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MESSAGE FROM THE CONFERENCE CHAIR - ICFA 2017

It gives me great pleasure and privilege to send this message as the Chair of the 4th International Conference on Fisheries and Aquaculture (ICFA-2017) organized by the International Institute of Knowledge Management (TIIKM) from 24th to 25th August 2017 at Colombo, Sri Lanka.

Aquatic biodiversity has enormous economic and aesthetic value and is largely responsible for maintaining and supporting overall environmental health. Human have long depend on aquatic resources for food, medicine, and materials as well as for recreational and commercial purposes. Further aquatic organisms also rely upon the great diversity of aquatic habitats and resources for food, materials, and breeding grounds. Depletion of aquatic biodiversity has become the most important environmental issue of the century, given the devastating impacts it has caused all over the world. Factors including overexploitation of species, pollution from urban, industrial, and agricultural areas, the introduction of exotic species, as well as habitat loss and alteration through damming and water diversion all contribute to the declining levels of aquatic biodiversity in both freshwater and marine environments. As a result, valuable aquatic resources are becoming increasingly susceptible to both natural and artificial environmental changes. Farming aquatic fauna and flora in aquaculture minimize such effect on environment as it contributes immensely for catering the increasing demand of aquatic products for present and future needs of growing world population. The contribution of aquaculture to total fish production has steadily increased over the last few decades and is continuing to increase around the globe.

In dealing with protection of aquatic biodiversity, while practicing aquaculture is required international cooperation and knowledge sharing, as no single nation alone can deal with the complicated impacts associated with this global issue. The 4th International Conference on Fisheries and Aquaculture 2017 (ICFA-2017) is held with the theme of 'Depletion of Aquatic Biodiversity and Aquaculture as a Decisive Remedy', as there is a big challenge ahead of us in facing the impacts of certain anthropogenic activities such as overexploitation, habitat modification and pollution loading into aquatic environment. All of our responsibility is to protect aquatic biodiversity while minimizing aforesaid activities along with enhancing best management practices in aquaculture by the end of the century. One of the key goals of the conference is creating dialogue among those involved in research and development activities in aquatic biodiversity and aquaculture, nationally and internationally.

As the Chair of the conference I congratulate all those involved for the success of the conference and wish a great success for the Conference!

Dr. Saman Athauda (B.Sc., M.Sc., Ph.D.)

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A1 **[01]**

BIODIVERSITY AND SPATIAL DISTRIBUTION OF MOLLUSCS (GASTROPODS AND BIVALVES) IN TANGERANG COASTAL WATER, INDONESIA

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ABSTRACT

The coastal water of Tangerang has been degraded due to human activities such as industry, aquaculture, reclamation and mangrove to pond conversion. Those activities impact the biodiversity of molluscs as decomposer organisms in the bottom of water. The purpose of this study is to determine the biodiversity and spatial distribution of molluscs in Tangerang coastal water. The samples were taken from fifty two stations during the period of April to August 2014. Samples were then identified by using World Register of Marine Species Standard and analysed by Canonical Correspondence Analysis (CCA). The research found 2161 specimens of molluscs scattered in 15 taxa (bivalves) and 9 taxa (gastropods). The highest abundance was found in *Nuculana bicuspidata* with density (range 1100-1517 ind/m^2) are found in the station T12, T16 and T17 are near with embouchure. Degradation by pollution accounts for a decrease in molluscs, showed in stations adjacent to the embouchure having high abundance while the number of species is low. The results showed bivalves have associated with a substrate of mud while gastropods associated with a substrate of sand. Texture of substrate, dissolved oxygen and pollution concentration is the key parameter for distribution of molluscs in Tangerang coastal waters, Indonesia.

Keywords: Tangerang, Mollusca, Biodiversity, Distribution, Gastropods, Bivalves

A2 **[02]**

VARIATIONS IN WATER QUALITY CONDITIONS AND FUNCTIONAL HABITATS IN NEGOMBO LAGOON WITH SPECIAL REFERENCE TO SEABASS CAGE CULTURE PRACTICE

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ABSTRACT

With the development of fin fish cage culture, the discharge of dissolved and solid wastes from the cages to the environment may causes serious problems of coastal eutrophication. This work was carried out to study the variations of two important functional groups, zooplankton and macrobenthos and the water quality of two locations, Munnakaraya and Dungalpitiya in Negombo lagoon used for culture of seabass (*Latus calcarifer*) in floating net cages against to a reference site at Katunayake where there is no culture practices are carried out. Thephysico-chemical parameters, species composition of zooplankton were monitored in the vicinity of two culture sites in the lagoon. Benthic samples were collected from seabass cage areas at Dungalpitiya under the cages and outside the cages using a Peterson grab. Observations also made for the seagrass habitats. Water quality parameters were not significantly different among the sites. The average ammonia levels were 0.087, 0.093 and 0.266mg/l, nitrite; 0.011, 0.012 and 0.01mg/l, nitrate; 0.374, 0.413 and 0.360mg/l and total phosphorus; 0.298, 0.448 and 0.299mg/l at Munakkaraya, Dungalpitiya and Katunayaka respectively. Average turbidity levels were not significantly different among the three sites and ranged from 2.05 to 29.9 NTU. Salinity was recorded in the range of 6-32, 1-31, 0-31ppt at Munnakaraya, Dungalpitiya and Katunayake respectively. Water depth among the three sites were significantly different ($p<0.001$) and the maximum mean depth (3.83m) was recorded at Munnakaraya. Higher zooplankton density was recorded during April-July 2015 due to higher chlorophyll concentration. Highest percentage density of rotifers at Dungalpitiya may be due to the higher nutrient loading and poor water circulation pattern compared with Munnakkaraya where tidal flushing is effective. The percentage of rotifer levels recorded at Katunayaka was significantly low compared to other two sites. Major benthic groups encountered under the seabass cages were not significantly different than those out of the cages. Anyhow when consider total density, there was high abundance of benthic invertebrates in the areas devoid of cages compared to adjacent cage areas ($p<0.05$). The sites with floating seabass culture net cages showed no difference in terms of water quality and zooplankton distribution while there is a possibility to increase density of bottom dwelling pollution indicator species, because of lower water depth and flow in Dungalpitiya that help to accumulate excess feed (trash fish) and faecal matter under the cages. Seagrasses were not observed in all the three sites during the period. But the water quality parameters were not reflecting any pollution condition and still remain in the acceptable range for aquaculture in Negombo lagoon.The findings would be important as the baseline data on determination of carrying capacity of Negombo lagoon for further development of seabass culture in future.

Keywords: Seabass Cage Culture, Zooplankton, Macrobenthos, Water Quality

A3 **[03]**

BASELINE SURVEY ON SPECIES DIVERSITY AND ABUNDANCE OF REEF FISHES INHABITING DIYABAGALA REEF AT OFF NEGOMBO COAST IN SRI LANKA

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ABSTRACT

Reefs are very productive ecosystems and rich in biodiversity. Presently, these ecosystems are threatened by both natural and anthropogenic activities. Due to these activities degradation of biodiversity is often happen. While restoring damaged ecosystems, the original situations must be known. However, due to lack of baseline surveys, most management and conservation strategies cannot be properly implemented. Diyabagala reef which is situated off Negombo in the west coast of Sri Lanka. It begins from Kapungoda area and lies towards Northward direction of the country. The total length of the reef is about 8km to 10km and situated 18-20km far away from the coast of Negombo. Since reef is consisting along many domes, it is considered as one of the most famous recreational diving sites in the West coast of Sri Lanka. However, the reef is presently being threatened by various human activities such as coastal developments and excessive fishing, a baseline survey is needed while managing practices implementing. Therefore, a baseline survey for reef fishes was conducted in February 2017**.** Under Water Visual Survey (UVS) was carried out at randomly selected study sites to study the biodiversity and abundance of reef fishes. Fish species were recorded from a video camera on separate swims along 50m long 5m wide transects. The fishes were identified using standard keys. The results indicated that, 20 fish species belonging to 12 families (Acanthuridae, Lutjanidae 8%, Blenniidae 1%, Chaetodontidae 7%, Pomacentridae 1%, Pinguipedidae 1%, Caesionidae 64%, Balistidae 16%, Zanclidae 1%, Labridae 1%, Haemulidae 1% and Pomacanthidae) along the transects. Data was analyzed using one way ANOVA test and the species richness of the each study sites were statistically significant. And grouping to the moderate to poor species diversity and density according to the Hilomen's species richness and abundance index of 2000. Among recorded fishes, reef associated fish families such as Caesionidae (Fusiliers), Balistidae (Trigger fishes) and Lutjanidae (Snappers) were dominant and showed schooling behavior. Since these types of dome reefs are used as nesting sites, probably Diyabagala reef provides a breeding site for these fishes. These information is useful for managing and conserving this reef in future.

