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MESSAGE FROM THE STRATEGIC PARTNER, THE NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY (NARA), SRI LANKA



It gives me great pleasure and privilege to send this message as a Chairman of National Aquatic Resources Research and Development Agency (NARA) and a Strategic Partner of the third International Conference on Fisheries and Aquaculture organized by the International Institute of Knowledge Management (TIKM) from 24th to 25th August 2016 at Negombo, Sri Lanka.

Aquatic resources at the center of an important economic activity to feed and provide livelihoods to a global population set to rise by 2.5 billion over the next 35 years. Fisheries and aquaculture make a significant support to food security and source of revenue of millions of people in the world. The production was estimated at 164 million tons in 2014, supplying around 20 kg/capita per year and 17 percent of global animal proteins and essential micronutrients. Fisheries has contributed immensely to accomplished economic growth in recent decades in several parts of the world through unsustainable exploitation of many aquatic resources. However, such growth has not commonly allowed resulting in ecosystem degradation, biodiversity loss and overfishing. Disease outbreaks, Illegal Unreported and Unregulated (IUU) fishing, natural disasters and climate changes are some of challenges for us. As a result, the average annual contribution of food fish from aquaculture for human consumption has increased seven folds, from 7 percent in 1970 to around 50 percent in 2014. This trend is projected to continue, with the contribution of aquaculture to fish food supply estimated to reach 65 percent by 2030. Both living and nonliving aquatic resources can be vital in the transition towards a Blue Economy due to their interconnectivity with and dependence on aquatic ecosystems and the forthcoming for people employed in it to act not only as resource users, but also as resource stewards.

The technical programme organized for the conference is quite impressive and provide opportunities to present and share recent findings of scientists and make platform to discuss and deliberate ideas on the theme, “Aquaculture as an imperative segment of blue economy and sustainable development goals“. I sincerely hope that the deliberations and recommendations would help in future policy directives, and planning and implementation of programs worldwide in relation to the theme of the conference.

I wish a great success for the Conference.

Dr. Anil Premaratne
Chairman

National Aquatic Resources Research and Development Agency (NARA)

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THE FIRST RECORD OF SUCCESSFUL IMAGE PEARL PRODUCTION IN SRI LANKA USING FRESH WATER PEARL MUSSELS

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ABSTRACT

Due to poor technological transfer, the income generations potentials of readily available natural resources are inadequately understood by many rural communities. The mass availability of two pearl mussel species: *Lamellidens marginalis* and *Lamellidens corrianus* in the north-western fresh water bodies in Sri Lanka, shows a greater potential of pearl production. But so far proper pearl production technique has not been developed for Sri Lankan condition. Therefore, the objective of this study was twofold; first, to develop pearl production technique, by using locally available low cost materials, which could be practiced by small-scale fishermen, and secondly to transfer the developed technology to small-scale fisher communities to sustain their own business. For this 12 culture trials were conducted after nucleus implantations at Vijaya Katupotha /“Karawita” tanks, in the northwest region of Puttalam district, from 2014-2015 by using 324 pearl mussels, of 55 – 70 mm in length, collected from the same location. Three sources of nucleus namely, “mantle tissue”; “plastic balls”; and “bivalve shells” were used for implanting purpose. Randomly selected five mussels were opened and observed for pearl formation after in 3, 6 and 9 month intervals. The effect of different sizes and shapes of the nucleus sources in obtaining pearls was determined. Mussel mortality and nucleus rejection were then monitored weekly for a period of one year post-implantation. Significantly low mortality rates ($P<0.05$) and nucleus rejection rates ($P<0.05$) were observed in the mussels implanted with mussel shells compared to plastic balls. Successful pearl formation was observed with higher success rate and low mortality percentage after a 6-9 months period. Introduced novel pearl production culture technique was successfully followed and practiced by the selected small-scale fishers of the community. Seasonal entrance of flood water and mussel feeding by carnivorous birds are the main drawback in establishing industrial scale pearl production at the study site. Identified best water quality parameters which causes the lowest mortality will important in initiating pearl productions in ponds in Sri Lanka.

Keywords: *Lamellidens marginalis*, *Lamellidens corrianus*, nucleus implantations



ORAL PRESENTATIONS



[01]

ASSESSMENT OF FISHERY RESOURCES STATUS IN KUWAIT

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ABSTRACT

The present study is based on statistics for the last 40 years ago to assess the fishery status in Kuwait. The driving forces model (DPSIR) was applied to find out pressures on fisheries status, impacts resulted and responses undertaken. The results showed an obvious decrease in the catch, particularly for commercial species. The data analysis indicated that fish imports comprised 59% of the local landing, followed by artisanal fishing (32%), companies fishing (6%) and aquaculture (3%). The assessment indicated that population growth coupled with coastal development projects are the indirect pressures. Moreover, noticeable increase of fishing effort represented by increasing of boats from 400 in 1988 to 2000 boats in 2013 is the most direct pressure. The situation also complicated by entry of huge number of amateurs' boats to the fishing grounds. The increasing of prices which, estimated to be 10 doubled for some species and the sharp decrease in fish per capita (< 10 kg/year) are the major impacts of fishery resources deterioration. The results revealed that there was a substantial shortage of 6,000 ton from local fishing during 2013 to keep the average global fish per capita (18 kg/year). On the other hand, an estimate of 110,000 ton from local fishing is required to meet the local demand in 2030. Several responses were applied to restore the fishery resources, however those still not enough effective to improve the fisher status. Some recommendations are pointed out as actions required to manage the fisheries resources on national and regional scales.

Keywords: fisheries, aquaculture, DPSIR, overfishing, fishing effort

[02]

COMMUNITY PARTICIPATION IN MONITORING OF CULTURE-BASED FISHERIES IN RESERVOIRS OF SRI LANKA

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ABSTRACT

Culture-based fisheries (CBF) development in inland reservoirs of Sri Lanka has been getting a momentum during the last few decades due to concerted efforts of research and development in the inland fisheries sector of the country. CBF development has been essentially a secondary use of ancient inland reservoirs of the country receiving < 187 cm annual rainfall, which were primarily developed for irrigation of rice cultivation. In the present study, performance of CBF activities in five perennial reservoirs namely Ampara wewa, Jayanthiwewa and Senanayake Samudra, Hambegamuwa and Urusitawewa was evaluated where effective data recording systems were introduced to facilitate CBF planning. The fishers of five reservoirs were motivated through participatory rural development (PRA) approaches to adopt CBF planning, implementation and monitoring. They were also provided with hands-on training at the aquaculture development centres on extensive fish farming. Leadership training and training on financial management in small entrepreneurships were also arranged.

A computer-assisted data recording system was successfully introduced in Ampara wewa, Jayanthiwewa and Senanayake Samudra for which a few educated youths in the CBF communities were trained. The success of CBF in these three reservoirs was demonstrated to other CBF communities, and as a result, fisher communities in Hambegamuwa and Urusitawewa were also motivated to adopt similar data recording system. CBF communities use stocking data and harvest data generated through this data recording system, to plan stocking and harvesting plans in the succeeding year. This strategy appears to be successful to sustain CBF in inland reservoirs of the country.

Keywords: culture-based, communities, perennial, reservoirs, stocking

[03]

GENETIC VARIATION AND POPULATION BIOLOGY OF *Tenualosa ilisha* IN THE BAY OF BENGAL AND THE PERSIAN GULF

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ABSTRACT

The national fish of Bangladesh, Hilsa Shad (*Tenualosa ilisha*) is the largest and single most valuable fishery in the country. It is distributed from Persian Gulf to the Arabian Sea and the Bay of Bengal. To investigate genetic variation and population biology of this species, 54 individuals were collected from three sites located at Bangladesh (i.e. The Bay of Bengal) and Kuwait (i.e. The Persian Gulf) and sequence variations in the mitochondrial DNA control region (D-loop) were examined. For all the populations, nucleotide diversities were low (0.07 – 0.1) whereas the haplotype diversities were as high as 0.82 to 0.99, indicating that the fish has undergone population expansion after bottleneck. The conventional population statistic F_{ST} , and exact test of population differentiation revealed significant genetic structuring between the Bay of Bengal and the Persian Gulf population. Phylogeny of haplotypes revealed two genetically diverged groups of *T. ilisha* between these two studied areas. Knowledge on genetic diversity and population structure will help to understand the evolution and demographic history of this species and also to establish its appropriate fishery management strategy.

Keywords: *Tenualosa ilisha*, genetic diversity, population structure, mtDNA control region

[04]

ECOSYSTEM BASED MANAGEMENT APPROACH; TO SUSTAIN DEPLETING SEAGRASS BEDS AT MANDAITHEEVU, JAFFNA, SRI LANKA

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ABSTRACT

Seagrass ecosystem at the Jaffna lagoon acts as a ecological buffer-zone and contributes to the fishery production of Jaffna. The study was conducted at a coastal area of Mandaitheevu, Jaffna lagoon. Selected site at Mandaitheevu was demarcated into perpendicular four transects and each transect was delineated into four spatial strata. Samples of Seagrass shoots were collected at each substratum with a stratified metal quadrat by skin diving. Species were identified with reference to their leaf tip characters. Shoots of individuals from each species were enumerated and weighed. Diversity indices were analysed with PAST software and statistical analysis was done with STATISTICA software. Both *Halodule pinifolia* and *Thalassodendran ciliatum* are the newly reported at Mandaitheevu. Seagrass abundance along transect possess a successive distribution. *Halodule pinifolia* (4672 ± 1534 shoots per m²) is the abundant species followed by *Halophilla ovalis* (2352 ± 921 shoots per m²) and *Enhalus acroides* (108 ± 83.4 shoots per m²) is the least abundant species at Mandaitheevu. Simpson evenness (0.7222) and Shannon diversity index (1.398) are comparatively higher at stratum 2 of transect 4. *Thalassia hemprichii* has the highest biomass productivity of 1187 ± 820 grams per m². In the shallow waters seagrasses are susceptible to the propellers of fishing boats and fyke net operations. Special consideration is essential to conserve the seagrasses of Mandaitheevu as species and as an ecosystem. Ecological based fishery management will be the best approach to attain sustainability in long-term progress.

