the study showed that the highest average length was found 85.57 cm in T<sub>6</sub> at first cutting where 100% N was supplied from pond sediment. After first cutting a mechanized floating irrigation system was developed to irrigate *Pangasius* pond sediment into the plot which increased the nutrient context of soil and resulting in higher growth (108.49 cm) of grass in T<sub>6</sub>. Accordingly, the yield of fodder grass was increasing with increasing dose of sediment nitrogen in an individual cutting ranging from 4.52 - 12.50 t/ha. The yield of fodder grass was almost similar for the corresponding treatments in three cutting periods. The harvested grass was instantly purchased by the local dairy farm owners showing their positive interest to cultivation of folder grass. Such use of *Pangasius* pond sediment that is considered as waste, could contribute to the environmental mitigation having broader environmental implications globally.

## **Alternative fish feed development to enhance fish production through black soldier fly larvae production at household level**

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### **Abstract**

Aquaculture is the fastest growing primary industry in Bangladesh which supplies more than 60% animal protein for human consumption. However, the adulterated feed increases production cost, creates environmental hazards and reduces profitability. An attempt was made to address these problems through high protein, fat and minerals containing non pest insect, Black Soldier <http://www.sciencedirect.com/science/article/pii/S0016236110006307> - hit5 Fly (BSF) larvae rearing technique to reduce feed cost, boost up production and tackle environmental hazards. Special chambers were made with plastic and cemented bucket having egg laying and larvae harvesting facilities where kitchen wastes and rotten fruits and vegetables were placed to attract wild BSF to lay eggs which then hatched and larvae emerged. Upon hatching the larvae consumed voraciously the putrescent wastes and larvae length reached up to 0.75 inch in size and migrated to turn to pupae. The fish feed was prepared replacing 25 and 50% fish meal to see the growth performances of tilapia fry in hapa for 90 days. Another set of tilapia fry was fed 100% dehydrated BSF larvae and feed prepared with no BSF larvae as control to see the effectiveness of feed in various treatments. The analysis showed that the BSF larvae production was fluctuating with the temperature and stopped in temperature less than 18<sup>o</sup> C. The examination also showed that larvae contained 62% moisture, 7% lipid, 16% protein, 3% ash, 3.2% crude fiber and 9% carbohydrate in live wet basis. Among the four formulated feed 50% BSF larvae containing feed performed best followed by 25%, control and 100% dehydrated BSF larvae. The survival rate of tilapia fry was more or less similar in all the treatments but fish production was 40.4, 36.1, 31.9 and 33.1 tons/ha in 50 and 25% BSF larvae containing feed, 100% dehydrated BSF larvae and in control feed respectively. The feed conversion ratio was least (1.18) with 50% BSF larvae containing feed and highest feed conversion ratio was with dehydrated BSF larvae. Further research needed to develop the captive breeding of BSF for sustainable fish production.

## **Effect of different levels of substitution of fish meal with blood meal in pelleted feeds on the growth performance of thai pangus (*Pangasianodon hypophthalmus*)**

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### **Abstract**

The experiment was carried out to determine the effect of blood meal in pelleted feeds on the growth, survival and production of *Pangasianodon hypophthalmus* for a period of 63 days in 12 experimental aquaria in Wet Laboratory of the Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. In the experiment, 168 fingerlings of initial weight of  $0.050 \pm 0.000$ g were released at the same stocking density (14 fingerlings per aquarium).