Keywords: Reef, Diyabagala, under water visual survey, Biodiversity

A4 **[04]**

SEA LEVEL RISE AND VULNERABILITY OF THE LOW-LYING HABITATS IN THE COASTAL BELT OF SRI LANKA

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ABSTRACT

The variation and change of mean sea level was a major manifestation of climate change on earth. With the increase of sea level, the low lying habitats along the coastal margin have become vulnerable to the ocean based hazards frequently caused by extreme weather conditions such as Meteo tsunamis induced by the global climate change. The elevation of the coastal belt was computed by assessing mean sea level; zero to 3m altitude with 1 m contour using SRTM (Shuttle Radar Topographic Mission) 90 m Digital Elevation Map (DEM) originally produced by the NASA with horizontal datum WGS84 and Vertical datum EGM96 using Arc Map 10.1. The sea level rise was quantified by time series tide gauge records from Colombo, Sri Lanka obtained by the Permanent Service for Mean Sea Level (PSMSL) of the British Oceanographic Data Centre (BODC) and the National Aquatic Resources Research and Development Agency (NARA) in Sri Lanka. The sea level trend was quantified using difference data sources obtained by satellite altimeter global data facilitated by Achieving, Validation and Interpretation of Satellite Oceanographic (AVISO) data over a period of two decades from 1993 to 2013. The results revealed a positive trend with an annual sea level rise of 2.9 mm, indicating a vulnerability sign of submerge of the low-lying coastal habilitates within 20cm elevation within the next 50 years as a consequence of climate change. Authorities as well as policy makers of biodiversity protection and conservation should necessarily concern about future planning in this regard.

Keywords: Sea Level Rise, Coastal Habitats, Coastal Hazards

A5 **[05]**

LARVAL ASSEMBLAGE OF BIOFOULING ORGANISMS IN COLOMBO PORT, SRI LANKA

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ABSTRACT

Colombo port is one of the key nodes in east-west shipping route. Due to increasing shipping operations there is a high risk of contaminating biofouling organisms. Larval stages play key role in biofouling community formation process, but this has not been studied in Colombo port. Larval stages of the Biofouling community were studied in Unity Container Terminal (UCT); Colombo International Container Terminal (CICT); and Passenger Jetty (PJ) within the Colombo Port from March 2016 to December 2016 fortnightly. Free-swimming larval stages of fouling community were collected at 3m depth, using a 0.25m (25cm) diameter and 5.5 x 10^{-5} m (55-µm) mesh size conical plankton collector. Samples were preserved with 5% Buffered Formalin solution and identified to the nearest taxonomic level possible. Eight larval stages of marine biofouling species ware recorded. They are; *Obelia sp*. (Cnidaria), *Neosabellaria cementarium* (Annelida), *Bugulina simplex, Bugula neritina, Membranipora membranacea* (Bryozoa) and *Ascidiella aspersa, Ciona intestinalis* (Chordata (Class Ascidiacea)). Eight larval stages were found in all the three sampling locations except *Obelia sp*. where found only in CICT. Information on the larval stages of biofouling assemblage is crucial in managing and monitoring biofouling community dynamics.

Keywords: Biofouling, Larval Assemblage, Colombo Port

B1 **[06]**

MOLECULAR CHARACTERIZATION AND FUNCTIONAL ANALYSIS OF AKIRIN HOMOLOGUES IN BIG BELLY SEAHORSE *Hippocampus abdominalis*

A. Pavithiran, S.D.N.K. Bathige, R. Kugapreethan, T.T. Priyathilaka, H. Yang and J. Lee

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ABSTRACT

Akirins, members of NF-kB signaling pathway, are highly conserved nuclear proteins which regulate gene expression in many physiological processes including immunity, myogenesis, carcinogenesis, embryogenesis and neural development. The akirin family in teleost fish consists of two to three genes; akirin1, akirin2 (1) and/or 2 (2). In the present study, three homologues of seahorse akirin gene were identified from transcriptome database and designated as *Ha*akirin1, *Ha*akirin2 (1) and *Ha*akirin2 (2). The mRNA expression level of *Ha*akirins in different tissues of healthy seahorses and transcriptional modulations in kidney and liver tissues during immune challenges (LPS, poly I:C and *Streptococcus iniae*) were determined by using qPCR analysis. Tissue specific expression analysis revealed that all three *Ha*akirin homologues were ubiquitously expressed in all examined tissues with higher expression in ovary. During the temporal analysis, all three *Ha*akirin homologues showed a significant early up-regulation in kidney. In liver, expression level of *Ha*akirin2 (1) and *Ha*akirin2 (2) was significantly up regulated during the late phase of most immune challenges. To affirm the nuclear localization of *Ha*akirins, transfection studies were performed using fat head minnow (FHM) cells. For NF-kB luciferase assay, Human embryonic kidney 293T (HEK293T) cells were cotransfected with *Ha*akirins-pCDNA3.1 (+) and NF-kB reporter plasmid, and luciferase activities were determined. Relative luciferase activity was significantly higher for all three *Ha*akirin homologues than mock control. The results suggest that *Ha*akirin homologues might play a role in regulating NF-kB dependent immune genes expression and is critical for defense against bacterial and viral infections.

Keywords: NF-kB, Akirin, Seahorse, qPCR, Nuclear Localization, Luciferase Assay

B2 **[07]**

ALGAL GROWTH MITIGATION IN RESERVOIR WATER: IMPLICATIONS OF BIOCHAR FOR WATER TREATMENT

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ABSTARCT

Algal blooms due to eutrophication have caused sporadic problems in water treatment processes for decades; however, the existing physical, chemical and activated carbon techniques seem expensive and impractical. Biochar is a carbonaceous material produced by heating biomass to high temperature under low oxygen conditions which can be used as an alternative to expensive activated carbon. The study was conducted to analyze the potential of woody biochar for removal of algae from reservoir water at Kilinochchi district, Sri Lanka. Three reservoirs were selected such as Iranamadu, Dryaru and Akkarayan to study about the algal removal by using biochar. A column set up of 30cm height and 3.81cm radius was performed to filter the algae rich water through biochar. Then powdered biochar which particle size was less than 30mm. It was added into the pipe and finally the water samples were filtered through that bio-char. The raw water and the filtered water were examined through the microscope while counting the density of algae by using Sedgwick rafter. *Microcystis*, *Anacystis*, *Oscillatoria*, *Spirulina*, *Anabena Gloetheca Navicula* and desmids were commonly present in all three reservoir's raw water. The average raw water algae density in Iranamadu, Dryaru, and Akkarajan were 4690±360, 2091.7±271.4, and 2881.6±85 respectively and reduced remarkably after the filtration through biochar column to 23.3±5.8, 1.7±2.9 and 15±0 respectively. The average algal reduction was 99.5, 99.9 and 99.5% respectively. This indicates the potential of biochar for algae mitigation in the water supply from the reservoirs of dry zone, Sri Lanka.

Keywords: Biochar, Blue-Green Algae, Reservoirs, Water Treatment

B3 **[08]**

CULTURE OF A THAI BLUE MARINE SPONGE, *Xestospongia* SP. IN NATURAL CONDITION TO PRODUCE BIOACTIVE SECONDARY METABOLITES

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[2]*School of Agricultural Sciences, Walailak University, Thailand*

ABSTRACT

A Thai blue marine sponge, *Xestospongia* sp., was cultured under natural condition during rainy and dry season in the Makham estuary, Andaman Sea, Thailand. The sponge typically produces very high potent anticancer secondary metabolites namely renieramycins. The completely randomize design (CRD) was used for this experiment. Three difference substrates containing plastic tubes, ropes and calcium carbonate pieces were used. All experimental units contained 4 replications. One way ANOVA and statistical analysis were calculated by SPSS program. Secondary metabolite was analyzed by HPLC while the environmental factors were determined by standard test kit and instrument methods, monthly. The results showed that sponge produced several secondary metabolites mainly, renieramycin m. Renieramycin m production corresponded to environmental conditions. It gave low concentration on dry season but showed high concentration on early rainy season. Compound concentration correlated to salinity, pH, and temperature of sea water. The highest concentration of reniermycin m was found at salinity 28 ppt, pH value of 7.6, temperature 28 °C in rainy season, but it gave very low concentration at salinity 30-33 ppt, pH value of 6.5-7.5, temperature 30-33 °C in dry season. We also found that the sponge showed high growth rate at low turbidity, this because of suspension materials block water circulation cannels in sponge's body. This experiment gave primary data to culture a blue sponge, *Xestospongia* sp., in hatchery or artificial ecosystem for mass production of renieramycin m. This experiment gave primary data to culture a blue sponge, *Xestospongia* sp., in hatchery or artificial ecosystem for mass production of renieramycin m.

Keywords: *Xestospongia* sp, Secondary Metabolites, Environmental Factors, Culture, renieramycin m

B4 **[09]**

GROWTH PERFORMANCE, IMMUNOLOGICAL RESPONSE AND BODY COMPOSITION OF RAINBOW TROUT (*Oncorhyncus mykiss*) FINGERLING FED DIFFERENT MARINE MACROALGAE POWDERS AS A FEED ADDITIVE

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ABSTRACT

In this study effect of three marine macroalgae, *Saragassum boveanum*, *Cystosiera myrica (Polycladia myrica)* and *Gracilariopsi spersica* as feed additives was investigated on growth performance, immunity and body composition of rainbow trout, (*Oncorhynchus mykiss* Walbaum, 1792). In this regard, 210 juveniles of rainbow trout (average weight 26.88±0.90 g) were distributed in seven experimental treatments with three replicates (21 fiberglass tanks 100L). Treatments contained these three macroalgae in two levels (5 and 10 % of diet) and control (without additive). Feed was offered three times a day to apparent satiation for 8 weeks. At the end of the experiment, three fish per replicate were caught randomly for blood analyzing and body composition. The highest body weight gain and lowest FCR were observed in treatments of *Gracilariopsis persica* at level of 10 % that had no significant difference with control treatment. The highest amount of protein was found, in control treatment, as well as the highest amount of lipid were found, in treatment of *Gracilariopsi spersica* at level of 5 %. Any significant difference was not observed in the content of EPA (P>0,05). The highest content of DHA and PUFA were observed in treatments with marine macroalgae that significantly differences with control treatment (P<0.05). The highest and lowest serum lysozyme was observed, respectively in treatments of *Gracilariopsis* 5% and *Cystosiera* 10%. Also the highest and lowest complement hemolytic activity was observed, in treatments Saragassum 5 % and *Cystosiera* 10 %. respectively. Overall, the results showed that use of marine macroalgae specially *Gracilariopsis persica* at level of 10% caused improve fish immunity, body composition but not significantly increase growth of rainbow trout.