Keywords: seagrass, diversity indices, transects

[05]

**FARMING OF SEAWEED *Kappaphycus alvarezii* IN SRI LANKA - A STATUS NOTE
AND STRATEGY FOR FARM EXPANSION**

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ABSTRACT

Seaweed *Kappaphycus alvarezii* is one of the major sources of carrageenan, a gelling agent used as a thickening agent in food, pharmaceutical, cosmetic and other industries. The current annual world production of *K. alvarezii* is about 200K MT and its value added product carrageenan is about 50000MT/yr. Since natural its stock became scant, cultivation of this seaweed was first started in early 1960s Philippines to meet the world demand. Later it was introduced to Indonesia, Malaysia, Tanzania, Madagascar and recently in India. The germplasm of *K. alvarezii* was imported to Sri Lanka in 2011 and acclimatized to Sri Lankan waters by maintaining trial plots in various locations in Kilinochi and Jaffana regions. Commercial farming of *K. alvarezii* was commenced in 2012 after carrying out thorough feasibility studies by employing floating bamboo raft and off-bottom monocline method. The average daily growth rate % (ADGR%) ranged between 4.0 to 5.5%, total farmers currently engaged in this activity is 50 to 60 people and total dry-weed produced last two years was about 120MT. The developments made last 3 years in terms of awareness creation, project stakeholders and their role, developing different cultivation techniques for commercial purpose, investment and return involved in it and income of seaweed farmers are discussed. Also strategy farm expansion of *K. alvarezii* in other coastal parts of Sri Lanka to create an alternative livelihood to larger number of coastal people and earn foreign exchange through either export of raw dry seaweed or its value added products like agricultural bio-stimulants and food additive carrageenan are discussed.

[06]

**ASSESSMENT OF SPATIAL VARIATION OF ICHTHYOFAUNAL DIVERSITY IN
UPPER CATCHMENT AREA OF BADULLU-OYA, BADULLA DISTRICT, SRI
LANKA**

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ABSTRACT

Badulu-oya a highland tributary of the river Mahaweli sustains numerous aquatic fauna while sustaining the domestic and agricultural water requirements. The study was based on twelve study locations along 24 km stretch of the upper catchment of Badulu-oya including four lateral tributaries for eight months period. Ichthyofauna was sampled using medium size seine net, scoop nets and cast net within a 150 m reach in each location as covering 3 types of geomorphic channel units. Shannon-Wiener diversity index (H'), Margalef species richness index (D_{mg}) and Shannon Evenness (E) indexes were calculated for each location. General Linear Model and Tukey pair wise comparison was performed to find out significant variation among study locations. Nineteen ichthyofaunal species including five endemics, eleven indigenous and three exotic species which belong to 10 families were observed from the selected 12 locations. Highest H' (2.56 ± 0.05), D_{mg} (2.95 ± 0.11) and E (0.91 ± 0.019) were recorded in Location 8 where had relatively undisturbed habitat qualities while locations that received high load of urban discharges and low riparian vegetation recorded lowest diversity indexes. Three Diversity indices were significantly differed ($P < 0.05$) spatially. Tributary locations where preserve relatively high habitat qualities harbour high species diversity. Healthy aquatic ecosystem provides divers habitats for their inhabitants with stress free environment.

Keywords: ichthyofauna, diversity, catchment

[07]

VERTICAL DISTRIBUTION AND DIVERSITY OF MOLLUSCS IN INTERTIDAL HABITATS OF PIGEON ISLAND NATIONAL PARK, TRINCOMALEE, SRI LANKA

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ABSTRACT

Pigeon Island National Park is one of the two marine national parks of Sri Lanka with some of the best existing live coral reefs of the country. It is located 1Km off the cost of Nilaweli, a coastal village in Trincomalee, Sri Lanka. It consists with two (small and large) islands. The shoreline of the island is covered by rocky and coral habitats, hence facilitating a diverse population of molluscs all around the island. However, information on their diversity and the distribution is scarce. Therefore this study was designed to study the diversity and the distribution of molluscs in the in Pigeon island marine national park. Ten transects with three replicates were deployed perpendicular to the shore starting from the high water mark representing snorkeling and bathing areas of island. Twenty four Species were identified and their abundance was calculated with the aid of 25cm x 25cm quadrat. Twenty four species were recorded representing ten families. The distribution pattern shows a vertical change with high abundance in shallow areas. *Noddilittorin aquadricincta* and *N. trochoides* are dominant within the shoreline of snorkeling site and *Littoraria undulate*, *Nerita plicata* and *Drupa morum* species were dominant in the bathing site. Most of the species were found in middle to upper littoral zone and covered an average of 29 % of the rock surface. At the top level of the upper littoral zone, family Littorinidae (169 individuals/m²), and at the lower part of the upper littoral zone families Neritidae (234 individuals/m²), Trochidae (187 individuals/m²), Planaxidae (153 individuals/m²), Muricidae (104 individuals/m²), were found in higher abundance, both on and under rocks. Abundance of individuals was slightly higher at the middle littoral zone representing families Nacellidae (94 individuals/m²), Fissurellidae (89 individuals/m²), Ostreidae (82 individuals/m²), and Chitonidae (69 individuals/m²). The species abundance decreased from upper littoral zone to lower littoral zone, in both sides of the island. *Patelloida striata*, *Saccostrea cacullata*, *Cellana capensis* and *Patelloida striata* are the most common species in the lower littoral zone. Shannon-Wiener diversity index for molluscs was significantly different in two sides of the island ($p < 0.05$). Shannon-Wiener diversity index was higher (2.52) in bathing site, which is most probably due to the sheltered habitats provided by rocky outcrops. Low abundance of rocks, higher abundance of coral rubble and unconsolidated substrate could be the most probable reasons for the low diversity value observed in the snorkeling site. This study covered the intertidal zone and a strip with a width of 5 meters from the low water mark around the island. A detailed study is proposed in-cooperating the deeper sites as larger molluscs such as *Tridacna* sp, *Lambis* sp, and *Conus* sp are known to be commonly found.

Keywords: molluscan distribution & diversity, coastal marine waters, Shannon wiener diversity.

[08]

**ESTIMATION OF POPULATION DYNAMICS INDICES OF CULTURED
ORNAMENTAL FISHES ACCORDING TO THE CLIMATIC CHANGES IN
KURUNEGALA DISTRICT, SRI LANKA**

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ABSTRACT

Population dynamics indices of cultured ornamental fishes according to the climatic changes in Kurunegala district, in Sri Lanka were estimated. Sample of gold fishes (*Carassius auratus*) and koi carps (*Cyprinus carpio*) which were harvested from mud ponds in ornamental fish breeding and training center was examined for ecto parasites. Four population indices were calculated for each abundant parasite species and diversity level of parasites in two fish species were estimated using Shannon-Weiner Species Diversity Index. Ten parasite species were recorded from both fish species and all calculated indices for gold fish were higher in dry season than wet season and for koi carp results vary for two seasons according to the parasite species. The calculated Shannon-wiener Species Diversity Index indicated that parasite diversity of gold fish was higher in dry sealason (dry: 0.4172 ± 0.0787 , wet: 0.1431 ± 0.0299) but it was wet season for koi carp (dry: 0.0896 ± 0.0170 , wet: 1.1138 ± 0.1497). Findings could be utilized when implementing treatment and quarantine programs for both ornamental fish species.

Keywords: population indices, gold fish, koi carp, parasitic infestation, Shanon weiner species diversity index

[09]

CHANGE IN SPECIES COMPOSITION AND ITS IMPLICATION ON CLIMATE VARIATION IN BALI STRAIT

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ABSTRACT

Sardinella lemuru is a dominant small pelagic fish (80-90%) caught by purse seiner in Bali Strait, while the remaining 10-20% consist *Decapterus* spp., *Euthynnus affinis*, and other fishes. These compositions typically vary seasonally, whereas in Southeast monsoon season dominated by *Sardinella lemuru*, while the Northwest monsoon season was replaced by *Decapterus* spp. and *Euthynnus affinis*. This study presented that fishing trend in the last 15 years indicate there was a regime shift with the shifting in species composition by a seasonal into the inter-annual pattern due to global climate change, such as El Niño and La Niña. 2006 was indicated a cold period of water temperature of the Bali Strait, which is triggered by the El Nino and positive Indian Ocean Dipole (pIOD). In this cold period, the *S. lemuru* reached peak of fishing, otherwise this fish disappear when the warm period (strong La Niña) in 2010 occur and continued until 2013, and gradually recovered in 2014. When *S. lemuru* disappeared during warm period, it was substituted by *Decapterus* spp. Furthermore, as predatory fish of both small pelagic fishes, *Euthynnus affinis* always appear throughout the year. Understanding the species composition trend from seasonal to longer period might be important for better strategy to manage fisheries of Bali Bali Strait in climate change era.

Keywords: pelagic fish, fishing, El Nino, regime shift, Bali Strait

[10]

**ICHTHYOFAUNA AND BIRDS DIVERSITY IN WETLAND OF PUNJAB IN DISTT.
TARN TARAN (INDIA) VIS-A-VIA CONSERVATION AND MANAGEMENT
STRATEGIES**

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ABSTRACT

The river Beas rises in the Himalayas in central Himachal Pradesh and flows to river Satluj in western Punjab state at Harike Pattan. Harike wetland is an important International freshwater man-made wetland under Ramsar site in northern part of India and also notified as wildlife sanctuary. Harike barrage was constructed over the the confluence of river Satluj and Beas enforcing large volume of water accumulation in the Harike wetland which now become important biodiversity habitat for different types of finfishes, amphibian, reptiles, mammals, variety of bird species and other animals including vulnerable/threatened/endangered species of animals. Water samples were collected from different spots at Harike wetland and different water quality indices were measured in field as well as in laboratory. The water quality characteristics at different sampling point found to be under optimum condition. 104 species of fishes and 97 species of birds belonging from different families were identified and recorded during field survey works. A part from this, variety of finfishes, shellfish, amphibian, and mammals was investigated diligently during the survey work. The biodiversity identified from Harike wetland revealed that water is suitable for the survival of different types of aquatic fauna, and many faunal diversity gets nourishment from natural water bodies, however, there is a need to conserve and manage wetland resources for maintaining its ecological health. The study reveals that local people and fishermen depend on water bodies which sustain faunal diversity. The present paper discusses about factors influencing wetland ecology and biodiversity with special reference to birds and fish species including its conservation and management practice.

