National Aquatic Resources Research and Development Agency

Annual Scientific Sessions – 2023

“Sustainable Fisheries for Economic Prosperity and Food Security”

13th December 2023

National Aquatic Resources Research and Development Agency (NARA)

Colombo15

Sri Lanka

Scientific Sessions Committee 2023

Dr. A. A. S. H. Athukoorala	Chairperson
Mr. P. A. D. Ajith Kumara	Committee Member
Dr. W. N. C. Priyadarshani	Committee Member
Mr. K. P. G. L. Sandaruwan	Committee Member
Mr. N. K. R. N. Jayawardena	Committee Member
Mr. U.S.P.K. Liyanage	Committee Member
Ms. D. G. T. Balawardana	Committee Member
Ms. D. W. L. U. De. Silva	Committee Member
Ms. K. H. K. Bandaranayake	Committee Member
Ms. K. H. K. Lakmali Piyasiri	Committee Member
Ms. R. R. A. Ramani Shirantha	Committee Member
Ms. S. R. C. N. K. Narangoda	Committee Member
Ms. R.A.S.S. Ranasinghe	Committee Member
Ms. Y. N. R. Nilupa Kumari	Committee Member

Cover Page Designed by:

Mr. D.M.A.B. Rathnayake

Contact:

Telephone: 0112-521-000/521-006

Fax: 0112-521-932

Email: postmasters@nara.ac.lk

Web: www.nara.ac.lk

Reviewers

Fisheries and aquaculture

Dr. C. Amarasiri, Principal Scientist (Retired), Marine Biological Resources Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. Chintha Perera, Faculty of Science, University of Kelaniya

DR. K R Gamage, Senior lecturer, Department of Fisheries and Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara

Dr. M. G. I. S. Parakrama, Department of Zoology and Environmental Management, Faculty of Science, University of Kelaniya
Prof. Upali Amarasinghe, Retired from Faculty of Science, University of Kelaniya

Dr. M. Gammanpila, Principal Scientist, Regional Research Center, National Aquatic Resources Research and Development Agency, Rekawa

Dr. Prajani Heenatigala, Principal Scientist, Inland Aquatic Resources and Aquaculture Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. R. P. P. K. Jayasinghe, Principal Scientist, Marine Biological Resources Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. S. S. K. Haputhantri, Principal Scientist, Marine Biological Resources Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. S.S. Herath, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara

Dr. Sajani Rathnapala, Department of Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara

Dr. Sanjaya Weerakkodi, Department of Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara

Dr. Vasantha Pahalawatta Arachchi, Retired Principal Scientist, Inland Aquatic Resources and Aquaculture Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. W. Rajapaksha, Senior Scientist, Inland Aquatic Resources and Aquaculture Division, National Aquatic Resources Research and Development Agency, Colombo

Mr. Arjen Rajasooriya, Retired Scientist, Marine Biological Resources Division, National Aquatic Resources Research and Development Agency, Colombo

Mr. P. A. D. Ajith Kumara, Senior Scientist, Inland Aquatic Resources and Aquaculture Division, National Aquatic Resources Research and Development Agency, Colombo

Prof. D. C. T. Dissanayake, Department of Zoology, University of Sri Jayawardena, Nugegoda

Prof. K. A. Sunanda Kodikara Arachchi, Department of Botany, Faculty of Science, University of Ruhuna, Matara

Prof. K. Masakorala, Department of Botany, Faculty of Science, University of Ruhuna, Matara

Prof. M. G. Kularathna, Department of Economics, Faculty of Social Sciences, University of Kelaniya

Prof. Mangala Yatawara, Faculty of Science, University of Kelaniya

Prof. P. B. T. P. Kumara, Department of Oceanography, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara

Prof. P. R. T. Cumaranathunga, Emeritus Professor, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara

Aquatic Biotechnology and Animal Health

Dr. D. R. Herath, Senior Scientist, Marine Biological Resources Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. Darshani Ruwandeepika, Faculty of Agricultural Sciences, Sabaragamuwa University

Prof. Chamari Hettiarachchi, Faculty of Science, University of Colombo

Oceanography and Hydrography

Dr. H. B. Jayasiri, Senior Lecturer, Department of Coastal and Marine Resources Management, Faculty of Engineering and Management, Ocean University of Sri Lanka

Dr. Jagath Rajapaksha, Senior Lecturer, Department of Oceanography, Ocean University of Sri Lanka

Dr. K. Arulananthan, Principal Scientist, National Institute of Oceanography and Marine Sciences, National Aquatic Resources Research and Development Agency, Colombo

Mr. A. N. D. Perera, Senior Lecturer, Department of Surveying and Geodesy, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka

Mr. S. R. C. Ranaweera, Chief Hydrographer, National Hydrographic Office, National Aquatic Resources Research and Development Agency, Colombo

Dr. S. U. P. Jinadasa, Senior Lecturer, Faculty of Engineering and Management, Ocean University of Sri Lanka

Fisheries Socio- economic and Marketing

Dr, Nesha Salpage, Senior Lecturer, Faculty of Fisheries and Marine Sciences, Ocean University of Sri Lanka

Dr. K. S. S. Atapaththu, Senior Lecturer, Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara

Mr. K. H. M. L. Amaralal, Principal Scientist, Socio-Economics and Marketing Division, National Aquatic Resources Research and Development Agency, Colombo

Aquatic Post Harvest Technology

Dr. Geevika Ganegama Arachchi, Principal Scientist, Technology Transfer Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. K. W. S. Ariyawansa, Principal Scientist, Institute of Post Harvest Technology, National Aquatic Resources Research and Development Agency, Colombo

Prof. O.D.N. Perera, Senior Lecturer, Department of Food Science and Technology, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka

Aquatic Environment, Conservation and Management, and Climate Change

Dr. Deeptha Amarathunga, Senior Scientist, Environmental Studies Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. K. A. W. S. Weerasekara, Principal Scientist, Environmental Studies Division, National Aquatic Resources Research and Development Agency, Colombo

Dr. M. P. Kumara, Senior Lecturer, Faculty of Fisheries and Marine Sciences, Ocean University of Sri Lanka

Dr. N. P. P. Liyanage, Senior Lecturer, Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University

Dr. Sanchala Gallage, Senior Lecturer, Faculty of Livestock Fisheries & Nutrition, Wayamba University

Dr. W. N. C. Priyadarshani, Principal Scientist, Fishing Technology Division, National Aquatic Resources Research and Development Agency, Colombo

Prof. (Mrs.) W. M. D. N. Wijeyaratne, Department of Zoology and Environmental Management, Faculty of Science, University of Kelaniya

Prof. H. B. Asanthi, Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara

GIS and Remote Sensing in Aquatic Sciences

Dr. Gihan Dahanayake, Senior Lecturer, Open University of Sri Lanka

Dr. M. D. E. K. Gunathilaka, Senior Lecturer, Department of Surveying and Geodesy, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka

Content **Page No**

Aquaculture and Fisheries

Aquatic Biotechnology and Animal Health

Oceanography and Hydrography

Fisheries Socio-economic and Marketing

Aquatic Post Harvest Technology

Aquatic Environment, Conservation & Management and Climate Change

GIS and Remote Sensing in Aquatic Sciences

Aquaculture and Fisheries

Effects of *Chlorella vulgaris* on growth and survival rate of Common carp, *Cyprinus carpio* Linnaeus, 1758 larvae

C.M. Samaraweera*[1], M.I.G. Rathnasuriya[1], P. Rajitha Dilshan Perera[2] and W.M. Pradeep Kumara[2]

1Department of Fisheries and Marine Sciences, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka

2 Aquaculture Development Center Dambulla, National Aquaculture Development Authority of Sri Lanka (NAQDA)

Chlorella vulgaris microalgae are used as a live feed for the early stages of fin fishes. Studies on *C. vulgaris* in Sri Lankan aquaculture are scarce, the present study aimed to identify the effect of *C. vulgaris* on the growth performances and survival rate of Common Carp, *Cyprinus carpio* larvae in an intensive hatchery process. The current study was conducted at the research facility of the Dambulla National Aquaculture Development Authority of Sri Lanka (NAQDA). Nine cement tanks (2mx2m) were used for an experimental setup with three treatments, each stocked 3000 larvae. Treatment 1 (T1) with 30 ml of soya milk daily, Treatment 2 (T2) with 30 ml of soya milk and 1 liter of *C. vulgaris* daily, and Treatment 3 with 2 liters of *C. vulgaris* daily. For the next 14 days, larvae were fed commercial feed (90g daily), mixed feed (commercial feed + 1 liter of *C. vulgaris* daily), and 2 liters of *C. vulgaris* daily for T1, T2, and T3, respectively. Weekly measurements of body length and weight were taken, and the survival rate of larvae was determined at the end of the experiments. Water quality parameters (DO, temperature, NH_3 level and pH level) were recorded daily during the study period. The Kruskal – Wallis test showed no significant difference in the body weights and lengths of the larvae at the end of the experiment ($P>0.05$, $N=54$). *C. vulgaris* fed larvae showed a low survival rate (57.7%) compared to the Commercial feed fed larvae (89.7%). The present study indicated that the use of *C. vulgaris* has no positive significant effect on the growth and survival of *C. carpio* early larval rearing. Future studies must be focused on the use of different densities of *C. vulgaris* in early larval feeding and as a supplementary diet for the early stages of *C. carpio*.

Keywords - *Chlorella vulgaris*, *Cyprinus carpio,* live feed, growth, survival

Corresponding author-email: chathumada99@gmail.com

Exploring the status of threats impacting coral-associated fishes in Sri Lanka: A systematic review

I.J.J.U.N. Perera[1*], M.D. Madhushan[2], K.K. Jayashanka[2] and U.G.A.Y. Sewwandi[3]
1Department of Agricultural Engineering and Environmental Technology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka
2Department of Environmental Technology, Faculty of Technology, University of Colombo, Mahenwatta, Pitipana, Sri Lanka
3Department of Agricultural Technology, Faculty of Technology, University of Colombo, Mahenwatta, Pitipana, Sri Lanka

Reef fishes are crucial for marine ecosystems, contributing significantly to the health and functioning of coral reefs. However, in Sri Lanka, anthropogenic activities and climate change have substantially threatened the stocks of coral reef fish. Hence, we conducted a systematic review to examine current threats, assess legislative gaps, and identify conservation strategies for the sustainable management of reef fish populations in Sri Lanka. For the literature search, we employed keywords such as "threats," "reef fishes," "reef fish management," "coral degradation," and "Sri Lanka". Our findings revealed that the primary threats to reef fish stocks in Sri Lanka include overexploitation, habitat degradation, invasive species, pollution and climate change. Destructive fishing practices have led to alterations in reef habitat structure. Commercial exploitation affects numerous coral reef species, and destructive methods like bottom-set nets and blast fishing have harmed reefs and depleted fish populations. The loss of branching corals reduced refuge availability for certain species, potentially increasing their predation risk. Habitat degradation stems from reef fish collection for the aquarium trade, where inexperienced collectors disrupt habitats to extract hidden fish, causing significant reef structure damage. Additionally, we observed that climate change-driven phenomena, such as coral bleaching, have further contributed to the degradation of coral reef habitats and several reefs in Sri Lanka experienced significant coral mortality during major bleaching events in 1998 and 2016. Moreover, several legislations in Sri Lanka pertain to reef fish management. The Fauna and Flora Protection Act No. 2 of 1937 and its amendments, along with the Fisheries and Aquatic Resources Act No.2 of 1996 and its amendments, safeguard a few uncommon or rare reef fish species, prohibiting their export. However, these species lack local protection against fishing activities, making them highly vulnerable even when not intended for export. Additionally, the use of nets on reefs is strictly prohibited under the Fisheries and Aquatic Resources regulations. Despite these severe impacts, most threats persist, and a lack of rigorous management and law enforcement undermines the resilience of the system, hindering potential reef recovery and the fulfillment of integrated coastal management objectives. In terms of conservation frameworks, it is recommended that laws and regulations aimed at preventing the destruction of reefs and over-fishing should be implemented, establishing consistent monitoring and observation practices for the sustainable conservation of reef fishes in Sri Lanka. Public awareness campaigns and education initiatives can play a vital role in promoting sustainable fishing practices and fostering a sense of responsibility among local communities. Furthermore, the adoption of a voluntary code of conduct for fishers can encourage more environmentally friendly methods, reducing the impact of destructive fishing practices. The development of marine protected areas, where fishing is restricted or regulated, can serve as sanctuaries for reef fish to thrive and recover. Collaborative efforts between government agencies,

non-governmental organizations, and local communities are essential for the successful implementation of these conservation strategies, ensuring the long-term health and resilience of reef fish populations in Sri Lanka.

Keywords: Coastal ecosystem, Coral reef degradation, Habitat degradation, Overexploitation, Threats to reef fishes

*Corresponding author-email: nisansalapereragt@gmail.com

Effect of dietary supplementation of Butterfly-pea (*Clitoria ternatea* L) on the colour enhancement of Fighter fish (*Betta splendens*)

M.N.F. Hafsa[1*], A.D.W.R. Rajapakshe[2], R.G.S. Wijesekara[1], and G.R.H. Rupika.[2]

[1]*Department of Aquaculture and Fisheries, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila NWP, Sri Lanka;*

[2] *National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.*

The market value of ornamental fish is greatly influenced by their attractive colours. Since fish may have limited ability in generating exotic colours on their own, supplementing the feeds with pigmenting agents may result to vivid coloration. The current research was conducted to determine the colour enhancement of Fighter fish (*Betta splendens*) by supplementing their feed with Butterfly-pea flower powder (*Clitoria ternatea* L). Four treatments in three replicates under completely randomized design were performed. Equal number of fish were stocked in twelve glass tanks and fed twice a day with commercial fish feed brand, Growfin, containing 0% (Control), 1% (T1), 2.5% (T2) and 5% (T3) of dried Butterfly-pea flower powder for 45 days. Growth and colour measurements were performed fortnightly. The head, dorsal, and tail colours of each fish were assessed through a colour reader, CR-10 Plus. The colour was measured in terms of L*, a*, and b* that is based on the International Commission on Illumination (CIE). The Hue (H°) and Chroma (C*) were calculated from a* and b*. Furthermore, the colour was assessed visually among panelists at the end of the experiment. Colour reader results showed that a significant increase ($p<0.05$) in blue colour (-b*) in T2 relative to control during the first two weeks. Visual analysis revealed that T3 exhibited the highest blue colour intensity of 88% ($p<0.05$) and this was followed by T2 and T1. The growth of fish did not significantly differ among the four dietary treatments ($p>0.05$). In conclusion, colour enhancement of Fighter fish can be achieved by supplementing fish feeds with 2.5% of *Clitoria ternatea* flower powder. Additionally, CR-10 Plus can be utilized to quantify color intensity using the (CIE) color system, which is more reliable, ethical, and simple than spectrometry and color charts.

Keywords: *Betta splendens*, *Clitoria ternatea* L, Konica Minolta Colour reader, Ternatin anthocyanins

**Corresponding author-email: nawaz.hafsa@yahoo.com*

Current status of Indian scad (*Decapterus russelli*) catch from Ring-net landings in Galle Fishery Harbour - Sri Lanka

K.G.M. Prabhani[1*], K.K.T. Nuwansi[2] and W.A.A.M. Bandara[2]

[1]*District Fisheries Office, Galle, Department of Fisheries and Aquatic Resources*

[2]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

The Indian scad, locally name as "Linna" is one of the most important and populous small pelagic fish species in local markets in Sri Lanka. It has high demand due to its availability with an affordable price for consumers and as a raw material for the fish canning industry. The Indian scad is mainly caught by Ring-net operations in Southern coast. This study sought to assess the current status of Indian scad catch and conducted during November to December from 2022 with a random sample of 107 multi-day boats in Galle fishery Harbor, represented 20% of total landings. Results revealed that 41 feet average length in sampled vessels with 17 average days, 4 average fishing days per trip, average of 7 crew members and active in both exclusive economic zone and high seas. The average Ring-net fish catch was 5,165kg per fishing trip out of which 2,054 kg were Indian scads. The percentage contribution of Indian scad to the total monthly fish catch of the Kandan Coarse was 40% and the remaining catch composited *Elagatis bipinnulata*, *Auxis thazard*, *Auxis thazard*, *Auxis rochei*, *Katsuwonus pelamis*, *Thunnus albecares*, *Coryphaena hippurus* (57%) and others (3%). Catch per unit effort (CPUE) was 24.88kg/trip/fishing day in total catch while 11.01kg/trip/fishing day in Indian scad. The average length of the Indian scad caught was 28.7±0.90 cm which is above their length at first maturity values (FishBase) and no threat to the sustainability of fishery. The average income per fishing trip without deducting the operational cost was LKR 2,222,288.00 while the Indian scad was LKR 889,273.00 and contributing 42% to the total income. Average price of Indian scad per kg was 573.50 rupees. The study suggests that it is crucial to study year-round fish catch and its population dynamics, to identify patterns of fish catch and for sustainable fisheries management.

Keywords: Catch per unit effort, Economic aspect, Indian scad, Multi-day boats, Ring-net

Corresponding author-email: prabhanikgm@gmail.com

Prevalence of multi-drug resistance and the diversity of integrons in *Pseudomonas* spp. isolated from apparently healthy freshwater food fish and their farming environments in the Central Province of Sri Lanka

R. M. P. A. Bandara[1], K. L. N. Ananda[2], N. U. Jayawardana[1], A.W. Kalupahana[2], S. S. S. de S. Jagoda[2*]

[1] *Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya*

[2] *Centre for Aquatic Animal Disease Diagnosis and Research (CAADDR), Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya*

Pseudomonas spp. are Gram-negative bacteria ubiquitous in aquatic environments and serve as opportunistic pathogens for fish, humans and terrestrial animals. The objectives of this study were to characterize *Pseudomonas* spp. isolated from the freshwater food fish (Tilapia - *Oreochromis niloticus*) and their corresponding farming environments, to investigate the antimicrobial resistance patterns of isolated *Pseudomonas* spp. and the diversity of integrons. Sampling was conducted at five tilapia culture facilities in Central Province between November 2022 and December 2022. Samples collected included apparently healthy tilapia (skin mucus) and environmental samples (pond water, pond sediment, and biofilms). The collected samples were transported to the laboratory and cultured on Trypticase Soy Agar (TSA) and Glutamate Starch Phenol Red Agar (GSP) for pseudomonad isolation. Presumptive *Pseudomonas* spp. were identified based on conventional biochemical tests, followed by genus-level confirmation using *Pseudomonas* genus-specific primers targeting the *16S rRNA* gene through PCR. Antimicrobial susceptibility testing was performed using the Kirby-Bauer disk diffusion method. Pseudomonads were isolated from 60% (12/20) of the samples cultured. A total of 14 isolates were phenotypically and genetically confirmed as the genus *Pseudomonas*. Resistance was observed against erythromycin (50%), amoxicillin (64.3%), chloramphenicol (57.14%), enrofloxacin (0%), and tetracycline (0%) among the isolates. More than half of the isolates (7/14) were identified as Multi-Drug Resistant (MDR), and 57.14% (8/14) exhibited Multiple Antibiotic Resistance (MAR) Indexes > 0.2, indicating significant contamination with antimicrobials in their isolation sources. None of the isolates (0/14) carried integrons. These findings confirm the occurrence of MDR *Pseudomonas* spp. associated with freshwater food fish and their farming environments. It is important to highlight that multi-drug resistant *Pseudomonas* spp. can readily enter humans and other terrestrial animals through the food chain, leading to infections that pose significant treatment challenges. Therefore, this study underscores the critical importance of using antimicrobials judiciously in aquaculture practices.

Keywords: Antimicrobial Resistance, Food Fish, Freshwater, Integrons, *Pseudomonas* spp.

**Corresponding author-email: samanthika@vet.pdn.ac.lk*

Evaluation of the efficacy of two commercially available biogenic products on growth performance of Goldfish (*Carassius auratus*)

S.S.K. Liyanage[1], K.L.N. Ananda[1], D.P.N de Silva[2], S.H.N.P de Silva[3], S.S.S de S. Jagoda[2*]

[1] *Department of Animal Science, Faculty of Animal Science & Export Agriculture, Uva Wellassa University of Sri Lanka*

[2] *Centre for Aquatic Animal Disease Diagnosis and Research, Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya*

[3] *Department of Crop Science, Faculty of Agriculture, University of Peradeniya*

The present study evaluated the effectiveness of *Lacticaseibacillus rhamnosus* and two commercially available biogenic products (A, B) on the growth performance of goldfish. The experiment was conducted in a completely randomized design (CRD). Apparently healthy, six-weeks-old goldfish (initial weight: 4.55 ± 0.049 g; initial total length:5.41 ± 0.02 cm; initial standard length: 3.51 ± 0.01 cm) were divided into eight experimental groups each with three replicates, each replicate containing 10 fish. These included a negative control group (without any beneficial bacteria or products), three different doses [5mL/15L; 10mL/15L; 15mL/15L] of the products A and B; and a positive control (*L. rhamnosus* $1.5x10^8$ CFU/mL 5ml/15L). Biogenic products and *L. rhamnosus* were added to the rearing water of the respective tanks on the first day of the experiment and every five-day interval after a water change, throughout the 49-day observation period. Weight and length of fish were measured weekly. No statistically significant increase in total length (TL) [A: 6.99 ± 0.04 cm; B: 6.85 ± 0.03 cm] standard length (SL) [A: 4.18 ± 0.24 cm; B: 3.74 ± 0.08 cm] and weight (W) [A: 4.93 ± 0.24 g; B: 5.15 ± 0.08 g] was observed in goldfish in both products compared to the negative control but weight gain was significant in the positive control ($p<0.1$) [TL: 7.24 ± 0.2 cm; SL: 4.20 ± 0.04 cm; W: 5.39 ± 0.63 g]. Gut colonization of *Lactobacillus* was observed in fish immersed in two products and the positive control. A separate experiment was conducted to assess the immersion concentration of *L. rhamnosus* on growth performance of goldfish. Six-month-old goldfish with an average weight of 6.55 ± 0.18 g were divided into three experimental groups each with two replicates, each replicate containing 10 fish. These included a negative control (without *L. rhamnosus*) and two different concentrations of *L. rhamnosus* in rearing water (T1: $4x10^5$; T2: $1.12 x10^6$ CFU/ml). Fish were observed for five weeks. Weight gain was measured weekly. A statistically significant weight gain was observed in goldfish in T1 and T2 compared to the control ($p<0.05$). Our results revealed that *L. rhamnosus* at $4 x 10^5$ CFU/mL in raring water significantly increases the growth of goldfish. Both the commercial products contained *Lactobacillus* at concentrations of $2.77x10^6$ CFU/mL (A) and $2.24x10^7$ CFU/ml (B) which were found to be suboptimal.

