

NARA Scientific Sessions 2022

BOOK OF ABSTRACTS

"Collective actions for blue economy"



21st October 2022

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



**National Aquatic Resources Research
and Development Agency**

Annual Scientific Sessions - 2022

“Collective actions for blue economy”

21st October 2022

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Marine and Coastal Fisheries

Present trends of small meshed gillnet fishery on the West coast of Sri Lanka

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Small pelagic fishery on the West coast of Sri Lanka plays a vital role both in terms of livelihood and food security. The present study was carried out using the time series data of 2001–2020 extracted from the Small Pelagic Database of the Marine Biological Resources Division, NARA, in order to provide the present status of the small pelagic fishery on the West coast. The West coast which comprises four fisheries districts namely Chilaw, Negombo, Colombo and Kalutara contributes around 58% to the total small pelagic fish production of the country. There are more than 4000 Outboard Engine Fiber Reinforced Plastic (OFRP) boats engage in this fishery. The target fish include sardines, herrings, anchovies and mackerels which are mainly caught by small meshed gillnets having a wide range of mesh sizes between 1.2 cm and 5.7 cm. The observations of recent five-year landings (i.e., 2016-2020) showed that the highest the average Catch per Unit Effort (CPUE) of 85 kg per OFRP boat per trip was reported from June to February which encounters the period from the onset of Southwest monsoon up to the end of the Northeast monsoon. The CPUE of the small pelagic fishery showed a great inter-annual variation with an average of 66.7 ± 17.3 kg per OFRP boat per trip during the past decade. The mean trophic level calculated for the coastal fisheries landings of the past twenty years ranged between 3.14 and 3.62. It was evident that the average CPUE of the key species, *Amblygaster sirm* has shown alarming signals with a 27% drop from 2001-2010 to 2016-2020. Further, a declining trend of the percentage contribution of *A. sirm* was observed; 50% in 2001-2010; 37% in 2011-2015 and 34% in 2016-2020. The findings of the present study will be fundamental for the management plan on small pelagic fishery in the West coast of Sri Lanka which is being formulated at present under the bilateral project of Norway -Sri Lanka.

Keywords: *Amblygaster sirm*, coastal fisheries, CPUE, mean trophic level

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Fisheries independent trawl survey to estimate biomass and density of shrimps and fish in Sri Lankan coastal waters

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Although time series catch and effort data from commercial fisheries are commonly used to assess the status of stocks, independent surveys are also essential. Therefore, a fisheries independent trawl survey was conducted in December 2021 at Kalpitiya shrimp trawl ground (~15 km²) using a commercial trawler (90 HP) with a trawl net to estimate shrimp biomass. Totally, twenty-five trawl hauls were conducted at randomly selected stations and GPS coordinates and bottom depths were recorded at the start and end points. Species composition, individual weight, length, and maturity stage were noted for all trawling stations. Swept area method was applied to estimate the density and biomass of shrimps and fish using StoX, a software commonly applied for fish biomass estimates of large commercial European fish stocks. Fish were caught as a by-catch in the survey and in total 108 species, comprising 84 fishes, 10 molluscs and 07 shrimp species were recorded. The total biomass of all the species was estimated at 5236 kg (1660 kg of shrimps and 3094 kg of fish by-catch) within trawling ground with a density of 1200 kg NM⁻². Furthermore, the densities of shrimps and fish were 380 and 709 kg NM⁻² respectively. Penaeid shrimps contributed 32% to the total biomass. Among the seven species of shrimps, *Penaeus semisulcatus* (43%) and *P. merguensis* (36%) were the most dominant and an exotic species *P. vannamei* was also recorded. The presence of 60% of immature *P. semisulcatus* indicated that there might be migratory routes or spawning grounds in this area. In contrast, the majority of mature individuals were found in *P. indicus* and *P. merguensis* populations. The fish species *Karalla dussumieri* and *Arius maculatus* highly contributed to the by-catch biomasses, 735 kg and 403 kg respectively. Time-series results of these studies are essential in developing sustainable fisheries management strategies.