Keywords: ichthyofaunal diversity, avianfauna, conservation, management, Harike wetland, Punjab

[11]

**GRACILLARIA ASSOCIATED AMPHIPOD AT ABALONES' REARING TANK,
LOMBOK MARINE AQUACULTURE DEVELOPMENT CENTER, LOMBOK,
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ABSTRACT

Some benthic minute amphipods has been found at abalones' rearing tank, at Lombok Marine Aquaculture Development Center, Sekotong, East Nusa Tenggara, Indonesia. The minute amphipod community were found along with *Gracillaria* sp which was harvested from Sekotong fishpond. There is some vigilance that it might be pest that interfere the production of abalones. This research aim to reveal the type of the minute amphipod at the ponds. Amphipod's sampling was done by hand picking, and preservation was done using alcohol 70%. Inverted microscope with low magnification was used to identify the crustacea. Some slide was made to recognise and identify minute apparatus of the amphipod. Result show that the amphipod is Gammaridean associated *Gracillaria*.

Keywords: *Haliotis asinina*, *Gracillaria*, benthic, Gammaridean, Lombok

[12]

NUTRITIONAL, HAEMATOLOGICAL AND HISTOLOGICAL RESPONSES OF AUSTRALIAN SNAPPER *Pagrus auratus* FED VARIOUS INCLUSION LEVELS OF NARROW-LEAFED LUPIN KERNEL MEAL

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ABSTRACT

A 10-weeks feeding trial was conducted to evaluate growth and physiological performances of juveniles Australian snapper *Pagrus auratus* fed various inclusion levels of narrow-leafed lupin *Lupinus angustifolius* kernel meal (LKM), as an alternative source of fishmeal protein. Four isonitrogenous (crude protein 46 %) and isoenergetic (21MJ/kg) diets were formulated to replace 20 % (LKM105), 40 % (LKM210), 60 % (LKM315) and 80 % (LKM420) fishmeal protein by the protein from the narrow-leafed lupin kernel meal. These four diets were tested against a control diet (LKM0) which contained no lupin kernel meal ingredient. No test diets resulted in any mortality, however, the growth rate and feed utilisation efficiency of snapper significantly decreased with increasing lupin meal levels in the diets. Snapper was capable to digest protein sourced from LKM. Dietary lupin meal did not affect the protein, lipid and gross energy in the muscle and whole-body tissues in snapper. However, the hepatic lipid of snapper fed diets containing more than 210 g/kg lupin meal significantly increased. High dietary lupin kernel meal had negative effects on haematological parameters of snapper. The dietary LKM did not cause any histopathological alterations in the intestines, except the excessive lipid deposition in the liver tissues of snapper. In conclusion, up to 105 g/kg LKM can be incorporated into snapper diet without impairing the physiological performance.

[13]

**CHARACTERIZATION OF LILY TYPE LECTIN: MOLECULAR ANTENNAS,
INVOLVED IN INNATE IMMUNE RESPONSES OF BLACK ROCKFISH *Sebastes
schlegelii***

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ABSTRACT

Pattern recognition receptors (PRRs) in fish play a vital role in pathogen recognition and the innate immune responses. Lectins are one of the major PRR molecules and behave as molecular antennas on the cell surfaces which mediate cell-cell interactions by recognizing and combining with various carbohydrates on the membrane surface of bacterial pathogens. Especially, the mannose binding lectins can initiate the lectin-based complement pathways to enhance the lysis of pathogens. In this study, a new lily type lectin (designated as SsLTL) with D-mannose binding domain at 54-112 amino acids was identified from black rockfish transcriptome database. To analyze the functional role of SsLTL in vitro, the recombinant SsLTL was synthesized in *E. coli* and subjected to haem and bacterial agglutination assays. Significant haemagglutination was observed with fish red blood cells. Further, transcriptional studies were done via qPCR in healthy rockfish and fish challenged with *S. iniae*, lipopolysaccharide (LPS) and poly I:C at different time points. SsLTL mRNA expression was found to be the highest in intestine and gill of healthy fish. While during the immune challenges, SsLTL transcripts of gill showed significantly up-regulated expression at 3h, 6h, 12h, 24h and 72h post injection (p.i), with a peak at 3h corresponding to both *S. iniae* and poly I:C. In blood, the expression level of SsLTL was significantly up-regulated at 6h, 12h p.i in response to *S. iniae* and poly I:C challenges, while a significant down-regulation was observed throughout LPS challenge in blood.

Keywords: pattern recognition receptors, lectins, rockfish, haemagglutination, qPCR

[14]

**THE FIRST RECORD OF THE PARASITE, *Sacculina* SPP. IN *Portunus pelagicus*
(BLUE SWIMMING CRAB) FROM MANNAR, SRI LANKA**

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ABSTRACT

Infection of Rhizocephalan parasite *Sacculina* spp was observed in Blue swimming crabs (*Portunus pelagicus*) caught in commercial catches in the coast of Talaimannar and Peasali in Mannar district during the period, May to October 2015. The morphological changes in crabs due to the parasitic infection were studied under the light microscope. The Parasitization caused two major effects, an internal root system and a globular shaped sac-like structure which referred as the “externa”. The externa was positioned inside the abdomen flap and not exceeded the abdomen flap. The colour of externa varied from creamy yellow or ivory colour to brownish colour. The globular shaped sac covered by a membrane and it covered all the gonopods. The inside of externa contained two layers. The middle region is in pale pink colour and the outer layer is in creamy yellow colour. In the creamy yellow colour region nearly packed thread like structure was identified. The thread like structure consisted of properly arranged cells. The cell arrangement was similar to arrangement of eggs in the external egg mass of crab. The infection was observed both in males and females and two or three globular shaped sacs were observed in some samples. The “Externa” was recorded as the significant characteristic in infection by *Sacculina* spp. *Sacculinids* changed morphometric characteristics such as colour pattern as well as the sexual characteristics in male crabs, finally making them acquiring female characteristics.

Approximately 8.00% of the *Portunus pelagicus* caught were found to be infected.

Keywords: externa, *Portunus pelagicus*, *Sacculina* spp.

[15]

**EFFECTIVENESS OF EUGENOLE (CLOVE OIL) AS AN ANESTHETIC FOR
FANCY GUPPY (*Poecilia reticulata*) IN SIMULATED PACKING FOR LONG
DISTANCE TRANSPORT**

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ABSTRACT

High cost incurred in transporting fish in large volumes of water is a major problem in airlifting ornamental fish to foreign market. The present study was carried out to investigate the efficiency of the anesthetic, clove oil on Fancy guppy (*Poecilia reticulata*) in simulated packaging for air transport. In the ornamental fish industry of different anesthetizing chemicals are used for export packing. The cost for those chemicals is more expensive than clove oil. Therefore to find out the most effective concentration of clove oil is important for the industry.

Clove oil significantly reduced the rate of oxygen consumption and controlled the reduction of pH. The most efficient concentration of clove oil which was responsible for the greatest reduction in rate of oxygen consumption and in regulating the reduction of pH in packing water was 26µl. Three months old, with a total length of 3cm fancy guppy 225 were packed in polythene bags 3l of water at 25⁰C and anathestetised with 26 µl/l of clove oil for a period of 40 hours without any mortality.

Clove oil concentration of 17 µl/l and 20µl/l produced mild sedation fancy guppy and 5.5% mortality and stressed fish were found. With the increase of clove oil concentration up to 38 µl/l with the same density of guppy and out changing other factors, suffered 100% mortality.

Result of this experiment the best concentration of clove oil was found 26 µl/l which kept under deep sedate for a long duration period of around 40 hours. The present study indicates that fancy guppy could be transported for foreign countries at higher packing densities, using clove oil, which will maximize the effective utilization of space and weight during transportation.

[16]

**PHYSIOLOGICAL RESPONSES OF JUVENILE BARRAMUNDI, *Lates calcarifer*
(BLOCH, 1790) WHEN FED BIOPROCESSED PLANT BASED DIETS**

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ABSTRACT

This study evaluated the physiological responses of juvenile barramundi (*Lates calcarifer*) when fed bioprocess plant-derived proteins. Sweet lupin (*Lupinus angustifolius*), peanut meals (*Arachis hypogaea*) and blue-green alga (*Spirulina platensis*) (SP) were either treated with fermentation, germination or enzymes before included to the fish diets. Three independent experiments were conducted with inclusion levels of 30%, 45%, 60% and 75% for lupin; 15%, 30% and 60% for peanut meal; and 10%, 20% and 40% for SP. The reference diets of these experiments were fishmeal as a sole protein source. Growth performance, digestibility, feed conversion ratios (FCR), blood biochemical changes of barramundi before and after the fish was subjected to stressor, and water quality parameters were used as indicators to evaluate the physiological responses of the fish. The results showed that bioprocess reduced antinutritional factors, peptide sizes and increased bioactive compounds of the original ingredients. Fermentation of lupin and peanut increased their inclusion levels up to 60% in the diet without any growth reductions. Fermentation also significantly increased digestibility of protein and phosphorus and improved FCR and water quality. The germination increased the growth and survival at low inclusion level. Enzyme treated SP increased the feed digestibility and improved the FCR. The blood related physiological responses of stressor-challenged fish showed improvements when fish were fed bioprocessed plant based diets than fishmeal based diet. The study concluded that bioprocessing of the plant-derived proteins can improve their functional quality and in turn can increase their inclusion levels, digestibility and the feed utilization efficiencies.

Keywords: bioprocessed, plant-derive proteins, barramundi, physiological responses

[17]

**TANK CLEANER FISH MEAL (*Pterygoplichthys SPP.*) AS A REPLACEMENT FOR
COMMERCIAL FISH MEAL IN BROILER CHICKEN FEED**Ganepola, G.A.U.R¹, Athauda, A.R.S.B², Vidanarachchi, J.K³ and Premaratne, S⁴^{1,2,3,4} *Department of Animal Science, Faculty of Agriculture, University of Peradeniya,
Peradeniya, Sri Lanka***ABSTRACT**

Tank cleaner, *Pterygoplichthys* spp. presence in Sri Lanka water bodies is an invasive, non-economical fish species affecting the natural ecosystems. This effort was to produce good quality fish meal using tank cleaner for feeding broiler chickens. Growth performance, feed conversion ratio (FCR) and nutrient digestibility of broiler chickens fed with tank cleaner fish meal, local fish meal and imported fish meal incorporated diets were compared. Fish meal was prepared according to the standard procedure by cutting, chopping, mincing, drying and grinding. A feeding trial was conducted using 45 Cobb 500 male broiler chicks. The experimental design was complete randomized design and each treatment group consisted of 3 replicates with 5 birds per replicate. Formulated diets and water were given ad libitum to broiler chickens throughout the feeding period. Feed intake was measured daily; body weight gain was measured weekly. At slaughtered day giblet, carcass and fat weights were taken. Ileal content was collected from 9 birds, one from each replicate. Imported fish meal fed group showed higher ($P<0.05$) live weight and total weight gain than local fish meal fed group. No significant differences ($P>0.05$) were observed among birds fed with diets incorporated with tank cleaner and imported fish meal and also tank cleaner and local fish meal in live weight and total weight gain. No significant differences ($P>0.05$) were observed in FCR among broiler chickens in three experimental groups. Both tank cleaner and imported fish meal fed groups showed higher ($P<0.05$) dressing % than local fish meal group. Ileal protein digestibility and fat digestibility were lower ($P<0.05$) in tank cleaner fish meal incorporated group than imported and local fish meal groups. In conclusion, tank cleaner fish meal could be successfully replaced the local fish meal in broiler chicken feeds.