Keywords: biogenic products, *Carassius auratus*, *Lactobacillus rhamnosus*, survival rate, water quality parameters, weight gain

**Corresponding author-email: samanthika@vet.pdn.ac.lk*

Antibacterial activity of *Phyllanthus acidus* and *Chaetomorpha antennina* extracts on fish pathogenic bacteria

S. K. Perera* and S. Gallage

Department of Aquaculture and Fisheries, Faculty of Livestock Fisheries & Nutrition, Wayamba University of Sri Lanka

Antibiotic resistance is one of the significant issues in disease control in the aquaculture industry. It results from the overuse and improper use of antibiotics against pathogenic bacteria. Therefore, there is a critical need to identify viable, cost-efficient alternatives of natural plant extracts with antibacterial properties that might be employed in the aquaculture industry. The present study was designed to determine the antibacterial activity of natural plant extracts against pure cultures of common fish pathogenic bacteria, *Aeromonas hydrophila*, *Edwardsiella tarda*, and *Vibrio* sp. Aqueous extracts of *Phyllanthus acidus* leaves and *Chaetomorpha antennina* were prepared in concentration of 100 mg/ml. Sterilized water was used as negative control and Ciprofloxacin aqueous solution was used as positive control. Fifty microliters (50 µl) of pathogenic bacteria suspension was mixed with 50 µl of each plant extract. Each pathogenic bacterial concentration was adjusted as 0.2 OD at 600 nm. The micro well dilution technique was used to check the antibacterial activity and samples were incubated for 24 hours at 37°C. Following the incubation, spread plate method was used to count the remaining bacteria to be given as Colony Forming Units (CFU) /ml. Percentage inhibitions were calculated based on the inhibition of positive control. In comparison to the 100% inhibition of Ciprofloxacin solution against all three selected pathogens, *Phyllanthus acidus* and *Chaetomorpha antennina* extracts show inhibition of *A. hydrophila* of 96.11± 0.3% and 95.7±0.39%, respectively, which is not significantly different from the inhibition of Ciprofloxacin. Furthermore, *Phyllanthus acidus* extract inhibits *Vibrio* sp. by 29.11±0.19%, followed by 85.96±0.11% inhibition against *E. tarda*. *Chaetomorpha antennina* inhibits *Vibrio* sp. by 18.56±0.04% inhibition and *E. tarda* by 93.3±0.27% inhibition. Based on the results, it can be concluded that *Phyllanthus acidus* and *Chaetomorpha antennina* extracts can effectively be used to inhibit *A. hydrophila* and *E. tarda* as potential alternatives to the antibiotics.

Keywords: *Aeromonas hydrophila*, Antimicrobial activity, *Chaetomorpha antennina*, *Edwardsiella tarda*, Phyllanthus acidus

**Corresponding author-email: shainikavindi@gmail.com*

Effect of dietary inclusion of Heen bovitiya leaf meal (*Osbeckia octandra*) on the growth performance of Koi carp (*Cyprinus carpio*)

D.I.P. Kularathna*, N.L.M. Sathyangana, H.A.T. Hettiarachchi, G.D.P.S. Dilshani, R.A.S. Kawshalya, A.N.N. Kumari, J.H.B. Indiwaree, and K.M.P. Yasasmi, C.N. Walpita, M. Naveenan, M.K.C. Priyadarshana

Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka

The use of herbal supplements in ornamental fish culture is one of the fundamental tools used in enhancement of growth, body pigmentation, and health-related aspects. Heen bovitia (*Osbeckia octandra*), is such an herbal plant with proven positive effects on human health, together with adequate pigments on its leaves and flowers. Therefore, the present study investigates the effect of incorporating *O. octandra* leaf meal in the diets of koi (*Cyprinus carpio*) fish. A total of 270 two-week-old fry were subjected to three dietary treatments, where *O. octandra* leaf meal was incorporated at 0% [T0 - control], 3% [T1], and 6% [T2]. The experiment was conducted for 3 months. Feeds were prepared to contain 38% crude protein, 8.5% crude fat, and 3880 kcal/kg gross energy. Fish with an initial mean body weight and length of 0.212±0.01g and 2.294±0.03cm were allocated into treatment tanks arranged in triplicates. Fish were fed up to 10%, 8%, and 6% of the body weight on first, second and third months respectively. Fish tanks were fed at a rate of three times per day. Water pH and temperature were maintained at 7.5 and 24 ^{0}C¬. However, with related to the growth performance, the final body weight (g) was significantly higher ($P<0.05$) at T2 (T0 - 6.78±0.59, T1 - 7.54±0.38, T2 - 9.51±0.26). Total body length (cm) was also significantly higher ($P<0.05$) at T2, whereas no significant difference was observed between T0 and T1 (T0 - 7.25±0.23, T1 - 7.63±0.13, T2 - 8.07±0.72). As per the results, no significant difference was observed among the treatments for feed conversion ratio (T0 - 4.90±0.59, T1 - 3.90±0.18, T2 - 3.92±0.20) and specific growth rate (%/day) (T0 - 0.32±0.15, T1 - 0.34±0.18, T2 - 0.52±0.10). The overall growth-related data suggested that the dietary incorporation of *O. octandra* leaf meal could lead to notable positive effects on the growth performances. Inclusion of *O. octandra* leaf meal at a rate of 6% is, therefore, effective on *C. carpio* culture.

Keywords: body length, body weight, *Cyprinus carpio*, growth rate, *Osbeckia octandra*

**Corresponding author-email: dipkularathna@std.agri.sab.ac.lk*

Effects of co-feeding probiotic bacteria on *Artemia* in icroalgae-Mediated culture environment

W.B.I. Udumbara Wickramasinghe[2], M.A.J.C. Mallawa Arachchi[1], Varthani Susruthan[2]

[1]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2]*Department of Biosystems Technology, Faculty of Technology, University of Jaffna, Sri Lanka*

Artemia nauplii are among the most used live feed in fish and crustacean larval culture because they are easy to culture and are in an appropriate size for many different larvae. It is vital to develop culture techniques for *Artemia* biomass and cyst production. The use of probiotic bacteria, based on the concept of competitive exclusion, and the use of immunostimulants are two of the most promising disease prevention techniques established recently. *Artemia* and bacteria are involved in a symbiotic relationship marked by mutualistic interactions. Bacteria contribute to *Artemia* growth through nutrient cycling, enzymatic digestion, disease suppression through antimicrobial metabolites, and facilitating a favorable environment for optimal growth, survival, reproduction, and developmental processes within the ecosystem. The present research was aimed at studying the effect of probiotic bacteria on *Artemia* growth, reproduction and survival in N*annochloropsis* spp. mediated culture system. The research was accomplished with two different levels [200 mg/L (T1) and 500 mg/L (T2)] of probiotic bacteria with *Nannochloropsis* sp. and the control was only with *Nannochloropsis* sp. The trial was conducted with a completely randomized design and all the data was analyzed using Statistical Analysis System (SAS 9.4). The initial stocking density was adjusted to 15 nauplii/ml. The experiment was carried out for 15 days Treatment with 500 mg/L showed significantly ($p < 0.05$) higher biomass (165.33 ± 2.8 mg/L) and the lowest biomass was recorded in the control (32.99 ± 9.88 mg/L). The final length of Artemia was affected by treatments. The probiotic concentration of 500 mg/l showed a significantly higher ($p < 0.05$) final length (22.46 ± 0.50 mm), and the lowest value was observed in the control (8.67 ± 0.50 mm). Treatment with 200 mg/l showed a significantly ($p < 0.05$) higher final density (3.7 ± 2.37 individuals/ ml and the lowest value was recorded in the control (1.6± 0.76 individuals/ml). Early reproductive maturity was observed in T1 and T2. Egg-bearing females were observed in both treatments on day 14 and none was in control until day 15. The results indicated that the co-feeding probiotic bacteria has a positive impact on Artemia growth and reproduction in a microalgae-mediated culture environment.

Keywords: *Artemia*, Biomass, Length growth, *Nannochloropsis* sp., Probiotic

**Corresponding author-email: wickramasingheudumbara@gmail.com*

Influence of different microalgae species on the growth, survival and fecundity of Brine Shrimp *Artemia*

*W.M.N. Tharushi[2], M.A.J.C. Mallawaarachchi[1], Varthani Susruthan[2]

[1]*Department of Biosystems Technology, Faculty of Technology, University of Jaffna, Sri Lanka*

[2]*National Aquatic Resources Research & Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.*

Artemia is a planktonic crustacean that is commonly used as live food in aquaculture also known as brine shrimp and can be cultured in large quantities in specialized tanks or ponds. Due to its high nutritional value and ease of cultivation, *Artemia* is widely used in aquaculture around the world. This study was performed to evaluate *Artemia* growth, survival, and reproduction efficiency with three different microalgae under laboratory conditions. Newly hatched *Artemia* nauplii were introduced into 250 ml seawater with 1 nauplii/ml density. *Artemia* were fed with three different microalgae, *Thalassiosira* sp. (T1), *Chaetoceros* sp. (T2), and *Chlorella* sp. (T3) for 21 days with 1.8×10^6 cells/ ml concentration. The experiment was conducted with a complete randomized design and each treatment was triplicated. *Artemia* growth were measured with length and biomass. *Artemia* length exhibited a significant difference ($p < 0.05$) in individuals fed with *Thalassiosira* sp. (10.00±1.0 mm), although this length was not significantly different from those fed *Chaetoceros* sp. (9.5 ± 0.5 mm). Regarding biomass, *Artemia* individuals in T1 exhibited significantly ($p < 0.05$) higher dry weight (0.28 ± 0.04 mg/individual) in comparison to those fed with T3 (0.12 ± 0.03 mg/individual). However, no significant difference ($p > 0.05$) was observed between T1 and T2 (0.21 ± 0.02 mg/individual). While the microalgae species did not have a significant effect ($p > 0.05$) on *Artemia* survival, T1(71.5 ± 5.4 %) demonstrated a notably higher survival rate compared to T2 and T3. The microalgae species did not significantly ($p > 0.05$) effect on fecundity of *Artemia*. However, T3 showed the highest number of eggs per female (57.00±7.96) and early maturity (15 days) compared to T1 and T2. The study concluded that feeding *Thalassiosira* sp. and *Chlorella* sp. to *Artemia* had two distinct potentials in aquaculture: biomass production and cyst production accordingly.

Keywords: *Artemia*, Biomass production, *Chaetoceros* sp. *Chlorella* sp. *Thalassiosira* sp.

**Corresponding author-email: 198tharushi@gmail.com*

Optimum dietary replacement level of local fish meal with *Azolla* sp. on growth performances and colour development in fingerling Koi Carp (*Cyprinus Carpio*)

A.L.I.N. Lekamage[1], Rochana Weerasingha[2*], M.C.L. Zoysa[1] and N. P. Harshani Deepakumari[2]

[1]*Department of Coastal and Marine Resources Management, Ocean University of Sri Lanka.*

[2]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.*

For decades, attempts have been made for dietary replacement of fish meals with alternative plant protein sources in formulating aqua feeds, especially for herbivore and omnivore fish. *Azolla* sp. is an aquatic plant that contains nitrogen, phosphorous and other macro and micro minerals which could serve in herbivorous fish. Among freshwater ornamental fish species, koi carp is a dominant exporting commodity. The present study focused on determining the effects of dietary replacement of local fishmeal (Agri-star® fish meal, CP-40%) with *Azolla sp*. on the growth, survival and colour enhancement of *Cyprinus carpio*. Four experimental diets were formulated using 0% (T_1) (a control diet), 10% (T_2), 20% (T_3) and 30% (T_4) of *Azolla sp.* in the diet. One hundred eighty early fingerling koi carp (initial weight: 290 mg) were arbitrarily distributed in 12 tanks at 15 fish per tank. The experimental fish were fed with isonitrogeneous (CP-37%) and isocaloric diets twice a day (09.00 a.m. and 03.00 p.m.) up to satiation for 70 days of feeding trial. In the growth performances of fish, a significantly (p<0.05) higher percent weight gain and specific growth rate (SGR) was reported in fish fed T_3 compared to that of fish fed T_1. The skin colour brightness determined using the Munsell book of colour showed a significant difference (p<0.05) in fish fed T_4 diet containing 30% of *Azolla* sp. after 70 days of the feeding trial. The present study concluded that the optimum replacement level of local fish meal with *Azolla* sp. in the diet could be 19% by the specific growth rate of Koi carp fingerlings. It proved that *Azolla* sp. in koi carp fingerlings diets enhances growth and colour development.

Keywords: *Azolla* sp., *Cyprinus carpio,* fingerlings, specific growth rate and colour development

**Corresponding author-email: rochanaweerasingha@gmail.com*

Life history traits and stock assessment of the Scalloped spiny lobster (*Panulirus homarus*) in Hambanthota district-Sri Lanka

*Upul S.P.K. Liyanage, J.S. Jayanatha, W.A.L. Wickramasinghe, S.P. Jayasuriya, J. F. Nizreena

National Aquatic Resources Research and Development Agency, Regional Research Center, Kapparathota, Weligama, Sri Lanka

The Scalloped spiny lobster *Panulirus homarus* (Linnaeus, 1758) is the most abundant and commerically important lobster species found along the shallow coastal streach of Hambantota district, the major lobster producing area in Sri Lanka. The lobster fisheries of the district have been declined since few decades due to capture of undersized juveniles, berried females and increasing fishing effort induced by growing price. Updated information of the fishery is important to review the existing regulations and management plans. The life history parameters estimation and stock assessment were performed with FiSAT II package based on the length frequency data collected in the year 2021.The estimated asymptotic length ($L\infty$), Von Bertalanffy growth coefficient (K), length at which length is theoretically be zero(t_o) and longevity ($A_{0.95}$) for the pooled data are respectively 123.38 mm, 0.5/year, -0.348mm and 5.296 years. The observed and estimated maximum carapace length for the species were 115mm and 113.03mm (CI 95%, 104.49 - 121.57mm). The natural mortality (M), total mortality (Z), and fishing mortality (F) were respectively 0.763, 2.33 (1.84-2.83), 2.053 $year^{-1}$. Estimated optimum length (L_{opt}), mean carapace length and growth performance index of the current study are respectively 81.78±10% mm, 71.87±11.04mm and 1.78. The percentage of lobsters in optimum length range was 36% although target is 100%. Recruitment pattern of the current study revealed that two uneven cohorts representing two recruitment pulses. According to this study *P. homarus* stock in Hambantota district is over fished hence fishery is not sustainable. Therefore, it is proposed to review existing management regulations, reduce the fishing effort, strengthen the co management mechanism while strongly enforcement of the regulations.

Keyword: life history, *Panulirus homarus*, scalloped spiny lobster, stock assessment

**Corresponding author-email: upulliyanage@hotmail.com*

Development of rapid multiplication technique for *Microsorum pteropus* (Java fern)

W.A.K.D. Madurangika[1], J.P. Eeswara[2], V. Pahalawattaarachchi[1], D.M.S. Sugeeshwari[1*]

[1]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2]*Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka*

Java fern (*Microsorum pteropus*) is one of the most popular freshwater aquarium plants with high demand in the aqua-scape industry. Thus, the development of a rapid multiplication technique for Java fern has become an urgent requirement to fulfill this growing demand.
The efficiency of multiplication of Java fern through callus initiation and sporophytes initiation were compared. Leaf explants were collected from the protected plant house of the National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka. Experiments were conducted to optimize medium compositions for callus initiation and plant regenerations. The effect of the five different concentrations (0, 0.5, 1, 2, and 5 mg/L) of 2,4-D, combined with 1 mg/L Kinetine on callus initiation was investigated. Further parallelly an experiment was conducted to find out the optimum Giberelic acid hormone concentration requires for the initiation of sporophytes. Mature leave bound to the Styrofoam sheets were kept in the prepared water tanks, one with 10 L water and 0.5 g/L Albert fertilizer as nutrients and GA hormone. The effect of 5 different GA hormone concentrations (0, 0.5 mg/L- 4 mg/L) on sporophyte initiation and plantlet formation was investigated. The highest percentage of callus initiation (10%) was observed in the Murashige and Skoog medium supplemented with 1 mg/L Kinetin + 5 mg/L 2,4-D. However, almost 8 months was taken for the callus initiation but plant regeneration was not observed. Sporophytes initiation was significantly low ($P<0.05$) and it was observed in 0.5 mg/L GA (T3) concentration within two months' time period and the initiated sporophytes produced plantlets successfully. The study confirmed that the multiplication of Java fern by sporophytes initiation is the most effective method compared with the callus initiation.

Keywords: callus, Java fern, sporophytes, sterilization

Corresponding author-email: tkssumangala@gmail.com

Seasonal and spatial variations of Indian scads harvesting from ring net fishery in Sri Lanka

H.M.T.C. Madhushankha*, W.A.K. Prabath, W.N.C. Priyadarshani

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Ring net fishery represents a specific category within the realm of commercial fishing operations, employing a distinctive type of net referred to as a "ring net," which belongs to the broader category of “encircling nets”, which is closely linked with floating objects often encountered in the high seas and is predominantly conducted by multiday fishing vessels. This method is commonly utilized for capturing species like mackerel, herring, and sardines. The primary focus of ring net fishing in Sri Lanka is the Indian Scads, specifically *Decapterus russelli* although other species are also incidentally collected. The current study focused on determining the seasonal variation of catch with fishing grounds. Fish catch data for the year 2019 was collected from 554 boat log sheets obtained from the fisheries offices in Kaluthara, Galle, and Hambanthota districts, 172 sheets, 198 sheets, and 183 sheets respectively. The weight of the target species was analyzed for four distinct monsoon seasons: North East monsoon (NE), first inter-monsoon (FIM), South West monsoon (SW), and second inter-monsoon (SIM). The analysis revealed that no statistically significant differences ($p<0.05$) were in the weight of the catch of target species among four monsoon seasons. The total catch of the target species was 248.08 Mt for NE, 180.61 Mt for FIM, 524.13 Mt for SW, and 178.72 Mt for SIM respectively. But, a significant difference ($P>0.05$) was observed the among total catch of *Decapterus russelli* in fishing grounds especially in in South-West region, Southeast region, and Northeast region. The highest catch was recorded from the Southeast region which is 488.67 Mt and the lowest catch (233.46 Mt) was recorded from the Northeast region. Harvest or target species within the Exclusive Economic Zone (EEZ), (164 boats) and beyond the EEZ, (389 boats) were significantly different ($p>0.05$) and the highest catch of 786.89 Mt was recorded beyond the EEZ. Catch per unit effort per boat was calculated for within EEZ and beyond EEZ and it was 2.0253Mt per boat and 2.0955 Mt per boat respectively. According to the findings, there is no temporal variation, but a spatial variation was detected.

Keywords: *Decapterus russelli*, EEZ, Fish catch, Monsoon, Ring net

**Corresponding author-email: thilanka.ruh@gmail.com*

Growth performances of micro-propagated aquatic plant, *Aponogeton natans* in different culture conditions

G.K. Galahena[1], K.K.T. Nuwansi[2]*, Varthani Susruthan[1], D.M.S. Sugeeshwari[2]

[1]*Department of Biosystem Technology, Faculty of Technology, University of Jaffna*

[2]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

Aponogeton natans is a highly demanded aquatic plant and micro-propagation is a suitable technique for the mass production. Acclimatizing the plant to the natural environment from in-vitro conditions is a challenge and it requires to develop proper techniques to acclimatize plants. Thus, present study aimed to develop proper hardening techniques to ensure the best survival of this plant. The first experiment was conducted to standardize the fertilization rate and three different concentrations of Albert's solution, (0.25mg/L, 0.5mg/L,1mg/L) were used as treatments. Plant growth parameters measured to assess the growth performances and statistical analysis done with SPSS 16 version. The mean Initial wet weight, and mean plant height were 0.52±0.02g, 3.25±0.09cm respectively. At the end of 60 days, the highest mean height(14.63 ± 0.7 cm), significantly highest number of leaves (13.33 ± 0.9 cm), leaf length (5.13±0.17cm), mean root length (13.42 ± 0.53cm), mean rhizobium length (1.10 ± 0.05cm) and wet weight (3.53 ± 0.2g) were observed in 1mg/L concentration. Thus, 1mg/L could be taken as the suitable concentration for hardening. In the second experiment applied the best concentration of above (1mg/L) to find a suitable substrate medium, viz., river sand, paddy mud, crushed stones, and coconut chips. The mean Initial wet weight, and mean plant height were 1.74±0.07g, 7.92±0.3cm respectively. At the end of 60 days, significantly higher mean height (26.03± 1.1 cm), number of leaves (16.00 ± 0.5), leaf length (6.40 ± 0.05 cm), and leaf width (2.40 ± 0.05 cm) and mean root length (11.56 ± 0.1cm) were observed in paddy mud. Significantly higher mean rhizobium length was observed in river sand medium (1.93± 0.08 cm). Wet weight of the plants was not significantly different between river sand and paddy mud. Crushed stones showed poor growth performances considering all selected media.Thus, 1mg/L Albert's solution with paddy mud could be recommended to harden the *Aponogeton* plants.

Keywords: *Aponogeton*, growth performances, in-vitro condition

Corresponding author-email: kktnuwansi@gmail.com

Effects of the dietary supplementation of coriander seed (*Coriandrum sativum*), Heen Bovitiya leaf (*Osbeckia octandra*) and Hathawaria leaf (*Asparagus racemosus*) against *Aeromonas hydrophilla* infection in Koi Carp, *Cyprinus carpio* (L)

M. Namithra[1*], A.D.W.R. Rajapakshe[2], E.T.S. Madhubhashini. and G.R.H. Rupika[2]

[1] *Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Kandy, Sri Lanka.*

[2]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.*

The ornamental fish culture is one of the developing sectors in Sri Lanka. High cost of production and mortality losses are caused by disease conditions in this industry. *Aeromonas sp*. is a major bacterium that causes infections in koi carp fingerlings. Many chemical compounds including antibiotics are used by farmers to control the disease conditions. The use of antibiotics is environmentally sound leading to antimicrobial resistance. Therefore, the application of native herbal plants in the aquaculture sector is considered as an effective and environmentally friendly way to enhance fish immunity and growth. This study was conducted to investigate effect of *Coriandrum sativum* (Coriander seeds), *Osbeckia octandra* (Heen bovitiya leaf), and *Asparagus racemosus* (Hathawaria leaf) against *Aeromonas sp* infection of koi carp fingerlings. Three feeds were produced by incorporating 1% of the dry powder of each plant into Growfin commercial feed separately. Growfin feed was used as the control Feed. The feeding period was six weeks. Growth performance, feed efficiency and haematological parameters were estimated. In the challenge test *Aeromonas hydrophilla* 0.1 ml (OD value 0.8, in 600 nm) was injected to three replicate of each feed groups at the end of the experiment. In terms of haematological parameters, herbal treated groups showed higher red blood cell count and white blood cell count compared to control, among them in Asparagus feed were give significantly higher results. There are no significantly differences between control and *Osbeckia* feed results. Asparagus feed showed the highest specific growth rate (SGR%) and lowest feed conversion ratio (FCR) 1.8 among the treatments. Coriandrum showed second highest SGR. In the challenge test, treated groups showed higher survival rate compared to the control. Among them, Asparagus treatment showed the highest survival rate (83.3%) and *Osbeckia*, Coriandrum and control groups survival rates respectively 66.67%, 50%, 33.3%. The results Showed that dietary supplementation of Asparagus leaf can enhance immunity, growth and resistance against *Aeromonas hydrophilla* in koi carps.

Keywords: *Aeromonas hydrophilla, Asparagus racemosus*, *Coriandrum sativum*, koi carps.

[*]*Corresponding author- email: namithramohanraj@gmail.com*

Wild harvest of Seaweed (*Grasilaria salicornia*) can be sustain in the near future?