Keywords: biomass, diversity, independent surveys, shrimps, trawling, Sri Lankan waters, StoX

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Distribution and abundance of Black sea urchin (*Stomopneustes variolaris*) in the West coast of Sri Lanka

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Sea urchins (Phylum: Echinodermata) are considered a good source of protein and are found to be rich in bioactive compounds. This study aimed to investigate the distribution and abundance of Black sea urchin (*Stomopneustes variolaris*) in three selected locations in the West coast of Sri Lanka to develop the fishery as an export-oriented Industry. A preliminary survey was conducted from October-December 2021 along the West coast from Beruwala to Negombo-Pitipana fishery harbour for site selection for the detailed survey. Accordingly, Maggona Beach in Beruwala, Uswetakeiyawa Beach and Morawala Beach coastal rocky shore areas in Negombo-Pitipana were selected as the study sites. An underwater visual survey was conducted by snorkelling to quantify the abundance of Black sea urchin inhabiting the three locations. Three different habitats (sandy, sub-tidal rocky and intertidal rocky) where sea urchins live were identified and surveys were carried out in each habitat separately in order to estimate the area-wise and habitat-wise abundance. In each location, 20 x 5 m (100 m²) belt transects were laid to quantify the abundance of sea urchin. All transects were laid perpendicular to the shoreline, and all the sea urchins present within the belt transects area were counted and recorded for analysis. The lowest average density (0.18 individuals/m²) was estimated in sandy bottom habitats from all three locations whereas the highest average density (7.61 individuals/m²) was recorded in intertidal rocky habitats from all three habitats. The average density for subtidal rocky habitat was 4.96 individuals/m². The lowest average density (0.18 individuals/m²) was estimated in sandy bottom habitats whereas the highest average density (7.61 individuals/m²) was recorded in intertidal rocky habitats. The average density for subtidal rocky habitat was 4.96 individuals/m². The highest standing stock is estimated in Morawala site (217,800 individuals) while the lowest stock is recorded in Beruwala site (80,940 individuals). Forty percent of the standing stock is recommended as the total allowable catch and harvest needs to be taken once in every two years. Since the harvestable stock from the wild is limited, encouraging the commercial culture of sea urchins for export is recommended.

Keywords: Black sea urchin, export, standing stock, Sri Lanka

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Present status of the Yellowfin tuna (*Thunnus albacares*, (Bonnaterre, 1788)) fishery in Sri Lanka

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Yellowfin tuna (*Thunnus albacares* (Bonnaterre, 1788)) is an important commercial fish species which significantly contributes to the seafood trade in Sri Lanka. Due to the great importance of the fishery as well as to the vulnerability due to overfishing, it is imperative to assess and monitor the resource periodically with available data. Hence, the study aimed to analyse the present fishery status of the Yellowfin tuna (YFT) in Sri Lanka using available data of the Indian Ocean Tuna Commission (IOTC) from 2013 to 2020. Accordingly, the relative contribution of the YFT production to tuna, tuna-like species and bill fish production in Sri Lanka has increased from 23.7% in 2013 to 36% in 2020, while 70 - 80% of the YFT catch comes from the longline fishery. The percentage YFT catch in gillnet fishery for the same period has markedly reduced from 20.4% to 6.3% and 14.5% to 2.6% in coastal areas and high seas respectively. The YFT production showed a positive trend (Mann-Kendall trend test), both in high seas and coastal fishery (Sen's slope values estimates were 1228.6, 82.8 and 1291.0 for total production, high seas and EEZ respectively). The total length (TL) of the YFT ranged from 47 cm to 287 cm in the offshore gill net fishery and 47 cm to 305 cm in the longline fishery on high seas from 2016 to 2020. In the EEZ, the TL varied from 29 cm to 266 cm in the coastal gill net fishery and from 26 cm to 272 cm in the longline fishery during the above period. The lowest percentage of immature YFT was reported in the offshore longlines (0.4%) and coastal longlines (1.7%). The results of this study could be used to find the direction for means of complying with IOTC resolutions and management of the fishery resources in Sri Lanka.