Keywords: *Pterygoplichthys* spp., broiler chicken, tank cleaner, fish meal

[18]

**FISH MEAL REPLACEMENT WITH RICE PROTEIN CONCENTRATE IN A
PRACTICAL DIET FOR THE PACIFIC WHITE SHRIMP, LITOPENAEUS
VANNAMEI BOONE, 1931**

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ABSTRACT

Replacement of fish meal (FM) with rice protein concentrate (RPC) as a practical diet for the Pacific white shrimp, *Litopenaeus vannamei*, was evaluated. Five isonitrogenous (36.6% protein) diets, formulated by replacing 0, 25, 50, 75, and 100% of FM by RPC, were fed to shrimp (initial weight of 6.99 ± 0.08 g) five times daily to satiation for 60 days. Relatively high final weight (FW 17.64–18.25 g) and weight gain (WG 10.81–11.39 g) were obtained in treatments up to 50% of the plant protein inclusion. Above this inclusion level, FW (14.93–14.35 g) and WG (7.68–7.23 g) were reduced. Survival was high (C95%) and similar for all diets. There were no significant differences (P [0.05] in tail-muscle composition (moisture, protein, lipid, and ash) among different dietary treatments. Dispensable and indispensable amino acids of the tail muscle of shrimp fed with 25, 50, and 75% RPC were significantly higher than the FM (0%) and 100% RPC diets. A decreasing trend in apparent digestibility coefficient (excluding dry matter) for crude protein (90.52–52.41), ether extract (94.11–80.03), organic matter (87.25–50.16), and gross energy (89.41–55.24) was observed at higher RPC inclusion rates. The results suggest that RPC meal can be a potential candidate for FM replacement up to 50% of the protein in shrimp diets.

Keywords: apparent digestibility coefficient, amino acid profile, growth, *Litopenaeus vannamei*, nutrition, penaeids, proximate analysis

[19]

EFFECTS OF DIETARY GUAVA LEAVE EXTRACT ON GROWTH, FEED UTILIZATION, BIOMETRIC INDICES AND INTESTINAL BACTERIAL COMMUNITY OF NILE TILAPIA *Oreochromis niloticus*

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ABSTRACT

A study was conducted to investigate the effect of guava leave extract in practical diets on Nile tilapia *Oreochromis niloticus* growth, feed utilization, biometric indices and intestinal bacterial community by using 16S rDNA and denaturing gradient gel electrophoresis (DGGE). Three experimental diets were supplemented with guava leave extract (GLE) at 0%, 0.5% and 1% (diets: control, GLE-5 and GLE-10 respectively). Following a 24-h fasting, 270 fish with initial mean weight of 8.9 ± 0.2 g were randomly distributed to each of 9 tanks (30 fish /tank) under a recirculation freshwater system for the period of 12 weeks. Final weight (FW), weight gain (WG) and specific growth rate (SGR) of fish fed GLE-5 and GLE-10 was significantly higher ($P < 0.05$) than fish fed the control diet. Nile tilapia fed diet GLE-10 had improved feed conversion ratio (FCR), protein efficiency ratio (PER) and survival rate than the control ($P < 0.05$). The inclusion of higher dietary level of GLE-10 found significantly higher hepatosomatic index (HIS), viscerosomatic index (VSI) and condition factor (K) compared to all groups. Total viable count (TVC) from fish intestinal and tank water sample was influenced significantly ($P < 0.05$) by supplementing GLE in diets. Cluster analyses of DGGE DNA fingerprints of the intestinal and water microbial population revealed highly similarity in the intestinal microbial flora of fish fed with different diets. The present study suggested that dietary inclusion of GLE could positively affect on growth, feed utilization performance and intestinal bacterial community of Nile tilapia.

Keywords: Nile tilapia, GLE, DGGE, growth, feed utilization and intestinal bacterial community

[20]

**UTILIZATION OF PREDIGESTED CORNCOB WITH CELLULASE FROM
Trichoderma viridieas AS FEEDSTUFF ON GROWTH PERFORMANCE, FEED
UTILIZATION AND CARCASS COMPOSITION OF NILE TILAPIA (*Oreochromis
niloticus*)**

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ABSTRACT

The utilization of predigested corncob with cellulase from *Trichoderma viridieas* as feedstuff was investigated to examine the diet contained predigested corncob in the fingerling Nile tilapia *Oreochromis niloticus* (L.). The initial weight of Nile tilapia fingerlings ranged from 14.66 – 16.66 g/fish. The experiment was divided into four groups by the levels of percentage of fiber were 0%, 2%, 8% and 15% with ratio of corncob and cellulase was 0.5 g : 1 ml and conducted for 120 days. At the end of experiment, the results showed that growth performance and feed utilization each groups were not significant different ($P>0.05$). On the other hand, the percentage of viscera of control group was lowest ($P<0.05$) while fat content in flesh were lowest in fish fed with 2% and 8 % predigested corn cob ($P<0.05$). Moreover, the water quality of fish fed with feed contained corncob at different levels were in range of water quality standard. The study indicated that the cellulase from *Trichoderma viridieas* was dispensable for these levels of corncob diet contained. corn. It's mean that Nile tilapia diets containing corncob available to 15% without predigesting by cellulase. Moreover, it's effected on cost - effectiveness.

Keywords: Nile tilapia, corncob, *Trichoderma viridieas*, growth performance

[21]

EFFECT OF BREWER'S WASTES AS A PARTIAL SUBSTITUTE FOR DIETARY FISHMEAL ON GROWTH PERFORMANCE OF GUPPY (*Poecilia reticulata*)

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ABSTRACT

A six-week feeding trial was conducted to evaluate the partial replacement of fish meal with brewers wastes (brewers spent yeast and brewers spent grain) on growth performance and feed utilization of guppy fish (*Poecilia reticulata*). Guppy (length 2.10±0.12cm, weight 0.10±0.02g) were stocked in 12 glass tanks (60x30x30cm) at a stocking density of 10 fish/tank. Fish were fed on one of four experimental diets, i.e.: CD (0% brewery wastes), BYD (6% brewer's yeast), BGD (6% brewer's grain) and BYGD (3% brewer's yeast and 3% brewer's grain) three times per day up to satiation during 6 weeks period. Fish fed diet contained 3% brewer's yeast and 3% brewer's grain (BYGD) recorded significantly highest body weight (0.55±0.17 g) and total length (3.48±0.33 cm) at the end of the experiment. % SGR (3.60±0.19 - 4.06±0.33), Condition factor (1.21±0.15 - 1.28±0.22), % Survival (86.67±5.77 - 96.67±5.77) and Feed conversion ratio (2.10±0.10 to 2.77±0.61) were not significantly different among the treatments. BYD (6% brewer's yeast) and BGD (6% brewer's grain) diets have no negative effects on growth performance and feed utilization of guppy fish compared to CD treatment. The profit index was significantly higher BYGD treatment (3% brewer's yeast and 3% brewer's grain) (54.58±1.69) compared to CD treatment (49.21±1.37). The results of the present study revealed that 6% of fish meal component can be replaced with 3% brewer's yeast and 3% brewer's grain in diets for guppy and the fish showed better growth performance and feed utilization without any negative effects on their survival. Therefore brewers wastes can be used as a substitution for fishmeal component in diets for guppy.

Keywords: fish meal replacement, brewer's wastes, guppy, growth performance

[22]

EFFECT OF FEEDING ENRICHED *Artemia* NAUPLII WITH COD LIVER OIL AND SUNFLOWER OIL ON GROWTH PERFORMANCE, SURVIVAL AND STRESS RESISTANCE OF GUPPY FRY (*Poecilia reticulata*)

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ABSTRACT

In the present study, the effects of feeding un-enriched *Artemia* (A), cod liver oil (animal oil) enriched *Artemia* (AC) and sunflower oil (plant oil) enriched *Artemia* nauplii (AS) on growth performance, survival and stress resistance in guppy fry (*Poecilia reticulata*) were evaluated. Two days old fry (7.89 ± 0.53 mm and 0.0012 g) were stocked in tanks (30 x 20 x 20 cm³) at a stocking density of 30 fry per tank. Guppy fry were fed un-enriched *Artemia* (A), cod liver oil enriched *Artemia* (AC) or sunflower oil enriched *Artemia* nauplii (AS) in 3 replicates. After a feeding trial of 21 days, the total length (A- 15.44 ± 0.13 mm, AC- 18.78 ± 0.68 mm, AS- 23.44 ± 0.24 mm) body weight (A- 0.030 ± 0.002 g, AC- 0.048 ± 0.001 g, AS- 0.108 ± 0.009 g) specific growth rate (A- 15.33 ± 3.38 , AC- 17.59 ± 0.07 , AS- 22.75 ± 2.71) were found to be significantly higher in fry fed AS followed by fry fed AC and A. Similarly, fry fed sunflower oil enriched *Artemia* (AS) had a lower cumulative mortality index (thermal stress test 6.67 ± 0.58 and salinity stress test 20.67 ± 2.30) than fry fed cod liver enriched *Artemia* (thermal stress test 11.33 ± 3.52 and salinity stress test 28.67 ± 7.37) and the fry fed un-enriched *Artemia* (thermal stress test 14.67 ± 1.15 and salinity stress test 35.33 ± 2.88). The survival rates (A- $93.05 \pm 2.40\%$, AC- $95.83 \pm 4.16\%$ and AS- $98.61 \pm 2.40\%$) were not significantly different among treatments and the condition factor (A- 0.82 ± 0.08 , AC- 0.73 ± 0.06 and AS- 0.81 ± 0.03) was not significantly different among treatments. The overall results suggest that fry fed sunflower oil enrich *Artemia* (AS) showed higher growth and stress resistance than that fry fed cod liver oil enrich *Artemia* (AC) or fry fed un-enrich *Artemia* (A). Therefore, it is suggested that sunflower oil is a good lipid source for *Artemia* enrichment compared to un-enriched or cod liver oil enriched *Artemia* for the than cod liver oil in sustainable nursery maintenance of *Poecilia reticulata*.