Keywords: Feeding, Marine Macroalgae, *Oncorhynchus mykiss*, Growth Performance, Body Composition, Immunological Response

B5 **[10]**

UTILIZATION OF BLOOD CLAMS (*Anadara Granosa*) TO MAKE HYDROLYSATE PROTEIN USING PAPAIN ENZYME

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ABSTRACT

Indonesia has a very rich of resource of fishery sector. It leads Indonesia as one of the biggest animal protein food supplier. However, Indonesia has lower animal protein consumption than Indonesian recommended dietary allowance. Hydrolysate protein is a product for food industry and pharmacy that has high protein. Making a hydrolysate protein can improve fishery product and also increase animal protein consumption in Indonesia. Blood Clam (*Anadara granosa*) is one of the Indonesia's fishery commodity product that have a high protein content, and can be made as hydrolysate protein. The purpose of this research are; to determine the hydrolysis time, the best concentration of papain enzyme and also the optimum pH in hydrolysate protein process. The result of this research specifies the best hydrolysis time is 15 hours with the residual solid 35.3 % (w/v), the best concentration of enzyme is 6 % (w/v), and pH 6. The characteristic of blood clam hydrolysate protein is 75.1% of protein and 16.45% of fat, and it produced 0.7 g/100 g of α-amino free nitrogen. Therefore, blood clam (*Anadara granosa*) can be an alternative to make hydrolysate protein that contain high protein which help increased animal protein consumption in Indonesia.

Keywords: Blood Clam, Enzyme, Hydrolysate Protein

B6 **[11]**

FEASIBILITY OF USING SAIL FIN CATFISH (*Pterygoplichthys* SPP.) MEAL IN THE DIETS OF JUVENILE GUPPY FISH (*Poecilia reticulata*)

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ABSTRACT

High abundance of invasive Sail fin Catfish has become a problem in most of the Sri Lankan reservoirs. There is a possibility of using Sail fin Catfish as an alternative protein source to replace commercial fish meal (FM) to produce low cost fish diets. This study investigated the effects of different inclusion levels of Sail fin Catfish meal (SCM) in the diets of juvenile guppy fish (*Poecilia reticulata)*. Guppy fish (1.99±0.09 cm, 0.07± 0.02g) were stocked in 12 glass tanks (60x30x30cm) at a stocking density of 10 fish/tank. Four isoprotein (36% Protein) and isoenergetic (energy 0.13kcal/g) experimental diets were formulated using FM and SC Min different ratios i.e: CD (30:0 FM:SCM), 10 SCM (20:10 FM:SCM), 20 SCM (10:20 FM:SCM) and 30 SCM (0:30 FM:SCM). Fish were fed three times per day up to satiation during the 6 weeks period. Total body weight, total body length, food consumption, % ADG, % SGR, HSI, FCR and % survival were measured during the experimental period. At the end of the experiment, food consumption (9.30±0.1 – 9.45± 0.50 %BW/day), total body weight (0.28±0.06 - 0.29±0.08g),% SGR (3.19±0.18 – 3.55±0.19), % ADG (6.75±0.69 – 8.20±0.88), % Survival (80.0±20.0 – 90.0±10.0), HSI (0.05±0.003 – 0.06±0.002) and Feed conversion ratio (1.77±0.16 to 2.21±0.26) were not significantly different among the treatments. Final total body length was ranged between 2.80±0.18 to 2.91±0.25 and 30 SCM recorded significantly highest total body length (2.91±0.25 cm).The profit index was significantly higher in 30 SCM (9.50±2.99) and 20 SCM (8.60 ± 6.73) treatments compared to CD treatment (6.57±5.43). The present study revealed that commercial FM can be replaced 100% with Sail fin Catfish Meal (SCM) in diets for guppy fish. Thus, preparing fish meal using Sail fin Catfish will be a feasible solution for the invasion problem in local reservoirs while producing low cost alternative protein source for the fish feed formulation.

Keywords: Fish Meal Replacement, Sail Fin Catfish Meal, Guppy, Growth Performance, Alternative Protein Source

B7 **[12]**

CRYOPRESERVATION OF SPERM OF CRITICALLY ENDANGERED MOHASHOL, *Tor tor* (HAMILTON) FOR *EX-SITU* CONSERVATION

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ABSTRACT

Cryogenic gene banking is a prime necessity for conserving the genetic constitutes of vulnerable, endangered and critically endangered native and exotic fish species. In this study attempts have been made to develop a cryogenic freezing protocol of spermatozoa of critically endangered mohashol, *Tor tor*. Juveniles of *Tor tor* were collected from wild and reared in ponds at Bangladesh Agricultural University campus. After maturation sperm were collected from hormone-induced males by stripping. The concentration of sperm was 4.47 x 10^{10} to 9.65 x 10^{10} cells/ml and pH was 8.6±0.5. Sperm motility was evaluated at different concentrations (0.1% to 1.0%) of activation solution (NaCl). Sperm motility decreased with increasing concentration of NaCl. Motility of sperm at 0.4% NaCl was more or less completely activated and that was completely inhibited at 1.0% NaCl. The toxicity of cryoprotectant, was evaluated by incubating sperm with DMSO and methanol at 5, 10 and 15% concentrations for a period of 5 to 55 min. The motility of sperm decreased with the increase of cryoprotectant concentration and 10% DMSO with Alsever's solution produced best motility at 10 min incubation (83.0±2.74%). Three extenders such as Alsever's solution, egg-yolk citrate, urea egg-yolk and two cryoprotectants, DMSO and methanol were used to preserve the sperm. Diluents were prepared by adding 10% cryoprotectant to 90% extender. Milt was diluted with Alsever's solution at the ratio of 1:9, and that of 1:4 with egg-yolk citrate and urea egg-yolk. The equilibration and post-thaw motility of sperm was recorded highest from Alsever's solution with 10% DMSO as 90±3.5% and 80±3.5% respectively. As no ovulated eggs were obtained fertilization using cryopreserved sperm was not possible. However, the protocol developed through this study can be applied for conservation of the critically endangered *T. tor* and it would also be used in other endangered fish species.

Keywords: Mohashol, *Tor tor*, Sperm, Cryopreservation, Conservation

B8 **[13]**

FORMULATION OF LOW COST FISH FEED FOR *Oreochromis niloticus* BY USING SCAVENGER *(Pterygoplichthys multiradiatus)* FISH MEAL

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ABSTRACT

The aim of this study was to develop a low cost fish feed using scavenger fish meal (SFM) as an alternative to commercial fish meal in in feed preparation for tilapia juveniles. Four isonitrogeneous (26%) and isocalaric (3200Kcal/Kg) diets were prepared using different proportions of SFM, coconut meal (CM) and rice bran (RB) changing the proportions of other ingredients and RB ratios in four diets were as follows; T1-10,31,18, T2-15,10,35,T3-15,28,16, T4-20,24,16) commercial diet (protein fat) was used as control treatment. Fish (weight 29.67 ±1.69g and length 11.7±0.85cm) were stocked in 15 tanks (3m x1.5m x 0.6m) at the ratio of 12 fish/ tank. Fish were fed with 3% body wt/day and the experiment was lasted in 40 days. Final weight of the fish were 54.0, 52.2, 51.5, 50.6, 46.8g for control, T4, T3, T1 and T2 respectively. Final length ranged from 46.83 ±13.14 (T2) cm to 54.05±10.58 cm (control). Final length, final weight, FCR and SGR were not significantly different among the treatments. Vicero Somatic Index (VSI) were 12.38±1.5, 13.55±0.58, 12.01±1.47, 9.93±0.76, and 10.15±1.3 for T1,T2,T3,T4 and control respectively Fish in T2 showed significantly highest VSI (13.55±0.58) and fish in T4 diet showed lowest VSI (9.93±0.76). Although feed cost of T2 diet was the lowest, the growth performance was better in fish in T4 diet and it can be suggested that T4 diet is economically more suitable when comparing the all four experimental diets.