J.S. Jayanatha[1]*, H.N. Ilanperuma[2, 3], I.G.H. Manujaya[4], W.A.L. Wickramasingha[1] and U.S.P.K. Liyanage[1]

[1]*National Aquatic Resources Research and Development Agency, Regional Research Centre, Weligama, Sri Lanka.*

[2] *Central Environmental Authority, Southern Provincial office, Koggala, Sri Lanka.*

[3]*The Open university of Sri Lanka, Nawala, Nugegoda.*

[4] *Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka.*

The wild seaweeds are globally impotent resources; as it uses in organic fertilizer for organic fertilizer, crop stimulators, food-grade chemical extractions. Overexploitation of natural seaweeds needs to be controlled for their sustainability through employing proper management strategies. Therefore, the quantification of available biomass and the evaluation of being used engaged techniques for wild collection are more crucial. The present study was designed to determine harvestable biomass and the abundance of *Grasilaria salicornia* and coexisting seaweed species along the Kiranchi-Kakathiw-Walaipadu coastal areas in the 2021. The quadrates and belt transect were performed; 100m transects were laid perpendicular to shoreline from high tide to low tide while the transects were divided into 10m or 5m intervals depending on the distribution of the seaweeds. A quadrant ($0.25m^2$) was placed at the sampling points in triplicate. Seaweed species present within the quadrant were collected and the wet biomass of *G. salicornia* weighed. Collected materials were kept in the polyethylene bags for further preservation and identification. A total of 67 quadrates were deployed in a$16.75m^2$ area consisting of *G. salicornia* fresh biomass of 178,738 kg in 389 plants/ bunches and a final fresh biomass of 10,670.93 kg/m^2. The harvestable quantity was 5 kg/ m^2 during the season, while, estimated fresh weight of *G. salicornia* from March and April was about 180,000kg. The total exported dry *G. salicornia* quantity was 100 tons from January to February in 2021 that dry quantity equal to fresh weigh of 1000 tons. The majority of harvesting done by scoop nets (90%) and there are no any selection procedures followed. Thus *G. salicornia* catch consist of other seaweed species including *Sargassum* sp, *Gracilaria edulis*, *Padina* sp, and other soft corals species, while this non-target by-catch is destroyed. Furthermore, locations where extract seaweeds resources were widely used by other artisanal fishermen to construct fishing traps/kraals. Harvested data reveled that there were over exploitation and destructive methods were employed; therefore, partially harvesting by hand-picking, collecting of only washed-up materials and regular monitoring would be recommended to sustain the resources. Furthermore, the community should strictly adhere to the recommended guidelines provided by relevant authorities.

Keywords- belt transect, *Grasilaria salicornia*, sustainable harvest, wild seaweeds,

* *Corresponding author-email: sarathjayanatha1978@gmail.com*

Challenges in utilizing fisheries logbook data for scientific analysis: A case study of Sri Lanka's logbook system

S.S. Gunasekara*

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15. Sri Lanka

The Department of Fisheries and Aquatic Resources (DFAR) introduced a logbook data collection system for multi-day vessels in 2012, later mandating its use for all mechanical fishing vessels through the extraordinary gazette of 1878/11 in 2014. As of 2019, the ELOGBOOK LITE app and database have been employed for the collection and storage of logbook data. This study analyzes 854,846 fishing operations recorded in the DFAR logbook database from January 2019 to June 2023. Notably, the collection of geographic coordinates initially employed degrees and minutes on paper, while the eLogbook app and database use a decimal convention. Out of the total operations, 85.96% have the correct format of geographic coordinates for the starting location of fishing activities, with 78.06% of operations falling within the legally designated fishing areas for Sri Lankan vessels. The spatial distribution of fish catches from this eLogbook data exhibited an abnormal pattern when compared to logbook data from 2016-2019 and VMS data provided by DFAR. Intriguingly, 22.5% of operations were observed in the Southern Indian Ocean (5°S-20°S and 80°E-90°E), an area with historically minimal fishing activity. The data entry app defaults to south as the latitude coordinate, potentially contributing to incorrect latitude values. Cross-validation of fish catch data (weight and amount) against hard copies revealed instances where multiple fishing operations had been merged and incorrectly entered into the database, rendering them unsuitable for calculating catch per unit effort or other subsequent analyses. Furthermore, the logbook database only includes four bait types (squid, flying fish, milkfish, and other), omitting artificial bait, which is the prominent bait used in longline fisheries. Additionally, fishing gear parameters displayed unusual values that deviated from established parameters. Such discrepancies may result from both inaccurate information provided by fishers and errors during data entry. These issues hinder compliance with national fisheries data requirements because fishery management authorities frequently deal with intricate systems and protocols, possibly overlooking the significance of precise data collection.

Keywords: challenges, data accuracy, fisheries, logbook data, Sri Lanka

**Corresponding author-email: sudheera@nara.ac.lk*

Development of in-vitro shoots multiplication technique for *Aponogeton natans*

D.M.S. Sugeeshwari*, W.A.K.D. Madurangika

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Aponogeton spp. have both ornamental and medicinal uses and six species are available in Sri Lanka. According to the IUCN Red List 2020 in Sri Lanka, *A. rigidifolious*, *A. jacobsenii*, and *A. kannangara* are in the critically endangered category. *A. dassanayakei* and *A. natans* in the engendered category. *A. crispus* in the vulnerable category. *Aponogeton spp.* has high demand in local and export markets since the development of rapid multiplication techniques is important. Assess the optimum Plant Growth regulator compositions for rhizome development and shoot multiplication from initiated plantlets of *A. natans* in in-vitro conditions. Selected seed ex-plants were sterilized and cultured in liquid MS medium with 2 mg/L BAP (6-Benzyl Amino Purine) and 0.5 mg/L IBA (Indole Butyric Acid) for plantlet initiation. Generated Plantlets were transferred to liquid MS medium with BAP and IBA, 1:1 ratio as (0.5 mg/L.1.0 mg/L, 20 m/L, and 3.0 mg/L) and control (without PGR) for rhizome development. Rhizomes were transferred to liquid MS medium with constant BAP (3.0 mg/L) combined with different IBA (0.5 mg/L, 1.0 mg/L, 2.0 mg/L, and 3.0 mg/L) concentrations and control (without PGR) for shoot multiplication. Each treatment consists of ten replicates. Developed rhizomes and shoot images were captured and data were collected using ImageJ software. Rhizome diameter was measured and the number of shoots was counted. Data were analyzed using R software. MS medium with BAP: IBA (3 mg/L) was significant ($P<0.05$) low for both maximum mean rhizome diameter (2.01 cm) and maximum mean shoot number (9.5). Hence the study concluded, that MS medium with BAP: IBA (3 mg/L) was the best medium for *Aponogeton natans* rhizome development and shoot multiplication.

Keywords: *Aponogeton natans*, multiplication, rhizome, shoot

Corresponding author-email: tkssumangala@gmail.com

Assessment of species composition of traded Elasmobranch products in Sri Lanka

D.G.T.C. Balawardhana*, K.R. Dalpathadu, W.G.M.S.D.S. Yatawaka, D.R. Herath, S.S.K. Haputhantri

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Shark fin trade has been identified as one of major reasons for the population decline of sharks and rays in the world. Sri Lanka is considered one of the leading shark product exporting countries. There is a dearth of species-specific information on shark product trade in Sri Lanka. Such information is crucial to assess the impacts on different elasmobranches stocks that thrive in or migrating across the Sri Lankan waters. This study was based on the species identification reports issued by the National Aquatic Resources Research and Development Agency (NARA) to the Department of Fisheries and Aquatic Resources for obtaining export permits by the exporters during 2020-2022. Fresh or dried elasmobranch products received to NARA were mainly identified by morphological features and molecular techniques were used if necessary. During the study period, 32 species belonging to 10 families were identified. Among which five species were critically endangered, one species as endangered and 15 species were vulnerable as per the IUCN Red List (2020). Dried shark fins (72.48%) were the dominant product followed by ray gill plates (19.3%), skins (7.7%) and shark jaws (%). More than 50% of dried fins and skins were derived from Requiem sharks followed by Family Dasyatidae (12.8%) and Sphyrinidae (12.6%). *Mobula* (Manta) spp, *Mobula mobula* and *M. tarapacana* were recorded as the Mobulid species that subjected to extract gill plates for trading. *Carcharhinus falciformis*, *Rhynchobatus* spp and *Sphyrna* spp were dominant for shark fins and *Galeocerdo cuvier* was more common in bulks of shark skins. It is clear that majority of the dried elasmobranch products are derived from threatened species. As there is an increasing trend in the trade it imperative to closely monitor the trade to maintain sustainability.

Keywords: dried shark fins, requiem sharks, shark products, Sri Lanka

**Corresponding author-email: thejani.fmst2008@gmail.com*

Stock status of Sea cucumbers on the North East coast of Sri Lanka

A.A.S.H. Athukoorala*, K.R. Dalpathadu, S.S. Gunasekara, M.P. Hendawitharana, M.M.C. Karunarathne, M.D.I.C. Kumara, J.A. C. Prasad, S.C.V.U. Senevirathna, R.P.P.K. Jayasinghe

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Sea cucumbers (Class: Holothuroidea; Phylum: Echinodermata) were subjected to high fishing pressure due to surging demand. To propose sustainable harvesting strategies, species diversity, biomass, Maximum Sustainable Yield (MSY), Total Allowable Catch (TAC), and length-weight relationship was assessed using an Underwater Visual Survey (UVS) covering an area of 498 km^2 in the Chalai in Mullaithivu district in June 2023 during the calm sea period. Sampling was executed in 30 random points using belt transects and the area of each transect was 100 m^2 (50 x 2 m). All the visible sea cucumbers within each transect were collected and length-weight measurements were obtained. The calculated biomass for the survey area was extrapolated to the entire area. The MSY was determined by using the MSY=1/2 MB_0. The TAC was determined by using 0.5 x MSY as it was an exploited stock. During the survey, four sea cucumber species *Bohadchia vitensis* (brown sandfish), *Holothuria edulis* (pink sea cucumber), *Holothuria spinifera* (Brownfish), and *Stichopus naso* were recorded in the daytime. The estimated total biomass was 276,896 t with 926,207,460 individuals. Among the four species, *B. vitensis* was the most commonly available (biomass 264,278 t) with MSY 79,283 t and TAC 39,642 t per year. *H. edulis*, the least abundant species (498 t) with MSY 149 t and TAC 75 t. The MSY and TAC of *H. spinifera* (biomass 1,544 t) were 463 t and 232 t per year respectively. In addition, estimates for *S. naso* (10,577 t) showed 3173 t for MSY and 1587 t for TAC per year. Furthermore, negative allometric length-weight relationships were observed as $W=2.6153L^{-1.7585}$ ($R^2=0.8253$) for *B. vitensis*, $W=2.165L^{-1.4963}$ ($R^2=0.5739$) for *H. spinifera*, and $W=1.3881L^{0.6173}$ ($R^2=0.5192$) for *Stichopus naso*. The findings of the research are useful to implement sea cucumber management plan and close fisheries monitoring system of the sea cucumbers in the Mullaithivu district.

Keywords: biomass, diversity, maximum sustainable yield, sea cucumber, underwater

Corresponding author-email: sujeewahemanthi@gmail.com

Preliminary study on biological, fisheries and socio-economical aspects of Gastropod fisheries in Kalpitiya area, Sri Lanka

S. Thanusanth, R. Srikrishnan, M.M.A.S. Maheepala and R.P.P.K. Jayasinghe*

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

The present study was conducted to report on the status of commercial gastropods in Kalpitiya area where lacking proper conservation and management plans. The survey was conducted from January to December 2022, covering various aspects in biology, fisheries, and socioeconomics. Data on catch, fishing effort, and socio-economic factors were gathered at Kalpitiya landing site through participatory monitoring of landings and conducting interviews on a monthly basis. Approximately 200 OFRP boats were utilized for the fishery. Harvesting was carried out using skin (18-20 m depth) and SCUBA (20-30 m depth) diving techniques during daylight hours. The fishery experienced an off-season from April to July, while the peak season occurred from November to February. Among the three gastropod species recorded, *Pleuroploca trapezium* (Horse conch) as the primary harvested species (above 95%), followed by *Chicoreus ramosus* (Branched murex) were harvested for operculum and meat while *Turbinella pyrum* (Sacred chank/divine conch) was harvested in specific peak periods, mainly for its ornamental and export value of the shell. Mean CPUE of *P. trapezium* mean was 201 ± 43 shells per boat per day and the weight of the shells ranged between 400-500 g which accounted 28% of total shells. In addition, the length class of 18-20 cm solely contributed 50% of the total catch. The harvest of smaller sized (12-14 cm) shells were negligible (around 1%). About 80% of Branch murex yield was exported to the Middle East, while the remaining portion is supplied to local market. The exported operculum, known for its quality, fetches a market value of nearly LKR 10,000 per kilogram. It was noted that accumulation of empty shells on the land leads to environmental issues, therefore; recycling or utilization as alternative sources of $CaCO_3$ should be further studied. There is an urgent comprehensive research need to recommend regulations for sustainability of the resources.

Key words: export, gastropods, length, operculum, recycle, sustainable

**Corresponding author - email: prabathj@nara.ac.lk*

Exploring the fisheries aspects of fyke net fishery in Puttalam Lagoon, Sri Lanka

S. Thanusanth, R. Srikrishnan and R.P.P.K. Jayasinghe*

National Aquatic Resources Research and Development Agency (NARA), Crow Island Colombo 15, Sri Lanka

Fyke nets are widely being operated in Puttalam lagoon year-round by small-scale fishers, targeting penaeid shrimps. A systemic study was carried out from January to December 2022 in seven prominent fishing grounds namely Pulluppitiya, Mandalakudah, Mattuthivu, Kottanthivu, Malkanthivu, Nedunthivu and Elamaga Ivura. The real-time data on species composition, length frequency, catch and effort on fish catch were obtained in each month. Totally 45 species (representing 35 families) were recorded throughout the year, including penaeid shrimps (n=5) as the target species, finfish (n=35), crabs (n=3), mollusc (n=1) and cnidarian (n=1). *Metapenaeus moyebi* was the most dominant target species, contributing 46% to the total annual shrimp production. *Penaeus merguiensis* was the second-highest, accounting for 24% of production, followed by *P. indicus* (14%) and *P. semisulcatus* (14%). Mean CPUE of shrimp showed a peak in January (0.635 kg/ trap) and a drop in June (0.114 kg/ trap). The highest (0.561 kg/ trap) and lowest (0.155 kg/ trap) mean CPUE were reported in 1st inter-monsoon and southwest monsoon respectively. Comparatively northeast and 1st inter-monsoon showed highest catch rate and it may favor due to the calm wind season in northwest coastal region. Mean CPUE of bycatch species were higher in January (0.984 kg/ trap) and lower in December (0.033 kg/ trap). The highest proportion (about 90%) of shrimp was observed in December and followed by July (69%). Survey indicated that throughout the year, fish species exploited as immature (2cm - 10cm and below 20g) where, commercial valued *Siganus* sp. was recognized as the major bycatch. The length frequencies showed, the most of the penaeid shrimps except *M. moyebi*, caught via the fyke net fishery were immature (TL: 10 cm – 14 cm) year-round. Therefore, proper management plans with gear modifications are crucial for conserving this wild fish stocks and maintaining sustainable resource levels.

Keywords: bycatch, Fyke nets, length, monsoon, Puttalam lagoon, shrimps

**Corresponding author - email: prabathj@nara.ac.lk*

The optimum dietary phospholipids requirement for hybrid lemon fin barb (*Hypsibarbus wetmorei* ♂ × *Barbonymus gonionotus* ♀) larvae: their survival, growth and disease resistance against *Aeromonas hydrophila*

Rochana Weerasingha[1,3], Mohd Salleh Kamarudin[1,2*], Murni Marlina Abd Karim[1,2] and Mohammad Fadhil Syukri Ismail[1,2]

[1]*Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*

[2] *International Institute of Aquaculture and Aquatic Sciences, Universiti Putra Malaysia, Batu 7, Jalan Kemang 6, TelukKemang, Si Rusa,71050 Port Dickson, Negeri Sembilan, Malaysia*

[3] *Present address: National Aquatic Resources Research and Development Agency (NARA),*

Crow Island, Colombo 15, Sri Lanka.

The utilization of hybrid carp species shows a promising trend in Asian aquaculture. Hybrid lemon fin barb is a crossed product of lemon fin barb (*Hypsibarbus wetmorei*, ♂) and silver barb (*Barbonimus gonionotus*, ♀). Wild lemon fin barb catches increase annually due to its taste. Hence, the Department of Fisheries of Malaysia introduced this fast-growing and tasty hybrid species. Reduction of larval rearing cost of the species mainly relies on minimizing feed costs. This study aimed to determine the optimum dietary phospholipid requirement for larval hybrid lemon fin barb on growth, survival and disease resistance against *Aeromonas hydrophila*. Three-day-old larvae were randomly stocked in 15 plastic tanks of 5L at 50 larvae/ L. While completing the yolk sac absorption and mouth opening at around day three after hatching, five feeds with increasing phospholipid (PL) levels of 0, 1, 2, 4 and 6% were randomly allocated into fish tanks. After 20 days of the feeding trial, weight gain (WG) and protein efficiency ratio (PER) of hybrid lemon fin barb larvae fed 4% PL (337.88±31.09; 7.36±0.34 respectively) were significantly higher (p<0.05) than those of larvae fed 0-2 % PL (101.52±18.43 - 172.73±18.37; 3.41±0.51 – 4.48±0.99 respectively) contained diet. Feed conversion ratio (FCR) and specific growth rate (SGR) of hybrid larvae fed 4% PL were significantly lower (1.86±0.16) and higher (7.36± 0.34) (p<0.05) respectively than those of larvae fed PL-free diet (values ± SD). However, WG, PER, FCR and SGR were similar (p>0.05) in hybrid lemon fin barb larvae fed 0-2 and 6% PL diets. The optimum dietary PL requirement for the growth of larval hybrid lemon fin barb was determined at 4%. Lipid vacuoles appeared in the liver and gut of larvae fed excessive dietary PLs. Eicosapentaenoic acid, DHA and n3-fatty acid increased in the larval body (p<0.05) at 2% dietary PL. During *Aeromonas* challenging tests, post-larvae fed 2% PL diet performed good survival (52%) and histopathology compared to post-larvae fed 0% PL diet (17%). The optimum dietary PL level showed more health benefits in hybrid lemon fin barb larvae.

Keywords: *Aeromonas hydrophila*, growth, Hybrid lemon fin barb, larvae, phospholipids

**Corresponding author-email: msalleh@upm.edu.my*

Reproductive biological aspects of Indian Mackerel (*Rastrelliger kanagurta*) in the West coast of Sri Lanka

H.M.U. Ayeshya*, L.D. Gayathry, S.C.V.U. Senevirathne, S.S.K. Haputhantri and R.P.P.K. Jayasinghe

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

The Indian Mackerel (*Rastrelliger kanagurta*) is a commercially important pelagic fish species predominantly inhabiting the west coast of Sri Lanka. This study investigates key aspects of the reproductive biology of Indian Mackerel inhabited in this region. From February 2021 to December 2022, field surveys were conducted to collect data pertaining to length frequency analysis along with the monthly biological samples of Indian Mackerel in the west coast, from Negombo to Chilaw coastal area. Accordingly, the length distribution, length-weight relationships, sex ratio, gonadosomatic index (GSI), and size at maturity were estimated. Total length (L) ranged from 160 mm to 275 mm with a mean of 222±27 mm. In addition, recorded body weight (W) was in the range from 24.3 g to 245.5 g with a mean of 133±35 g. The estimated length-weight relationship was $W=0.016*L^{2.88}$ and $W=0.068*L^{2.80}$ for male and female respectively. Thus, the results indicated that almost all captured species exhibited a negative allometric growth. Also, the overall sex ratio indicated as F: M = 1:1, within the studied population. Maturity stage assessment reveals 5 distinct stages of gonadal development in both male and female individuals and spent stage (43%) witnessed the highest. Additionally, Gonado-somatic index values were found to vary with season. Further, the highest was observed during the 2nd inter monsoon (3.80) followed by 1st inter monsoon (2.79), which reflects the reproductive dynamics of *R. kanagurta* on the West coast of Sri Lanka. Consequently, size at maturity determined for both male (211.9 mm) and female (213.18 mm), which offers critical insights into the minimum size at which individuals become capable of reproduction. In conclusion, this study provides an understanding of the reproductive biology and population characteristics of *R. kanagurta* in the West coast of Sri Lanka. Further, size at maturity is essential for establishing appropriate regulations and management strategies to safeguard the reproductive potential of the population. Moreover, the results obtained in the study will be invaluable for fisheries management and conservation efforts in the region. Further research and ongoing monitoring are also recommended to ensure the sustainability of *R. kanagurta* populations in this vital ecosystem.

Keywords: gonado-somatic index, length-weight relationship, population characteristics, sex ratio, size at maturity

**Corresponding author-email: ayeshya22@gmail.com*

Effect of interaction between bacteria and microalgae on *Chaetoceros calcitrans* growth and biomass production

*D.M. Hettiarachchi, M.A.J.C. Mallawa Arachchi, Varthani Susruthan

[1]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2]*Department of Biosystems Technology, Faculty of Technology, University of Jaffna, Sri Lanka*

Microalgae are typically found in freshwater and marine systems. They are unicellular species that exist individually, or in chain or group. *Chaetoceros calcitrans* is a diatom inhabited in the marine environment. Diatoms are widespread photosynthetic eukaryotes that are responsible for approximately one-fifth of the total photosynthesis on Earth. *C calcitrans* are used as feed in aquaculture primarily for the development of larvae and young shell- and finfish as well as for the creation of the zooplankton needed for feeding young animals. Probiotics are microorganisms, that are associated with beneficial effects for the host. This research aimed to study the effects of interaction between probiotic bacteria and *C. calcitrans* on the growth aspects of *C. calcitrans,* based on cell count, optical density and biomass. The research was carried out to determine the best probiotic concentration for *C. calcitrans* growth. The experiment consisted of three concentrations of a commercial probiotic. The treatment levels were 100 mg/l (T1),) 200 mg/l (T2), 500 mg/l (T3) and the control without probiotics. The trial was conducted in a completely randomized design and all the treatments and control were triplicated. All the data were analyzed using Statistical Analysis System (SAS 9.4). The *C. calcitrans* in T2 reached to stationary phase on day 2 while other treatments and control reached on day 3. On day 2 the maximum cell count was recorded in T2 ($2.31 \pm 0.26 \times 107$ cells/ml) and the lowest cell number was recorded in the control ($1.69 \pm 0.13 \times 10^7$ cells/ml). After 14 days of culture, the highest level of absorbance was observed in T2 while the lowest values were recorded in control. At the end of the experiment, *C calcitrans* in T3 showed significantly higher biomass compared to control. However, it was not significantly different from T1 and T2. The results have revealed that the interaction between microalgae and bacteria improves the cell growth, and biomass of *C calcitrans*.

Keywords: bacteria, biomass production, *Chaetoceros calcitrans*, microalgae, probiotics

**Corresponding author-email: dewshi1998@gmail.com*

Use of palm olein to replace fish oil in juvenile Asian Sea Bass (*Lates calcarifer*) diets reared in floating cages of lagoon waters of Sri Lanka.

R. Weerasingha*, P. A. D. Ajith Kumara, A. Maheepala, A. J. Jayatissa and M.S.M. Fahim

National Aquatic Resource Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.

Sea bass farming is a slow-growing business in Sri Lanka due to a lack of low-value manufactured feeds and its mortalities. Small-scale sea bass farmers in the country use trash fish to feed their fish. Relying on the trash fish supply is no longer sustainable if this aquaculture expands further. Besides, trash fish remain among edible food commodities in some areas. Present import restrictions have affected feed prices and led to unnecessary price inclines. Feeding trash fish may cause the spreading of diseases and low survival, ultimately, farmers evacuate from the business due to low economic return. Fish oil is one of the most expensive feed ingredients in the feed industry. Palm oil contained a low content of HUFAs compared to fish oil. However, olein palm oil contains a low saturated fatty acid level compared to crude palm oil. Moreover, palm oil is a rich source of carotenoids and vitamin E. Therefore, the study aimed to examine the effects of the replacement of fish oil with olein palm oil on growth and histological changes in juvenile sea bass. Two diets were prepared separately to contain 4% fish oil (+basal diet, T1) and 4% olein palm oil (+basal diet, T2) (CP = 40%). Two cages consisting of 30 fingerlings per each were fed with two diets separately. Feeding was done three times a day up to the satiation level. Cage cleaning was done once a week. After 10 weeks of the feeding trial, fish weight and length data were collected and samples were collected for histological analysis. Weight gain, total length gain and specific growth rate of fish fed palm olein-containing diet were high compared to fish fed fish oil-containing diet ($p<0.05$). The intermediate sampling data which is after 46 days revealed that the fish that passed the early fingerling stage showed no significant difference after feeding either fish oil or olein palm oil. However, the fish that passed the juvenile stage effectively could use olein palm oil.