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Four different treatments ( $T_1$ ,  $T_2$ ,  $T_3$ , and  $T_4$ ) each with three replications were used having different sources of protein containing diets,  $T_1$ -30% Fish Meal (FM),  $T_2$ -30% Blood Meal (BM),  $T_3$ -20% Fish Meal (FM) + 10% Blood Meal (BM) and  $T_4$ -10% Fish Meal (FM) + 20% Blood Meal (BM). All four diets had a constant inclusion level of the following ingredients: rice bran 20%, wheat bran 40%, molasses 8.5%, vitamin and mineral premix 1%, and 0.5% chromic oxide. Feeds were supplied at 10% body weight twice daily in the morning at 9.00 am and in the afternoon at 5.00 pm throughout the study period and sampling were done at 7 days interval. The range of water temperature, pH, and dissolved oxygen varied from 23.56 to 23.83°C, 8.06 to 8.60, 8.2 to 10.2 mg/l, respectively which were within the acceptable range. Non significant final weight, weight gain (g), percent weight gain (%), specific growth rate (%/day), and average daily weight gain, varied from  $0.613 \pm 0.060$  to  $0.837 \pm 0.062$ ,  $0.557 \pm 0.061$  to  $0.787 \pm 0.062$ ,  $993 \pm 135.040$  to  $1573 \pm 124.691$  and  $1.638 \pm 0.09$  to  $1.938 \pm 0.050$ , respectively. Highest FCR ( $2.996 \pm 0.0474$ ) was found in  $T_4$  and the lowest FCR ( $2.305 \pm 0.0392$ ) was found in  $T_1$ . The highest PER ( $0.018 \pm 0.002$ ) was found in  $T_1$  and the lowest PER ( $0.012 \pm 0.002$ ) was found in  $T_3$ . The highest survival rate ( $92.860 \pm 0.510$ ) was found in  $T_2$  and lowest survival rate was found in  $T_3$ . Best growth performance was found in  $T_2$  followed by  $T_1$ ,  $T_3$  and  $T_4$ . The present research findings suggested that quality feed would be formulated by blood meal with total replacement of fish meal to enhance the growth, production and survivility of *Pangasianodon hypophthalmus*.

## Fish health and environmental issues of emerging pangas (*Pangasianodon hypophthalmus*) farming in Bangladesh

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### Abstract

Pangas (*Pangasianodon hypophthalmus*) has been emerging as an economically very important species to South-East Asian aquaculture. Pangas farming is one of the fastest growing types of aquaculture in Bangladesh. With the rapid expansion and intensification of farming system, environmental and health problems have become a great concern in recent years. The aim of the present study was to investigate environmental and fish health problems associated with pangas farming. The study focused on Bhaluka, Trishal and Muktagasa upazila under Mymensingh district. Data was collected through questionnaire survey and participatory rural appraisal like focus group discussion (FGD). All together 40 farmers were interviewed and 6 FGD sessions were conducted. Clinical, bacteriological and histopathological techniques were also employed with diseased fishes. It was found that most of the pangas farms were previously rice fields and natural water areas that posed risks on balanced ecosystem of the study area. Algal bloom, oxygen depletion, pH drop and harmful gas production were the common water quality problems. Regular water exchange and discharge was also observed. Excess feed supplied in the pangas pond made the water nutrient rich and had resulted eutrophication problem. Moreover, the unutilized settled down feeds produced huge bottom waste in pangas ponds. The waste was remarked as responsible for creating unfavorable situation for the cultured fishes. Pangasius was found as well domesticated fish and escape was not found a big problem. Indiscriminate use of chemicals and antibiotics was found very common that seemed to have an impact on the environment and human health. Fish health and disease problem was found as a big issue in pangas farming. Among the recorded diseases rectal protrusion was most prevalent and

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dangerous one for the farmed pangas. Other problems included ventral reddening, superficial cotton wool like lesion and white spot over body surface. A number of *Aeromonas hydrophila* have been isolated from anus and kidney of diseased fish. This study also highlighted chemical treatment trail and histopathological changes of different organs of fish due to ill health.