Keywords: *Poecilia reticulata*, enrichment, growth, survival, stress resistance, sunflower oil, cod liver oil

[23]

PRODUCTION OF MICROBIAL SILAGES FROM ANIMAL WASTES AS FISHMEAL REPLACER IN AQUACULTURE DIETS

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ABSTRACT

The experiment was carried out to produce and assess the storage quality of microbial silages from three animal wastes namely fish offal (FO), chicken gut (CG) and shrimp head (SH) using yoghurt as dietary fishmeal (FM) replacer for aquaculture. There was prevalent relationship between decreasing of pH and silage process that was analyzed by One-Way ANOVA as the alpha level ($p < 0.05$). Ensilage process was completed within 14-21 days and three liquefied silages of desired pH level (< 4.5) were obtained. The crude protein content found was highest in shrimp head silage (31%) followed by chicken gut silage (30%) and fish offal silage (16%) while highest crude fat was found in fish offal silage (69%) followed by shrimp head silage (53%) and chicken gut silage (43%) respectively. Total amount of essential amino acids (EAA) in chicken gut silage was found highest (9.33 g.100⁻¹ protein) followed by shrimp head silage (8.91 g.100⁻¹ protein) and fish offal silage (4.70 g.100⁻¹ protein) respectively. During 90 days storage, pH was found to be stabilized below 4.5, no change in color and smell and no sign of putrefaction in the produced silages were seen. The results of proximate composition including EAA reveal that produced silages have potentials to be used as protein supplement in aquafeed.

Keywords: microbial silage, animal wastes, fishmeal, ensilage, liquefied, EAA

[24]

SUPPLEMENTATION OF BROMELAIN EXTRACT IN DIET ON GROWTH, FEED UTILIZATION AND NITROGEN EXCRETION IN TILAPIA (*Oreochromis niloticus*)Yuangsoi, B¹, Klahan, R² and Charoenwattanasak, S³^{1,3}*Department of Fisheries, Faculty of Agriculture, Khon Kaen University, Mueang, Khon Kaen, Thailand*²*Faculty of Agricultural Technology, Phetchaburi Rajabhat University, Mueang, Phetchaburi, Thailand***ABSTRACT**

The effect of different levels of bromelain supplemented feed in Tilapia on growth, nutrient digestibility, feed utilization and Nitrogen Excretion was studied. This study investigates the bromelain activity extracted from the wastes Phu Lae pineapple cultivars (economical fruits, Thailand). The waste portions such as the peel and crown were 27.64±3.36 and 11.97±2.12. Proteolytic activity was 0.36±0.07 and 0.34±0.02 U/min/mg protein, respectively. Protein digestibility in protein sources (fish meal and soybean meal) was determined by in vitro digestibility method with bromelain extract. The best protein digestibility was found to be 90.10-98.65% by bromelain extracted from peel. A 60 day's feeding trial was conducted on the feed supplemented with bromelain extracted from peel at 0, 1, 2 and 3% in juvenile tilapia (6.05-6.85 g, average initial weight). The fish fed on the feed supplemented with 1% bromelain extract resulted in lowest feed conversion ratio (FCR), specific growth rate increased, high protein digestibility, higher protein efficiency ratio (PER), and nitrogen retention efficiency (NRE). Viscera ratio and hepatosomatic index decreased significantly with increasing bromelain extract (p<0.05). The concentration of free ammonia and total nitrogen in water with fish fed dietary bromelain supplemented at 0, 12 and 24 hr found that no significant differences among dietary treatments. However the concentration of free ammonia and total nitrogen in water of fish fed with 1% bromelain supplementation had a decreasing trend. Therefore, supplementation of bromelain extract at 1% in diet had no adverse effect on digestibility and resulted in better growth performance and improve water quality.

Keywords: tilapia, bromelain, growth, feed utilization, water quality

[25]

**BIOACCUMULATION OF HEAVY METALS IN AQUATIC ANIMALS
COLLECTED FROM POOVAR ESTUARY, KERALA, SOUTH WEST COAST OF
INDIA**

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ABSTRACT

The present study was carried out in the coastal waters with special reference to Poovar estuary adjacent to the beach resorts of Poovar – Vizhinjam area in Thiruvananthapuram District, Kerala State, India. Fresh specimens of the fin fish (*Mugil cephalus*) and shell fish (*Penaeus indicus*) common fish varieties in the Poovar estuary were collected in triplicate from the study stations during the three seasons of the study period with the help of local fisherman. The present study on the heavy metal content in fish samples collected from different stations in Poovar estuary indicates that most of the heavy metals studied (Pb, Zn, Cd and Fe) were detected in the tissue samples. The higher levels of heavy metals in the fish muscle may result in toxic effects on human beings consuming these fishes. The study also revealed that the bioaccumulation of heavy metals in the shellfish samples collected from the study area was in the order Fe > Mn > Zn > Cu > Pb > Cd. Therefore, it is concluded that the heavy metal contamination in the aquatic environment of Poovar estuary causes subsequent accumulation of these metals in the aquatic organisms especially in sediment dwelling organisms like shell fish. The high levels of heavy metals recorded in the fin fish and shellfish tissues may reach human beings as fishes form the staple food for them. This may result in toxic effects on human beings consuming these fishes. To prevent the aquatic pollution, it is suggested that the practice of discharging sewage and wastes from tourist resorts without treatment to the estuary should be prohibited.

Keywords: bioaccumulation, heavy metals, tourist resorts, aquatic animals, estuary, treatment

[26]

**IMPACT OF WATER LEVEL FLUCTUATIONS ON NESTING PERFORMANCE
OF EXOTIC CICHLID *Oreochromis niloticus* (L.) IN SELECTED IRRIGATION
RESERVOIRS OF KALA OYA RIVER BASIN, SRI LANKA**

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ABSTRACT

In many Asian countries, African cichlid species, most notably *Oreochromis mossambicus* and *O. niloticus*, are important sources of cheap animal protein for rural poor. In Sri Lanka, they are dominant in reservoir fisheries. Nesting in the littoral zone of is a characteristic feature of *Oreochromis* spp. in their reproductive behaviour. We investigated nesting performance of *O. niloticus* in 10 irrigation reservoirs of Sri Lanka. The optimal nesting depth of *O. niloticus* ranged from 78.2 cm to 136.6 cm possibly due to differences in underwater light condition. Nest diameter in the 10 reservoirs ranged from 43.6 cm to 59.3 cm. Larger nests are deeper than the small nests, probably related to body size of nest building females. Nest density (ND m⁻²) of *O. niloticus* was negatively related to nest diameter (D in cm), slope of the nesting sites in the littoral zone (S in degrees) and silt percentage (Silt %) in sediment as follows:

$$ND = -0.012 D + 0.938 \quad (R^2 = 0.461)$$

$$ND = -0.70 S + 0.536 \quad (R^2 = 0.415)$$

$$ND = -0.017 \text{ Silt \%} + 0.433 \quad (R^2 = 0.256)$$

The optimal nesting depth (D_{opt} in cm) of *O. niloticus* was negatively related to water turbidity (Turb in NTU) as $D_{opt} = -5.136 \text{ Turb} + 154.69$ ($R^2 = 0.509$). Mean relative reservoir level fluctuation (RRLF) determined as, $RRLF = (\text{Mean Reservoir Level Amplitude} / \text{Mean depth}) \times 100$, had a significant negative relationship with ND according to $ND = 187.02 \text{ RRLF} - 1.185$ ($R^2 = 0.518$). Effective dialog among multiple users of reservoirs to achieve a win-win could possibly be adopted to optimize fish yield.

Keywords: cichlids, Kala Oya basin, nesting behaviour, *Oreochromis niloticus*, water level fluctuation

[27]

CARBON SEQUESTRATION THROUGH INTEGRATED MICROALGAE AQUACULTURE

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ABSTRACT

Aquaculture is the fastest growing food production sector in the world. But this rapid growth faces some limitations in the availability of suitable sites and in the ecological carrying capacity of the existing sites. It is necessary to overcome such limitations and meet the future world food demand and in this respect integrated multi-trophic aquaculture (IMTA) is increasingly promoted. Fed species like finfish, inorganic extractive species like microalgae and seaweeds, organic extractive species like suspension and deposit-feeders culturing together has the promise to contribute towards the sustainability of aquaculture. Improving feed efficiency in industrial systems has high priority because feed is the largest production cost for commercial aquaculture. Microalgae are some of the most important feed sources in aquaculture (live feed for larvae of bivalves, crustaceans and marine fish; food for rotifers and shrimps), due to their nutritional value (naturally rich in antioxidant carotenoids and vitamins) and their ability to synthesize and accumulate great amounts of ω 3-polyunsaturated fatty acids (PUFAs). Not only as feed but in most IMTA systems, algae are used to uptake the waste nutrients while restoring the water quality and providing extra income to the farmers. Microalgae are considered to be suitable candidates for global warming mitigation through atmospheric carbon sequestration by virtue of their attributes such as faster growth, ability to grow in low quality water and tolerance towards a wider range of temperature, salinity and nutrient deficient environment. Further, the downstream processing of micro-algal biomass yields a variety of value added products including biodiesel as a lucrative alternative to fossil based fuels.

Keywords: algae, PUFAs, live plant feed, global warming, waste water treatment

[28]

POTENTIAL OF USING HUMAN URINE AS A LOW COST MEDIUM TO PRODUCE *Spirulina platensis* BIOMASS TO BE UTILIZED AS A PROTEIN SUPPLEMENT IN HOUSEHOLD SCALE

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ABSTRACT

Spirulina platensis is a planktonic filamentous photosynthetic cyanobacterium which is mostly exploited as a valuable source of protein. In addition, it has ability to produce diverse nutraceuticals such as vitamins, carotenoid pigments, amino acids, beneficial fatty acids and polysaccharides. However, the high cost associated with culture medium has become a barrier for production of this microalgae in domestic level. Hence, this study investigated the potential of using human urine as a low cost medium to produce a biomass of *Spirulina platensis* to be utilized as a protein supplement in household scale. Male human urine was collected, sterilized and a series of diluted test concentrations were prepared as 1/50, 1/100, 1/200, 1/300, 1/400, 1/500, 1/600 with distilled water. Zarrouk medium which is used as the recommended medium for *Spirulina platensis* culture was used as the standard. All the test concentrations were inoculated with *Spirulina platensis* culture and were provided 12 hours photoperiod by natural sunlight under the 20% shade with atmospheric temperature. After 14 days period optical density of each culture was measured by UV spectrophotometer (650 nm). As per the results, 1/300 had the highest optical density (0.874) compare to other dilution concentrations. However, it was not high as the optical density in Zarrouk medium (0.965). The dilution level 1/300 had the highest *Spirulina platensis* cell density. Further, investigations are recommended to enrich the natural urine medium with necessary nutrients and the analysis of nutritional composition of the producing microalgae biomass.