Keywords: Scavenger Fish Meal, Low Cost, Feed, *Oreochromis niloticus*, Growth Performances

B9 **[14]**

EFFICACY OF NATURAL OIL ENRICHED ARTEMIA ON GROWTH AND SURVIVAL OF SEAHORSE FRY (*Hippocampus kuda*)

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ABSTRACT

Seahorse industry has become viable as it is a potential high value species with rapid growth and short life cycle. Seahorse has high demand as an ornamental fish as well an ingredient in traditional Chinese medicine. Frequent catches has led to rapid depletion of wild stocks from their natural habitats. The major obstacle in seahorse aquaculture is massive mortality of during early stages of in fry growth. Though it is very low in unsaturated fatty acids seahorse hatcheries mainly use *Artemia* as an initial fry feed. The present study is planned to evaluate the nutritional efficiency of *Artemia* enriched with two highly unsaturated fatty acids (HUFA) rich natural oils, sunflower oil and sesame oil on growth and of survival seahorse (*Hippocampus kuda*) fry. In this experiment 15 days old *H. kuda* fry were fed with sesame oil enriched *Artemia* nauplii (T1), sunflower oil enriched *Artemia* nauplii (T2) and unenriched *Artemia* nauplii as the control. *Artemia* in star II larvae enriched with two types of oils with concentration of 0.6 ml enrichment/liter of sea water. Each treatment was triplicated in glass tanks and each tank consisted of 15 numbers of fry. Measurements on length and weight gains, and survival were measured after 68 days of rearing. Specific Growth Rates (SGR) and the survival rates were calculated by means of the growth parameters. SGR was the highest in T1 (1.2790 ± 0.0291), and the highest survival rate recorded in T2 and in control (16.296 ± 5.592).SGR and survival rates were not significantly affected ($p < 0.05$) by the two differently enriched *Artemia*. Thus, we conclude that use of natural oil concentrations is not efficient enough to make significant effect on seahorse (*Hippocampus kuda*) fry growth and survival. Further experiment with alternative levels of sesame, sunflower oils and animal oils are suggested.

Keywords: *Hippocampus kuda*, *Artemia* Enrichment, Sesame Oil, Sunflower Oil

C1 **[15]**

AQUACULTURE IN PAKISTAN: CHALLENGES AND OPPORTUNITIES

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ABSTRACT

Pakistan is basically an agricultural country and is naturally endowed with huge water resources, both freshwater (8,563,820km^2) and marine water (290,270km^2) as well as brackish water, 1120km long coastal belt with an Economical Exclusive Zone of 350 nautical miles. Fisheries sector provide direct employment to about 400,000 fishermen and 600,000 people in ancillary industries. Estimated annual fisheries production is about 0.6 mmt including 63% marine and 37% inland. Pakistan has about 193 freshwater fish species, and 800 marine species. Only 31 fresh water fish species are considered as commercially important those are cultured. While, 120 marine species are commercially important but none of marine species yet practiced for being cultured. Fisheries production is of top 10 export commodities that share 1.0% of the country's total GDP. The domestic consumption of fish is about 1.9kg per capita is the lowest in the world. However, unlimited resources are evidence that fisheries play an important role in the economy and the diet of the population. The capture fisheries production is declining due to due to overexploiting natural resources. While, in recent year fisheries sector facing with numerous challenges including natural and anthropogenic such as natural disasters, climate change, industrialization, environmental pollution and overfishing. These factors collectively have significant threat to the income and food security of the population. Therefore, it urges for immediate actions by government and policymakers.

Keywords: Aquaculture, Challenges, Natural Resources, Opportunities, Pakistan, Production

C2 **[16]**

POTENTIAL OF SIGANID FISHERY AS AN AQUACULTURE COMMODITY IN THE CALUANGAN LAKE AND BARUYAN RIVER IN CALAPAN CITY, ORIENTAL MINDORO, PHILIPPINES

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ABSTRACT

Ecological Assessment of the siganid fishery was conducted in Baruyan River and Caluangan Lake in the City of Calapan, Oriental Mindoro, Philippines from June 2013 to May 2014. Two siganid species were identified in the study area, the mottled spinefoot, *Siganus fuscescens* (Houttuyn, 1782) and orange spotted spinefoot, *Siganus guttatus* (Bloch, 1787). Dissolved oxygen was found to fall within the permissible standard both during the wet and dry season sampling that gives suitable habitat for the two species of siganid to thrive to. Exceedance was observed in pH which surpassed the allowable range of 6.0-8.5mg/L. Sodium, chlorine, sulphate as well as the total dissolved solid (TDS) also registered values way above the permissible standard. Socio-economic conditions were also determined to see the level of exploitation the surrounding community wherein the availability of other sources of livelihood prevents the exploitation of siganid and other fishery resources in the study area. The two siganid species have potential for aquaculture but as shown in the study has not yet fully tapped in the Caluangan Lake. The study was able to achieve the objectives – hypothesis matrix to answer the questions in determining baseline environmental condition of the study area as well as capturing level of exploitation the community is exerting on the siganid resource.

C3 **[17]**

ABILITY OF AQUATIC PATHOGEN; *Vibrio campbellii* TO FORM BIOFILM ON DIFFERENT ABIOTIC SURFACES

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ABSTRACT

Biofilm formation by Luminous Vibrios is a serious concern in the shrimp aquaculture and the persistence of the organism in biofilms becomes a constant source of contamination leading to severe losses. *Vibrio campbellii* is one of the shrimp pathogens that lead to luminous Vibriosis resulting enormous economic losses in shrimp aquaculture and this micro flora form biofilms as a contrivance for their higher virulence inside the host owing to high degree of resilience of biofilms to external and internal disturbances. It is utmost important to have a clear idea on ability of biofilm formation prior to implement mitigation measures and this study was aimed at studying the ability of aquatic pathogenic *V. campbellii* (LMG 21363) to form biofilms on four different surfaces (Wood, Plastic, Galvanized metal and Tile), which are commonly used in shrimp aquaculture settings. Biofilm formation ability on different surfaces was studied for 192 hours and biofilm cells were enumerated at three time points; i.e., 48 hours, 96 hours and 192 hours by spread plate technique in replicates and reproducibility was checked in independent experiments as well. The study revealed that the highest potential to form biofilms by *V. campbellii* was at 48h ($6.27\pm4.81x10^6$ CFU/cm^2) and 96h (5.82 ± 2.50 $x10^6$ CFU/cm^2) on tile surface, whilst that of at 192h (349 ± 2.66 $x10^4$ CFU/cm^2) on plastic surface. *V. campbellii* showed lower affinity for galvanized metal and wood surfaces than that of on tile and plastic at all-time points. In addition, the highest total mean no of colonies at three time points were observed on plastic ($4.20x10^6$CFU/cm$^2\pm1.17x10^4$) followed by that of tile ($3.94x10^6$ CFU/cm$^2\pm2.81x10^4$), wood ($2.83x10^6$ CFU/cm$^2\pm1.05x10^4$) and galvanized metal ($1.5x10^6$ CFU/cm$^2\pm$ $1.54x10^4$). This study concluded that biofilm forming ability of *V. campbellii* (LMG 21363) on tile and plastic is higher than that of on wood and galvanized metal revealing the importance of least usage of tile and plastic on shrimp aquaculture settings.

Keywords: *Vibrio campbellii*, Biofilms, Abiotic Surfaces, Shrimp Pathogen

C4 **[18]**

STATUS OF FRESH WATER ORNAMENTAL FISH FARMING INDUSTRY AS A SMALL-SCALE AQUA BUSINESS IN GALLE DISTRICT, SRI LANKA

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ABSTRACT

A survey was conducted to investigate the status of fresh water ornamental fish farming industry in Galle district, Sri Lanka from March-May, 2017. Data were collected from 10 randomly selected fish farms in Galle district using pre-structured questionnaire and direct interviews with farmers. The study aimed to analyze and document the information on farm status, types of cultured species, target markets, management practices and constraints to develop the industry. Farms were categorized into three levels; small (< 0.02 ha, 60%), medium (0.02-0.05 ha, 20%) and large (0.05< ha, 20%) and fresh water (well water) was used as the main water source in all farms. Cement cisterns, mud ponds, glass aquaria and plastic basins are being used as rearing tanks. Seven varieties of fish; Guppy, Angel, Barb, Swordtail, Tetra, Platy and Koi carps are cultured in selected farms. 50% of farms are culturing only a single species and two or more species are cultured in rest of the farms. The sizes of rearing tanks (range from 9 to 2500 ft^2) and stocking densities of fish (range from 3 to 40 per ft^2) vary within and between farms which particularly depend on the cultured species. Only 50% of farmers are producing ornamental fish for export market. Financial difficulties (100%), high feed cost (90%), disease outbreaks (80%), difficulties in feed supplement on time (70%), and lack of space to expand the farm (60%) are identified as the major challenges to develop the industry. However, there is a possibility to further develop small-scale ornamental fish industry in the rural areas and further research is needed to find sustainable solutions for constraints to enhance the status of ornamental fish farming.

Keywords: Ornamental Fish Farming Industry, Constraints, Farm Management

C5 **[19]**

PRODUCTIVITY OF CATFISH IN AQUAPONIC RED WATER SYSTEM

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ABSTRACT

This study aims to obtain the highest catfish productivity in aquaponic by addition of probiotic red water system (RWS). The research was conducted in February - March 2016 at Ciparanje Experimental Pond Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran. The research designed with Completely Randomized Design in five treatments and repeated three times. Treatment A: RWS on 7.5 µl / L / week probiotic addition without aquaponic, Treatment B: aquaponic without RWS, treatmentC: RWS on 7,5 µl / L / week probiotic addition, treatment D: RWS on 10 µl / L / week probiotic addition, and treatment E: RWS on 12.5 µl / L / week probioticsaddition. Parameters measured are specific growth rate, Survival Rate, FCR and also water quality include dissolved oxygen, pH, temperature, ammonia, nitrate and phosphate. The results showed the specific growth rate, the highest SR and FCR were obtained at 10 µl / L / week RWS with 3.56%, 93% and 1.22 respectively.