## **Study on fish disease and health management in rural aquaculture**

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### **Abstract**

Lack of information exists on fish disease and health management in rural aquaculture. In order to understand fish health problems and to identify and characterize pathogens clinical, bacteriological and histopathological techniques were employed with naturally infected fishes collected from different rural farms. Primary identification and characterization of bacterial isolates included Gram's stain, motility test, oxidase test, O-F test, O/129 and antibiotic sensitivity tests. Further characterizations were accomplished using API-20E microbial identification kit. A total twelve bacterial isolates were collected from the sampled fish. All the isolates were identified as *Aeromonas hydrophila*. They were mostly recovered from kidney and lesion of affected fishes. Hemorrhagic lesion over body surface especially in mouth and caudal region and rectal protrusion in pangas were associated with the bacterial infection. Internally, kidney, liver and spleen were swollen and enlarged. The pathogenicity of the bacterial isolates has also tested by injecting fish intramuscularly with bacterial suspension. The percent cumulative mortality obtained upon termination of the trial at 14 days post-challenge ranged from 30% to 90% for different isolates. Histopathologically, kidney and lever of pangas was found more affected due to Aeromonad infection. Renal tubules were totally lost and necrotic haemapoietic tissues could be seen. Colonies of bacteria was found in kidney of infected fish. Other organs were also found severely affected due aeromond infection. The isolates of *A. hydrophila* found to vary in their sensitivity to the ten antibacterial agents tested. All the isolates were sensitive to doxycycline, erythromycin, sulphadiazine-trimetroprim, sulphamethoxazole-trimetroprim and Nitrofurantoin. They were resistant to amoxiciline, ampicilline and tetracycline. Arithromycin and cortimoxazole was found less sensitive. The effects several antibiotics have been examined with experimentally infected fish. Variations were found with the effect of the antibiotics on infected fishes. Future studies focus on further isolation and characterization of pathogens and treatment trial with selected drugs in field condition to find out effective disease treatment and fish health management packages.

## Comparison of performance among three commercial and a formulated test feeds on survival and growth of freshwater prawn

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### Abstract

An experiment was conducted to compare the efficacy of three selected commercial and a laboratory formulated test feeds of freshwater prawn *Macrobrachium rosebergii* (De Man 1979) for a period of 120 days during July to October 2012 in earthen ponds at the Fisheries Field Laboratory, Bangladesh Agricultural University, Mymensingh. The purpose of this trial was to explore the better feed for further use towards prawn brood development. Four treatments F<sub>1</sub>, F<sub>2</sub>, F<sub>3</sub> and F<sub>4</sub> with three replications each were, treatment F<sub>1</sub> (Mega feed with Crude protein 33.49%, Lipid 5.38%, Carbohydrate 30.31%), treatment F<sub>2</sub> (SABINCO feed with Crude protein 26.70%, Lipid 5.50%, Carbohydrate 34.34%), treatment F<sub>3</sub> (CP feed- with Crude protein 38.90%, Lipid 8.09%, Carbohydrate 25.37%) and treatment F<sub>4</sub> (Test feed with Crude protein 33.00%, Lipid 11.13%, Carbohydrate 25.43%) were compared on growth and survival of prawn. Juvenile prawns of 4.16±1.26 cm and 1.24±0.96 g were stocked at a density 3.0 m<sup>-2</sup>. Feeds were applied twice daily at dawn and dusk at feeding rate 10% body weight for first two months then reduced to 5% for next two months. Water quality parameters such as water temperature, DO, DO saturation level, NH<sub>3</sub>-N, NO<sub>2</sub>-N, NO<sub>3</sub>-N, PO<sub>4</sub><sup>-3</sup> and depth among the treatments did not vary significantly (p>0.05); other parameters like pH, transparency, TDS, conductivity and chlorophyll-a were found to vary significantly (P<0.05). The mean survivals were 71.18±6.78<sup>b</sup>%, 68.06±6.78<sup>c</sup>%, 78.47±4.34<sup>a</sup>% and 61.11±3.18<sup>c</sup>% in treatments F<sub>1</sub>, F<sub>2</sub>, F<sub>3</sub> and F<sub>4</sub>, respectively, which varied significantly among the treatments. The growth rates of prawn at harvest were obtained as 58.00±8.72g, 56.00±9.54g, 67.00±7.55g and 47.00±4.36g in the treatments F<sub>1</sub>, F<sub>2</sub>, F<sub>3</sub> and F<sub>4</sub>, respectively. SGR (specific growth rate) values were 3.03±0.12%, 3.17±0.15%, 3.32±0.10% and 3.03±0.08% in the treatments F<sub>1</sub>, F<sub>2</sub>, F<sub>3</sub> and F<sub>4</sub>, respectively and did not vary significantly. F<sub>3</sub> that is CP feed was found to show an apparently better performance in its effect on growth and survival than the rest feeds.