Keywords: human urine, low cost medium, protein supplement, *Spirulina platensis*

[29]

MALE *Oreochromis mossambica* AS INDICATOR FOR WATER POLLUTION WITH TRACE ELEMENTS IN RELATION TO CONDITION FACTOR FROM PAKISTAN

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ABSTRACT

Iron, Copper, Cadmium, Zinc, Manganese, Chromium levels were estimated to study the risk of trace elements on human consumption. The area of collection was Dera Ghazi Khan, Pakistan and was evaluated by means of flame atomic absorption spectrophotometer. The standards find in favor of the six heavy metals were in accordance with the threshold edge concentrations on behalf of fish meat obligatory by European and other international normative. Regressions were achieved for both size (length and weight) and condition factor with concentrations of metal present in the fish body.

Keywords: metals, *Oreochromis mossambica*, male, toxic analysis, body size, condition factor

[30]

ACCUMULATION OF HEAVY METALS COPPER (Cu) AND LEAD (Pb) IN WATER, SEDIMENT AND GILLS OF MILK FISH (*Chanos chanos* FORSKAL) IN THE AQUACULTURE AREA OF UJUNG PANGKAH, GRESIK-INDONESIA

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ABSTRACT

This study attempted to evaluate heavy metals (Cu and Pb) accumulation in the water, sediment and the gills of milk fish (*Chanos chanos* Forskal) cultured in ponds. The aquaculture relied on the Bengawan Solo River for the water systems while the water quality of the river has decreased due to high input of pollutant from the industrial activities in the areas. Heavy metals in the water, sediment and the gills were collected from three milk fish ponds. Heavy metal concentrations were found higher in the sediment rather than in the water for both Cu and Pb. The average concentration of Cu in the water was 0.315 ppm and in the sediment was 0.700 ppm. On the other hand, the average Pb in the water was 0.011 ppm and in the sediment was 0.077 ppm. Cu was found to accumulate more (0.192 - 0.256 ppm) in the gills of milk fish compare to Pb (0.040 - 0.170 ppm). Higher accumulation of Cu compared to Pb in the gills of milk fish was related to higher concentration of Cu in the water and sediment. In addition, Cu is also an essential nutrient to organisms that is needed in low concentration. This study shows that concentrations of both Cu and Pb in the gills of milk fish were still below the permissible limit for toxic metals set by Indonesian National Standard (SNI-2009).

Keywords: heavy metal, lead (Pb), copper (Cu), milk fish, bioaccumulation

[31]

**EVALUATION OF GROWTH PARAMETERS OF FRESHWATER PRAWN
(*Macrobrachium rosenbergii*) UNDER FORMULATED DIETS SUPPLEMENTED
WITH PROBIOTICS**

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ABSTRACT

A four weeks feeding trial was conducted to study the effect of probiotic Biosyn-AQ on growth and survival of freshwater prawn *Macrobrachium rosenbergii* juveniles. The basal diet (35.14% crude protein) was prepared by the supplementation of probiotic Biosyn-AQ (comprising *Lactobacillus* sp, *Bifidobacterium* and *Streptococcus*) at 3 different concentrations 1%, 2% and 3% used as treatments T1, T2 and T3 respectively in triplicates. Prawns were stocked at a rate of 40 juveniles/tank (60 cm ×30 cm ×30cm). Feeding was done at 10% of body weight per day to juveniles had mean initial length of 3.75±0.26 cm and mean initial weight of 1.02±0.29 g. Prawns were sampled every 2 weeks. At the end of the trial, Final lengths of prawns were 4.16, 4.72, and 4.78 cm for diets with 1%, 2% and 3% probiotics respectively. Final weights of prawns were 1.18, 1.88 and 1.96 g for diets with 1%, 2% and 3% probiotics respectively. Significantly higher values (p<0.05) of growth parameters such as length gain, weight gain, specific growth rate and survival rate were recorded for diets supplemented with 2% and 3% probiotics fed groups than diet supplemented with 1% probiotics fed group. On the other hand, effect of different probiotic concentrations was not significant between diets with 2% and 3% probiotics fed groups. So that, diet with 2% probiotics performed statistically on par with diet with 3% probiotics. Therefore, 2% of probiotics was selected as an ideal concentration in terms low cost than 3% probiotics and better growth performance. Hence, it can be concluded that, basal diet formulation supplemented with 2% probiotics Biosyn-AQ leads to better growth performance of prawns and can be suggested for promoting sustainable culture of *M. rosenbergii* under Sri Lankan conditions.

Keywords: *Macrobrachium rosenbergii*, juveniles, probiotics Biosyn-AQ

[32]

EVALUATION OF BREEDING PERFORMANCE OF FIGHTING FISH (*Betta splendens*) UNDER DIFFERENT SUBSTRATESSrikrishnan, R¹, Hirimuthugoda, N.Y³ and Rajapakshe, A.D.W.R³¹Department of Animal Science, Faculty of Agriculture, University of Jaffna, Sri Lanka²Department of Animal Science, Faculty of Agriculture, University of Ruhuna, Sri Lanka³National Aquatic Resources Research and Development Agency, Rekawa, Sri Lanka**ABSTRACT**

The Siamese fighting fish (*Betta splendens*) is widely distributed throughout Southeast Asia and is one of the most popular species for freshwater aquarium. Although successful breeding techniques have been developed for this species, high rate of larval mortality rate is a critical issue. There are various factors affecting the larval survival including nutrition, substrate, water quality, pathogen and stress. Substrates are floating materials which are dominant in spawning area for constructing the bubble nest. An experiment was conducted to study the effect of substrate on larval survival of fighting fish fry. Nine small glass aquaria (60 cm × 30 cm × 30 cm) were used as breeding tanks. One male fish was paired with female fish in each tank. Equal pieces (80 cm²) of rigifoam, polythene and banana leaf were placed on the tank surface to facilitate the male to form the bubble nest under it. Different substrates such as rigifoam, polythene and banana leaf were considered as treatments T₁, T₂ and T₃. The bubble nest area was significantly wider (p<0.05) under rigifoam (71.85±2.02 cm²) and polythene (32.45±1.36 cm²) substrates than the banana leaf substrate (24.10±1.62 cm²). Survival of fry was significantly higher under banana leaves (96%) and rigifoam (95%) than polythene (94%). Water quality parameters recorded in different treatments during the experimental period were pH (7-7.5), temperature (26-28^oC), and dissolved oxygen (5mg/l). According to the results, Regifoam was the better substrate than polythene and banana leaves in terms of bubble nest area and fry survival. Therefore it can be concluded that rigifoam can be used as a better substrate to facilitate good breeding performance and reduce the fry mortality of fighting fish.

Keywords: *Betta splendens*, substrate, bubble nest area, survival

[33]

EFFECT OF ARTIFICIAL SUBSTRATES ON THE CAGE CULTURED STINGING CATFISH, *Heteropneustes fossilis*

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ABSTRACT

Stinging catfish (*Heteropneustes fossilis*), an air-breathing species is a very popular and high valued fish in Bangladesh. Although attempts have been taken to develop cage based culture system of this burrowing fish species for addressing the difficulties of harvesting from deeper and larger water bodies but the results were not very satisfactory due to low survival rate. With a goal to develop an efficient culture technique for *H. fossilis*, the present experiment was conducted to assess the effect of setting artificial substrates viz. plastic pipe and mud inside cage on the survivability, growth performances and economic benefits of cage cultured stinging catfish. There were 12 treatments with four substrates (C1: only mud, C2: mud and pipe, C3: only pipe and C4: without any substrate) and three different stocking densities (D1: 100 fish/cage, D2: 200 fish/cage and D3: 300 fish/cage). The experiment was conducted in triplicates under a two factor design in 1m³ sized cages. Fish fries with a mean weight of 5.51±0.10g were reared for 144 days in different cages fed with commercial pellets. The water quality parameters were well within suitable range for fish culture during the experimental period. At the end of the rearing period, the highest survival rate of 79.33±1.53% was found in C1D1, with mud substrate and 100 fish/cage stocking density. The highest production of 5.27±0.10 Kg cage⁻¹ was found in treatment C1D3. However, the highest benefit cost ratio (BCR) were found in treatment C2D2, where both mud and pipe used as substrate with 200 fish cage⁻¹. Therefore, the results suggest that introduction of artificial substrate inside cage can significantly increase the survival rate as well as production of *H. fossilis* in cage culture.

Keywords: *Heteropneustes fossilis*, substrates, stocking density, growth, survival rate, BCR

[34]

**FOOD AND FEEDING HABITS OF STING CATFISH, *Heteropneustes fossilis*
(BLOCH) FROM MANCHAR LAKE DISTRICT JAMSHORO SINDH PAKISTAN**

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ABSTRACT

The analysis of food and feeding habits of *Heteropneustes fossilis* from Manchar Lake district Jamshoro Sindh, Pakistan were assessed from 110 specimens size ranged from 5.1 to 30.0 cm during March – June 2014. The study revealed that the feeding habit of *Heteropneustes fossilis* was found to be carnivorous with main preference of crustacean (60%) followed by animal matter (30%) and lowest preference worms (10%). The ratio of stomach weight versus body weight of *H. fossilis* from Manchar Lake was calculated and it indicated that the feeding activity of fish increase with increase in size of fish, as the stomach weight increases with the increase of the body weight. Finally it was resulted that *H. fossilis* was found to be highly carnivorous in feeding habit and mainly fed upon crustaceans from Manchar Lake, District Jamshoro Sindh Pakistan.