Keywords: Fish oil, Juveniles and growers, Palm olein oil, Sea bass

**Corresponding author-email: rochanaweerasingha@gmail.com*

Aquatic Biotechnology and Animal Health

Investigating the prevalence and molecular detection of Megalocytivirus in ornamental fish in family *Osphronemidae*

D.M.Y. Sathsarani[1*], K.L.N. Ananda [2], G.V.T. Ananda[1], S.S.S.de S. Jagoda[2], A.W. Kalupahana[2]

[1]*Faculty of Veterinary Medicine and Animal Science, University of Peradeniya,*

[2]*Center for Aquatic Animal Disease Diagnosis and Research, Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya,*

Megalocytivirus, an infectious viral pathogen classified within the *Iridoviridae* family, poses a substantial threat to the health and survival of ornamental gourami fish (members of *Osphronemidae*). The virus replication in the infected cell induces large intranuclear and intracytoplasmic inclusions, leading to clinical signs like lethargy, loss of appetite, abnormal swimming behavior, and external lesions. Virus transmission occurs through direct contact and contaminated water or equipment. This study aimed to screen gourami fish samples collected from the Gampaha district of Sri Lanka during the rainy season in May-June 2023 for the presence of Megalocytivirus. The gill samples were subjected to PCR targeting 777 bp fragment of Major Capsid Protein (MCP) common for all major groups of Megaocytivirus. A total of 50 healthy fish samples were collected from 23 different aquaria in the region. None of the samples tested positive for Megalocytivirus infection, suggesting that gourami fish in this area during the rainy season were not affected by this virus. The literature revealed that fish diseases, including Megalocytivirus, are more common during the hot summer season. Therefore, the timing of this study during the rainy season was expected to have a lower probability of detecting Megalocytivirus infection in gourami fish. The absence of positive samples suggests a potential absence or low prevalence of Megalocytivirus in the studied population during this specific time frame. These findings provide valuable insights into the health status of gourami fish in the Gampaha district, indicating the absence of Megalocytivirus during the rainy season. Future studies should explore the prevalence of Megalocytivirus in gourami fish during different seasons and across various regions to obtain a comprehensive understanding of its distribution and impact on fish populations. This will contribute to develop effective management strategies to prevent and control Megalocytivirus outbreaks in ornamental gourami fish, thus reducing economic losses for the ornamental fish industry.

Keywords: Gampaha district, gourami fish, megalocytivirus, rainy season, polymerase chain reaction (PCR)

**Corresponding author- email: anilwkalupahana@yahoo.com*

Phylogeographic analysis of dugongs (*Dugong dugon*) of Sri Lanka and other warm coastal waters

S. Yatawaka[1], D.N.A. Ranmadugala[2], A.A.D.G. Amarakoon[2], U. Liyanage[1], R.P.P.K. Jayasinghe[1] and D.R. Herath[1*]

[1]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2]*Formerly of National Aquatic Resources Research and Development Agency (NARA), Colombo 15, Sri Lanka*

Dugong (*Dugong dugon*) is the most gigantic vegetarian marine mammal that can be found in warm coastal sea waters and it is categorized as a vulnerable species in the IUCN Red List. This study generates the comparison of mitochondrial control region sequences of Dugong populations within Sri Lanka with the global data to assess genetic lineages, population structure and genetic diversity. Sequences of Dugong samples collected by NARA from the coastlines of Mannar, Trincomalee and Kalpitiya over eight years were compared with sequences of dugongs from other countries with similar ecological conditions; India, Thailand, Mauritius, the United Arab Emirates, Kenya, Australia, and Egypt. Successful amplification of the cytochrome b region was achieved for the Dugong samples collected from strandings that occurred in Sri Lanka. Those sequences edited and aligned by using the BIOEDIT program were used to construct the phylogenetic tree with the neighbor-joining method using MEGA X. The resulting dugong sequences when matched with other sequences revealed that certain species of dugong from India and Sri Lanka share a common ancestor. All sampling sites in Sri Lanka revealed unique haplotypes, with a high nucleotide diversity (0.66±0.04) and overall haplotype diversity (0.19±0.001). The study included 12 haplotypes, with a haplotype diversity estimate of 0.87±0.04 overall. Moreover, various analytical methods using the global dugong dataset (n=21, approximately 400 bp) support the claim that Sri Lankan dugongs are members of the South Asian Indian Ocean genetic cluster with unique divergent mtDNA haplotypes. This study concluded that the population of Sri Lankan dugongs has a significance on a worldwide scale since they form a genetically distinct group in warm coastal sea waters.

Keywords: cytochrome b gene, Dugong, *Dugong dugon*, stranded

**Corresponding author- email: deishini.herath@yahoo.com*

Genetic diversity of short-finned pilot whales stranded on the coastal beaches of Sri Lanka

D.R. Herath*, S. Yatawaka, M.P. Hendawitharana, R.P.P.K. Jayasinghe, G.K.A.W. Fernando and U.S.P.K. Liyanage

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Mass stranding incidences of short-finned pilot whales (*Globicephala macrorhynchus*) were recorded twice within 3 years along the coast of Sri Lanka. Almost 120 short-finned pilot whales (SFPW) were stranded on the Panadura beach, in the Southwestern coast of Sri Lanka on 2nd November 2020. This was considered to be the largest marine mammal mass stranding that has ever occurred in Sri Lanka. Though almost all of them were forced back into the sea, 2 whales could not be saved. On 11th February 2023, 14 SFPWs were stranded on the Northwestern coastal beach in Kalpitiya. The whales were directed back into the sea, but 4 SFPWs did not survive. The objective of the study was to compare the SFPWs stranded on the Sri Lankan coast with those of other regions of the world. The DNA extracted from the tissue samples of 1 carcass from the Panadura stranding and 4 carcasses from the Kalpitiya SFPW stranding were PCR amplified and sequenced. The cytochrome b gene region sequences were compared with other similar published sequences of short-finned pilot whales of Taiwan, Pacific Ocean, Atlantic Ocean and USA. The analysis revealed that the Sri Lankan short-finned pilot whales form a separate clade, and the rest of the specimens form a separate clade. It has been shown that the global distribution of these whales separates into 3 distinct types: one type distributed predominantly in the Atlantic Ocean (Atlantic type), one on the Western/Central Pacific and Indian Oceans (Naisa type), and the third in the eastern Pacific Ocean (Shiho type). Our results show that the short-finned pilot whales stranded in Sri Lanka belong to this Naisa type, being separate from the rest of the specimens from the Pacific and the Atlantic Oceans.

Keywords: cytochrome b gene, marine mammals, mass strandings short-finned pilot whale

**Corresponding author- email: deishini.herath@yahoo.com*

Metagenomics analysis of bacterial communities associated with carbon source fermentation

M.A.J.C. Mallawa Arachchi[1,2*], F.M. Yusoff[2,3], H.T. Tan[3], Y.S. Khaw[3], Z.M. Zulperi[2], I.S.M. Yasin[2,3]

[1]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2]*Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia*

[3]*Aquatic Animal Health and Therapeutic Laboratory, Institute of Bioscience, Universiti Putra Malaysia*

Fermentation alters the metabolite profile of the carbon source. This process converts complex carbohydrates into simple sugars that can be efficiently assimilated by bacteria. The organisms involved in fermentation determine the end product properties. This study aimed to evaluate bacterial communities associated with carbon source fermentation with Saccharomyces cerevisiae. Rice bran, tapioca flour and molasses were fermented with yeast for 72 hours. The bacterial genomic DNA was extracted from different fermented carbon sources. To evaluate bacterial communities, 16S rRNA gene V3-V4 regions were amplified and analysed using an Illumina MiSeq platform. Metagenomics profiling identified 64, 66, and 41 bacterial species (OTUs) in rice bran, tapioca flour and molasses, respectively. It was found that 23 OTUs were commonly found in all three carbon sources. The highest source-specific OTUs were found in tapioca flour. The Cho 1 and Ace indices revealed higher species richness in rice bran and tapioca flour. According to Shannon and Fisher indices, the highest species diversity was observed in rice bran. However, it was not significantly ($p < 0.05$) different from tapioca flour. While considering the most abundant 10 families, Vibrioceae and Pseudomonadaceae were found in all three carbon sources. Bacillaceae, Rhodobacteriaceae and Lactobacillaceae showed species-specific signatures that were observed only in molasses, tapioca flour and rice bran, accordingly. Enterobacteriaceae is the dominant group in both rice bran and molasses. Whereas Vibrioceae is the dominant group in tapioca flour. While the most abundant 10 species in different carbon sources were examined, *Salinivibrio proteolyticus* was found in all three carbon sources, whereas its relative abundance was higher in rice bran and lowest in tapioca flour. *Clostridium methoxybenzovorans* and *Pseudomonas balearica* were shared in tapioca flour and molasses. According to the findings of the study, it is vital to evaluate and consider associated bacterial populations while using fermented carbon sources for biofloc development in aquaculture.

Keywords: biofloc, carbon source, fermentation, molasses, rice bran

**Corresponding author- email: jayanthi240@gmail.com*

The first record of a very rare adult Pacific squaretail, *Tetragonurus pacificus* from the Indian Ocean

Y.C. Aluwihare[1], R.P.P.K. Jayasinghe[1]*, S.S.K. Haputhantri[1], S. Fernando [2], M.S. Gunasinghe[2], R.D.C. Ranasinghe[2], M.A.S. Ranjula[2], T.N. Weerakoon[3] and P.N. Psomadakis[4,5]

[1]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.*

[2]*Department of Fisheries and Marine Sciences, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka., Tangalle, Sri Lanka*

[3]*Healthy Headwaters Lab, Department of Integrative Biology, University of Windsor, ON, Canada, N9B 3P4*

[4]*Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00153 Rome, Italy*

[5]*South African Institute for Aquatic Biodiversity, Private Bag 1015, Makhanda, 6140, South Africa*

The family Tetragonuridae (Squaretails) comprises a single genus with three valid species namely *Tetragonurus atlanticus* Lowe 1839, *T. cuvieri* Risso 1810, and *T. pacificus* Abe 1953, inhabiting in worldwide tropical and temperate seas. These fishes are mesopelagic or epipelagic oceanic fishes feeding on soft-bodied invertebrates. They are characterized by an elongated body with long caudal peduncle square in cross-section (as for their common name "squaretails"), each side with two lateral keels of modified scales. During a survey organized by the EAF-Nansen Programme of FAO in 2018 to obtain data on the fisheries resources, marine biodiversity and oceanography of Sri Lankan's EEZ using the Norwegian research vessel Dr. Fridtjof Nansen, three adult individuals (129, 130, 133 mm SL) of the rare Pacific squaretail *Tetragonurus pacificus* were caught by pelagic trawls off Chilaw (7°2.29'N, 79°25'E) area. They represent the first circumstantiated record of adult specimens, not only from Sri Lankan marine waters, but also for the whole Indian Ocean, as only early juveniles (9–21 mm SL) were previously documented from the region nearly seven decades ago. A combination of morphological and genetic methods was used to validate the taxonomic identification of the Sri Lankan specimens and provide an expanded description of *T. pacificus* including a revision of the diagnostic characters previously used to distinguish this species from its congeners. The generated COI gene sequence was deposited in the National Center for Biotechnology Information (NCBI) GenBank database and showed 100% similarity with a previously submitted sequence of *P. pacificus* by a Japanese research group and a clear genetic divergence (pairwise K2P, 0.10% and 0.15 %) from *T. cuvieri* and *T. atlanticus*, respectively. A revised key to the species of *Tetragonurus* based on the newly available material of *T. pacificus* was also provided.

Keywords: COI gene, rare species, RV Dr. Fridtjof Nansen, *Tetragonurus pacificus*

**Corresponding author- email: prabathj@nara.ac.lk*

Oceanography and Hydrography

Assessment of positioning accuracy for surveying using smartphones with dual-frequency multi-GNSS receiver

C.M.K.S. Deshapriya* and K.K.D.W.S. Kannangara

Department of Surveying and Geodesy, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka

The current era of smartphones has led in a wide array of location-based services and applications. This study investigated into the practical implementation of smartphones equipped with dual-frequency multi-constellation Global Navigation Satellite System (GNSS) receivers for preliminary surveying purposes. Four distinct smartphone models were analysed: Google Pixel 4XL, Google Pixel 3, Samsung S10, and Xiaomi POCO F3. Measurements were gathered and subjected to post-processing GNSS techniques employing positioning methods that incorporate code and phase observations. Subsequently, the attained positioning accuracies were evaluated in comparison to reference points. Among the smartphones tested, only the Pixel 4XL had the capability to operate within the dual-frequency GNSS range. Nonetheless, its usefulness in surveying tasks was found to be limited due to accuracy constraints. Concerns also arose regarding the data quality obtained from the Pixel 4XL, imposing restrictions on potential solutions needful on dual-frequency bands in phase observations. Nevertheless, by extending the observation duration, these smartphones could still accomplish positioning accuracy within a margin of less than half a meter. Consequently, the Pixel 4XL can be effectively employed in applications with less stringent accuracy prerequisites, such as data acquisition for mapping and certain hydrographic surveys. Furthermore, despite being a single-frequency phone, the Samsung S10 exhibited superior accuracy compared to the Pixel 4XL in the Standard Positioning Service (SPP) mode. Additionally, the study investigated the impact of the phone's orientation during data collection, revealing that holding the phone in a vertical position yielded the most favourable results. In summary, this research shed light on both the potential and limitations of utilizing smartphones in positioning and navigation applications. It underscored the significance of considering accuracy requirements, data quality, and phone orientation when collecting data to achieve optimal results.

Keywords: Global Navigation Satellite System, Multi-constellation GNSS, Single Point Positioning (SPP), Smartphone Positioning

**Corresponding author-email: cmkkssdd.kd@gmail.com*

Satellite-derived chlorophyll-a variability in the Bay of Bengal (2018-2022) with a focus on the Sri Lanka Dome

A.M. Buddhima Alagiyawanna*, H.B. Jayasiri

Department of Oceanography, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Colombo 15.

The Bay of Bengal, situated in the northeastern part of the Indian Ocean, is renowned for its biological diversity and high productivity. In this study, we explore chlorophyll-a dynamics in the Bay of Bengal from 2018 to 2022, focusing on the Sri Lanka Dome. Due to various oceanographic and climatic factors, Sri Lanka Dome can vary from year to year and within the monsoon season itself. The general coordinates for the Sri Lankan Dome during the Southwest Monsoon are approximate Latitude: 5°N - 10°N and Longitude 80°E - 85°E. Utilizing Copernicus Marine data, including Global Ocean Color Plankton MY L4 monthly observations at level 4, created monthly maps illustrating the spatial distribution of chlorophyll-a concentration during the Southwest Monsoon, Northeast Monsoon, and Inter-Monsoon periods, derived from satellite data. The data analysis software of R Studio is used to prepare chlorophyll maps. One-way ANOVA was used to study the annual and seasonal variation of chlorophyll in the Sri Lanka Dome from 2018-2022. The annual chlorophyll-a content did not vary significantly among the studied years ($p=0.37$). The mean±SD chlorophyll concentration in the Sri Lanka Dome from 2018-2022 was 0.537±0.169 mg m^{-3} ($n=60$). However, chlorophyll-a in Sri Lanka Dome varied significantly among seasons ($p<0.001$), and significantly higher chlorophyll-a content was reported during the Southwest Monsoon than the other three seasons. Research yields valuable insights into the seasonal and spatial dynamics of chlorophyll concentration in the Bay of Bengal, with a specific focus on the Sri Lankan Dome. The observed dynamics of chlorophyll-a levels can be attributed to various factors, including nutrient availability, temperature variations, and local hydrodynamics. These elements influence the growth and distribution of phytoplankton, impacting chlorophyll-a concentrations.

Keywords: Bay of Bengal, Chlorophyll-a, Seasonal variability, Sri Lanka Dome

**Corresponding author-email: buddhimaisu98@gmail.com*

Diversity and abundance of phytoplankton off Kirinda, Sri Lanka

S.A.I. Madhuwanthi* and H.B. Jayasiri
Department of Oceanography, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Colombo 15.

Phytoplankton sustains almost all life in marine and estuarine ecosystems and produce 50% of Earth's oxygen. However, they make blooms and some of them are toxic particularly the dinoflagellates to marine organisms and human. The main objective of this study is to identify and enumerate phytoplankton in off Kirinda, Southern Sri Lanka. Ten sampling sites were selected randomly from the coastal area near the Kirinda in February 2018. Phytoplankton samples were collected towing a net (10 µm mesh) vertically from known depth and preserved in Lugol's solution. The collected phytoplankton samples were identified to the lowest possible taxonomic level and counted under the Sedgwick rafter cell using Light Microscope. The mean abundance of the area is 83.3±64.7 indivi. /l and varied from 12-197 indivi. /l. Among the sampling locations, the 09th location had highest plankton abundance, emphasizing its significance in sustaining marine life. This study identified 44 phytoplankton species comprised of diatoms (27 species), dinoflagellates (17 species). Diatoms were dominated in the area with 61.36% followed by, dinoflagellates 38.64%. Diatom species of *Chaetoceros* sp. (37%) and *Nitzschia* sp. (14 %) are dominated in the area and indicate the possibility of blooms of these diatom species in off Kirinda when environmental conditions are favorable. The calculated Shannon-Wiener diversity index (H values) ranged from 1.05 to 2.75 and evenness ranged from 0.115 to 0.327. Furthermore, the study identified certain toxic species, namely, *Alexandrium catenella, Alexandrium monilatum, Dinophysis caudata, Gymnodinium sp., Protoperidinium depressum*, and *Prorocentrum micans*. These findings underscore the crucial role of plankton in marine environments, even encompassing toxic species with potential ecological implications. This insight enables us to better understand the ecological stability and potential resilience of the coastal ecosystem.

Keywords: Diversity Indices, Kirinda, Phytoplankton, Toxic species

**Corresponding author-email: saireshamadhuwanthi@gmail.com*

Introducing a new depth model of Sri Lankan Exclusive Economic Zone: updating the GEBCO-2023 grid with Restore-Remove Method

Y.M.R. Nilupa Samarakoon*, R.M.D.I. Ratnayake

National Aquatic Resources Research & Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Accurate Digital Elevation Models or bathymetry maps are essential for undertaking marine scientific research. The International Hydrographic Organization (IHO) recently announced that only 25% of the sea floor is mapped and those data are gridded with the General Bathymetric Chart of Ocean (GEBCO). Hence IHO introduced the Crowdsourced bathymetry concept: collecting bathymetry from non-survey vessels, as it is hard to afford money and time for collecting systematic bathymetry. A majority of the Sri Lankan EEZ also has not been sampled by echo sounders, even at a resolution of about 15 arc seconds. That is, the bathymetry of 91% of the EEZ is predicted based on less precise, low-resolution satellite-derived gravity data. Accordingly, apart from high-quality systematic bathymetry, crowd-sourced bathymetry has been gathered and combined to develop this new bathymetric grid. These data are comprised of single beam and multibeam soundings which were processed using the MB-System and Teledyne PDS. A quality control process was implemented to assess the reliability and accuracy of the crowd-sourced data. The GEBCO_2023 15 arc second grid was used as the base grid which, after removing obvious outliers, the new grid was built on. All collected high-resolution single beam and multibeam data were pre-processed with block median filtering and gridded with spline in tension in GMT. The final grid with 15 arc-second resolutions was compiled by adding dense source data on top of the base grid using the remove-restore method in GMT. By subtracting the base grid from the updated model, a difference map was made to show the improvements in the significantly updated areas of the new model. The updated digital elevation model represents a significant advancement over the global-scale grids and demonstrates the effectiveness of blending heterogeneous data. Also, the grid will be valuable for the scientific community which needs a better bathymetric depiction. Challenges related to data quality, standardization, and privacy will be continuously addressed. As new data is brought in new versions of the grid will be issued.

Keywords: Crowd-Sourced Bathymetry, GEBCO, Gridding, Remove-Restore, Sri Lankan EEZ

**Corresponding author-email: nilupa.samarakoon@gmail.com*

Seasonal dynamics on the Southern coast of Sri Lanka revealed through meteorological and oceanographic observations

K.W. Indika*

National Aquatics Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

The monsoon signals are initiated by the convergence of trade winds in the Inter-tropical Convergence Zone (ITCZ) of the Indian Ocean, resulting in distinct wet and dry seasons for equatorial nations, as opposed to cold and warm seasons. This study aims to investigate the origin of seasonal responses along the southern coast of Sri Lanka. The research utilizes meteorological and oceanographic data collected from the sea level monitoring network, ARGO, Sea Glider, and satellite observations. Ex-situ meteorological observations are obtained from the Prediction of Worldwide Energy Resource (POWER) Project, Archiving Validation & Interpretation of Satellite Oceanography data (AVISO), Sea Glider data from Joint project University of Notre Dame - National Aquatics Resources Research and Development Agency (NARA) and sea level data from NARA in Sri Lanka. During the southwest monsoon, the Mix Layer Depth (MLD) and Thermocline range between 34-48 m and 205-210 m, respectively, while during the Northeast monsoon, they vary between 52-61 m and 195-200 m. Steric heights exhibit variations from 0.0126 m to 0.0251 m in the southwest monsoon and from 0.0156 m to 0.0201 m in the northeast monsoon. Maximum wind velocity is observed southwestward from May to September, ranging from 4-12 m/s, while minimum velocity is observed northeastward with 2-8 m/s from October to March. Satellite-derived seasonal sea level ranges from 18-22 cm, while the tide gauge range is 24-27 cm in the southern coast of Sri Lanka. Maximum seasonal sea level variation occurs during December to January, with the minimum during July to August. The daily averaged maximum precipitation was recorded as 48.33 mm during the Southwest monsoon in 2020 during last 4 years. The annual atmospheric temperature fluctuates by 3.66°C (28.86°C- 25.20°C), with the maximum in March and the minimum in December. The studied meteorological and hydrological parameters respond to the seasonal signal in the southern coast of Sri Lanka. The seasonal coastal dynamic is crucial for the sustainable fisheries and food security of the country.

Keyword: monsoon signal, sea level, seasonal dynamics, southern coast, steric height

**Corresponding author-email: iweligamage@yahoo.com*

Prospecting sand resources at the continental shelf in off-southwestern area of Sri Lanka

T.B.D.T Samaranayake[1*] and H.A.S.D Perera[2]

*[1]*National aquatic Resources Research and Development Agency, RRC, Kapparatota*

[2]*National aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

Over-extraction of river sand could lead adverse environmental impacts; therefore, offshore sand was introduced as an alternative for fulfill the elevated sand demand. The project aimed to study the off-Ambalangoda area of the Southwestern coastal stretch for the availability of sand for construction purposes. The site was selected based on a comprehensive literature survey and 30 sand samples were obtained using Van-Veen grab sampler from predetermined locations. The survey was planned to cover major three components namely, grain size characterization, sediment thickness and sediment quantity of the study area. Size distribution of individual particles in a particular sample was determined by sieve analysis. Sub-bottom profiling survey was conducted using the instrument "INNOMAR –SES 2000" and the line distance was 1km. The results showed that the mean grain size of samples varied from 0.17 to 3.58 in phi scale while the average D50 was 1.8 ϕ indicating the sediment in the area is in the form of very coarse to fine sand. The standard deviation provides important clues for the sorting index. It varied from 0.54 to 0.98 in phi scale indicating moderately well sorted to moderately sorted sand. The average chloride percentage was comparatively high (2.4%) by the weight of the sand, while the recommended range was 0.075% for construction sand. In addition, results revealed that the average sediment thickness varied from 0.2m-2.0m while the total estimated sand volume was 22.5Mm^3. Therefore, the study site can be concluded as a suitable location for construction sand extraction, provided it satisfies the environmental considerations.