## Effect of different feeding regimes on growth and production performance of air-breathing stinging catfish, shing (*Heteropneustes fossilis*) and major carps in pond polyculture

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### Abstract

The stinging catfish or shing (*Heteropneustes fossilis*) is a high value, micronutrient dense, air-breathing fish that has a strong capacity to tolerate poor oxygen environments. Because of this, the culture of shing has grown substantially over the past decade in Bangladesh. Feed constitutes almost 80% of the total variable costs of producing shing, so methods to

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reduce feed inputs can provide significant benefits, particularly if fish are polycultured with carps that rely primarily on natural pond productivity rather than direct consumption of formulated feeds for their growth. A study was carried out at the Fisheries Field Laboratory at Bangladesh Agricultural University to evaluate the effects of reduced feeding regimes on the growth and production of major Indian carps, rui (*Labeo rohita*) and catla (*Catla catla*) in pond polyculture with shing over a 120-day growout period. The experiment comprised three treatments in nine ponds (100 m<sup>2</sup> area, 1.5 m depth) each stocked with an equivalent number of carps (catla, 20 and rui, 80) and shing (500); with full feeding daily (T1), half feeding daily (T2), and full feeding on alternate days (T3). All ponds were fertilized weekly (N:P = 2.0:0.5). Commercial pelleted feed was applied according to current culture practices (20% down to 5% body weight of shing) either daily (T1) or on alternate days (T3) at full ration level or at half-rations daily (T2; 10% down to 2.5% bw of shing). Pond water temperature, TDS, conductivity, total alkalinity, pH, dissolved oxygen, ammonia-nitrogen, phosphate-phosphorus and chlorophyll-a did not differ among treatments ( $p > 0.05$ ), while transparency was reduced in T1. No significant effect of treatment on survival rates was observed among the three species. Specific growth rates (SGR) of rui and catla did not vary significantly among treatments, but SGR was slightly reduced for shing in T3 relative to T1. No difference in shing SGR was observed between the T1 and T2 groups. The mean harvest weight of shing was similar in T1 (full feeding) and T2 (half feeding) groups, while both were higher than T<sub>3</sub> (alternative day full feeding) fish. The apparent combined feed conversion ratio (FCR; feed applied to body weight gain) was lower in T2 and T3 relative to T1. The production of each (of three) species was higher in T1 than the T2 and T3 groups. The combined net production for the three species was 3,300 kg/ha for T1, 2,136 kg/ha for T2, and 2,440 kg/ha for T3. Despite the higher net production of fish in T1, the benefit-to-cost ratio (returns - investment) was better for T2 (3.34) and T3 (2.97) than for T1 (2.55). This is largely due to the lower costs of feed associated with 50% feed reduction strategies. Thus, despite lower production levels, daily feeding at half ration levels was the most cost effective strategy.

## Reproductive biology of nutrient-rich small fish, mola (*Amblypharyngodon mola*) in hapa system

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### Abstract

An experiment was conducted over ten months for Mola (*Amblypharyngodon mola*) study of biology in fine mesh hapa system in the BAU Fisheries Field Laboratory, Mymensingh. Some of their physico-chemical parameters of water, gonad maturation, morphology, etc. of mola were studied in confined area in hapa set in the pond to create a breeding friendly ecosystem. There were six hapas: three are 20m<sup>2</sup> and three are 2m<sup>2</sup> i.e stocking densities 100g and 250g wt. (avg. 1-2g) mola, respectively. The commercial feed was supplied to the brood of mola in hapas, those bred on several occasions in the same season indicating their prolific breeder characteristics. The presence of mature broodfish, smaller size fry and juvenile were found in the same hapa over the season. The female mola in most cases was found to disappear after breeding. Some were in weak health and sick condition which indicated that within a short period after breeding the female brooder die. However, all the fishes were not matured at a time and the small fish become matured with 2-3 months after

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stocking, new females recruited as brooder and the process thus continued. Although, the hapa based system has given some ideas on the breeding biology of few mola, not all mola bred in the other hapas at the same time. The observation of the mortality of the female broodfish of mola within short period after breeding has confirmed the speculation that the female broodfish of mola die after breeding.