Keywords: Aquaponic, RWS, Probiotic, Catfish

C6 **[20]**

USE OF BIOLOGICAL PARAMETERS IN ASSESSING THE AQUACULTURE POTENTIAL OF THE MUD CLAM, *Polymesoda erosa* (BIVALVIA: CORBICULIDAE) IN SANTIAGO RIVER, DAGUPAN CITY, NORTHERN PHILIPPINES

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ABSTRACT

Members of the genus *Polymesoda* were reported to be resilient to adverse environmental conditions, hence, could be potential species for aquaculture amidst climate change. Assessment on the natural population of the *Polymesoda erosa* in Santiago River was conducted to determine the aquaculture potential of this species in northern Philippines. Derived asymptotic length (L_∞) and growth coefficient (K) were 87.75 mm and 1.10 yr^{-1}, respectively. Fast growth was predicted for the first two years. Longevity of the clams is approximately 11 years. Length-weight relationship showed a positive allometric growth (r^2 = 0.98). Total (Z), natural (M) and fishing (F) mortalities were 3.45 yr^{-1}, 2.71 yr^{-1} and 0.74 yr^{-1}, correspondingly. Estimated exploitation rate (E = 0.21) was lower than the predicted maximum sustainable exploitation (E_{max} = 0.36). Two recruitment pulses were derived with unequal strengths and duration. Highest condition indices (CI) were recorded during May to August, averaging to 179.79 (±6.47 SE). Monthly mean gonado-somatic indices (GSI) ranged from 9.64 to 26.51, averaging to 16.04 (±1.54). Chlorophyll *a* concentration and sediment TOM have significant ($P < 0.05$) influenced in CI variations. DO and water temperature significantly ($P < 0.05$) affected the changes in GSI. Filtration rates under laboratory conditions significantly increased ($P < 0.05$) at lower salinities (0-15 ppt) but pseudofaeces production was not affected by the salinity variations ($P > 0.05$). These biological information suggest high potential for aquaculture of *P. erosa* in northern Philippines. Development of culture techniques for this clam is recommended.

Keywords: Ecophysiology, Bivalve, Population Dynamics, Fisheries, Pangasinan

C7 **[21]**

ECONOMIC VIABILITY OF SMALL SCALE SHRIMP (*Penaeus monodon*) FARMING IN THE NORTH-WESTERN PROVINCE OF SRI LANKA

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ABSTRACT

Shrimp export is the second most valuable export of fish and fishery products of Sri Lanka and it was 8% of the total export earnings of fishery products during 2013. Among many commercial aquaculture initiatives so far, shrimp (*P. monodon)* farming has been the most lucrative, but the business is subject to high risk and uncertainties since it started in the mid-1980s. The present study evaluates the profitability and risks associated with semi intensive small scale shrimp aquaculture practices in the north-western province of Sri Lanka.

Data and information for profitability analysis of the operation over 10 years were collected from small scale shrimp aquaculture farms in Puttalam district, Sri Lanka, during 2014-2015. Economic analysis revealed that the variable cost per unit production and break-even production for the black-tiger shrimp through semi-intensive culture system is 4.4 US$/kg and 2,500 kg respectively. Assuming minimum (15%) acceptable rate of return (MARR) of this study, the NPV value at the end of 10 years was found 33,003 US$ for the total capital invested and 34,993 US$ for the equity. Internal Rate of Return (IRR) for the total capital investment is 41% and 74% for the equity. At the end of the ten years, sum of total and net cash flow is 95,176 US$ and 84,093 US$ respectively. Pay-back period for the capital investment is 3 years and it was two years for the equity.

Sensitivity analysis indicated that profitability was highly sensitive to changes in sales price. When the value of the sales price falls by 20% or more, the IRR value becomes 13% and is not profitable. The sales price has frequency of 28% of receiving negative NPV, followed by sales quantity (6%) and variable cost (5%). Results of present study indicate that investment is highly profitable although the shrimp farming is most sensitive to changes in sales price.

Keywords: Cost-Benefit Analysis, Economic Viability, Profitability, Shrimp Farming

D1 **[22]**

IMPACTS OF TOURISM ON CORAL REEFS AT CASUARINA BEACH OF KARAINAGAR ISLAND IN JAFFNA PENINSULA, SRI LANKA

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ABSTRACT

Casuarina is a one of the most popular beaches in Jaffna Peninsula of Sri Lanka. It is considered as a unique travel destination due to presence of white sand beaches, casuarina trees and coral reef patches. Major recreational activities of visitors include sunbathing, swimming, snorkeling and boating to reef regions in this beach. Casuarina provides an ideal location for tourists since reef sites can be easily accessed due to its topography. In this study, impacts to the coral reef regions by tourism were assessed by questionnaire and direct site observations. The average number of sightseers was 83,306 which is substantially higher during the last five years than at any time in the past. Among these nearly 6,000 tourists per year were brought to the reef region by boat and visitors stepping on the coral reefs. Boatmen use a specific path to land the tourists on the reef regions which is two kilometers from the shore to reef edges. These coral reefs patchy area are directly subject to physical damage from inappropriate anchoring of boats and trampling by tourists. These activities result in breaking of fragile and branched corals and causing lesions to massive and soft corals. Also, collection of branching, encrusting, fan and leathery corals by tourists are threatening the coral communities. In addition, injuries, death and displacements of juveniles and breeding marine animals like shark, sea cucumber, turtle and coral associated species are happened due to the propeller and collisions by engine boats. Subsequently, these lead into the coastal territorial degradation. Since, coral reefs are the most diverse marine ecosystem providing habitat for thousands of marine creatures, degradation of reef systems due to the diverse anthropogenic disturbances over the past years indicate the high urgency to conserve the coral reefs through an effective management strategy.

Keywords: Trampling, Anchoring, Collisions, Coral Reef Ecosystems, Sri Lanka

D2 **[23]**

CAPACITY UTILIZATION IN SMALL-SCALE FISHERIES: A CASE OF OMAN

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ABSTRACT

Small-scale fisheries in Oman are at the core of national economic development agenda. With reference to the strategic objectives such as sustainable utilization of fisheries resources, enhancement of socio-economic welfare and food security, various projects have been implemented by the authority to enhance efficiency of small-scale fishing fleet and the overall productivity of the sector. The issues of technical efficiency (TE) and capacity utilization (CU) are of global importance and related to the problems of overcapitalization and overfishing. However, effort to provide measures of TE and CU in the context of small-scale fisheries is limited.

To fill the gap, this paper provides measures of TE and CU in small-scale fisheries in Oman using an output-oriented model under the Data Envelopment Analysis (DEA). The data for inputs such as boat length, engine power, number of crews, and outputs involving aggregated catch of three species categories namely large pelagic, demersal and other species for 97 active boats for the year 2010 were used in the analysis. The key findings are as follows.

Under the assumption of constant returns to scale (CRS), about 53% of the boats have TE < 0.5 (SD=0.275),while under variable returns to scale (VRS) the proportion is about 45% (SD= 0.299). The unbiased CU measures indicate that under CRS 41% (SD=0.119) and under VRS about 82% (SD=0.20) of the boats were operating below the full capacity (CU=1). The management and policy implications of the results are discussed in the paper.

Keywords: Small-Scale Fisheries, Technical Efficiency, Capacity Utilization, Data Envelopment Analysis (DEA), Oman

D3 **[24]**

STUDY ON FISH DEPLETION DUE TO FISHING AND POLLUTION IN CIRATA RESERVOIR

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ABSTRACT

Cirata Reservoir is one of the artificial waters in West Java Indonesia which has significant fish resources potency which come from endemic fish from adjacent river waters, as well as fish introduction through water enrichment program. The wealth is used by surrounding communities as a source of food and livelihood through fishing activities. In addition, this is also used massively for the cultivation of floating nets, most of which are done by entrepreneurs, because the business capital needed is high enough and not reachable by the people around the reservoir. Unfortunately, the production of fishing in these reservoirs has significantly decreased from year to year due to unregulated and open access fishing activities, as well as water pollution caused by feed from cultivation activities as well as domestic and industrial wastes discharged into the waters. This study analyzes the depletion of fish resources due to fishing and pollution at these sites. The method used is the logistic standard bio-economic model and Gompertz to see the impact of fish catching on the dynamics of fish resources, and linear and non-linear regression to obtain the coefficient of pollution on production. The depletion of fish resources was calculated using the Amman Duraipah model (2004), which was modified by Anna (2003). The results of the study show that the depletion rate of Cirata fisheries, show differences from year to year, with an average depletion of 25% during the year of observation. only from fishing activities alone, whereas if combined with pollution, the rate of depletion is increased. The implication of the MSY or MEY instruments is required to control the aquatic habitat.