Keywords: sand resources, sediment, southwestern coast

**Corresponding author-email: thilakshanitbs@gmail.com*

Variations of salinity in Lankapatuna Lagoon located on the east coast of Sri Lanka

H.A.S.D. Perera*, K. Arulananthan, R.M.R.M. Jayathilake, T.B.D.T. Samaranayake

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Lankapatuna Lagoon in Trincomalee District located on the east coast of Sri Lanka is a bar-built shallow water lagoon open to the sea by a narrow channel. The mouth of the lagoon remains closed except for the wet northeast monsoon season. The lagoon has a Surface area of 16 km^2, with an average depth of 2 m and it is fed by the 'Verugal Aru' and residual water from Ullai Kulum at the south (at the proximity of the channel) and north respectively. Annual rainfall of approximately 1300 mm is received primarily during the Second Inter Monsoon (SIM) (October - November) and Northeast Monsoon (NEM) (December - February). Tide and freshwater inflow drive the water exchange in the lagoon, thus determining the salinity distribution of the lagoon. Water samples were collected from 30 locations during all four seasons for the analysis of salinity (Autosal 8400B). During sampling, the tide was measured at the lagoon's head and mouth, while the current was measured at the mouth using an RCM (Rotter-type current meter). The mean salinity of the lagoon reached its highest value (36 PSU) during the fall of Southwest Monsoon (SWM) (May - September), when the lagoon mouth is closed. Convectional rainfall fed Verugal Aru's freshwater discharge during the SIM dramatically bringing down the mean salinity of the lagoon to half of its value, recorded during the SWM. The lowest mean salinity of 17 PSU was recorded during the NEM when the lagoon mouth was opened. During the FIM and SWM, the mouth is closed, no freshwater is discharged, and the lagoon is exposed to evaporation, leading to a gradual increase in the mean salinity of the lagoon. A 1.2 PSU/km salinity increase was observed during the FIM. A strong salinity variation was observed during the SIM when the mouth is closed and Verugal Aru commences to discharge freshwater. The Salinity at the proximity of the channel, where the Verugal Aru discharges salinity reaches 6 PSU, while the mean salinity of the lagoon remains at 20 PSU. During the SIM salinity decreases towards the head, it's probably due to the discharge of residual water received on the head of the lagoon from Ullai Kulum.

Keywords: Lankapatuna Lagoon, river discharge, salinity

**Corresponding author-email: damithruh@gmail.com*

Fisheries Socio-economic and Marketing

The impact of nature tourism on rural community; A case study on Kudawella blowhole in Hambanthota, Sri Lanka.

E.D. Iroshani Kumari*, Omala Perera

University of Colombo, Sri Lanka.

Nature tourism conserves the environment, turns the traditional rural livelihood into a livelihood that depends on tourism and promotes the living standard of the community (Shi *et al.*,2022; Mbaiwa & Stronza, 2010). The Kudawella blowhole *(Hummanaya)* in Sri Lanka is a captivating destination with its sparse and attractive landscape. This research investigates the impact of the tourism site on the surrounding rural community, aiming to identify sustainable tourism development potentials related to the blowhole, study seasonal variations in tourist visits, and assess the impact on the local community. The data were obtained through a questionnaire survey directed to the households in the Grama Niladhari Division using a random sample (n=108) and supplemented by secondary sources. Quantitative and qualitative analytical methods including chi-square test, time series analysis, T-test, preference ranking, and Multiple Buffer Zone analysis were employed using SPSS, MS Excel, and ArcGIS (Esri) software. The Kudawella blowhole was identified as one of the main places to visit in the Hambantota district. The majority of domestic tourists (75%) visited the blowhole during school holidays, showing an annual increase from 2003 to 2017. Sixty percent of the international tourists witnessed the blowhole during the *warakan* season (December to March), with a fluctuating pattern during the same period. The study assessed sustainable tourism potential by examining ecological resilience, cultural significance, community involvement, and infrastructure readiness. Inadequate facilities for visitors and a significant risk of environmental degradation were identified as negative impacts. Well-managed washrooms and a cafeteria to provide local food are the essential improvements. The rural community's livelihood, which is 68% dependent on tourism, faces challenges due to fluctuations and uncertainty in tourist visits. If a proper program is launched to attract more domestic and international tourists, it would enhance the rural community's well-being, generate more income, and conserve this spectacular place for future generations.

Keywords: blowhole, impact, nature tourism, rural community

**Corresponding author-email: iroshani0520@gmail.com*

Unveil the gender responsibilities of inland and ornamental fish farming fisherwomen in the local fisheries value chain in the Puttalam district, Sri Lanka

M.T.M. Cooray

National Aquaculture Development Authority of Sri Lanka, No. 41/1, New Parliament Road, Pelawatte, Battaramulla, Sri Lanka

Inland fisheries and aquaculture sub- sector play an important role in strengthening rural economy of Sri Lanka and contributes positively towards ensuring food security, enhancing nutritional standards, providing employment/livelihood opportunities and earning foreign exchange. However, due to limitations based on gender that cap maximum returns, the benefits and outcomes from fisheries and aquaculture are heterogeneously distribute among men and women. The main objective of this paper is to unveil the gender responsibilities of inland and ornamental fish farming fisherwomen in the local value chain in the Puttalam district, Sri Lanka. This study was carried out in 5 fishing villages in the Puttalam. 100 households' respondents were randomly selected and interviewed using a semi-structured questionnaire includes open – ended questions and the daily activity schedule tool. Data were analyzed using Moser method and Microsoft Excel package. Female the percentage engagements of women in inland and ornamental fish farming were 85% and 15% respectively. Majority of married literate women (98%) in the Middle Ages (49 %) engaged in fishing activities. Nevertheless, more women engaged in post-harvest activities (69%), compared to pre-harvest activities (31%). The average working time of fisherwomen in the study location was 16 hours per day, while the average daily income of inland fisherwomen was approximately Rs 300, and it was well below the standards of International Labor Organization. Fisherwomen face challenges in both productive and household activities of local fisheries value chain, including lack of basic needs, credits, social acceptance, unpaid care work, and gender-based violence. Therefore, eliminating these challenges is essential to boosting sustainable fisheries for economic prosperity and food security for the social advancement and development of not only women but also for the entire family unit, society, and the country. It recommended to acknowledging fisherwomen's gender responsibilities into fisheries policies for the prosperity of this sector.

Keywords: constraint, fisherwomen, gender roles, policy, social norms

**Corresponding author-email: tharinimc@gmail.com*

Fish consumption behavior of university students: A case study at Sabaragamuwa University of Sri Lanka

T.N.E. Liyanapathirana[1*], M.A.E.K. Jayasinghe[1]

Department of Agribusiness Management, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya

Fish consumption holds significant importance in human diets due to its unique nutritional value. This study aims to analyze the fish consumption patterns among undergraduate students and identify associated challenges. A pretested, structured questionnaire was administered to two clusters; Faculty of Agricultural Sciences and Applied Sciences of Sabaragamuwa University of Sri Lanka. Primary data was collected from 100 students. The results revealed that, among the various marine fish species, Yellowfin tuna (*Thunnus albacares*) (69%) and sardine fish (*Sardinella gibbosa*) (48.8%) emerged as the preferred choices. Nutritional value and taste were identified as the foremost factors influencing fish consumption. Furthermore, it was observed that there exists a significant knowledge gap in the identification of suitable fish for consumption. Among inland fish species, Tilapia emerged as the top choice. However, some individuals (22%) refrained from consuming inland fish due to taste and odor concerns. Dried fish (70.2%) and Maldives fish (51.2%) were the preferred fish post-harvest products. The lack of fresh fish in the area and the wide fluctuation of fish prices are the main problems associated with fish consumption. These findings offer valuable insights for the planning of nutritional programs targeting younger generations in universities, to enhance their overall nutritional status. Moreover, increasing awareness about fish species and their nutritional benefits can contribute to a healthier dietary pattern among undergraduate students.

Keywords: fish consumption, fish postharvest products, inland fish, undergraduates

**Corresponding author-email: thathsaraniel@gmail.com*

Challenges in onboard handling of Skipjack tuna in multi-day fishery in the West coast of Sri Lanka

W.A.A.M. Bandara*, K.P.G.L. Sandaruwan, D.W.L.U. De Silva, P.G.D.M Anupama, N. Liyanapathirana and K.H.M.L. Amaralal

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.

Skipjack tuna (*Katsuwonus pelamis*) species is commercially important and populous as well as widely consumed in Sri Lanka. Skipjack tuna is highly perishable in nature and needs a better post-harvest handling and distribution to the end user. Post-harvest handling of Skipjack tuna is essential due to it contains dark muscles which undergo a rapid deterioration due to self-decomposition and oxidative rancidity of fish muscle. Hence onboard handling of Skipjack tuna plays a vital role in maintaining the quality of fish. This study aimed to introduce the gilling and gutting technique to Skipjack tuna caught by multiday fishers and identify barriers to promote the technique. The methodology was two-fold; first, four awareness programs were conducted in Beruwala and Negombo fishery harbours for 20 boat owners and 20 skippers to demonstrate the technique. Secondly pre-tested structured questionnaire surveys were administrated to assess the acceptance levels and barriers to adapt the technique. Study revealed that 43% of respondents were aware of the technique but never practiced it due to physical, financial and marketing barriers while the rest neither aware nor practiced. Providing of physical infrastructures for on-board processing and handling of fish and market access facilities to premium markets are recommended to popularize the technique to skipjack tuna fishery in Sri Lanka.

Keywords: gilling and gutting, multi-day fishery, Skipjack Tuna, Sri Lanka

**Corresponding author-email: ayomimenka6@gmail.com*

Socio-economic Analysis of Sea cucumber value chain in North and North-western coast of Sri Lanka

K.P.G.L. Sandaruwan*, M.T.N. Thilakarathna, W.A.A.M. Bandara, D.W.L.U. De Silva, H.P.D.A. Lakmali, V.S. Gunarathna and K.H.M.L. Amaralal

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Sea cucumber is an export-oriented fish variety that contributes in foreign exchange earnings of Sri Lanka where production come from both wild catch and aquaculture. The study intended to explore the value chain of sea cucumber capture fisher using apre-tested structured questionnaire survey. A randomly selected sample with representative of fishers (divers), collectors, processors and exporters in Kalpitiya and Mannar districts was drawn. The total sample was 80 which comprised of 65 divers, 10 collectors and processors and 5 exporters. Result revealed that majority (32%) of value chain actors had in a range of 11-20-year experience in sea cucumber fishery. It was found that sea cucumber value chain was comprised of sea collectors, middlemen and exporters. Both skin and scuba divers served as the collectors hence scuba diver incurring significantly higher total capital investment than skin diver. The profit earned by actors varied depending on species and grades. Results revealed that on average, a diver/collector had earned 77,400 LKR while a middleman had earned 286,860 LKR per month as a profit. The export price range of dried sea cucumber was in the range of 20,000-30,000 LKR per kilo and Singapore, China, Hong Kong, and Taiwan were major export destinations. Lengthy procedures adopted in issuing the management license, high fuel price, poor market linkages, lack of harvest handling skills and inadequate safety measures at sea were the major constraints in present sea cucumber industry and these should be resolved accordingly by the value chain upgrading.

Keywords: sea cucumber, socio-economic analysis, Sri Lanka, value chain

**Corresponding author-email: kariyawasam.lahiru@gmail.com*

Aquatic Post Harvest Technology

Different fish post-harvesting techniques in Mahakanadarawa reservoir Anuradhapura, Sri Lanka

C.K. Illangasingha*, I.U. Wickramaratne, W.M.S.U. Dassanayake, M.G.K.N. Gamage
Department of Animal Science, Uva Wellassa University, Sri Lanka

Mahakanadarawa reservoir is a major reservoir in the Anuradhapura district. Fisheries is one of the major occupations of the villagers. Nearly 120 fishermen were engaged in fisheries. The availability of scientific data about different fish post-harvesting techniques and fish market chain were scanty. This study aims to identify different post-harvesting techniques, causes, and effects. A pre-test questionnaire survey applying stratified sampling was carried out for fishermen (n=72) with their consent. Primary data were collected using a semi-structured questionnaire, interviews, and direct field observations. Collected data were analyzed as descriptive statistics using SPSS. This study revealed 23.61% of fishermen were involved in fish post-harvesting practices. The majority of them were female (88.24%). Both smoking and drying were identified as post-harvesting techniques and majority (64.71%) were involved in smoke fishing. Advanced fish smoking chambers and traditional oven systems were used to produce smoked fish. Production and quality of the product is increased with the advanced chamber. The majority of fishermen (27.78%) allocated between 11% - 20% of the total harvest for post-harvesting. Small fish species were used directly by 49.41% of the fishermen, while the remaining harvest of the main species was first sold before being used by 70.59% for post-harvesting. *Oreochromis niloticus*, *Channa strists*, and *Catla catla* like fish species were applied as remaining stock, and *Puntius sarana*, and *Mystus zeylanicus* like small species were applied directly into the post-harvesting. Demand and supply (2.5%), quality and quantity of fish (30.56%), commission agent (4.17%), and climate changes (2.78%) were affected to the value-added product pricing process. The estimated monthly income level of fishermen by fish post-harvesting was between LKR 10000 – Rs 15000. The current study upholds the information on fish post-harvesting practices of the fishing community to sustainable management of the Mahakanadarawa reservoir in the long run.

Keywords: Dried fish, Fish pricing, Mahakanadarawa reservoir, Smoke fish

**Corresponding author- email: chamanthikavindya@gmai.com*

Determination of chemical properties of selected dried fish varieties under different market conditions in the Kiribathgoda area of the Gampaha district

R.M.M.A Rathnayaka[1], M.G.C.R. Wijesinghe[2], K.G.S. Nirbadha[2] and G.W.A.S. Lakmini[1*]

[1]*Department of Agricultural Technology, Faculty of Technology, University of Colombo*

[2]*The National Aquatic Resources Research and Development Agency, Crow Island, Colombo 15, Sri Lanka*

This study aimed to investigate the chemical properties of dried fish prepared by three fish species that have high consumer preference, stored under different ambient shelf storage conditions in retail marketing (retail shops in open markets and supermarkets) located within the Kiribathgoda area of Gampaha district. A total of fifty-four (54) samples comprising six samples per each of Talang Queenfish (*Scomberoides commersonnianus*), Shark Fish (*Selachimorpha*), and Sardinella (*Sardinella lemuru*), were randomly acquired from retail markets. Each sample was de-skinned and deboned stored in plastic pouches at room temperature pending analysis. Each sample in triplicate was analyzed for content of moisture, dry matter, crude protein, crude fat, and crude ash using standard methods. The results indicated that Sardinella and Talang Queenfish which were in open markets had significantly higher differences ($p<0.05$) in moisture content (35.168 - 49.015%) than supermarkets while sharkfish had not a significant difference. There were no significant differences in crude protein content across the same species collected from different markets and ranged between 32.918-40.697%. Conversely, there were significantly higher ($p<0.05$) differences in the mean values of crude fat content (1.262 - 5.162%) for all species in open markets than in supermarkets. Ash content ranged between 16.822 -22.027 % and supermarkets had significantly higher ($p<0.05$) content in all the species than open markets. Based on the findings, it can be concluded that supermarkets tend to offer optimal conditions (22^0C-25^0C, 40%-45% RH) for storing, packaging, and handling dried fish products in retail marketing, resulting in variations in their chemical composition compared to those found in open markets (28-30^0C, 75% RH). In conclusion, this study emphasized the importance of retailing packed dried fish and storing it under low storage temperatures (≈ 22° C) as observed in supermarkets in maintaining a high quality of dried fish, which could have significant implications for consumers and the fishing industry in the region.

Key Words: chemical properties, dried fish, Kiribathgoda, market conditions

**Corresponding author- email: lakminiws@at.cmb.ac.lk*

Development of a canned fish product using *Channa striata* (Striped Snakehead fish)

K.M.U.D. Senarathne[1], N.P.G. Pushpitha[1], H.K.M.R.N. Thilakarathna[2], P.L.N. Lakshman[2,] W.A.S. Chamika[3,4*]

[1]*Department of Fisheries and Marine Sciences, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Mahawela Road, Tangalle, Sri Lanka.*

[2]*Department of Food Science & Technology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka.*

[3]*Department of Food Science and Technology, Pukyong National University, Busan, South Korea*

[4]*Institute for Research & Development, 393/3, Lily Avenue, Robert Gunawardane Mawatha, Battaramulla 10120, Sri Lanka*

Striped snakehead (*Channa striata*) is a highly nutritious, medicinally valuable freshwater fish. This study aims to provide canned *C. striata* as a modified food and to check consumer preference. The canning process was based on pressure canning method. Dressed fish fillets with bones (250-300 g), salt (5 g) and spices (2 cardamoms, 2 cloves, cinnamon) were added into sterilized glass jars. These were filled with chili oils (olive (T_1), sunflower (T_2) and sesame (T_3)) separately and pressure cooked for two hours (121 ^{0}C, 15 PSI). Sensory evaluation was carried out on a 9-point hedonic scale using T_1, T_2, and T_3 prototypes. A significant difference was there in taste and overall acceptance between the samples, but not in appearance, color, odor, and texture (Kruskal Wallis test). Canned fish with sunflower oil and olive oil showed higher and equal median acceptance while sesame oil showed the lowest for the taste. The highest overall acceptance was shown for the canned fish with olive oil, followed by sunflower oil and sesame oil with median scores of 8, 7.5, and 7 respectively. Thus canned *C. striata* with olive oil was most preferable and was subjected to proximate analysis. The sample (fish and filling solution) was finely ground into a pulp before proximate analysis. The moisture, ash, fat and protein content of the sample were 79.93%, 3%, 12.30% and 4.73% respectively. Comparatively higher fat content and the lower protein content in the sample (5% and 27.3% respectively in commercial canned fish) is accountable for the immersing oil which is ground together with fish fillet before analysis which dilutes the sample in it. Improvement of protein content and evaluation of shelf life should be done in further research. Thus, canned *C. striata* in olive oil can be introduced as a consumable canned food.

Keywords: *Channa striata*, Freshwater canned fish, Pressure canning, proximate composition, Sensory evaluation

** Corresponding author: shiranchamika@gmail.com*

Development of a fish sausage using spotted triggerfish (*canthidermis maculata*) with acceptable sensory qualities

W.S.K. Nimsarani[1], N.P.G. Palliyaguru[1], H.K.M.R.N. Thilakararathna[2], P.L.N. Lakshman[2], and W.A.S. Chamika[3,4*]

[1]*Department of Fisheries and Marine Sciences, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Mahawela Road, Tangalle, Sri Lanka.*

[2]*Department of Food Science & Technology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka.*

[3]*Department of Food Science and Technology, Pukyong National University, Busan, South Korea.*

[4]*Institute for Research & Development, 393/3, Lily Avenue, Robert Gunawardane Mawatha, Battaramulla 10120, Sri Lanka.*

Spotted triggerfish (*Canthidermis maculata*) is a low-price and low-demand fish whose meat quality is very similar to chicken meat. The current study aims to produce a new fish sausage using spotted triggerfish as an alternative to the chicken sausages that are expensive during this crisis situation and to evaluate consumer preference. After the primary processing fish fillets were separated without bones, mixed, and minced with other ingredients (chili powder 1%, pepper 1%, salt 1%, soya 15%, corn flour 3%, olive oil 1%) using a mixing grinder. Four different prototypes were produced by changing two variables; color (with/without beetroot juice) and flavor (with/without chicken-stock powder) while keeping all other ingredients constant. Those prototypes were color added and flavor added (T_1), color added and flavor not added (T_2), color not added and flavor added (T_3), and color not added and flavor not added (T_4). Then the mixture was stuffed into casings, steam cooked, cooled to room temperature, packed in sterile zip-lock bags, and frozen at -20 ^{0}C. Sensory evaluation was conducted with 30 semi-trained sensory panelists using a 9-point Hedonic scale. Data were analyzed using MINITAB 20 software. There was no significant difference ($P>0.05$; Kruskal-Wallis test) between each prototype for aroma, taste, and texture. However, there was a significant difference between appearance, color, and overall preference. The highest mean rank for appearance, color, and overall preference was received by color-added, unflavored fish sausage (T_2). This indicates that consumers prefer the color of regular sausage but they prefer the original fish flavor in the fish sausage. Proximate analysis showed that prototype T_2 contained moisture 71.4%, ash 3.17%, protein 9.01%, fat 14%, and carbohydrate 0.744%. Therefore, with the high nutrient content in color added, unflavored fish sausage it can be introduced to the market as an alternative to regular chicken sausages.

Keywords: *Canthidermis maculata,* consumer preference, fish sausage, proximate composition, sensory evaluation

** Corresponding author- email: shiranchamika@gmail.com*

Assessment of the potentiality of using squid ink as a natural hair colorant

N.C.D. Nawagamuwa[1*] and W.A.S. Chamika[2,3]

[1]*Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Mahawela Road, Tangalle, Sri Lanka.*

[2]*Department of Food Science and Technology, Pukyong National University, Busan, South Korea*

[3]*Institute for Research & Development, 393/3, Lily Avenue, Robert Gunawardane Mawatha, Battaramulla 10120, Sri Lanka*

Ink ejection is shown by some cephalopods to escape from predators by obscuring their view. Squid ink mainly contains melanin, enzymes, catecholamines, polysaccharides, and antioxidants. The scope of this research is to assess the potentiality of using squid ink as a natural hair colorant. For the formulation of hair dye, squid ink was obtained from common squids in the market. The ink was separated from the ink sac and collected. The application of squid ink was done in three different treatments (1: squid ink was applied raw, 2: raw squid ink with black tea extract and boiled water, 3: dried ink powder with tea extract and boiled water). Each treatment was applied to 4 natural hair types (black, white, colored, and bleached), washed after 60 minutes, and blow-dried. Photos of each hair sample were taken before and after treatment with a 12mp wide-angle camera under the same light, angle, and brightness levels. The color difference of each hair sample was represented by RGB values obtained by Photoshop 2017 software. The obtained RGB values were analysed with MINITAB 20. Paired sample t-tests were applied for each type of treatment. The level of success of each type of ink form was presented as a percentage of p-values less than 0.05 (representing a significant difference). 37.5% of treatment 1, 54% of treatment 2, and 62 % of treatment 3 samples showed a significant color change in the treated hair samples. Therefore, the dye needs to be formulated with some other ingredients that help to make the ink permanent in the hair before it is applied to the hair. However, since this study focused on the ability to use squid ink for the production of hair dye, improvement of squid ink should be done by adding a pleasant odor, adding preservatives to enhance shelf life, and adding ingredients to enhance the retention of the color.

Keywords: Hair dye, Semi-permanent, Squid ink

**Corresponding author- email: chathumini1023@gmail.com*

Effect of storage temperature on bacterial growth and histamine formation in Yellowfin tuna

P.H. Ginigaddarage[1], G.J. GanegamaArachchi[1], K.W.S. Ariyawansa[1], G.P. Roshan[1], J.H. Meepearachchi[1] and C.M. Nanayakkara[2]

[1]*National Aquatic Resources Research & Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2] *Department of Plant Sciences, Faculty of Science, University of Colombo, Colombo 03, Sri Lanka*

The present study was carried out to evaluate the effect of storage temperature on the bacterial growth and histamine content in Vacuum-packed Yellowfin tuna (YFT). Sixty-three samples of YFT were obtained from a seafood processing factory in October 2022 and stored at different temperatures (2, 7 and 15 °C) for 18 days. Samples were analysed for histamine content (AOAC 977.13 method), Aerobic Plate Count (APC) at 37°C and histamine-forming bacteria which were enumerated on Niven's medium. At the initial stage, the average histamine content was 2 ppm and the APC was 5×10^3 CFU/g. APC count of fish samples stored at 2 °C reached up to 3.5×10^6 CFU/g on the 15th day and the APC of samples stored at 7°C and 15 °C reached 4.0×10^7 and 1.2×10^8 CFU/g on the 12th and 6th days, respectively. Stored YFT at 7°C reached 110 ppm on the 15th day and 159 ppm level was detected on the 3rd day of the samples stored at 15 °C. Isolates of histamine forming bacteria were detected from fish stored at 15°C and they were able to form histamine in the range of 78 – 2700 ppm in tripticase soy broth supplemented with 1 % L- histidine. These bacteria were identified by amplifying and sequencing approximately 1400 bp of the 16S ribosomal DNA (rDNA). *Citrobacter freundii* and *Hafnia alvei* were among the bacteria isolated from the samples drawn on the 3rd day stored at 15°C and they produced 78 and 150 ppm of histamine, respectively. Other 7 isolates were confirmed as *Morganella morganii* which produced >1500 ppm in the histidine broth. Results of this study implied that formation of histamine in YFT can be controlled at low temperatures as 2°C.