## **Appraisal, assessment and management of Bombay duck *Harpadon nehereus* stock in the Bay of Bengal**

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### **Abstract**

The Bombay duck, *Harpadon nehereus* (Hamilton, 1822), *Aulopiformes: Synodontidae*, locally known as lottya is an important fish species, widespread in the Bay of Bengal, and commonly caught in every marine fishing point in Bangladesh. Bombay duck is an excellent food fish, highly commercial having substantial export demand, marketed fresh and dried or salted or smoked. The fish is extremely adorable, extensively used as a relish with curry, and consumed pan-fried. The present research work was proposed to determine its occurrence and distribution, age and growth, recruitment pattern, spawning period, frequency of spawning, length of spawning season and fecundity, and both natural and fishing mortality with a management suggestions to conserve the stock of this valuable fish species using fish samples to be collected from the Bay of Bengal for a period of two years. Data collection is being continued and would be end up in December 2014. A total of 600 specimens from 6-month samples were collected by June 2013. Among the total number of fish 306 were male and 294 were female. Sex ration between male and female did not deviate from parity ( $\chi^2$  test,  $p > 0.05$ ). The standard length of male ranged from 73 to 185 mm, and the body weight ranged from 2.41 to 38.9 g. The standard length of female ranged from 50 to 191 mm, and the body weight ranged from 2.04 to 34.7 g. The required analyses to address the objectives of the research project are in progress.

## **Study of reproductive endocrinology of mud eel *Monopterusuchia* for artificial propagation**

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### **Abstract**

In order to understand different aspects of reproductive biology of endangered mud eel *Monopterusuchia* gonado-somatic index (GSI), gonadal maturity stages, fecundity, ova diameter and secondary sexual characters were studied for a period for one year. Fish samples were collected from *haor* and *beel* areas of Mymensingh, Netrokona and Rangamati districts. The highest GSI of  $6.002 \pm 1.672\%$  was observed in mid May and lowest of  $0.232 \pm 0.015\%$  in September. This indicated that the peak breeding season of mud eel was from late April to early May. Monthly study of oogenesis revealed that the mature stages of oocytes (premature and mature oocytes) were found from April to June samples of ovary,

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indicating the spawning season of *M. cuchia*. Fecundity was measured for a period from mid March to mid May and ranged between 132 (body weight 240g) to 461 (body weight 380g). The highest fecundity was observed in mid April and the lowest was in mid May. The most distinct feature to separate the both sexes was shape of their genital papilla. The female papilla became rounded and swollen; on the other hand the male genital papilla was sunken and elongated, observed in April-May. To get a clear understanding about the exact trigger of inducing reproduction of this fish during season immunohistochemistry (IHC) of *cuchia* brain IHC trial which revealed that sGnRH-ir (immunoreactive) fibers were observed in the ventral olfactory bulb of the mud eel brain, and running to the preoptic area. Induced breeding trial of captive *cuchia* collected from two geographical locations (Netrokona and Rangamati) is underway. Since *cuchia* is summer-monsoon spawner (April - July), its induced breeding trial manipulating the environment (creating thick layer of aquatic weed in breeding *hapa*) and different inducing agents (e.g., PG, HCG, GnRHs, etc) are ongoing. This study provides the first detailed information about oogenesis of *M. cuchia* from the Sylhet basin of Bangladesh. It is expected that the information of this study can potentially be used for bringing a new high priced fish into aquaculture for supporting export earnings of the country in future.

## **Histological study of gametogenesis in riverine and marine populations of *Tenualosa ilisha* in Bangladesh**

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### **Abstract**

A study was conducted on the length-weight relationship, condition factor, fecundity, gonadosomatic index (GSI) and gonadal histology of hilsa shad (*Tenualosa ilisha*) from the Chandpur stock and Barisal stock. During first year of the study, samples for length-weight relationship, condition factor, GSI, gonadal histology and annual reproductive cycle were collected from the Chandpur stock. Sampling was done monthly starting from June 2012 till date. Sampling during the spawning season of hilsa was done weekly or fortnightly. From the first year's sample, GSI was estimated using standard formula. The GSI value shows that peak breeding of Hilsa in Chandpur stock occurs twice in October (mid October – full moon and late October – new moon) followed by sudden fall in GSI from November. Our finding is in contradiction with the hilsa fishing ban plan declared by Department of Fisheries (DoF) where fishing ban was from 25 September to 05 October 2012. It is expected that gonadal histology and study of annual reproductive cycle will give better understanding on the spawning cycle of *T. ilisha* in future.