Keywords: Fish Depletion, Capture Fisheries, Pollution, Bio-Ecnomic Model, Policy Implication

D4 **[25]**

ASSESSMENT OF TRAMMEL NET FISHERIES OF MUNNAKKARAYA, NEGOMBO LAGOON (SRI LANKA)

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ABSTRACT

Munnakkaraya is one of the major landing sites of Negombo lagoon. The study was carried out from November 2016 to February 2017 in two days per week from 7.00 to 9.00 a.m. by monitoring the landings. The research focused on the species composition, catches weight, bycatch species and weight. Trammel net is a three-layered fishing net, the middle layer of which is fine-meshed. The mesh size of the fish trammel nets were 4cm (net 1) and 7cm (net 2) (encircling gillnets were 13 cm and 15cm) with 600m in length. The estimated catch of fish nets was 60% of total harvested value. A 27 fish species were recorded from 35 samples and 5 of these being major contributors to the catch (*Arius thalassinus, Argyrops spinifer, Sillago vincenti, Nematalosa nasus* and *Lates calcarifer).* Target catch was 85.02% to the total catch and bycatch was 14.97% for the net 1 and target catch was 76.71% to the total catch and bycatch was 25.39% for the net 2.The estimated prawn catch of prawn trammel nets was 82.43% of total catch and 25.14% discarded. Three species (*Penaeus indicus ,Penaeus semesulcatus, Metapenaeus dobsoni)* were recorded from 40 landings. According to the catch data of 2cm meshed net (encircling gillnet was 4cm), 51.16% from *Penaeus indicus*, 48.41% from *Penaeus semisulcatus* and 0.42% from *Metapenaeus dobsoni,* 5.51% discarded and 20.67% by-catch. 67.17% from *Penaeus indicus*, 32.82% from *Penaeus semisulcatus*, 6.30% discarded and 32.18% by-catch to total catch were recorded from 3cm meshed net.

Keywords: Trammel Net, By-Catch, Mesh Size, Target Catch, Lagoon

D5 **[26]**

BIOLOGICAL ASPECTS OF THE MOLA CARPLET *Amblypharyngodon mola* (CYPRINIDAE) IN THE PAYRA RIVER, SOUTHERN BANGLADESH

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ABSTRACT

Amblypharyngodon mola is a freshwater cyprinid fish widely distributed in Bangladesh, Pakistan, India, Myanmar and Afghanistan. The biological aspects including size at sexual maturity, spawning season and growth of *A. mola* was studied in the Payra River, southern Bangladesh during February 2016-January 2017. Monthly samples were collected from the small-scale fisher of set bagnet fishery in the Payra River. The specimens were sexed by visual inspection of the gonad by naked eye. The gonadosomatic index (GSI) was calculated as: GSI (%) = (GW/ BW) × 100. Size at sexual maturity was estimated by the relationship between the GSI and standard length (SL). Spawning season was estimated based on the monthly variations of GSI. Growth patterns for both sexes were modeled by fitting the von Bertalanffy growth equation to the mean SL at various ages. Size at sexual maturity of this species was estimated to be 3.0 cm SL. Monthly GSI was higher during April to July with a peak in May, indicating this was the main spawning season. Both males and females were first recruited in June, with modal size around 25 mm SL showing similar growth pattern as no significant difference was observed between the sexes. The longevity of this species was estimated to be around 1 year (13 months for male and 15 months for female). The findings of this study would be very effective for stock management of *A. mola* in the Payra River and surrounding ecosystems.

Keywords: Standard Length, Sexual Maturity, Spawning, Growth, Length-Frequency, *Amblypharyngodon mola*

D6 **[27]**

DICHOTOMOUS KEY FOR SELECTED MARINE FOOD FISH SPECIES IN SRI LANKA

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ABSTRACT

Diverse fish stocks in the Indian Ocean are considered as overfished, resulting in large-scale fishery termination will appear in the near future. Attitudinal changes of the consumers to take positive purchasing decisions on overfished fish varieties is an effective way to sustain fisheries impacted species. Prior to take the purchasing decision, correct identification of those fish species is vital. Four dominant fishery impacted marine food fish groups were identified by Indian Ocean Tuna Commission which holding 22 common marine food fish species. Morphological identification guides for each fish species under four dominant fisheries impacted marine food fish groups were developed using reliable secondary data. Color of ventral finlets, availability of the horizontal strips in the lower side of the body, pattern of alternative light lines on belly region, shape of the bill, first dorsal fin height, mid-body depth, shape of the pectoral fin, shape of the lateral line, color of the second dorsal fin tips, space between two dorsal fins and the size of pectoral fins are some of the key characters which used in the preparation of dichotomous keys. Hence, all those characters are very user-friendly and can quickly grab by customer while purchasing. Those prepared dichotomous keys could be the base to prepare the online sustainable fish guide, "Lanka Fish" which is hosted by Uva Wellassa University.

Keywords: Fish Identification, Lankafish, Sustainable Fishery, Food Fish, Dichotomous Key

POSTER PRESENTATIONS

P1 **[28]**

COMET FISH PRODUCTION (*Carassius auratus auratus* L) AND WATER QUALITY IN THE AQUAPONIC SYSTEM

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ABSTRACT

This study aims to determine the growth and survival of comet fish (*Carassius auratus auratus* L) and water quality in aquaponic cultivation system. The water distribution used in aquaponics uses a dripp irrigation. The study was conducted from March to June 2016 at the Aquaculture Laboratory of the Faculty of Fisheries and Marine Sciences Padjadjaran University. The research method used was experimental using Completely Randomized Design (CRD), consist of six treatments with three repetitions. Treatment in the study included: A (Positive control using organic liquid fertilizer), B (Negative control without using liquid fertilizer), C (Aquaponate Drip irrigation with water volume 100 ml / day / plant), D (Aquaponate Drip irrigation with water volume 150 ml / day / plant), E (Aquaponate Drip irrigation with water volume 200 ml / day / plant), F (Aquaponate Drip irrigation with water volume 250 ml / day / plant). The parameters observed were growth and survival (*Carassius auratus auratus* L) and water quality in the aquaponic system. Growth and survival rate data were analyzed using variance and water quality data using descriptive analysis. The results showed that the absolute growth of fish reached 8.65 grams and the survival of the fish reached 96%. Water quality during the study included ammonia, nitrate, phosphate, DO, temperature, and pH still within the standard threshold recommended for comet fish cultivation.

Keywords: Aquaponics, Comet Fish, Survival, Water Quality, Growth

P2 **[29]**

REPLACEMENT OF IMPORTED FISH MEAL WITH SCAVENGER FISH *(Pterygoplichthys multiradiatus)* MEAL TO DETERMINE THE GROWTH PERFORMANCE OF SWARD TAIL (*Xiphophorus helleri*)

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ABSTRACT

Swordtail (*Xiphophorous helleri*) is a dominant ornamental fish species of the export market in Sri Lanka. Feeding of complete nutritious diet is crucial for the ornamental fish species during nursery stage. This experiment was conducted to investigate the effect of replacing imported fish meal (IFM) by Scavenger (*Pterygoplichthys multiradiatus*) fish meal (SFM) in sword tail diet. The experiment was done with three isonitrogenous and isocaloric experimental feeds. There were three treatments viz. Feed 1 (IFM 40%+0% SFM) Feed 2 (IFM 30%+SFM 15%) and Feed 3 (IFM 26%+SFM 20%) with three replicates per treatment. Each replicate contained 10 one day old post larvae. Fish was fed at five times a day for 35 days period. The growth parameters such as body weight gain (BWG), body length gain (BLG) and specific growth rate (SGR) were measured. All three treatments were significantly different from one another with respect to BWG and BLG ($P<0.05$). The means of BWG (g) of feed1, feed2 and feed3 were 1.38±0.03, 1.71±0.02, and 1.48±0.02 while those for BLG (cm) were1.34±012, 2.00±0.33 and 1.53±0.04 respectively. No mortalities occurred during the study period. Since treatment 2 has produced highest BWG, BLG and specific growth rate (SGR-9.5±0.15) with compare to other two treatments. Therefore, it can be concluded one third of imported fish meal could be replaced by scavenger fish meal to reduce the cost in swordtail diet at nursery stage.

Keywords: Fish Nutrition, Scavenger Fish Meal, Swardtail (*Xiphophorous helleri*)

P3 **[30]**

POLYCYSTIC LIVER IN TWO ORNAMENTAL CICHLID FISH SPECIES

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ABSTRACT

The flower horn fish (hybrid cichlid) was first produced in Malaysia and is believed to be the result of hybridization between the Midas Cichlid (*Amphilophus citrinellus*) and the Threespot Cichlid (*Cichlasoma trimaculatum*). This fish is also believed to have emerged through selective cross-breeding of the Threespot Cichlid (*C. trimaculatum*), Guayas Cichlid Cichlasomafestae, and Jingang blood parrot cichlid (another hybrid) in 1996. The flower horn fish and the Threespot Cichlid are becoming increasingly popular as a pet, especially in Southeast Asia.