Keywords: Aerobic plate count, histamine, *Morganella morganii,* yellowfin tuna

Corresponding author: email – hasangi_g@yahoo.com

Antimicrobial resistance profile of *Escherichia coli* and *Salmonella* isolated from shrimp in Central Fish Market, Peliyagoda Sri Lanka

K.V.D.M. Bhagya[1], R.A.S.S. Ranasinghe[2*], P.H. Ginigaddarage[2], J. Rajeetha[1], G.P. Roshan[2], J.H. Meepearachchi[2] and S. Ariyawansa[2]

[1]*Department of Bio Systems Technology, Faculty of Technology, University of Jaffna, Sri Lanka*

[2]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

Antibiotics play a vital role as treatments or prophylactics against various bacterial infections in both humans and animals. The indeliberate use and misuse of antibiotics in animal production intended for human consumption is one of the key sources for the development of antimicrobial resistance (AMR) in pathogens infections in humans. Although the usage of antimicrobial agents is banned in shrimp culture in Sri Lanka, the presence of AMR in bacteria isolated from shrimp cultures is found in the literature. This study aims to assess the antibiotic sensitivity (AST) profile of *Escherichia coli* and *Salmonella* isolated from shrimp samples obtained from the Central Fish Market, Peliyagoda Sri Lanka. Twenty-four (24) *E. coli* and *Salmonella* isolates were recovered by analysis of 30 samples of shrimp using SLS 516-12:2013 and ISO 6579:2017 methods, respectively. The AST profiles of both types of bacteria isolates were assessed over six antibiotics including amoxicillin (30mcg/disc), oxytetracycline (30mcg/disc), tetracycline (30mcg/disc), ampicillin (30mcg/disc), erythromycin (15mcg/disc), and chloramphenicol (30mcg/disc); which are commonly prescribed human therapeutic antibiotics, using the Kirby Bauer Disc diffusion method according to guidelines issued by the Clinical and Laboratory Standards Institute. *E. coli* showed the highest resistance, 83.33% (20/24) to erythromycin. In contrast, the least resistance, 12.5% (3/24) was observed for chloramphenicol. All the *Salmonella* isolates (8/8) were resistant to erythromycin while showing susceptibility to both tetracycline and amoxicillin. Multiple antimicrobial resistance of pathogens for erythromycin that is found by this study indicates a potential health hazard for humans. The present study recommends investigating potential channels or sources carrying chloramphenicol and other such antibiotics that are to enter into shrimps in commercial shrimp farms or other shrimp handling facilities.

Keywords: Antibiotics, *E. coli, Salmonella*, shrimp, susceptibility

**Corresponding author- email: sudeeparanasinghe@gmail.com*

Isolation and identification of spoilage microorganisms from Indian Scad (*Decapterus russelli*) stored at chilled temperature and evaluation of spoilage potential

L. Rajendren[1], P.H. Ginigaddarage[2*], R.A.S.S. Ranasinghe[2], S.L. Panoshan[1], G.P. Roshan[2], J.H. Meepearachchi[2], R. Perera[2] and S. Ariyawansa[2]

[1]*Department of BioSystems Technology, Faculty of Technology, University of Jaffna, Sri Lanka*

[2]*National Aquatic Resources Research & Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

Fish is considered an essential food in the human diet. Indian scad (*Decapterus russelli*) is a commercially and economically important fish in Sri Lanka. Inappropriate post-harvest handling and storage may deteriorate its safety and quality. The present study attempted to isolate and identify the spoilage-causing microorganisms from Indian scad fish and evaluate their spoilage potential. Fresh fish samples (n=18) were collected from the Peliyagoda central fish market, in Sri Lanka and were analyzed at two days intervals (n=3) from July to October 2023 for Aerobic Plate Count (APC) and Total Volatile Basic Nitrogen (TVB-N) for a period of 14 days. Spoilage bacteria were isolated by using peptone iron agar. Isolated spoilage bacteria were identified based on the molecular technique (16s rDNA). With the increasing storage time (0, 3, 6, 9, 12 and 14 days) at 2 – 4^{o}C, the APC and the TVB-N steadily increased, which influenced the quality of Indian scad fish. The APC of Indian scad fish samples increased from 3.24±0.24^{c} to 5.28±0.15^{a} log 10 CFU/g. The average TVB-N content increased from 30.45±2.16^{b} to 82.20±2.23^{a} mgN/100g. The bacterial isolates were identified as *Shewanella* sp. and *Aeromonas* sp. based on 16s rDNA sequencing. Isolated *Shewanella* sp. and *Aeromonas* sp. were inoculated into sterile fish broth and stored at 2 – 4^{o} C in order to evaluate the spoilage ability of those bacteria and TVB-N content and APC values were analysed at two days intervals for 14 days. TVB-N values of *Shewanella* sp. and *Aeromonas* sp. inoculated samples were in the range of 36.92±5.58^{ab}–45.25±9.77^{a} mgN/100g and 36.01±9.67^{ab}– 40.53±10.13^{a} mgN/100g and APC values were in the range of 6.6 – 7.3 log 10 CFU/g and 6.5 – 6.6 log 10 CFU/g respectively. From the obtained high TVB-N values in inoculated fish broth samples it was evident that *Shewanella* sp. and *Aeromonas* sp. have a high spoilage potential.

Keywords: Aerobic Plate Count (APC), Indian scad fish, Spoilage potential, Total Volatile Basic Nitrogen (TVB-N), 16s rDNA.

Corresponding author: email – hasangi_g@yahoo.com

Evaluation of quality and quantity losses of edible Anchovies (*Engraulidae*) during preparation of cooking and processing

P.S. Jayasinghe[1], L.F. Himasha [2], Keerthini[2], G. Ganegamarachchi[1] R. Perera[1]
[1]*National Aquatic Resource Research and development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2]*Department of Biosystems Technology, Faculty of Technology, University of Jaffna.*

Dried anchovies are important source of protein in the diet of Sri Lankans and this is rich in fat, and calcium including other valuable dietary minerals. Locally produced dried anchovies are found highly contaminated with sand particles. Therefore, high levels of material losses are occurred during cleaning and washing of anchovies when preparing for cooking. This study was conducted on dried anchovies that were contaminated with sand in order to estimate weight losses of edible material during washing with water. Dried Anchovies were collected from drying sites of Anchovy in Negombo, Chilaw, and retail shops. The Anchovies samples were beheaded and washed minimum of four or more times until sand particles were not retained at the bottom of the washing pan. The dried weight of edible material and sand particles removed during each washing step were determined after drying at 102 ^{0}C for 24 hours and results were reported in dry weight basis. Yield of beheaded raw dried sprat (before washing) collected from Negombo, Chilaw, and retailing were 81.23, 88.3 and 79.02**%.** After four washing steps of beheaded anchovies, the total sand content of Negombo, Chilaw, and retail shop samples were 3.524±0.21, 4.447±1.52, and 3.696±2.06 %, respectively. Losses of edible material of cleaned Anchovies (dry weight basis) after washing four times, in Negombo, Chilaw, and retail samples were 14.6±5.92, 9.01±3.53, and 6.81±27.49 %, respectively. Yield of beheaded and cleaned edible anchovies which were from Negombo, Chilaw and retail shop, after four washings were 52.30, 61.47and 70.23 % respectively. The protein content of beheaded Anchovies after cleaning and washing Negombo, Chilaw, and retail samples were 18.92, 34.48 and 17.76%, respectively. The reduction of fat in Anchovies after washing with four times Negombo, Chillaw, and retail samples were 1.0912, 1.083, and 1.5288 % respectively. Present study indicated high level of losses in edible materials of dried anchovies during repeat washings of anchovies in order to remove sand particles in dried anchovies. Therefore, valuable nutrients in dried anchovies are also lost owing to rigorous washing process. It is recommended to adopt proper methods to prevent the high level of sand contaminations in dried anchovies during handling and drying of anchovies.

Keywords: Anchovies, Nutrition loss, Sand content, Weight loss

**Corresponding author- email: lfhimasa@gmail.com*

Aquatic Environment, Conservation & Management and Climate Change

Evaluating perceptions, attitudes, and awareness of beach goers on beach plastic pollution: A study on the Western coast, Sri Lanka

E.A.S.M.R. Edirisinghe*, A. Suresh, S. Dissanayake, S.M.D.S. Samarakoon, U.G.S.M. Sewwandi, W.A.S.S. Wickramasinghe

Department of Coastal and Marine Resources Management, Ocean University of Sri Lanka.

Plastic pollution is a growing environmental concern worldwide, with coasts bearing the brunt of its impact. This study aimed to assess the perceptions, attitudes, and awareness of beach goers on beach plastic pollution at randomly selected beach sites (n=15) of Moragalla, Beruwala, Kalido beach, Wadduwa, Panadura, Angulana, Dehiwala, Wellawatta, Modara, Crow Island, Preethipura, Uswetakeiyawa, Seththappaduwa, Kamachchada, and Kammalthrai along the Western Coast of Sri Lanka. Through a questionnaire survey and observational data, the study sought to understand the level of awareness about plastic pollution, the attitudes towards responsible waste management, and the public's perception of the severity of the issue. The survey was conducted from March 13, 2023 to June 5, 2023 and utilized a systematic random sampling approach, selecting every fifth individual to participate (n=102) in the study. Findings indicate that respondents were most aware of PET bottles (32%) as the common plastic waste on beaches, followed by food wrappers (22%) and plastic bags (18%). Understanding this awareness is crucial for recognizing the primary sources of plastic pollution in coastal areas and guiding efforts to minimize plastic waste. Approximately 27% hand over their plastic waste to proper collection units, while 23% reuse their plastic waste. However, 24% of participants showed no awareness, suggesting the need for further educational initiatives. Many respondents expressed concern about plastic's negative impact on the aesthetic value of the beach (30%) and aquatic life (28%), highlighting the growing awareness of environmental issues due to plastic pollution. A considerable percentage of respondents rely on both mass media (38%) and social media (36%) for information on plastic pollution. Respondents believe both the municipality (29%) and the community (20%) have crucial roles in reducing plastic pollution, reflecting the need for collaboration. They recommend awareness programs (18%), improved waste management (18%), capacity building (17%), and reducing plastic usage (14%) to tackle the issue. In conclusion, the study findings shed light on the prevalence of public awareness on beach plastic pollution and emphasize the significance of collective efforts in addressing this environmental challenge.

Keywords: awareness, Plastic pollution, public perception, Sri Lankan beaches

Corresponding author-email: ShehaniCRM2018008@student.ocu.ac.lk

El Niño-induced rainfall variability in Sri Lanka

Pathmarasa Kajakokulan[1], Gayan Pathirana[1,2*], Xin Geng[2,3], Yi-Kai Wu[4]

[1]*Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka.*

[2]*Division of Environmental Science and Engineering, Pohang University of Science and Technology (POSTECH), Pohang, South Korea.*

[3]*CIC-FEMD/ILCEC, Key Laboratory of Meteorological Disaster of Ministry of Education (KLME), Nanjing University of Information Science and Technology, Nanjing, China.*

[4]*School of Tourism and Geography, Shaoguan University, Guangdong, China.*

The El Niño Southern Oscillation (ENSO) is a strong ocean-atmosphere coupled phenomenon in the Pacific Ocean that affects the climate of the tropics. However, ENSO impact on Sri Lanka's (SL) weather remains under studied. Therefore, observational/reanalysis datasets from 1981 to 2020 from the Climate Hazards Group Infra-Red Precipitation with Station (CHIRPS), ECMWF (European Centre for Medium-range Weather Forecast) and National Oceanographic and Atmospheric Administration (NOAA), were analyzed to investigate how ENSO influence rainfall variability in Sri Lanka. Here, we show that El Niño enhances rainfall over SL during the September-October-November (SON) of the ENSO developing year, and contributes to dry conditions in other months of the decaying ENSO year. A possible explanation is that during the SON in the developing year of El Niño, the western (eastern) Indian Ocean is anomalously warm (cold), causing anomalous easterlies in the region. This leads to large-scale convergence of moisture fluxes and enhanced precipitation extending into the SL region. In contrast, the enhanced anticyclonic circulation and the reduction of the large-scale moisture flux convergence reduce precipitation in other seasons, resulting in a drier climate in SL. Furthermore, based on a composite analysis of extreme El Niño events (i.e., 1982/83, 1997/98, and 2015/16), it is also found that the enhanced wet (dry) conditions are robust in the SON of El Niño developing (decaying) years. Thus, El Niño is a key factor influencing the seasonal precipitation of SL.

Keywords: El Niño, Rainfall, Sri Lanka

Corresponding author: upgpathirana@fish.ruh.ac.lk

Diversity and abundance of saltmarsh flora in Kalpitiya coastal region, Sri Lanka

E.G.P.D.B.J. Dissanayake*, H.B. Jayasiri, A. Suresh, Y.M.N.N. Yapa

Department of Coastal and Marine Resources management, Ocean University of Sri Lanka, No 15, Crow Island, Colombo 15

The Kalpitiya coastal region in Sri Lanka is renowned for its rich and diverse saltmarsh ecosystems and, playing important role in supporting various flora and fauna. This research aimed to assess the diversity and abundance of flora in selected areas (8.2518^{o}N of 79.7509^{o}E) of the saltmarsh ecosystem in Kalpitiya. The study was conducted in March 2023. Floral diversity assessment was done using 50 m line transects, in selected salt marsh sites (n=3: A-Anawasal (8.2518^{0}N of 79.7712), B-Nearby Regional Research Centre of NARA (8.2483^{0}N of 79.7703^{0}E), C-Near Kalpitiya Puttalam main road (8.2220^{0}N of 79.7511^{0}E)) around Kalpitiya Lagoon. The 50 m line transects (n=6) were placed perpendicular to the shoreline, in which salt marsh vegetation were studied using quadrats (0.5m x 0.5m) (n=12) placed in randomly selected points in each line transect. Saltmarsh species inside the quadrats were identified and counted. The abundance of saltmarshes in the area was 1095±890 ind.m^{-2} (mean±SD) and ranged from 573-2119 ind.m^{-2}. The abundance of saltmarsh species varied significantly (One-way ANOVA; p=0.006) between the three sites and the significantly higher abundance was reported at the site A (2119 ind.m^{-2}) than that of other two sites. The three saltmarsh species namely *Salicornia brachiata*, *Heliotropium curassavicum* and *Sesuvium portulacastrum* were reported in the area. At all the three sites, the Shannon-Wiener Index, species richness and evenness were (Site A- 0, 1, 0, Site B 0.05, 2.00, 0.02 and Site C- 0.07, 3.0, 0.02) respectively denoting lower species diversity and also the abundance of salt marsh plants in the study area. Jaccard index of similarity was higher between sites B and C (0.67), followed by A and B (0.50). This study contributes essential knowledge towards the diversity and abundance of saltmarsh flora in Kalpitiya coastal region.

Keywords: Abundance, Diversity, flora, Kalpitiya, Saltmarsh

**Corresponding author-email: prasadi.live7@gmail.com*

Community structure and composition of macrobenthic fauna in the coastal ecosystems of Kalpitiya, Sri Lanka

Kanchana Herath*, Ahalya Suresh, Kasunthi Amarasekara, Nishitha Yapa

Department of Coastal and Marine Resources Management, Ocean University of Sri Lanka.

A preliminary study on the presence of macrobenthos in Kalpitiya coastal region was conducted in March 2023. The study aimed to understand structural variabilities of macrobenthos in different coastal ecosystems of Kalpitiya, Sri Lanka. Collected 48 random sediment samples from designated areas, scooping the surface layer (minimum 2cm) into plastic bottles with a 10% Rose-Bengal solution. The sediments were processed by washing, drying, and extracting fauna types. Faunal specimens were identified to the lowest taxonomic level. To determine similarities in macrobenthic communities across diverse coastal ecosystems, non-metric Multi-Dimensional Scaling (nMDS) using the Bray-Curtis similarity coefficient was employed. Cluster Analysis (CA) delineated sites with similar macrobenthos species composition. The findings revealed a diverse array of macrobenthic species inhabiting the Kalpitiya coastal ecosystems. A total of 48 quadrats (1m x 1m) captured 7,370 individuals encompassing four phyla (gastropoda, bivalvia, polychaeta, crustacean) (average, 461 individuals/m^2) from the diverse coastal settings including mangrove ecosystems (3987 individuals/m^2), seagrass habitats (3161 individuals/m^2), salt marsh (214 individuals/m^2) areas, and barren lands (8 individuals/m^2). Highest recorded gastropods were *Pirenella cingulata* and *Clithon aualaniense*. Meanwhile most abundant crustacean and polychaete were *Amphibalanus amphitrite* and *Schistomeringos rudolphi* respectively. Molluscs were the dominant taxon, accounting for 94% of the total, followed by arthropods 5.6%. A noteworthy similarity was observed in species structure among the sampling sites (ANOSIM, Global $R = 0.451$, $p < 0.001$), with the greatest resemblance found between mangroves and seagrasses (Global $R = 0.704$, $p < 0.05$). CA divided the sites into three distinct groups; with mangroves and seagrass into the same group which was characterized by the greatest macrobenthos abundance (447/m^2). This is due to the favorable ecological conditions and habitat characteristics. These findings provide insights into the relationships between coastal habitats and macrobenthic fauna, guiding conservation efforts in Kalpitiya, Sri Lanka, and beyond.

Keywords: coastal ecosystems, community structure, macrobenthic fauna, Sri Lanka

**Corresponding author-email: madushaniherath7@gmail.com*

Assessing the impact of PET bottles used as fishing gear on plastic pollution: A case study of Morawala beach, Negombo, Sri Lanka

Dinethri Rashmi Bandara[1,2*], Lochana Gangabadaarachchi[1,2], Diyasen Jayasundara[1,2], M. P. Hendawitharana[3,4], Rohantha Rukshan Jayasinghe[1]

[1]*Alliance for Aquatic Research and Conservation (Gurantee) Limited, Colombo, Sri Lanka*

[2]*Faculty of Fisheries and Marine Sciences, Ocean University of Sri Lanka, Tangalle, Sri Lanka.*

[3]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka;*

[4]*Department of Biology, Faculty of Sciences, Ghent University, Ghent, Belgium*

Plastic pollution poses a significant threat to the oceans. In the western coast of Sri Lanka, where fishing pressure is high, Polyethylene terephthalate (PET) bottles are frequently repurposed as fishing gear. These bottles, both Sri Lankan and foreign (Transboundary) in origin, are characterized by a rope tied around the bottleneck, serving as a cost-effective alternative to traditional Styrofoam buoys. This study aimed to assess the impact of pollution caused by these plastic bottles used as fishing gear which implies a novel threat to the marine environment. The research was conducted at Morawala Beach, Negombo, from June to August 2023. The study area was observed with high pollution levels from terrestrial activities, as well as from pollutants washed ashore by oceanic currents. A 10m x 1000m stretch of the beach surface was surveyed, and all PET bottles within the area were collected and categorized as fishing gear or non-fishing gear bottles by observing the ropes around bottle necks. Additionally, fishing gear aid bottles were further classified according to their origin, whether Sri Lankan, transboundary, or unknown. The presence of fouling organisms on these bottles was also documented. Throughout the study, 1259 PET bottles were collected. A two-way ANOVA test revealed no significant difference between fishing and non-fishing gear bottle numbers ($P<0.05$) with 47.5% of the bottles used as fishing gear. From fishing gear bottles 41.5% were with transboundary and 40.5% were Sri Lankan. 18% remained unidentified due to a lack of labels. Biofouling was observed in 47.5% of the bottles, with species such as *Amphibalanus amphitrite* and *Lepas* sp. urging for further investigation. In conclusion, this study highlights that these PET bottles are an emerging source of plastic pollution. Urgent awareness and necessary measures are needed to mitigate this issue before it becomes even more concerning for Sri Lankan coastal areas.

Keywords: Fishing gear, Marine environment, PET bottles, Plastic pollution, Sri Lanka

*Corresponding author- email: *dinethrirashmi@gmail.com*

Determination of microplastics accumulation in seagrass beds in the Puttalam lagoon, Sri Lanka

M. A. M. Bhathiya[1*], Susantha Udagedara[2], P. A. K. N. Dissanayake[1], P. Mangala C.S De Silva[3]

[1]*Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara 81000, Sri Lanka*

[2]*Blue Resources Trust, 86, Barnes Place, Colombo 7, Sri Lanka*

[3]*Department of Zoology, Faculty of Science, University of Ruhuna, Matara 81000, Sri Lanka*

Microplastic (MP) contamination is widespread across various ecosystems including seagrass habitats, and its impacts on the environment remain insufficiently understood. In this study, a thorough assessment of microplastic pollution within seagrass beds was conducted in the Puttalam lagoon during the North-East monsoon period of 2021. Seagrass samples and sediments from both vegetated and unvegetated areas were randomly collected using quadrates (0.25 m^2) and sediment cores (2.5cm diameter x 30cm length) respectively. The mean abundance, morphotype, and color of MP were assessed and statistically analyzed using SPSS 26.0. According to the findings, all sites were contaminated with MP. The mean abundance of total MP particles in seagrass samples ranged from 7.7 to 13.7 MP $blade^{-1}$ while it was significantly higher ($P<0.05$) in vegetated sediments (62.8 ± 30.7 MP kg^{-1}) than in unvegetated sediments (29.8 ± 12.1 MP kg^{-1}) revealing the high potential of MP accumulation in the seagrass ecosystem. Notably, the predominated morphotype was the fragments in both seagrass blades (6.7±1.4 MP $blade^{-1}$) and vegetated sediments (32.3±10.1 MP kg^{-1}) followed by fibers (4.0±1.7 MP $blade^{-1}$ in seagrass and 28.0±3.8 MP kg^{-1} in vegetated sediments) while fibers were the dominated morphotype in unvegetated sediments (15.8±4.5 MP kg^{-1}) followed by fragments (13.3±5.3 MP kg^{-1}). Blue color (33.32%) was the most common color observed in fibers and fragments in both environments. As probable MP contributors, agricultural practices, residents, fishing, and commercial industries were recorded and the pattern of MP contamination among sites coincides with the degree of anthropogenic pollution and suboptimal solid waste management practices in the region. It is recommended to conduct a comprehensive study covering both monsoon and inter-monsoonal periods to understand the influence of hydrology on MP densities and distribution. Furthermore, sustainable waste management practices are indeed necessary to reduce MP generation.