## **Stock assessment and management of spotted snakehead *Channa punctata* in Bangladesh**

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### **Abstract**

Stock parameters of spotted snakehead eel, *Channa punctata*, a small indigenous fish species in the haor waters of Mohanganj upazilla in Netrokona district of Bangladesh were

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assessed. Commonly used models were employed using 1200 individuals from 12 monthly samples over one year. Male-female ratio did not deviate from parity ( $\chi^2$  test,  $p > 0.05$ ). Recruitment occurred at standard length (SL) of 81.66 and 85.87 mm, and at age about 0.43 and 0.46 years for male and female respectively. ELEFANI model estimated 217.88 mm asymptotic SL for male and 186.6 mm for female. Growth coefficient was 1.1 for male, and 1.35 for female per year. The asymptotic body weight (BW) for male and female were 220.65 and 164.25 g respectively. The longevity of male and female were 2.72 and 2.22 years respectively. Growth performance index for male was 4.71 and that of female was 4.67. The study confirmed this species spawned from February to May with a peak in April. The minimum SL of a spawning female was 106 mm, and the mean SL at first sexual maturity was 125.07 mm. The analyses of SL-fecundity and BW-fecundity relationships revealed strong relationships between them ( $R^2 = 0.979$  and  $0.872$ ), and they were statistically significant ( $p < 0.05$ ). The fecundity was 5796 eggs at SL at sexual maturity. The natural and fishing mortalities for male were 1.69 and 2.07 per year, and they were 0.80 and 1.02 per year for female. Males were exploited at a rate of 0.32 and females 0.33 per year in the river haor waters under study. The maximum yield per recruit obtained for male was 21.23 g at fishing mortality of 2.0 per year, and that for female was 18.59 g at fishing mortality of 2.8 per year. The biomass analyses suggested that male attained about 29.38 kg when 12 months old while female 26.03 kg at age of 10 months if 1000 individuals for each sex recruited to the adult stock. A management policy guide to the sustainable fisheries management of *C. punctata* in haor waters was prepared.

## **Assessment of the post-harvest loss of Ilish, *Tenualosa ilisha* in Bangladesh**

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### **Abstract**

The total catch of hilsa *Tenualosa ilisha* was 3.4 million tones in Bangladesh in 2012. A considerable portion of this fish is presumed to have been lost during the period between harvest and retail sale. The current study is an innovative attempt to assess post-harvest loss of hilsa throughout the country under a holistic approach considering all steps of distribution channels where potential losses might be occur. In the first phase of the study, the post-harvest handling, distribution pattern and quality conditions were assessed. The second phase was designed for assessing quality loss in wet fish and products. Rigor-mortis was found to occur very early in hilsa, within 15-30 minutes of death. The fish achieved full rigor within 2 hours at ambient temperature (33°C) and rigor lasted for 16±0.4 hours. Fishing gears and harvesting period determined the initial quality of hilsa. Monofilament and other gill nets and set-bag nets deteriorated the quality. Hilsa with higher lipid content in pre-spawning catch got muscle deterioration earlier than those with lower lipid in post-spawning or lesser season (winter) catch. Hilsa was sold at very high price, so better care was taken in post-harvest handling and marketing, unless any sudden glut catch disrupted ice supply and other facilities. Glut catch occurred once or twice in a year, mostly during September-October. Handling of hilsa on-board fishing vessel, at landing and in different steps of distribution and marketing was found to be adequate. Icing in traditional fashion was sufficient in case of market size hilsa, except during glut catch when ice supply could not meet huge demand. Majority of the hilsa were transported by bamboo baskets of different shapes and sizes, with