In September 2014 and August 2015, a three spot cichlid (*Cichlasoma trimaculatum* Günther, 1867), a long bodied and a short bodied flower horn fish (hybrid cichlid) were referred to the Faculty of Veterinary Medicine with progressive anorexia, abdominal distention and increased respiratory rate. No parasite or ova was observed in wet smears of skin, gills and faeces of all fishes. The fishes were anesthetized in 100 ppm PI222 (Pars Imen Daru, Iran) (PI222 is an herbal medicine and contains "eugenol, carvacrol, eugenol acetate and some other effective substances" as the active ingredients). Standard digital radiographs were taken in right lateral and dorsoventral (DV) projections. Right lateral radiographs showed increase in size of soft tissue mass in ventral abdomen and decrease in size of swim bladder. Ultrasonography was performed from the left side of all fish. Ultrasonography of visceral organs showed free fluid and an enlarged liver, containing multiple cysts of various sizes in all cases. At necropsy, free fluid in the abdominal cavity and several cysts in an enlarged and pale liver were observed. Cysts were delineated by a thin layer and filled with clear fluid. No internal parasites were observed in 3 cases. Also no bacterial growth was observed after 72h. Histologically, The cysts walls were composed of squamous epithelium and some contained eosinophilic and proteinous fluid. Numerous sinusoids were dilated by red blood cells. Severe fatty changes were seen in hepatocytes. Histological lesions in the gills were hyperplasia of lamellar epithelium, fusion of lamellae and mild proliferative bronchitis. On the basis of the macroscopic and microscopic characteristics, origin of cysts and cause of this condition remained unknown. However, genetic predisposition appears to be the best explanation for these lesions.

Keywords: Three Spot Cichlid, Flower Horn Fish, Polycystic Liver

P4 **[31]**

SPOILAGE AND SHELF-LIFE EXTENSION OF RAINBOW TROUT (*Onchorynchus mykiss*) SLICES WRAPPED WITH GELATIN-ALGINATE FILM CONTAINING OREGANO ESSENTIAL OIL

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ABSTRACT

The overall objective of this study was to develop antimicrobial gelatin-alginate film (GAF) containing 1.5% oregano essential oil (OEO) on the shelf life of rainbow trout (*Onchorynchus mykiss*) slices during refrigerated storage over a period of 15 days. The blend film was prepared at 75% fish gelatin to 25% sodium alginate ratio and OEO was added to the film formulation. All the treatments (the control and wrapped slices) were analyzed periodically in terms of microbiological factors (total viable count, psychotrophic count, and spoilage microorganism such as lactic acid bacteria, *Pseudomonas* spp., and *Enterobacteriaceae*). In addition, the samples were analyzed in terms of total volatile base nitrogen (TVB-N) and pH. Use of the OEO-blend film delayed bacterial growth throughout 15 days of storage compared with the control and slices treated with blend films without OEO ($p < 0.05$). The lowest TVB-N and pH levels were 59.98 and 6.75, respectively, in OEO-film at the end of the storage. The obtained results indicated that OEO-blend film is suitable for the preservation of rainbow trout fresh fillets and to efficiently maintain the quality attributes to an acceptable level during storage.

Keywords: Gelatin-Alginate Film, Oregano Essential Oil, Antimicrobial Potential, Rainbow Trout Slices

P5 **[32]**

A STUDY ON GROWTH PERFORMANCE AND SURVIVAVILITY OF *Ompok pabda* (HAMILTON 1822) FINGERLINGS IN EARTHEN POND FED WITH DIFFERENT FEED INGREDIENTS

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ABSTRACT

An experiment of one and half month was conducted to perceive the growth performance and survivavility of *Ompok pabda* (Hamilton, 1822) fingerlings in earthen pond fed with different feed ingredients. These are four distinct types of feed ingredients with different percent of protein content in rice bran (RB) 14, mustard oil cake (MOC) 30, Floating feed (FF) 32% and fish meal (FM) 45% respectively. These all feed stuffs are formulated as EF-I (RB+MOC), EF-II (RB+FF) and EF-III (RB+FM) Three experimental ponds uniform sizes of rectangular earthen ponds (20 × 10 × 1.5) meters with triplicate replication was conducted. *Ompok pabda* experiment was started with few old days' fingerling having an average weight and length of (1.609 gm) and (6.85cm) respectively. 70 fishes are initially stocked. The highest gain in Weight P3C (9.20gm), P1C (6.70gm) & P2C (5.40gm), Length P1C (9.8cm), (P3C 8.8cm) & (P2 8.6cm), Average Daily Weight Gain P3C(0.175), P1C (0.692) & P2C (0.062), Specific Growth Rate P3C (2.102), P1C (1.731) & P21 (1.114), and Survivavility of fishes P1C (97%), P3B (82%) & P3A (97%) And lowest Food Conversion Rate after experiment was P3B (0.488), P1C (0.692) & P2C (1.378) respectively. Beside this, the water quality parameters showed most of the fluctuations in phosphate level in water as compare to Ph, Ammonia, Temperature, Dissolve oxygen and others. The result implies that fish has better growth performance and survivavility with EF-III firstly and secondly in EF-I as compare to EF-II respectively.

Keywords: *Ompok pabda*, Experimental feed (EF), P1, P2 and P3=Pond numbers with section codes like A, B and C etc, Survivavility

VIRTUAL PRESENTATIONS

[33]

NEURONAL AND OXIDATIVE DAMAGE IN CATFISH BRAIN ALLEVIATED AFTER TREATMENT WITH *Mucuna pruriens* SEED EXTRACT

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ABSTRACT

The neurodegenerative activity of synthetic detergent sodium dodecyl sulphate (SDS) on brain physiology in Indian native catfish *Heteropneustes fossilis* and the efficacy of methanol extract of Indian medicinal herb, *Mucuna pruriens* seeds for alleviating such effects were demonstrated. Fish (n=36, 2 replicates) were exposed to SDS (2.75 mg/l) for 0 (control), 15 and 30 days. After 30-days treatment, methanol extract of *Mucuna* seed (15.5 mg/kg body weight) was injected for continuous seven days and sampling was done on each alternate odd days (1, 3, 5 and 7 days). Levels of different enzymatic and non-enzymatic antioxidants, Na^+-K^+-ATPase, acetylcholine esterase, monoamine oxidase, nitric oxide were measured in *H. fossilis* brain tissue. 30- days treatment with SDS caused significant decrease in reduced glutathione, catalase, superoxide dismutase, glutathione S-transferase activities, while glutathione reductase, malondialdehyde levels increased significantly ($P<0.05$) compared to those in control without SDS treatment. Administration of *Mucuna* extract was found to restore the neurological activity and reduce stress in a time-dependent manner as the biochemical and neurological parameters in fish after 7-day extract administration showed no significant difference ($P>0.05$) compared to those in control, except for glutathione S-transferase and glutathione peroxidase which were unable to return to the basal level. SDS induces oxidative stress in brain by inhibition of antioxidative enzymes and functional damage to enzymes critical for neuronal physiology. *Mucuna* seed extract treatment has showed significant antioxidative and neuroprotective function, and thus might act as a possible natural source of antioxidants and could be useful in therapy of free radical pathologies.

Keywords: *Mucuna pruriens*, SDS, Stress, Neuronal Damage, *Heteropneustes fossilis*

[34]

MUSSEL REEFS IN SUB-LITTORAL ZONE; AN IMPORTANT HABITAT FOR INFAUNAL AND ICHTHYOFAUNAL DIVERSITY

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ABSTRACT

A Sub-littoral mussel reefs harbours rich and diverse invertebrate communities. They utilize the reef complex as their habitat, rich feeding substrate and also as refuge from predation. Though the invertebrate diversity of the reefs is available, reports pertaining to their relation to dietary habit of reef fishes are lacking. A study was taken up at the sub-littoral mussel reefs occurring off Someshwara Coast (12^0 47' 19" N 74^0 51' 05"E) in Karnataka (eastern Arabian Sea) to ascertain the diversity reef as well as the fish fauna of the region. The invertebrate community of the reef was collected by quadrant sampling method. The details on fish fauna of the reefs were collected by visual census and also by using semi-structured interviews with local fishers. Detailed study was carried out to find the dietary relationship of the ichthyofauna with the diverse organism associated with the sub littoral mussel beds.

Apart from barnacles and seaweeds, the invertebrate community was dominated by polychaetes followed by amphipods and crablets. The major ichthyofaunal diversity includes fishes of the family Gobiidae, Lutjanidae, Siganidae, Sciaenidae, Epinephelidae, Carangidae, Ariidae, Cynoglossidae, Engraulidae and others. The information pertaining to the dietary habits of the fish assemblages were compared with the infaunal and ichthyofaunal diversity of the reefs to bring out the importance of mussel bed habitat.

Keywords: Mussel Bed, Invertebrate Diversity, Dietary Habits, Ichthyofaunal Diversity

[35]

COMMUNITY-BASED FISHERIES DEVELOPMENT IN THE DISTRICT OF NORTH GORONTALO

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ABSTRACT

Maritime and Fisheries Affairs Development is emphasized to improve the welfare and economic growth with sustainable management of natural resources and at the same time maintaining its carrying capacity. To optimize the potential of marine natural resources need to dominate in various fields. In the field of arrest of the need for adequate fishing fleet both in terms of quantity, type, or types of equipment in accordance with the provisions of fishing in each fishing area (Phasha, R. 2000). Connection with the above, this research program carried out for the development of community-based fisheries and environmentally sound is a necessity to not only the optimization of catches can be achieved but sustained production can catch. The method is a survey method that uses data collection instruments in the form of questionnaires and observation sheets, (Singarimbun and Effendi, 1995).Production data and fishing effort in Gorontalo North District for a period of five years, namely 409.80 tonnes (2005), 450.10 tons (2006), 308.089 (2007), 10125.65 tons (2008), 11400.00 (2009) , Catching fisheries are still relatively increasing from year to year. Fisheries Technological Development forcing fishermen to catch fish farther from the shoreline, for to prevention efforts, the problem solving for this are by means of the application of alternative fishing effort with technology that is simple, inexpensive and can increase the production of fishermen, one of them by using FADs (Journal, 2003). According *Subani (1986)*, FADs is Improved technology necessary for more efficient utilization in efforts to increase production and increase the income of fishermen. Sustainable utilization of fisheries resources is one of the efforts to determine the potential of fishery resources, the information will be very helpful for policy makers to make efforts Potential Utilization and Management of Fisheries Resources.