Keywords: microplastics, morphotype, Puttalam lagoon, seagrass, sediments,

Corresponding author- email: menuka.bhathiya@gmail.com

Floristic composition and abundance of coastal vegetation in Matara district Coastal Area, Sri Lanka

L.S.P. Malalanayake*, and E.A.K.K. Amarasekara

Department of Coastal and Marine Resources Management, Faculty of Engineering and Management, Ocean University of Sri Lanka, Colombo 15

The coastal vegetation of Sri Lanka is adapted to the dynamic and salient coastal environment. It plays a vital role in establishing coastlines, providing habitat for a variety of species, and offeringa range of ecosystem services. Despite the importance of coastal vegetation in Sri Lanka there areonly limited number of researches conducted on the topic. This study evaluated plant species composition and abundance in the Matara district coastal area of Sri Lanka. 12 study sites were randomly selected from Matara coastal area and each site was surveyed using 3 belt transects (5mx 50m) which were laid perpendicular to the shoreline and cross the water-land gradient. Totally 36 belt transects were used and floral species in each transect were identified and counted. The results of the study indicate that the coastal area of the Matara district is mosaic of five major coastal vegetation types: herbs, trees, shrubs, creepers, and grasses. A total of 125 floral species, representing 109 genera and 41 families, were recorded from the studied sites. *Digitaria ciliaris* of the Poaceae and *Ipomoea pes-caprae* of the Convolvulaceae were the most abundant species inthe study site. Herbs were the most dominant growth form of studied sites. Out of 125 plant species45 plant species were herbs, 35 plant species were shrubs, 25 plant species were trees, 14 plant species were creepers and 8 plant species were grasses. Among the recorded plant, 86 plant species were recognized and documented as plant with medicinal value. Under the vulnerable conservationstatus, *Gmelina arbore* plant species were recorded. Further research is needed to understand the ecological aspect of these coastal vegetation, as they have not been studied for years. This knowledge is essential for their protection.

Key words: coastal ecosystem, coastal environment, coastal vegetation, floristic abundance, floristic composition

**Corresponding author-email: laknasewwandi15@gmail.com*

Diversity and abundance of macrobenthos in Kandakuliya saltmarsh ecosystem in Kalpitiya, Sri Lanka

V.A. Wickramasinghe*, M.C.L. Zoysa, H.P.S. Jayapala

Department of Coastal and Marine Resources Management, Ocean University of Sri Lanka

Macrobenthos refers to the community of organisms that inhabit the benthic (bottom) zone of aquatic ecosystems. Macrobenthic invertebrates are generally considered as a biological indicator because they can provide information that reflects the quality of environmental conditions. They also play a vital role, including being part of the food web, improving sediment structure, determining the water quality and helping to nutrient cycling. The present study was carried out to investigate the macrobenthic faunal diversity in Kandakuliya saltmarsh ecosystem in Kalpitiya, Sri Lanka. Five soil samples were collected from randomly selected six locations (total 30 samples) once a month over three-month period from March to May 2023 by using a 1m × 1m quadrat and a soil auger. The collected soil samples were sieved through a 0.5mm sieve in the laboratory to identify the macrobenthos. The diversity of macrobenthos was calculated using Shannon-Wiener index. Two species of gastropods, one species of crustaceans, and one species of bivalves were recorded in benthic samples. Among the two gastropod species, 73% belonged to the family Potamididae and were the most abundant in studied site. Among 434 total number of macrobenthic invertebrates observed, *Cerithidea cingulata*, *Haminoea zelandiae*, crabs and *Gafrarium sp.* were presented at the percentages of 65.21%, 23.73%, 6.22%, and 4.84% respectively. The calculated diversity index for the site was 0.94. This research is important as a baseline study to understanding the ecological diversity of the Kandakuliya saltmarsh. However, it is recommended that to get an overall understanding of this ecologically important ecosystem, diversity, distribution, and abundance in terms of seasonal patterns would be studied.

Keywords: aquatic ecosystem, biological indicator, diversity, invertebrates, macrobenthos

**Corresponding author-email: vishmaanupama9961@gmail.com*

Determining total bacterial load on Microplastics sampled from Kandy Lake and inlets: A pilot study

W.K.H. Welagedara[1], H.M.S.A.T. Gunathilaka[1,] M.S. Lakmali[1], R.I.S. Karunathilaka[1], I.P. L. Jayarathne[1], D.N. Magana-Arachchi[1*]

[1] *National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka*

Microplastics represent a critical concern, as they are ubiquitous in the environment. It has already been recorded that pathogenic bacterial species have been found on microplastics. Hence, this study aimed to identify the bacterial community attached to microplastics. The total bacterial load associated with microplastics sourced from Kandy Lake waters was quantified as an initiative. Water samples (300mL each) were collected in July 2023, in a dry season of the year using a plankton net (250 µm, HYDRO-BIOS), two from Kandy Lake (S1 & S2), and four from inlets (S3, S4, S5, S6). The sample (100 mL) was filtered through a 5 mm metal sieve and followed by Whatman Glass Fiber Filters (Pour size-0.7 µm) and the treatment was duplicated. To isolate microplastics, the filter was observed under a light microscope (X10, Olympus-BH2). Aseptic conditions were maintained throughout the procedure. The isolated microplastics were suspended in sterile distilled water, shaken at 170 rpm for an hour, and the suspension was cultured on LB agar. The microbial quantity on microplastics was determined by quantitative real-time PCR using a 16S rDNA primer-probe set. An analysis of variance was performed for data analysis. Eight distinct morphologies were identified from culturable microorganisms, where 57.14% gram-positive rods, 14.29% gram-positive cocci, 7.14% gram-negative rods, and 19.05% gram-negative cocci. The total microbial load on microplastics isolated from the inlets S3, S4, S5, and S6 varied as 1.73 $x10^8$ cells/mL,4.34 $x10^6$ cells/mL,7.63 $x10^6$ cells/mL, and 4.48 $x10^6$ cells/mL respectively. The total microbial load on microplastics isolated from lake samples S1 and S2 was 8.14 $x10^5$ cells/mL and 2.44 $x10^5$ cells/mL respectively. A significantly higher microbial count was recorded in microplastics collected from inlets compared to the lake (p<0.05). In conclusion, the total bacterial load on microplastics collected from inlets was ~80-fold higher than in the lake.

Keywords: bacteria, Kandy lake, micro-plastics, microscopy, real-time pcr

**Corresponding author- email: dhammika.ma@nifs.ac.lk*

Assessment of blue carbon stocks in tropical mangrove forests, Rekawa Lagoon, Sri Lanka

W.K. Suwandhahannadi[1,4]*, D. Wickramasinghe[1], D.D.G.L. Dahanayaka[2], Loic Le De[3]

[1]*Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, Sri Lanka*

[2]*Department of Zoology, Faculty of Natural Sciences, The Open University of Sri Lanka, Nawala, Nugegoda*

[3]*School of Public Health and Interdisciplinary Studies, Auckland University of Technology, Auckland, New Zealand*

[4]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

Mangroves' ecological functions as carbon sinks and stores are extremely beneficial to mitigate global warming and climate change. The lack of knowledge about mangrove carbon pools poses a challenge in conserving and managing these ecosystems, it is recognized as a significant obstacle for national climate change mitigation strategies. Efforts to address this knowledge gaps are crucial for effective conservation and management of mangrove species. Therefore, an attempt was taken to evaluate the total blue carbon reserves of the mangrove forests in Rekawa Lagoon, southern Sri Lanka. The field surveys were conducted from April 2023 to September 2023. The total biomass and Total Organic Carbon (TOC) were calculated using allometric equations in 15 sampling plots (10 m × 10 m), whereas the TOC in mangrove soil was determined by using the Loss on Ignition (LOI) technique. A total no's of 832 trees were measured in the study area, where there are 11 true mangrove species. The statistical analysis of one-way ANOVA revealed that there were no significant differences in above- and below-ground biomass among the plots ($p > 0.05$). The total biomass of the mangrove plants in Rekawa Lagoon was 358 Mg ha^{-1} which sequestered 154 Mg C ha^{-1} of organic carbon. Above-ground plant components contained more biomass (209 Mg ha^{-1}) than the below-ground (149 Mg ha^{-1}) parts. *Avicennia marina* had the highest average above-ground biomass (85.63 Mg ha^{-1}), followed by *Avicennia officinalis* (46.13 Mg ha^{-1}), *Heritiera littoralis* (15.99 Mg ha^{-1}), and *Lumnitzera racemosa* (12.49 Mg ha^{-1}). TOC in mangrove soils (up to 30 cm depth) was recorded as 139 Mg C ha^{-1}. The total blue carbon stock of the mangrove ecosystem in Rekawa Lagoon from all carbon pools (above, below, and soil) was therefore 293 Mg C ha^{-1}, out of which 47% was sequestered in soil. The average amount of stored carbon dioxide equivalents by the mangroves in Rekawa lagoon was 1075.31 Mg CO_2-eq ha^{1}. The present study has found that mangrove ecosystems play a significant role in climate change mitigation through the fixation of blue carbon, it emphasizes the urgent need to conserve these important ecosystems.

Key words: biomass, blue carbon, mangrove ecosystem, Rekawa lagoon

**Corresponding Author-email: wathsala05kk@yahoo.com*

Determination of soil suitability for mangroves planting at Oluvil coastal zone: A mechanism to prevent coastal erosion

G.D.G.P.P. Gamage, G. Nishanthan* and M.H. Rihan

Department of Biosystems Technology, Faculty of Technology, South Eastern University of Sri Lanka, University Park, Oluvil, Sri Lanka.

Coastal villages near Oluvil Beach on Sri Lanka's southeast coast have been profoundly affected by sea erosion following the construction of the Oluvil fishing harbour in 2009. The present study assesses the possibility of slowing erosion by establishing mangrove forests at Oluvil Beach. This study was carried out to determine the suitability of soil for planting mangroves in Oluvil Beach. Physical (colour, texture, moisture, temperature, pH, salinity, bulk density, electrical conductivity), Chemical (N, P, K), and Biological (organic matter and organic carbon) parameters of soil samples were analysed and compared with the nearest mangrove established coastal zone of Batticaloa. Suitable mangrove varieties were recommended for field planting. The approximate inward movement of the sea at Oluvil Beach from 2006 to 2022 was estimated as 309.87 m using Google Earth Pro, Version 7.3.6.9285 (stone barriers to selected point). The physical soil parameters of Oluvil Beach were significantly different from the Batticaloa site, except for salinity (2.33±1.52 ppt and 2.00±1.00 ppt respectively). The highest moisture (89.03±6.89%) was reported on the Batticaloa site. The chemical parameters and biological parameters of the Batticaloa were significantly higher than the Oluvil Beach (ANOVA, $p<0.05$). Potassium (K), organic matter, and organic carbon values in the Batticaloa were 27.04, 7.93, and 8.0 times higher than those in the Oluvil Beach samples. Based on the soil analysis reports, *Nypa fruticans*, *Excoecaria agallocha* and *Rhizophora apiculate* were found to be the most suitable for establishing a mangrove forest at Oluvil Beach considering the soil salinity profiles of those species. Mangrove plants were collected from the Batticaloa area and 30 mangrove plants were planted in selected locations at Oluvil. 21 cultivated mangrove plants were successfully established at Oluvil and 9 plants were destroyed by high-speed waves. This study found that Oluvil Beach is a suitable location for establishing mangrove forests to protect the beach from marine erosion.

Keywords: coastal erosion, mangrove, Oluvil Beach, Oluvil Harbour, soil parameters

**Corresponding author- email: seenishan@seu.ac.lk*

Paving the way for an ocean literate future: A grass root movement for marine conservation

L. A. G. Arachchi*, A. D. R. P. Bandara, M. I. U. Manikarachchi
[1]*Department of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Mahawela Road, Tangalle.*

Ocean literacy, a modern concept, emphasizes the vital role of oceans in sustaining life on Earth. In 2005, UNESCO and the IOC organized the 'Ocean Literacy for All' conference in Paris, uniting global participants. UNESCO established seven key principles to define ocean literacy, guiding educational and awareness initiatives. Although initially in the Western-centric world, ocean literacy is gaining a significant ground, in Asia, it remains low in many areas. Sri Lanka lacks comprehensive ocean literacy efforts, despite its island and coastal importance. This study aimed to evaluate the level of ocean literacy among school students in Tangalle, Sri Lanka, and to assess the subject contents about the ocean in the current school curriculum. Five nearby schools to the Ocean University of Sri Lanka were chosen randomly for this study. It included 300 students (157 male and 143 female) across grades 3 to 12. They answered grade-specific multiple-choice questions based on ocean literacy aligned with Next Generation Science Standards. Textbooks were analyzed for alignment with ocean literacy principles. According to the Kruskal-Wallis test, ocean literacy among Tangalle students showed significant differences between grade categories ($P<0.05$). The highest mean (mean ±SD) ocean literacy was reported in grades 3 to 5 (71.43±20.59), followed by grades 6 to 8 (64.29±17.42), and grades 9 to 12 (52.38±16.89). According to the Mann-Whitney U Test, the ocean literacy between females and males showed a significant difference ($P<0.05$), with male students having higher knowledge. According to the content mapping of the textbook, a lack of ocean-related knowledge was identified (Grade 8 Science textbook). The 7th principal showed the least knowledge level among students, possibly due to a lack of content in the textbooks. Enhancing ocean literacy through updated textbooks, error-free content, training, workshops, scientist collaboration, and nationwide awareness campaigns is the suggested path for fostering understanding and conservation.

Keywords: curriculum assessment, government schools, ocean conservation, ocean literacy, Sri Lanka

**Corresponding author-email: LochanaFMS2019025@student.ocu.ac.lk*

Microplastic contamination in beach seine fishery in southern and western coastal waters in Sri Lanka

A.I. Madhumali[1], A. A. D. Amarathunga[2], M. A. P. C. Piyathilaka[1], M. D. S. R. Maddumage[2], K. Dalpathadu[2],

[1]*Department of Environmental Technology, Faculty of Technology, University of Colombo, Pitipana, Homagama, Sri Lanka*

[2] *National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

Microplastic contamination in fish is a growing concern due to its potential negative impacts on human well as the environmental health. When microplastics are released into the environment, they can be accumulating in fish and via the food chain, either through direct ingestion or indirect processes. This study aimed to investigate the occurrence and abundance of microplastics in the gastrointestinal tract (GIT) and gills of 160 belongs to 11 species (*Stolephorus insularis, Encraischolina insularis , Sardinella albella, Encrasicholina heterologa,Sphyraena barracuda, Stolephorus commersonil, Thryssa encrasicholoides, Amblygaster leiogaster, Encrasicholina heteroloba, Stolephorous waitei*) across 8 locations in the Southern to Western coastal waters during January to December in 2022. The study involved treating gut and gill contents with 15% KOH, incubating at 65ºC for 24 hours, and filtering the digested sample. Suspected microplastics were analyzed using a EUROMAX stereomicroscope. Further identification of microplastics was done through Fourier-transform infrared spectroscopy (FTIR), providing a detailed analysis of polymer types. The results of the study showed that microplastic pollutants were accumulated in a significant proportion of fish, approximately 295 microplastics were detected in 160 fish, 56 % were found in Gill, while 44% of plastic particles in GIT. The study revealed that the most common shape of microplastic fragments in fish samples was fibers (36%), followed by fragments (59%), films (4%), and pellets (1%). The majority of particles were less than 999 µm, with no microplastic pollutants found in samples larger than 7000 µm in size. This study indicates the need to raise the concern of potential consumption of fish that are contaminated with microplastics, caught by beach seine fishery in the Southern to Western coastal waters. Present study also suggests extending the investigations on the prevalence microplastics in fish harvested in other coastal areas together with the identification of microplastics.

Keywords: beach seine fishery, contamination, fish, microplastics

**Corresponding author- email: deeptha.amarathunga@gmail.com*

Assessment of surface water quality in the Mirissa and Beruwala fishery harbors with reference to anthropogenic activities.

A. A Kodippili[1], A. A. D. Amarathunga[2*], M. A. P. C. Piyathilaka [1], M. D. S. R. Maddumage[2], S. R. C. N. K. Narangoda[2], H.N.L. Jayasekara[1], M.G.C.R. Wijesinghe[2], P.H. Ginigaddarage[2], K.A.W.S. Weerasekara[2]

[1]*Department of Environmental Technology. Faculty of Technology. University of Colombo*

[2]*The National Aquatic Research Resource and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.*

The research emphasizes some of human activities, specifically fishing and harbor operations, have led to significant coastal pollution in fishery harbors of Beruwala and Mirissa located in Western and Southern coasts, respectively of Sri Lanka. The pollutants accumulated in these harbors include crude oil, raw fish fragments, and other waste products produced by fishing vessels and other harbor operations. The study aims to identify the physicochemical characteristics and some of the pollutants such as oil and grease, zinc, and presumptive coliforms in these two harbors from October 2021 to December 2022. Fifteen Water samples were collected from water surface of the water column including eight from Beruwala Harbor and seven from Mirissa Harbors. The mean value and (range) of Biological Oxygen Demand (BOD), Fecal Coliform, Total Coliform, and *Escherichia coli* (*E. coli)- Coli* of water were, 2.11±1.61 (0.00-6.40) mg/L, 1800 Most Probable Number (MPN), 1800 MPN, and 1038 MPN, respectively in Beruwala Harbor; and 1.18±1.25 (0.00-3.30) mg/L, 834 MPN, 256 MPN, and 16 MPN respectively, in Mirissa Harbor. The mean value and (range) of level of pH, electrical conductivity (EC), total dissolved solids (TDS), salinity, dissolved oxygen (DO), chemical oxygen demand (COD) and Zinc ions (Zn^{2+}) were 7.95 ± 0.22 (7.01-8.25), 46.18 ± 2.95 (40.10-52.10) mS/cm, 26.29 ± 1.93(22.60-28.90) mg/L, 29.65 ± 0.88 (28.00-31.10) ppt, 4.44 ±1.85 (1.50-7.60) mg/L, 653.75 ± 458.4 (0.00-1920.00) mg/L, and 0.125 ± 0.121(0.01-0.41) mg/L, respectively, in water present in basin of Beruwala harbor while levels of same chemical parameters were found as 7.94 ± 0.25 (7.25-8.35), 46.58 ± 3.92 (38.90-54.30) mS/cm, 25.14 ± 1.54 (21.00-27.10) mg/L, 30.11 ± 1.09 (28.00-34.00) ppt, 6.84 ± 2.41(0.00-12.00) mg/L, 600.0 ± 335.72 (40.00-1320.00) mg/L, and 0.206 ± 0.255 (0.05-1.0) mg/L, respectively, in water in Mirissa Harbor. The mean value and (range) of Temperature, turbidity, TSS (Total suspended solids), and Oil and Grease were 29.05±0.55 (28.50-30.10)ºC, 2.14±1.36 (0.52-5.48) NTU, 45.04±11.05(3.60-77.20) mg/L, 15.00±13.54 (2.00-70.00) mg/L in water present in basin of Beruwala Harbor while levels of same physical parameters were found as 28.86±0.19(28.70-29.20) ºC, 1.28±1.16 (0.01-4.03) NTU, 48.29±14.43 (22.80-96.80)mg/L, 35.21±32.40 (4.00-103.00)mg/L respectively, in water in Mirissa Harbor. The mean result and (range) of nitrate-N, nitrite-N, and phosphate were 0.05±0.04 (0.00-0.14) mg/L, 0.04±0.10 (0.00-0.39) mg/L, 0.14±0.19 (0.01-0.85) mg/L in water present in basin of Beruwala Harbor while levels of same nutrient result were found as 0.01±0.004 (0.00-0.02) mg/L, 0.01±0.01(0.00-0.02) mg/L, 0.02±0.02 (0.00-0.09) mg/L respectively, in water in Mirissa Harbor. T-test was utilized to compare the significantly different means between the two harbors. However, the levels of oil grease in both the Beruwala and Mirissa fishery harbors were not within acceptable ranges according to permissible levels proposed by EPA, 1986 [GSR 7, dated Dec. 22, 1998] Primary Water Quality Criteria for Class SW-IV Waters (For Harbour Waters).

Keywords – Harbor pollution, Microbial pollution, Mirissa, Water quality, Trace elements

**Corresponding author- email: deeptha.amarathunga@gmail.com*

Abundance and characterization of microplastics in the coastal region of the North Eastern Coast of Sri Lanka

M.A.S.P. Dissanayake[1], A.A.D. Amarathunga[2*], C.K. Hemachandra[1,] S.R.C.N.K. Narangoda[2], H.N.L. Jayasekara[1], H.G.T. Piumali[2]

[1]*Department of Environmental Technology, Faculty of Technology, University of Colombo, Pitipana, Homagama*

[2]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15. Sri Lanka*

The objective of the study was to evaluate the occurrence, abundance and characteristics of the microplastics that had been accumulated in the North Eastern Coast of Sri Lanka. 60 sediment samples from 5 main sampling sites (Kallady, Kurukkalmadam, Kalmunai, Oluvil, and Akkaraipattu) were collected in October 2021. In each sampling site, 3 sub sampling locations were considered with 4 replicates from each location. Microplastics were extracted using standard procedures and observed under a stereo-microscope. The findings of the study revealed that the microplastics were available in different types such as fibers, fragments, pellets, films, foams, and sheets under different size classes (<250 µm and >250 µm). The overall abundance in the area, determined by concentrations observed in 15 spots across three locations in each of the five study areas using 60 samples, was calculated to be 505.83±1115.69 particles/kg and when it comes to each study area, the mean abundance of microplastics ranged from 0.83-7500 particles/kg, 0.91-29.79 particles/kg, 0.66-18.33 particles/kg, 1.66-3.91 particles/kg and 1-2.3 particles/kg in Oluvil, Kurukkalmadam, Akkaraipattu, Kalmunai and Kallady respectively. Oluvil exhibits the highest microplastic abundance, with 2501.63 particles/kg, a statistically significant quantity. A comparison with other examined areas, where the microplastic levels in Kallady (1.23 particles/kg), Kurukkalmadam (15.94 particles/kg), Kalmunai (2.8 particles/kg), and Akkaraipattu (7.59 particles/kg) provides substantial support for this result. From the total MPs in the whole study area, 82.8% were fibers, recording as the highest deposited morphological form of microplastics, followed by the films (14.0%), fragments (3.1%) and pellets/grains (0.1%). The colours of the MPs in the area were blue (29%), blackish blue (22%), white (16%), black (11%), purple (10%) and other colours such as light-brown, light-green, blue-green, red-orange, grey, yellow and silver (12%), The percentage abundance of <250 µm fraction of MPs in the whole study area was 99.7%. Therefore, the present study revealed that the North Eastern coast is highly contaminated with MPs in the Oluvil area, with <250 µm fibers of mostly blue colour. The MPs might have potentially been originated from fisheries activities operated in the harbour. Further, this study indicates the potential ecological risk to aquatic organisms especially in the Oluvil area due to heavy MP contamination.

Keywords - eastern coast, microplastics, polymers, sediment, Sri Lanka

**Corresponding author- email: deeptha.amarathunga@gmail.com*

Assessment of the impact of harbor operations using sediment of the Beruwala and Mirissa fishery harbors in Sri Lanka

H.N.L. Jayasekara[1], A.A.D. Amarathunga[2*], S.M. Young[1], S.R.C.N.K. Narangoda[2], M. D.S.R. Maddumage[2,] A.A. Kodippili[1], M.G.C.R. Wijesinghe[2], P.H. Ginigaddarage[2], M.A.S.P Dissanayake[1], K.A.W.S.Weerasekara[2],

[1]*Department of Environmental Technology. Faculty of Technology. University of Colombo*

[2]*The National Aquatic Research Resource and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.*

Examining fishing harbour sediment is crucial for understanding its impact on marine environments and community well-being. Therefore, the present study aimed to assess the concentration in sediments for trace elements, organic matter content, microbial pollution, and other harmful substances. Samples were collected using Ekman grab sampler and collected randomly from Beruwala (n=8) and Mirissa (n=7) fishing harbours located in the western and southern coast of Sri Lanka from August 2021 to September 2022. Sediment electrical conductivity (EC) and moisture content of sediments collected from Beruwala harbour were 41.95±4.74 mS/cm and 6.39±0.45 % respectively, while the percentage composition of the sediment was sand 96.3±0.33 %, clay 2.75±0.38 %, silt 0.96±0.29 %. The organic matter content of the same sediment was 18.59±3.34 %, and the nitrate, nitrite, phosphate and oil – grease contents were 0.027±0.004 ppm, 0.16±0.04 ppm, 0.018±0.004 ppm and 0.83±0.26 mg/kg respectively. Further there were (Cu) 0.32±0.12 mg/L, (Cr) 0.007±0.001 mg/L, (Ni) 0.06±0.03 mg/L, (Zn) 1.23±0.16 mg/L and (Pb) 0.004±0.001 mg/L. Sediment electrical conductivity (EC) and moisture content of sediments collected from Mirissa harbour were 45.52±7.67 mS/cm and 5.84±0.81 % respectively, while the percentage composition of the sediment was sand 95.52±0.92 %, clay 2.17±0.31 %, silt 2.18±0.96 %, The organic matter content of the same sediment was 9.91±1.37 %, and the nitrate, nitrite, phosphate and oil - grease contents were 0.03±0.004 ppm, 0.38±0.037 ppm, 0.02±0.003 ppm, and 1.02±0.29 mg/kg respectively. Further there were (Cu) 0.11±0.09 mg/L, (Cr) 0.003±0.001 mg/L, (Ni) - 0.06±0.04 mg/L, (Zn) 0.58±0.19 mg/L and (Pb) 0.002±0.001 mg/L. Microbiological studies revealed that both harbors were contaminated with total *coliform*, fecal *coliform* and *E-coli in* several sample collecting locations. The results indicated that contaminants were not present at levels higher than the Australian and New Zealand Environment and Conservation Council (ANZECC) and Post-Archean average Australian Shale (PAAS) standards. Two – sample t-test have performed using Minitab software and it indicated that there is a significant difference (t = 0.04), (p = 0.965) between analyzed parameters at Beruwala and Mirissa harbour. However, it is recommended to conduct regular monitoring of fishing harbours.