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or without hogla mat or polythene covered and with sufficient ice. Hilsa landed in Padma-Meghna confluence are mainly transported through water-ways by typically renovated insulated country boat. Hilsa landed in Chittagong and Cox's Bazar are transported by road or railway transports. Other fish boxes used were plastic drum, steel made half-drum, sac made of *hogla* and polythene sheet, aluminium container with or without lid, wooden, fibre glass or plastic craters, styrofoam box and ice boxes. Quality conditions of fish in all boxes were acceptable, except for the glut catch used in salting. Hilsa transporting to Mymensingh from either Cox's Bazar-CTG or Barguna-Chandpur are in acceptable condition up to retail markets. The DP between the two routes differed in both wholesale and retail markets. It was observed that hilsa transported to Mymensingh from Barguna-Chandpur were better in quality than those transported from Cox's Bazar-Chittagong. As a whole, handling and transportation of hilsa throughout the country was good, but sometimes, from auction to retail shop transport concurred little post-harvest loss. Neither of the fish lost their quality when they were in fishermen, landing centers or commission agents in primary fish market. A 2% and 5% loss in hilsa destined for consumer market as wet fish was, however, recognized in landing centers and *Aratders*. Hilsa sold by vendors were found to be deteriorated significantly. Hilsa used for salting was found to suffer a substantial loss while they were in fishermen (14%) or landing center (43%). As much as 67% of post-harvest loss of hilsa was recorded at the processors of hilsa salting.

## **Development of fish pickle and fish condiment (Chutney) from pangus Fish (*Pangasianodon hypophthalmus*) and its shelf life study under various storage condition**

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### **Abstract**

The abstract preferably less than 400 words should state concisely the scope of the work and the principal findings and should not just recapitulate the results. It should be complete enough for direct use by abstracting services and name & address of list of authors. Later it will be included in BAURES proceedings. Acronyms and references should be avoided). Fish pickle and fish condiment were developed from Thai pangus (*Pangasianodon hypophthalmus*) by using different types of food additives. Mustard oil and soybean oil were used for making fish pickle and fish condiment. Dorsal muscle and whole fish muscle without bone were used as raw material for making both the products. A panel of six persons of teachers and students of the Department of Fisheries Technology provided the sensory assessments of the products. Fish pickle prepared by using mustard oil was more accepted than soybean oil by the panelists. Fish pickle prepared from dorsal muscle and whole fish muscle were equally accepted by the panel. On the other hand, fish condiment prepared from whole fish using mustard oil was more acceptable by the taste panelists than the condiment prepared from dorsal muscle using either mustard or soybean oil. A study on the shelf life of the products at different storage temperatures has been carrying out. Data until 2 months of storage at different temperatures showed that- the shelf life of fish pickle prepared from dorsal muscle and whole fish muscle using both mustard oil and soybean oil was not longer than 15 days at room temperature. Bad smell and fungal attack appeared in the product. But in case of refrigeration temperature the quality of the pickle was stable and remained good even after 60 days. Neither bad smell nor fungal attack was apparent. The deterioration

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occurred in the pickle samples for both temperatures though it was slower at refrigeration temperature. Moisture, lipid and protein decreased as days passed. Ash and pH value increased and the samples became acidic. In case of soybean oil sample deterioration was higher than the samples with mustard oil. The fungal attack was larger in mustard oil pickle. Bacterial load was higher in soybean oil pickle and the pickle prepared from whole fish muscle. At both temperatures bacterial load increased in the samples significantly though at refrigeration temperature the bacterial growth was slower. On the other hand, the self life of fish condiment prepared from dorsal muscle and whole fish muscle using both mustard oil and soybean oil, was also not longer than 15 days. Bad smell and fungal attack were apparent in the product after 15 days at room temperature. But in case of refrigeration temperature the quality of the condiment was stable and remained good even after 60 days. Neither bad smell nor fungal attack was apparent. The deterioration occurred at the condiment samples for both temperatures though it was slower at refrigeration temperature. Moisture, lipid and protein percent decreased as days passed. Ash and pH value increased and the samples became acidic. In case of soybean oil used sample the deterioration was higher than the samples prepared with mustard oil. The fungal attack was larger the condiment prepared with mustard oil. Bacterial load was higher in the condiment prepared with soybean oil from whole fish muscle. At both temperatures bacterial load increased in the samples significantly although at refrigeration temperature bacterial growth was slower.