Keywords: sting catfish, food and feeding, Manchar Lake, *Heteropneustes fossilis*

[35]

PROSPECTS OF SUSTAINABLE FISH CULTURE PRACTICE FOR LIVELIHOOD SECURITY IN DISTT. TARN TARAN (PUNJAB) INDIA

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ABSTRACT

Tarn Taran district was formed in 2006 from Amritsar and is one of the border districts which lies in the North West frontier of Punjab which is bounded by Amritsar, Kapurthala and Ferozepur district. It lies between 31° 7' and 32° 3' north latitude and 74° 29' and 75° 23' in the east longitude. Tarn Taran district has a population of 1,120,070 as per 2011 census which has density of 464 inhabitants per Km². The population growth rate over the decade was noticed 19.28%. About 4192 ha area of the district is beyond the border wiring; Out of this area 3597 is cultivable. The net sown area in Tarn Taran is 2.17 lakh ha which is almost 100 % double cropped and some area is even put to 3 crops a year. The average rainfall of the district is 482.9 mm. Fish culture and aquaculture represents the fastest growing food sector industry in the world. It is also the source of livelihood of millions of common people, local and migrant fishermen and farming community. Harike Pattan is also known for the international wetland of Ramsar site, tourist hot spot and river Satluj and river Beas water which sustains different types of fauna and flora including commercially important finfishes such as clupeids, major and minor carps, large and small catfishes, mullets, murrels, spiny eels and other aquacrops etc. The local and migrant fishermen also depend on these water bodies which sustain ichthyofaunal diversity and fulfil their livelihood security by bringing catches in local fish market. But with changing socio-economic conditions, poor marginal local and migrant fisherman are now facing problems and intends to adopt fish culture practice or integrated fish farming practice and other allied activities to meet their basic requirements. In this connection socio-economic study of the fishermen community was conducted for identifying the constraints and intends to develop human capacity of poor and marginal farmers. It reveals to provide support, functional cooperation, and improved skill knowledge regarding fish culture or integrated fish farming in sustainable manner for farmer`s livelihood security as well as prosperity.

Keywords: scope, fish farming, livelihood security, Tarn Taran, Harike-Pattan, Punjab

[36]

**COMPARISON OF CROP-LIVESTOCK BASED ORGANIC FERTILIZERS ON
THE GROWTH OF COMMON CARP (*Cyprinus carpio*) POST LARVAE IN
OUTDOOR CEMENT TANKS**

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ABSTRACT

Organic fertilizers are the most effective way of increasing natural food supply in ponds to improve fish production. Three different kinds of locally available, crop-livestock based organic fertilizers were evaluated on the growth and survival rate of common carp (*Cyprinus carpio*) post larvae reared in outdoor cement tanks. The treatments consisted of control (CT), chicken manure (CM), cow dung (CD), and Ipil ipil leaves (IL). All treatments were triplicated. After 7 days of basal fertilization, common carp post larvae were introduced to each tanks and fed with similar diets. Physico-chemical parameters and biological parameters of the water were analyzed during the experimental period and growth rate of fish were analyzed weekly. CT showed significantly lower value of water temperature compared to other treatments. The pH value of the water was varied from 7.0 to 9.0 and not significantly depended on the treatments. Dissolve oxygen values of water were significantly higher in CM, CD, and IL treated tanks compared to control tanks. CM fertilized tanks showed the significantly higher phytoplankton and zooplankton densities compared to other treatments. Fish reared in CM and CD treated tanks showed significantly higher growth rates in terms of weight and length compared to other treatments during first week of growth. Higher values ($P < 0.05$) of the survival rates were observed in CM, CD, and IL treated ponds compared to control tanks. In conclusion, chicken manure is more effective as an organic fertilizer in pond fish culture compared to cow dung and ipil ipil leaves.

Keywords: organic fertilizer, common carp, post larvae, growth rate, chicken manure, cow dung, Ipil ipil

[37]

UTILIZATION OF TUNA (*Thunnus SP*) OFFAL FOR FISH OIL EXTRACTION, QUALITY EVALUATION AND EFFECT OF TOCOPHEROL ON OXIDATIVE RANCIDITY IN EXTRACTED OIL

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ABSTRACT

Tuna offal (head, intestine, fins) is much cheaper source for fish meal and fish oil production. Press liquor is a byproduct of fish meal processing which has considerable amount of lipids. Hence, extraction of lipid from press liquor decreases the load of treatment of effluent water and environmental pollution while giving financial advantages. Fish oil is a predominant dietary source of long-chain polyunsaturated fatty acids (LC PUFA) of the omega-3 series which are widely used for pharmaceutical purposes and as food supplements. But the presence of high amount of PUFA in marine oils makes them more prone to lipid oxidation and leading to deterioration of organoleptic quality and nutritional value. The purpose of the current study was to evaluate the quality of extracted tuna oil from press liquor and study the effect of Tocopherol on oxidative rancidity. Analysis of proximate composition of Tuna fish offal and press liquor was performed. Oil extraction from press liquor was carried out by centrifugation at 10,000rpm. Quality of the extracted oil was evaluated with and without addition of Tocopherol at 50 ppm and 150 ppm during one month storage period. Fatty acid profile of treated and untreated crude fish oil was analyzed by gas chromatography. Results showed that Tuna fish offal and press liquor contained 20.40±2.06% and 56.12±2.35% fat in dry basis. The percentage of total extractable oil from press liquor by centrifugation at 10,000 rpm was 51.75%. The reddish brown colored crude oil consists 4.63±0.042% free fatty acids (FFA) and 107±0.021% iodine value. During the storage period, FFA value of control and 50ppm Tocopherol added tuna oil was ranged approximately 5.5-6%. Iodine value of both treated and untreated Tuna oil was ranged 64-67%. No peroxide formation was observed throughout the research period. Fatty acid composition of Tuna fish oil showed the highest content (23.47%) of Docosahexaenoic acid (C22:6) which was more or less similar throughout the storage period in both treated and untreated crude Tuna oil. In conclusion, this study reveals that both 50ppm and 150ppm Tocopherol have no significance effect on retarding oxidative rancidity in Tuna fish oil.

Keywords: oxidative rancidity, press liquor, Tocopherol, Tuna fish offal, Tuna fish oil



POSTER PRESENTATIONS



[38]

CONSTRUCTION OF MOLECULAR / MORPHOLOGICAL PHYLOGENETIC IDENTIFICATION DATABASE FOR THE NEON DAMSELFISH, *Pomacentrus coelestis*

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The purpose of this study was to obtain molecular and phylogenetic data to establish a database for the identification of the neon damselfish, *Pomacentrus coelestis*. This species recently extended its habitat to the tropical waters of Korea owing to rising seawater on global warming. We conducted a comparative morphological analysis and mitochondrial DNA analysis. The neon damselfish was found in four regions (Jeju, Korea; Okinawa, Japan; Indonesia; Micronesia). We used the following morphological parameters: full length, body length, body width, length from the mouth to the dorsal fin, length from the eyes to the dorsal fin and length from the ventral fin to the dorsal fin. In addition, we obtained genetic sequence of the cytochrome oxidase c subunit I and cytochrome b belonging to mitochondrial DNA. These sequences were used as indicators of species phylogenetic distinct, which possesses the properties of matrilineal heredity and non-recombination. The morphological results showed that the ratio and slope of the full-length and body length had almost same distribution in the four local populations. In the mitochondrial DNA analysis, the genetic substitution between four local populations was hardly appeared. This study shows that the biological branching, as seen by comparing the geographical and genetic distance, is not long, which suggests this species has only recently been introduced into Korean waters. This study provides biological information of the markers found in this subtropical species originating from tropical regions and establishes the molecular genetic basis for the genetic variability of subtropical species that settle in Korean water.

Keywords: cytochrome b, cytochrome oxidase c subunit I, genetics, Korean waters, morphology, Neon damselfish

[39]

AN EDIBLE FOOD PRODUCT FROM ARMORED CATFISHES (*Pterygoplichthys* SPP.)

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ABSTRACT

Armored Catfishes commonly known as tank cleaner- has become one of the invasive fish species in Sri Lankan water bodies. Currently, there is no any identified measure to control this species in inland water bodies and this species does not have any food value in Sri Lankans fish market. Hence this study was conducted to develop an edible food product using Armored Catfishes. Three different processing techniques were used to prepare the raw fish samples before mixing with other ingredients i.e. T1 – cooked in boiling water and minced; T2 – Surimi technique; T3 – minced without any treatment. Other ingredients were equally added to the prepared fish samples and fish balls were made. The fish balls were stored under frozen condition (-18°C) for further analysis. Fat, protein, fiber, moisture and ash contents were measured. To determine the quality of the value added product pH, Total plate count (TPC) and *E-coli* were tested at 0, 7, 14, 21 and 28 day of storage. Sensory evaluation was conducted at 0, 7 and 14 days with fried fish balls. Results revealed that, tank cleaner could be effectively utilized to produce an edible food product. Three treatments were significant ($p < 0.05$) with regard to sensory attributes at day 0 and thereafter it was non-significant ($p > 0.05$). The highest estimated rank sum was observed in T2 at day 0. Results of proximate analyses showed that fat, ash and fiber contents were significantly different ($p < 0.05$) among samples. Protein content was lowest ($p < 0.05$) in T2 and moisture content was highest ($p < 0.05$) in T3. All the developed products were negative for TPC and *E-coli* during storage period and pH was remained non - significant ($p > 0.05$) among the treatments throughout the storage. Further studies are recommended to evaluate the heavy metals in these samples to ensure the safety.

Keywords: armored cat fishes, fish ball, sensory

[40]

CAPILLARIOSIS IN GREEN TERROR (*Andinoacara rivulatus*) IN IRANRahmati-Holasoo, H¹, Haddadi, A² and Mousavi, H.A.E¹^{1, 2, 3} *Department of Aquatic Animal Health, Faculty of Veterinary Medicine, University of Tehran, P.O. Box: 14155-6453, Tehran, Iran***ABSTRACT**

Cultivation and propagation of ornamental fishes have been increasing in last 20 years in Iran. More than 150 species of fresh water ornamental fishes are farmed in Iran. Green terror (*Andinoacara rivulatus*) from cichlidae is popular and expensive aquarium fish that lives in fresh water. The fish originates from the Pacific side of South America in the coastal waters from the Tumbes River in Peru to the Esmeralds River in Ecuador. In the past few years farming of this fish has been well developed in Iran. Some cases of its propagation have been reported in Iran but most of them have been imported to the country. To the best knowledge of the authors there are few studies about diseases of Green terror (*Andinoacara rivulatus*) and causes of fatality reported in Iran. The object of this study was to survey causes of loss of the fish in propagation centers in Tehran, Iran. Ten Green terror fish with signs of anorexia, loss of balance, moribund and darkness in skin color were referred to Ornamental Fish Clinic of Veterinary Faculty, University of Tehran in October 2015. Fish were first evaluated in terms of ectoparasites using wet mount under a light microscope. In both fish no ectoparasite was detected. To study bacterial infection and endo-parasitic infestation they were euthanized. Necropsy was performed under aseptic conditions and the alimentary canal was extruded. The alimentary canal was then observed under a stereo microscope. 1 to 10 nematodes were detected in intestine of each fish. Some nematodes were observed under a light microscope. Female nematodes bore oval shaped eggs and male nematodes had spicule. Regarding morphological characteristics of the nematodes and their eggs they were identified as *capillaria* sp. For treatment of other fish that were kept in 150 liter aquariums in propagation center, levamisole (2mg per 1 liter) was administered for 2 days. After 1 and 2 weeks, the treatment was repeated again. The treatment was effective and the loss (20 fish per day before the diagnosis and treatment) was terminated.