Keywords - fishery harbor, organic matter, pollution, sediment, trace elements

**Corresponding author- email: deeptha.amarathunga@gmail.com*

Abundance and characterization of microplastics in a commercial salt manufacturing process in Southern Sri Lanka

J.M.D.N.P. Jayamanne[1]*, H.B. Jayasiri[2], A.A.D. Amarathunga[3], H.P.S. Jayapala[4]

[1,2,4]Department of Coastal and Marine Resources Management, Faculty of Engineering and Management, Ocean University of Sri Lanka, Colombo 15.

[3] National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka.

Plastic debris, a fast-growing urban waste segment, cause pollution by breaking into microplastics (MPs) of less than 5mm. The Microplastics (MPs) are classified as primary, microscopic virgin granules used to make plastic items and secondary, resulting from degradation of large plastics. The present study was planned to characterize and quantify MPs available in sea water and salt samples (n=50) collected from 15 different stages of the process in salt manufacturing process in southern Sri Lanka. The salt samples of 50 g each were dissolved in distilled water and poured through a stack of 1mm and 300 μm mesh stainless steel sieve plates. Solid which was collected in each sieve was transferred onto a filter paper using a vacuum filtering apparatus and rinsed with distilled water. Wet Peroxide Oxidation was performed to remove the organic compounds from the sample using aqueous Fe (II) (0.05M) and hydrogen peroxide (30%) below 75°C. Density separation was performed using NaCl (1:5) and MPs were collected onto a membrane filter paper (0.45μm). A stereo microscope and Fourier transform infrared spectroscopy were used to analyze the characteristics of MPs and type of polymers. The statistical analysis was performed using SPSS version 23 and MS Excel 2010. The mean total MPs count was 90.4±132.61items/kg. A highest count of MPs was recorded in salt heap 01 (15.0±22.49 items/kg) while the lowest count of MPs was reported in table salt after grinding and iodized (2.80±4.09 items/kg). Shape categories of MPs in salt samples were recorded as fiber (51.54%), fragment (44.49%), film (1.76%), filaments (1.54%) and sphere (0.66%). The identified polymer types in all samples were low-density polyethylene (LDPE; 52%), polyethylene terephthalate (PET; 45%), polypropylene (1%), polyamide (1%) and polystyrene (1%) polymers. This study provides the first evidence of MPs contamination in a salt manufacturing process in Sri Lanka which is one of the sources of bioaccumulation of MPs in consumers.

Keywords: abundance, composition, microplastics, polymer, salt production process, sea salt

**Corresponding Author: pathumini.cea@gmail.com*

Assessment of heavy metal contamination in shallow sediments of Nilwala river floodplain in Matara, Sri Lanka

K.W.R.R. Amaraweera*[1], K.H.M.A. Deepananda[2] and U.A.D. Jayasinghe[2]

[1]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2]*Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka*

Nilwala River floodplain in Matara, Sri Lanka is important for aquatic-based livelihood generation. Over the last decades, this sensitive environment has become urbanized and industrialized. The present study aims to investigate how heavy metal content in sediments impacts the Nilwala River floodplain and its effect on biota due to the accumulation through the food chain. Twenty sediment samples were collected from selected twenty sites in the monsoonal (May) and non-monsoonal (February) seasons in 2019, placed into sealed polyethylene bags, brought to the laboratory in an ice box, and stored at −20 °C in the dark until analysis. Digested sediment samples using nitric acid were analysed for Cd, Cr, Pb, and Hg metals using the atomic absorption spectrophotometer (Model GBC 932 plus). The student t-test was employed to analyse the temporal variation of element concentrations. One-way ANOVA and Tukey's pairwise comparisons were used to analyse spatial variation of the mean concentration of elements. In the non-monsoonal season, the mean concentration of Cd, Cr, Pb, and Hg ranged between 0.011-0.263, 9.41-87.99, 0.586-3.38, and 0.015-1.05 mg dry weight/kg, respectively. During the monsoonal season, the mean concentration of Cd, Cr, Pb, and Hg ranged between 0.018-0.283, 9.75-90.90, 0.685-4.62, and 0.0107-0.25 mg dry weight/kg, respectively. There were significant differences ($p<0.05$) in Cd, Cr, and Pb concentrations amongst the sites, albeit Hg concentration did not show significant differences amongst the sites in monsoon and non-monsoon seasons. The mean concentrations of Cd, Cr, and Pb were relatively higher in the monsoon season than in the non-monsoon season. The highest Cd, Cr, Pb, and Hg concentrations were recorded at sampling sites at Godagama (0.283), Nadugala-1 (90.90), Sulthanagoda wewa (4.62), and Nagodawatiya wewa (0.25) mg/kg respectively. The lowest Cd, Cr, Pb, and Hg concentrations were recorded at sampling sites in Pahala Aturaliya (0.11), Navimana-South (9.41), Katuwangoda Wewa (0.586), and Kosgahabenaya wewa (0.0107) mg/kg, respectively. The present results provide valuable information about metal contamination in sediments and present findings help reduce aquatic health risks and environmental damage in Nilwala River floodplain, Sri Lanka.

Keywords: floodplain, heavy metal, Nilwala river, sediments

*Corresponding author-email: ruciraamaraweera2@gmail.com

Re-colonization of macro-zoo benthos in sand dredging site located off shore Negombo, Sri Lanka

K.H.K. Bandaranayake*, S.S.K. Haputhantri and R.P.P.K. Jayasinghe

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Sand dredging is often carried out in the sea for coastal development activities. As a result, most of the organisms that inhabits the dredging site may be affected due to direct physical removal or rapid changes occur in their natural habitats. Therefore, the present study was carried out in off Negombo, Sri Lanka in order to investigate the long-term impacts on marine macro zoo benthic communities due to sand dredging and improve our understanding of the re-colonization and recovery of the ecosystems. Accordingly, the grab sampling was conducted in 12 sampling locations from 2016 to 2019 as per representing both the dredging site and pre and post-dredging periods. In the baseline study, a total of 29 macro zoo benthos organisms which represented six major phyla namely, Mollusca, Annelida, Arthropoda, Echinodermata, Retaria, and Chordata (lower Chordata) were identified in which bivalves were account for more than 50% of the total species identified. The majority of these shells were dead and the occurrence and accumulation of these dead shells may be mostly due to either washed-off from the near shore areas by water currents or due to in-situ depositions of dead organisms. The number of species recorded over time period showed that initially there was a rapid decrease in crustaceans and polychaetes but, a gradual increasing trend could be observed afterwards. Crustacean species such as *Gammarus* sp and *Penaeus* sp have been recorded comparatively in low densities (<50 per m2) in the baseline study but were absent even two years after the dredging. It has also been noted that polychaetes such as *Neries* sp were abundantly (100-500 per m2) recorded in the baseline survey and after a two-year interval, they appeared with few densities. In the baseline study, lower chordates such as *Amphioxus* sp were abundantly recorded at 03 sampling locations with a range between 50-500 per m^2 but during the monitoring phases, the species was found in a few locations only with <50 per m^2 densities. In contrast, bivalves and gastropod shells recorded comparatively with high densities in 2018, after one year of cessation of the dredging. Moreover, an improvement of species diversity (Shannon-Wiener Diversity Index >2) can also be observed in 05 sampling locations in 2018. Overall, it can be concluded that, the site has undergone the initial recovery followed by slower recovery phase during the study period.

Keywords: abundance, baseline study, diversity, grab, monitoring, recovery

**Corresponding Author-email: kisharabandaranayake@gmail.com*

A review of marine litter pollution in coastal waters of Sri Lanka

S.R.C.N.K. Narangoda*, K.A.W.S. Weerasekara, A.A.D. Amarathunga, N.D. Hettige

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Marine litter currently poses a growing threat to the marine and coastal environment all over the world. Most marine litter consists of materials that degrade slowly, if at all, continuous input of large quantities of those items results in a gradual build-up in the marine and coastal environment. Fourteen districts of Sri Lanka are covered by coastal lines and the majority of the population is concentrated in the coastal areas. Marine and beach litter are concentrated mostly along the beaches, shores, on surface waters and along the shores of lagoons and estuaries. Current actions, the accumulation of debris is increasing and this could cause irreversible damage to both the economy of the country and the ecology of the coastal sites. To protect ecosystems and ensure sustainability, the marine litter issue should properly be understood and addressed. Even though it is important, the available data and sources of information about marine debris are very limited. Therefore, a systematic literature review was conducted using Google Scholar (GS), Scopus and Science Direct (SD) discovery engines for the duration of 10 years (2013-2022). The selection of these search engines is based on broader coverage and the possibility of being assessed without any subscriptions. The keywords used are selected from the topic as "marine" AND "litter" OR "debris" OR "plastics" OR "microplastics" AND "Sri Lanka". A total of 30 articles were used for this review strictly adhering to the above keywords to gather the relevant information. Only journals and conference proceedings were included in the review, while abstracts and other documents (reviews, books, and book chapters) were excluded from the evaluation. The review revealed that the shipping sector, lack of land-based infrastructure to receive litter, combined with a lack of awareness among main stakeholders are major causes for the increased marine debris pollution. 90% of GS articles recommended the importance of having specific rules and regulations and their implementation to reduce marine pollution. Although there are necessary rules and regulations in place, these rules should be tightened properly and new strict regulations should be implemented to minimize the vast collection of debris from anthropogenic activities. In the context of microplastics, most of the papers suggested conducting further research to investigate the impacts of microplastics on the marine environment. Addressing the problem of plastic debris in the oceans is a difficult task, and a variety of approaches are urgently required. However, providing awareness from the school level to the general public for better understanding, mitigation and prevention of litter pollution in coastal waters of Sri Lanka, will lead to a pollution-free marine environment for the country's future generations.

Key words: coastal pollution, marine debris, marine litter, microplastics, Sri Lanka

**Corresponding author-email: chnarangoda@nara.ac.lk/chanarangoda@yahoo.com*

Status of two reef sites, Arippu and Silawathurai on the Northwest coast of Sri Lanka

M.M.C. Karunarathna[1], M.P. Hendawitharana[1,2] and R.P.P. K. Jayasinghe[1*]

[1]*National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2]*Department of Biology, Faculty of Sciences, Ghent University, Belgium*

Arippu and Silawathurai coral reefs are located offshore from 5km away from the beach on northwest coast of Sri Lanka. This ecosystem has endured significant pressure, impacted by both anthropogenic and natural factors. In 2021, an underwater visual survey was conducted to evaluate fish abundance, species diversity, and live coral coverage. In the Arippu reef, live coral coverage was recorded at 47.5%, primarily consisting of branching and tabular *Acropora* species. Additionally, a dead coral coverage of 10.3% was observed. Similarly, the Silawathurai reef featured a dominance of branching and tabular *Acropora* species. Here, hard coral coverage reached 30%, while the coverage of dead coral exceeded 15%. The Arippu reef hosted totally 253 fish individuals across 18 families: Acanthuridae, Apogonidae, Chaetodontidae, Cirrhitidae, Gobiidae, Haemulidae, Holocentridae, Labridae, Lethrinidae, Lutjanidae, Mullidae, Meuranidae, Nemipteridae, Pempheridae, Pomacentridae, Scaridae, Serranidae, and Siganidae. Pomacentridae was the most abundant family, representing 48% of the total fish identified. Chaetodontidae and Labridae accounted for 20% and 7% of the total individual fishes, respectively. At the Silawathurai reef, totally 223 fish individuals were recorded, spanning 15 families: Acanthuridae, Apogonidae, Chaetodontidae, Gobiidae, Haemulidae, Holocentridae, Labridae, Lutjanidae, Mullidae, Nemipteridae, Pempheridae, Pomacanthidae, Pomacentridae, Scaridae, Serranidae, and Siganidae. Like the Arippu reef, Pomacentridae was the most abundant family, representing 41% of the total fish identified. However, Chaetodontidae and Scaridae contributed 23% and 14% respectively. The average fish abundance recorded in this study was 216 individuals per 1000 square meters in the Arippu location, indicating a poor level. In Silawathurai, the average was 190 individuals per 1000 square meters, indicating a very poor level. It can be concluded that the density levels in both locations are below acceptable thresholds. Special attention should be given to aquarium fish collection and edible fish harvesting techniques on and around the Arippu and Silawathurai Reefs.

Keywords: corals, edible fish, reef-associated fish, underwater visual surveys

**Corresponding author-email: prabathj@nara.ac.lk*

Assessment of physicochemical and biological characteristics of surface water in Galle Fishery Harbour, Sri Lanka

J.K.P.C. Jayawardhane, A.A.D. Amarathunga*, K.A.W.S. Weerasekara

National Aquatic Resources Research & Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Analysis of water in fishery harbour basins is particularly important as harbour basins can be a serious source of marine pollution. Galle fishery harbour is a deep-sea industrial fishery port located in an international place for tourism and mooring facilities for visiting yachts. The harbour consists of a large number of service facilities and store complexes. The present study was conducted to assess the physicochemical characteristics and plankton community structure of harbour water at Galle fishery harbour in 2022. Surface water samples were collected monthly for three months in 2022 from five selected locations with three replicates from each including water inlets to the harbour basin. A total of 13 physicochemical parameters [pH, dissoved oxygen (DO), salinity, electrical conductivity (EC) total dissolved solids (TDS), turbidity, nitrate nitrogen, orthophosphrous, oil and grease, total suspended solids (TSS), nitrite nitrogen, biochemical oxygen demand (BOD), chemical oxygen demand (COD), Chlorophyll-*a*], heavy metals [Lead (Pb), Chromium (Cr), Zinc (Zn), Copper (Cu), Nickel (Ni)] were analysed using standard methods and planktons were determined using available keys. Results were statistically analysed using one sample t test against Indonesian water quality standards for ports and harbors, marine recreation and marine ecosystems, 2004 and ASEAN Marine water quality criteria for aquatic life protection, 2005. According to the results, mean pH (7.3±0.5), DO (5.0±2.0 mg/L) and TSS (45.0±23.7 mg/L) were within the standard levels whereas mean values of Secchi disk depth (water clarity) (1.2±0.7m), nitrate nitrogen (129.9±195.9µg/L), orthophosphrous (320.1±265.3 µg/L) and oil and grease (25.2±12.3 mg/L) were beyond the acceptable standard criteria. Moreover, it was discovered that the average concentrations of Pb (5.0±1.2 mg/L), Cr (4.1±0.8 mg/L), Zn (1.9±0.6 mg/L) and Cu (0.6±0.3 mg/L) were greatly exceeded the respective maximum permissible levels in marine water. Mean physicochemical parameters in which the maximum standards are not available, such as EC, TDS, turbidity, nitrite nitrogen, BOD, COD and chlorophyll *a* were 48.6±13.2 mS/cm, 28.6±7.5 mg/L, 7.6±7.3 NTU, 1.92±1.37 µg/L, 2.5±1.7 mg/L, 40±23.5 mg/L) (5.3±3.1 µg/L) respectively. A total of 52 phytoplankton species were recorded including *Nitzchia* sp., *Navicula* sp., *Zygnema* sp., *Cyclotella* sp., and *Odontella* sp., with the highest relative abundance. Calanoids and cyclopoids were the most common zooplankton. In conclusion, water quality of Galle fishery harbour had been degraded and subjected to the contamination of heavy metal, oil and nutrients which can have a negative impact on coastal living resources and human health. The present study recommends initiatives for an effective waste management and disposal system within the harbour and among the coastal communities who discharge their waste to coastal waterways.

Key words: Galle harbour, heavy metals, nutrients, Physicochemical parameters, water quality

**Corresponding author-email: deeptha.amarathunga@gmail.com*

Study on distribution and accumulation patterns of marine litter and microplastics on beaches in the West Coast of Sri Lanka

R. Dushyanthi[1], R.C.L. De Silva[2], A.A.D. Amarathunga[1*]

[1] *National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka*

[2] *Department of Chemistry, University of Kelaniya.*

Marine litter and microplastic pollution have been recognized as a serious environmental concern in recent decades. This study investigated the distribution and accumulation patterns of marine litter and microplastics on beaches in the Crow Island and Wattala coastal areas during the Northeast monsoon. In this study, any anthropogenic and persistent solid material which are larger than 5 mm in size was categorized as marine litter, and microplastics were defined as plastics between 1mm to 5mm in size. Surface marine litter was determined over 12 quadrats (1 m^2) per beach area while buried marine litter and microplastics were analyzed in sand samples obtained within 0.5 m×0.5 m area of the same quadrats in two different depths (surface to 3 cm, and 3 cm to 6 cm). Accumulation patterns of marine litter were analyzed between the storm line and the vegetation area or sand dune. Much marine litter was found in the Crow Island beach area (27 surface marine litter pieces/ m^2) through which Kelani River drains to the ocean, compared to that of Wattala beach area (2 surface marine litter pieces/ m^2) which is undisturbed by canals or rivers. Both Crow Island and Wattala beach areas contained a high number of plastic marine litter on the surface (94.4% and 75.0% respectively) and deep layers (99.5% and 82.4% respectively) of sand. ATR-FTIR analysis indicated that Polyethylene, Polyethylene Terephthalate (PET), and Polypropylene were the most abundant types of polymers identified from the surface (24%, 38%, and 21% respectively) and buried (48%, 27%, and 17% respectively) plastic marine litter collected from the Crow Island beach area. Wattala Beach had a high number of PET pieces (33%) from the collected surface plastic marine litter. Plastic pellets (21%) and Styrene ethylene butylene styrene (21%) were in high numbers in the buried plastic marine litter collected from the Wattala beach area. The Crow Island beach contained many polyethylene microplastic pieces (54%) and Polystyrene microplastics (48%) were in high numbers in the Wattala beach samples. The number of buried marine litter was significantly affected by the depth of the beach and distance from the storm line ($p < 0.05$). However, the accumulation of surface marine litter and microplastics is nearly independent of the depth of the beach and distance from the storm line. The findings of this study could contribute to planning suitable mitigatory measures for the flowing deposition of marine litter in two beach areas on the West Coast. Long-term monitoring is imperative to understand the effect of temporal changes in marine litter distribution and accumulation.

Keywords: buried marine litter, FTIR, microplastics, surface marine litter, West Coast

Corresponding author-email: deeptha.amarathunga@gmail.com

Blue flag certification; developing sustainable tourism and economic growth through environmental conservation

N.K.R.N. Jayawardena, S. Thirukeswaran, K.A.W.S. Weerasekara*

National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Tourism can be identified as an economic driver for the coastal areas around the world, but its growth usually comes with the degradation of the marine environment. Blue Flag Certification (BFC) is a globally renowned eco-label that has become a tool to balance environmental protection and revenue increment by tourism. The beaches that want to be certified with the blue flag must fulfill strict requirements related to water quality, environmental management, safety, and environmental education. This study investigates how BFC enhances economic development while protecting the environment. A comprehensive review of articles relevant to the BFC and its benefits was carried out. The primary finding is that there is a direct relation between increased tourism revenue and BFC. It was also found that BFC helps tourist places become more sustainable and more appealing to environmentally conscious tourists looking for eco-friendly experiences. It attracts travelers who are prepared to pay more to visit places that place a high priority on environmental protection. Additionally, favorable media helps recognized marinas and beaches draw in tourists from around the world and enhance their status as desirable, responsible travel destinations. The local governments and businesses save money while using sustainable methods to pursue and maintain BFC. Reducing waste and energy usage, and conserving water are some of those practices that lower operating costs while also making the space cleaner and more appealing to guests. Fisheries and biodiversity conservation are just a few of the vital services that healthy ecosystems offer to local economies. In addition to promoting responsible stewardship of our natural resources, it draws tourists who care about the environment, lowers operating costs, and guarantees the long-term health of marine ecosystems. In conclusion, the value of BFC is a potent tactic for striking an equilibrium between preserving the environment and generating revenue from tourism.

Key Words: blue flag, conservation, environment, management, sustainable tourism

Corresponding author- email: shyamalikaws@gmail.com

GIS and Remote Sensing in Aquatic Sciences

Evaluating the impact of geomorphological changes at the lagoon mouth on the lagoon environment using remote sensing techniques

D.D.D. Weragodathenna*and A.B.A.K Gunaratne

National Aquatic Resource Research and Development Agency (NARA), Crow Island, Colombo 15, Sri Lanka

Many lagoons located around Sri Lanka play a vital role in the development of aquaculture, which in turn enhances the livelihoods of communities in these areas. However, the geomorphological changes occurring at the lagoon mouth, driven by natural processes (tidal patterns, river flow, sediment transport, climate conditions) and human activities (land use alterations) pose significant challenges. Long-term changes at the lagoon mouth can adversely affect to the lagoon ecosystem by impacting water quality. Therefore, analysing these long-term geomorphological changes can provide insights into why and how lagoon ecosystems transform. This study focused on three lagoons on the east coast of Sri Lanka, Kokilai, Nayaru, and Nandikadal with the objective of promoting environmentally friendly aquaculture practices. Freely available Landsat satellite imagery utilized with 30-meter resolution, spanning different time periods (1988, 1994, 2000, 2006, 2010, 2015, and 2020) to represent both the South-west and North-east monsoons, to analyse lagoon mouth dynamics. Remote Sensing technics of geometric, radiometric, and atmospheric correction were conducted prior to image analysis. Object-based classification using ERDAS 2011 was employed to identify changes in the lagoon mouth. Time series analysis showed fluctuating sandbar formation in Kokilai and Nayaru Lagoons, with a year-round sea-lagoon connection, which allows for aquaculture activities as confirmed by the water quality analysis, such as shrimp and crab farming, in certain parts of the lagoon. Nandikadal Lagoon stays blocked year-round by a sandbar, leading to freshwater conditions in the Northeast monsoon and higher salinity than the sea in some areas during the Southwest monsoon. Hydrological conditions, including water flushing and residence time, vary from a few hours (during the rainy season) to no flushing (in the dry season), significantly influencing the structure and function of biotic communities and the resulting water quality of the lagoon. The extreme salinity fluctuations render the Nandikadal Lagoon and its associated ecosystem unsustainable. Therefore, for the purpose of sustainable aquaculture practices in Nandikadal Lagoon, it is imperative to replace the causeway with an overpass to facilitate water inflow into the lagoon and carry out canal dredging to deepen the lagoon to introduce pen culture for finfish and mud crab as an income generation for the community.

Keywords: aquaculture practices, geomorphological changes, GIS and Remote Sensing, lagoon mouth, Nandikadal lagoon

**Corresponding author-email: dilhari@nara.ac.lk*