## **Production of fish silage from small low cost fish, fish entrails, small shrimp and shrimp waste suitable for protein supplement in fish, poultry and animal feed**

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### **Abstract**

This study was undertaken to investigate the suitability of fish entrails (heads, bones, viscera, fins) as raw materials for fish silage production using lactic acid bacteria (LAB) *Lactobacillus*. For the isolation and identification of lactobacilli a protocol was established in the basis of characteristics of typical *Lactobacillus* bacteria. *Lactobacillus* was isolated from fresh milk. Two types of fish silage were prepared using pure culture of *Lactobacillus* as lactic fermentation starter and formic acid as acid fermenter. The starter bacteria and molasses were added to mince of fish entrails in three different compositions for the production of three different fermented silage (FS-1, FS-2 and FS-3). On the other hand only 3% formic acid was added in minced entrails for acid silage (AS-1) production. All the four treatments were kept at room temperature (25-30) °C for 90 days. Changes in pH, lactic acid bacteria (LAB) and non-protein nitrogen (NPN) in the treatments were continuously monitored throughout the fermentation period and finally their proximate composition and amino acid composition were determined. A rapid decrease in pH and increase in NPN concentration of all the silage were observed and desired pH level (4.5) was reached within 6 days of fermentation. According to the amino acid profile biological value of all the four types of silage were very high because all the essential amino acids were present in fairly high concentration. Percentage of crude protein and fat were less in fermented silage may be due to addition of molasses and lower proportion of fish mince in fermented silage. Seven iso-nitrogenous test diets were prepared with two types of silage replacing 25%, 50%, 75% and 100% fish meal. On the basis of the observed growth rate, food conversion ratio, protein efficiency ratio and apparent net protein

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utilization of the fish feed diet 7 (replacing 50% of fish meal protein with lactobacillus fermented silage) exhibited the best growth performance followed by diet 6 (75% of formic acid treated silage). The result of the present study demonstrated that the dry fish silage prepared by using lactobacillus could partially replace the costly fish meal in fish feed.

## **Influence of chemicals and drugs on microbial flora used indiscriminately in aquaculture**

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### **Abstract**

Aquaculture of finfish, crustaceans, mollusks, and algal plants is one of the fastest-growing food-producing sectors in the world. To combat disease outbreaks and to ensure productivity, various inputs are required for successful production. Chemicals are important components in health management of aquatic animals, soil and water management. Although there are plenty information available related to their effect on fish body, but there are little no information related to their effect on microbial flora residing in fish body and in aquaculture environment. Studies were, therefore, conducted to determine the influence of antibiotic especially oxytetracycline (OTC) on microbial flora. Aquarium experiment in triplicate was set at the Laboratory of Fish Harvesting, Department of Fisheries Technology, BAU and pond experiment were set at the 10 ponds located at the vicinity of the Faculty of Fisheries, BAU to determine the effect of OTC on ruhu (*Labeo rohita*), mrigel (*Cirrhinus mrigala*), shingi (*Heteropneustes fossilis*), magur (*Clarias batrachus*), Thai pangus (*Pangasius hypophthalmus*) where medicated diets were fed for 5 days and later fish and water samples were collected at definite time intervals for analysis. Water collected from aquaria were subjected to physico-chemical analysis for ammonia, nitrate, nitrite, hydrogen sulfide by using standard procedures whereas, bacterial load and detection of *E. coli* and *Salmonella* was determined using standard procedure. Results of quantitative estimation of aerobic heterotrophic bacteria in the experimental aquaria and pond water and in fish gill filaments and intestine of ruhu, mrigel, shingi, magur and Thai pangus showed that for ruhu, in day-0 (before treatment) there was highest bacterial load in aquarium water was  $2.16 \pm 0.06 \times 10^3$  cfu/ml which was reduced to  $0.87 \pm 0.03 \times 10^2$  cfu/ml after 13 days. Similarly bacterial load of ruhu fish gill, intestine decreased with the application of OTC medicated diet. The pattern of changes in bacterial load in mrigel, shingi, magur and Thai pangus were more or less similar to that obtained for ruhu fish. Interestingly it was also observed that OTC treatment on fish also influenced *Escherichia coli* and *Salmonella spp.* which are regarded as sanitary index organism. They also have great influence in quality of end products. It was found that *Salmonella spp.* was not found in the OTC treated aquaria and pond water but *E. coli* was present throughout the research period indicating positive effect of OTC for reducing sanitary organisms in the aquaculture system.