Keywords: Fishing Gear, Production, Sustainable

[36]

EVALUATION OF MOST SUITABLE SITE FOR LIVE ROCK AQUACULTURE IN SOUTHERN AND EASTERN COAST OF SRI LANKA

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ABSTRACT

Live rock culture is a growing industry have a huge potential in European and American markets emerging throughout Sri Lanka now days. As a tropical island Sri Lanka possess suitable conditions for live rock aqua culture in coastal belts. The study was conducted to find out the most suitable sites for live rock culture in Southern and Eastern coast of Sri Lanka. From two major sites (Southern and Eastern coast) three sub sites were selected with different locations like rocky shore, sea grass bed and sandy shore) where man made concrete rocks were laid and environmental parameters were measured once per week for three months from September to December 2015. The area of coralline algae and other fauna and flora were measured to understand the species diversity and distribution. The biodiversity indexes were calculated for each live rock blocks where randomize block ANOVA was used for other data interpretation. Five types of coralline algae were identified *Lithophyllum frondosum*, *Peyssonnelia sp*., *Lithophyllum incrustans*, *Hydrolithon onkodes* and *Hildenbrandia rubra*. *Hildenbrandia rubra* have distributed in both natural environment and live rocks in Southern and Eastern coast. *Lithophyllum incrustans* and *Hildenbrandia rubra* were showed significant different between two major live rock sites but only *Lithophyllum incrustans* was showed significant different for distribution among major sites, sub sites and locations. *Hildenbrandia rubra* was showed significant different for distribution in natural environment of Southern and Eastern areas. *Peyssonnelia sp*. and *Hydrolithon onkodes* have low distribution in both areas than other species. *Lithophyllum incrustance* was showed higher abundance than other species on live rocks.

Keywords: Live Rock, Coralline Algae, Species Diversity, Distribution

[37]

A COMPARISON OF SOCIO-ECONOMIC STATUS OF FISHERS AND FISHERS HAVING AN ADDITIONAL INCOME FROM ANIMAL AND CROP IN KALMADU MEDIUM PERENNIAL RESERVOIR IN VAVUNIYA DISTRICT: A CASE STUDY

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ABSTRACT

Culture-based fisheries in perennial reservoirs has become a promising and profitable methodology to achieve self-sufficiency in the food sector and also to generate diverse livelihood opportunities for rural people in Sri Lanka. Information on the socio-economic status of fishers in comparison to fishers having an additional income also from livestock and agriculture forms a good base to study since reservoir fisheries economy fluctuates continuously. Present study was conducted to assess the socio-economic status of fishers of the Kalmadu reservoir from April 2016 to June 2017. Data were collected from all the fishers in the selected area using a pretested and well-structured questionnaire. Majority (98%) of the fishers belonged to the age groups of 25 to 50 years, and composed of 96.9% Tamil-Hindu community. About 94 % had a primary education, while only 6% had secondary education. About 12.5% farmers were involved in fisheries only (FO), whereas, 87.5% of the fishers involved in livestock and crop production (FLCP). Mean monthly income of the fishers from fisheries was around Rs 5 000 to 30 000, whereas, from livestock, paddy and coconut were Rs 3 500 to 13 155 and 4 300 to 15 335 respectively. Vegetables were produced mainly for their home consumption and they exchanged their excesses with neighbours. Men were involved in fishing while 60% women assisted in freshwater prawn collection, dry fish production, net mending, cleaning and separation of fish from gear. On the other hand, 95% women were involved in livestock production. The income, food intake, well-being, and health of the FLCP were superior to that of FO. The FLCP farmers informed that their socio-economic conditions improved due to diversification. Poor knowledge in achieving sustainable fisheries, growth overfishing, recruitment overfishing and water level fluctuations were identified as the major constraints in fisheries, while water scarcity, poor production of the animals, lack of land and infrastructure were identified as the major constraints in crop and livestock production.

Keywords: Additional Income, Culture-Based Fisheries, Socio-Economics, Sustainable Fisheries

[38]

ECONOMIC EFFICIENCY OF APPLYING THE PROBIOTIC "PROLAM" AS A BIOLOGICAL FERTILIZER IN POND PISCICULTURE

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ABSTRACT

This article describes the action of the probiotic Prolam used as a biological fertilizer with the aim to increase natural food resources of ponds. The probiotic raises trophicity of a water body and as a result, increases its natural fish productivity with minimum economic costs, moreover it improves microbiological situation in the water body without acting as a biocide and by that causing no harm to the inhabitants of the reservoir. This probiotic does not contain harmful or genetically changed microorganisms or toxic substances, it is harmless to people, animals, fishes, insects, plants, zooplankton, does not pollute water, soil, air, and the metabolic products of this biological preparation biodegrade completely. The purpose of this research was to analyze the available data on the effect of the probiotic used as a biological fertilizer to increase the fish productivity of reservoirs and to calculate the economic efficiency of its application. Collection and treatment of hydrobiological samples were carried out in accordance with the Methodological Guidelines "Collection and processing of zooplankton in fishponds" (Tevyashova, 2009). This preparation was introduced along the bed of the reservoir so that its distribution occurred evenly. For the experiment, four identical ponds were selected, one of which was a control pond, in the other three the probiotic was applied with different concentrations. The probiotic applied methodically and regularly increased the natural food resources and, as a consequence, raised natural fish productivity with minimum financial costs and also favored the microbiological situation without acting as a biocide and causing any harm to the inhabitants of the reservoir. During the experiment we compared zooplankton parameters in the control and pilot ponds and observed noticeable positive effects of the probiotic on the development of water invertebrates, both at the initial stage of the test and at the end of the research. The technology of application of this probiotic is the newest alternative to the existing methods of increasing the natural food resources in pond fish farming, since all the processes it causes in the reservoir are aimed at improving water quality, increasing dissolved oxygen in it, destroying pathogenic bacteria, treating and preventing infectious and parasitic diseases of fish due to the complex of microorganisms that constitute the Prolam probiotic. The results of our study give evidence of positive influence of the probiotic on the development of water invertebrates and indicate to the expedience of its use as a stimulator of natural food supply development in fish-breeding reservoirs, with material costs being insignificant, so we can draw a conclusion that when rearing fish artificially this biological decision is economic and correct.

Keywords: Zooplankton, Decomposer, Probiotic, Microorganisms, Fertilizers, Food Supply, Economic Effect, Fish Productivity, Trophic System

[39]

APPLICATION OF PROBIOTIC PREPARATION "PROLAM" AS A BIOLOGICAL FERTILIZER IN AQUACULTURE PONDS

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ABSTRACT

A number of studies have been conducted lately on the use of probiotics in fish farming in such areas as treatment of eggs and larvae and feeds for carp and sturgeon fries and fingerlings. We applied the probiotic "Prolam" as a biological fertilizer in fish-breeding ponds in order to increase their trophicity. A distinctive feature of this probiotic is its ability to increase fish productivity of reservoirs by stimulating the development of food organisms. It is proved that some bacteria can produce biologically active substances necessary for the growth of other bacteria, utilize harmful metabolic products and thus maintain the ecological balance. We applied Prolam of different concentrations into three hatchery ponds of the same area and depth, the fourth pond was used as a control one. In five days after the Prolam application, an increase in the biomass of zooplankton was observed in all experimental ponds. In pond No.1 the biomass of zooplankton increased 2.5 times and amounted to 1.346 g/m^3. In pond No. 2 the zooplankton biomass increased more than 4.5 times, from 0.451 to 2.103 g/m^3. In pond No. 3, during the same period, the amount of zooplankton increased fourfold and made up 1.970 g/m^3. Twenty days after the start of the experiment a further increase in the biomass of plankton organisms was noted in ponds No. 2 and No. 3 where the respective probiotic concentrations were of 10 l/ha and 15 l/ha. We have compared quantitative indicators of zooplankton in the control and experimental ponds; a considerable positive effect has been shown of probiotics on the development of aquatic invertebrates both at the initial and at the final stages of the study. In all three ponds throughout the whole experiment the rotifers *Brachionus calyciflorus*, crustaceans *Bosmina longirostris* and *Moina rectrostris* and the representative of copepods *Cyclops strenuous* and their larval stages were predominant. The data obtained have proved a beneficial effect of the probiotic Prolam that can be used as a stimulator of natural food organisms in fish-breeding waterbodies.

Keywords: Fish Productivity, Zooplankton, Probiotic, Microorganisms, Fertilizers, Food Reserves, Trophicity, Aquaculture