Keywords: green terror, nematode, *capillaria*, levamisole, Iran

[41]

**PATHOLOGICAL STUDY ON SKIN LESIONS OF REFERRED FISHES TO THE
AQUATIC CLINIC OF THE FACULTY OF VETERINARY MEDICINE**

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ABSTRACT

The aquaculture industry is a growing trend all over the world and Iran. Identification and study of the pathogenic species of fishes end up sound management maintenance and restocking of the fishes. Skin lesions (bacteria, viruses, fungi and parasites) in fish breeding industry are of high importance to avoiding high mortality rate and to properly manage them. In the present study, a total number of 173 fishes with skin lesions were referred to the Aquatic Clinic of the Faculty of Veterinary Medicine from September 2014 to September 2015. They were studied macroscopically and microscopically. Based on the results, of 173 fishes, 40 Red Mark Syndrome, 5 neoplasia, 61 parasitic diseases, 33 bacterial diseases, 9 fungal diseases and 25 other diseases were identified. Most fishes (ornamental fish from cichlidae) showed parasitic diseases and *Ichthyophthirius multifiliis* was the most predominant pathogen. The main histopathological findings of this parasite was necrosis of some epidermal cells. In addition, the lowest prevalence rate was associated with benign skin tumors (one case). Among infectious diseases, the highest rate of infection was related to parasitic diseases, bacterial diseases and fungal diseases, respectively. Results showed that the pathogens and pathological findings were related to the fish species and time of year. Red Mark Syndrome (RMS) was found just in rainbow trout farms in winter. The main histopathological findings of RMS were lymphocytic dermatitis and lymphocytic myositis. Skin lesions are predisposing factors for affection with secondary infections, economic losses, increased healthcare costs and growth reduction. Therefore, early diagnosis and conducting studies on these lesions are of high importance in fishes.

Keywords: fish, skin, pathological study

[42]

**ANALYSIS OF TOTAL PETROLEUM HYDROCARBON CONTAMINATION IN
EDIBLE OYSTERS ALONG SELECTED INTERTIDAL REGIONS IN THAILAND:
COASTAL CONSERVATION APPROACH**

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ABSTRACT

Hydrocarbon petroleum contamination is one of the key anthropogenic stresses along coastal ecosystem. Sessile organisms are directly affected by these kinds of environmental stressor. Assessment of hydrocarbon petroleum accumulation rate in coastal intertidal invertebrate communities is important to identify the pollution level of the particular ecosystem. This current study focused on the analysis of hydrocarbon petroleum contamination level in Rock Oysters, *Saccostrea cucullata* along selected rocky, intertidal shore regions in Eastern Thailand to identify any possible harmful impacts of coastal oil pollution. Total Petroleum Hydrocarbon contamination level was assessed in Rock Oyster samples collected from 3 different intertidal regions (AngSila, Samaesarn, Bangsaen), Eastern Thailand using solvent extraction method followed by spectrofluometric technique. Based on the results, all oyster samples were contaminated with petroleum hydrocarbon. The detected Total Petroleum Hydrocarbon range was 0.039 – 0.119 µg/g. Significant changes of Total Hydrocarbon oil accumulation rate in different shellfish species is mainly due to different factors such as oil pollution level, total amount of body lipid and filtering rate variability. These findings could be used as base-line data to monitor and compare the environmental quality, particularly of the coastal ecosystem.

Keywords: total petroleum hydrocarbon, accumulation rate, rock oyster, indicator



VIRTUAL PRESENTATIONS



[43]

LONG TERM COASTAL EROSION AND SHORELINE POSITIONS OF SRI LANKA

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ABSTRACT

Coastal zone of Sri Lanka is a key to sustainable development of the country. The erosion of country's coastal zone has been identified as a long standing problem. Therefore, coastal sediment dynamics around the country has to be identified to develop an appropriate coastal zone management plan. Remote sensing and GIS techniques can be used for quantitative and qualitative analyses of coastal processes including the coastal erosional and accretional trends. In this study, past and very recent Google Earth satellite images have been processed and analysed in an ArcGis environment to investigate erosional and accretional trends in the coastal zone all around Sri Lanka. Using the results of the study, near shore sediment transportation directions and patterns along the coastline around the country were also predicted. Most of the south-western coastline of Sri Lanka shows considerable erosion during stormy conditions under south-western monsoon period, but most of them get recovered during fair weather north-eastern monsoon conditions. Therefore, no any severe long term erosion conditions prevail in the western, south-western and north-western coasts. However, some isolated locations in the north-eastern and eastern coastline show considerable erosion. Predicted nearshore sediment transportation directions proved that it is mainly governed by wind and waves of southwest and northeast monsoons.

Keywords: coastal erosion, coastal sediment dynamics, coastline, Google Earth images

[44]

HIPPOCAMPUS IN SOUTHWEST OF MADAGASCAR

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Hippocampus is overexploited due to their importance in traditional Chinese medicine. Nowadays, hippocampus fishing is becoming one of the main activities of fishermen at Ankilibe, a village located at 15 km in the south of Toliara City, Southeastern coast of Madagascar. This 3 months study (February to April 2014) aims at (i) analyzing fishery and trade of this animal in Ankilibe village and (ii) essaying the juveniles production and rearing in the hatchery. For the fishery and trade study, surveys of fishermen, resellers, collectors and exporters were conducted. For juveniles' production, brood stocks collected by fishermen were transported and transferred directly into the hatchery for breeding and rearing. The results showed that 5 species of hippocampus exist and exploited in Ankilibe village: *H. fuscus* (31,13%) *H. borboniensis* (23, 49%), *H. spinosissimus* (20,05%), *H. trimaculatus* (19,98%) and *H. histrix* (0,35%). Prices of one fresh hippocampus at resellers and collectors vary from Ar 100 to Ar 4.500 (0,05-2,5 US\$) depending on their size. Dry products are sold to exporters at Ar 200000 to Ar 800000 Kg⁻¹ (100 to 400 US\$). For juvenile production and rearing, results showed that one hippocampus parent gave birth on average 300 juveniles (varying from 50 to 450 according to their size). A strong correlation ($r=0,96$) was observed between the length of the parent and the number of juveniles produced. During the experimentation, hippocampus juveniles died few days after birth. The cause of the mortality seemed linked with the food availability. Aquaculture is one of best solutions to the overexploitation of hippocampus in the region.

Keywords: hippocampus, Ankilibe, juveniles & broodstock

[45]

CARAPACE WIDTH-WEIGHT RELATIONSHIP OF MUD CRAB (*Scylla serrata* FORSKAL, 1775) (FAMILY: PORTUNIDAE) FROM THE NAVANTHURAI COASTAL WATERS, JAFFNA, SRI LANKA

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ABSTRACT

The present investigation was carried out to estimate the carapace width - weight relationship of *Scylla serrata* (Forsk, 1775) in the Navanthurai coastal area, Jaffna, Sri Lanka. The Mud crab, *S. serrata* is the largest crab found throughout the Indo- Pacific Ocean. Weekly random samples were collected from March 2012 to February 2014 from Navanthurai landing centre, Northern part of Sri Lanka. A total of 621 specimens ranging from 8 – 24 cm carapace width and 126 – 1530 g body weight were examined. Covariance analysis for carapace width - weight relationships of male and female *S. serrata* revealed that there was significant variation between male and female crabs ($P < 0.05$). The estimates of the regression parameters for male, female and pooled data of *S. serrata* obtained by regression analysis are $TW = 0.103 * CW 3.164$ ($N = 276, r^2 = 0.916$), $TW = 0.157 * SL 2.998$ ($N = 343, r^2 = 0.863$) and $TW = 0.134 * SL 3.060$ ($N = 621, r^2 = 0.886$) respectively. The results of two-sample t-test show the regression exponent value 'b' values of female (2.998) and pooled (3.060) were much closed to 3, did not deviate significantly from 3 ($P > 0.05$) indicating isometric growth whereas in male (3.164) significantly different from 3 ($P < 0.05$) indicating positive allometric growth. This information would be useful for fishery managers and cultivator convert length measurements in to total bio mass in the field.

Keywords: length-weight relationship, *Scylla serrata*, regression analysis, covariance analysis, allometric growth

[46]

**PRELIMINARY STUDIES ON LENGTH-WEIGHT RELATIONSHIP OF *Atule mate*
(CUVIER, 1833) (PISCES: CARANGIDAE) FROM THE JAFFNA ESTUARY, SRI
LANKA**

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The present investigation was carried out to estimate the length weight relationship parameters and growth pattern of *Atule mate* (Cuvier, 1833) from the Jaffna estuaries. *Atule mate* is commonly known as yellow scad found in the tropical areas of Indian and Pacific Ocean. Random samples were collected monthly from January to December 2010 from landing centre of Navanthurai, Kakaitheevu, Kurunagar and Pasaiuoor, Northern part of Sri Lanka. A total of 152 specimens were analyzed. Covariance analysis for length–weight relationships of male and female *Atule mate* reveals that there was significant variation between male and female (($p < 0.05$) but there is no difference between male or female. The estimates of the regression parameters and equations for male, females and pooled data of *Atule mate* obtained by regression analysis are $TW = 0.013TL^{2.945}$ ($N = 70$, $r = 0.925$), $TW = 0.008 TL^{3.102}$ ($N = 82$, $r = 0.912$) and $TW = 0.008 TL^{3.095}$ ($N = 152$, $r = 0.928$) respectively. The exponent value, $b=2.945$ for males and $b=3.102$ for females, significantly different from 3 ($P<0.05$) reflect an allometric growth in both instances. Two-sample t-Test shows that females were not significantly ($P>0.05$) heavier than males. The results obtained from the present study help in establishing yield and also in converting one variable into the other as is often required during monitoring field measurements.

Keywords: length-weight relationship, *Atule mate*, regression analysis covariance analysis, allometric growth