Keywords: coastal fishery, fish production, high sea fishery, Yellowfin tuna

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Status of shrimp trawl fisheries in the shallow seas off Kalpitiya and Mannar on the Northwestern coast of Sri Lanka

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The study was carried out to find out variations in catch per unit effort (CPUE: kg boat⁻¹) and total production in Kalpitiya and Mannar shrimp trawl fisheries from January to December 2021 using data from the landing sites and market logbooks. Generally, 23, 11-t trawlers and 180, 3.5-t trawlers were operated in Kalpitiya and Mannar respectively without any close seasons. Being opposite to Kalpitiya (06 fishing days per trip per week), in Mannar, fishing was conducted at night (03 single fishing days per week). *Penaeus semisulcatus* was the most abundant targeted shrimp species and ponyfishes were dominant in the by-catch in both fishing grounds. The lowest and highest CPUE (shrimp kg 06days trip⁻¹ boat⁻¹) of Kalpitiya fishery were 94.0 kg (in February) and 189.7 kg (in August) respectively. The estimated annual total shrimp production in Kalpitiya was 142 tons which mostly comprised medium-sized (30g - 49g) shrimps. The CPUE (shrimp kg 01day trip⁻¹ boat⁻¹) of Mannar exhibited the lowest value (12.2 kg) in October and the highest (38.7 kg) in February and an annual total shrimp production of 415 tons mainly with small sized (13-29 g) shrimps. In addition, a higher mean CPUE was recorded in Kalpitiya during the Southwest monsoon season (around 48% of total annual shrimp production) while for Mannar, it coincided with the Northeast season (about 30% of total production). However, only in Mannar shrimp fishery, there was a statistically significant difference ($P < 0.05$) in mean CPUE between four monsoonal seasons. By interviewing the fishers, the gross income (per trawl trip) was estimated at LKR 180,000.00 and LKR 15,000.00 while operational costs were LKR 140,000.00 and LKR 9,000.00 in Kalpitiya and Mannar respectively. Generally, penaeid shrimps contributes approximately 90% to the economy and the findings of this study will be useful to formulate management plans.

Keywords: fisheries, monsoon, shrimp, sustainability, trawl

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Feeding habits of the Spangled emperor, *Lethrinus nebulosus* (Forsskål, 1775) in the Sri Lankan waters

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Species belonging to the family Lethrinidae are the most targeted fish in the demersal fishery in Sri Lanka. Among them, *Lethrinus nebulosus* is one of the key species in the commercial catch. Despite the importance of *L. nebulosus*, limited information is available on their ecological aspects such as feeding strategies. This study was conducted to understand the food and feeding habits of *L. nebulosus* in the Sri Lankan waters using 41 gut samples collected from a fishery-independent survey conducted by the research vessel R/V Dr Fridtjof Nansen, from 24th June to 16th July 2018. As most of the food items had been digested to some extent, they were grouped into Fish sp. 1, 2, 3, 4 and 5, based on some biometric parameters such as snout length, head length relative to the body length, and the relative origin of the fins. Whenever possible, the food items were identified up to the lowest possible taxonomic level with the aid of identification guides. The result of the gut content analysis showed that the majority of the mature *L. nebulosus* in the Sri Lankan waters preyed on 'Fish sp. 2' while the immature ones preyed mostly on 'Fish sp. 1'. In addition, the diet of *L. nebulosus* was composed of *Loligo* sp., *Lagocephalus* sp., *Selaroides leptolepis* and partially digested invertebrate parts. The Schoener's index (S) for mature and immature fish was estimated at 0.19 which is less than the biologically meaningful diet overlap value of 0.60. The Amundsen graphical analysis suggests that *L. nebulosus* in the Sri Lankan waters are specialist consumers with fish being the more dominant food items in their diet than the invertebrates.

Keywords: diet overlap, gut content analysis, *Lethrinus nebulosus*, specialist consumers, Schoener's index

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Some aspects of the population characteristics of key Anchovy species in the West coast of Sri Lanka

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The two Anchovy species, *Stolephorus commersonnii* and *Encrasicholina heteroloba* contribute significantly to the year-round coastal fishery of Sri Lanka. Although the anchovy fishery is well-established in the country, information especially relating to population dynamics is still lacking. As such, this study aims to determine the length–weight (L-W) relationship and size at maturity of the two species in the West coast of Sri Lanka. Length and weight data of 2,110 individuals of both species, caught by drift gillnets with the mesh size ranging from 5 to 14 mm were collected monthly at the landing sites in Negombo and Chilaw fisheries districts during the period from January to December 2021. The sex ratio was observed as 1:1.32 and 0.84:1 (F:M) for *E. heteroloba* and *S. commersonnii* respectively. The L-W relationship obtained from linear regression for male and female *E. heteroloba* were $\text{Log } W = -4.943 + 2.892 \log \text{ TL}$ and $\text{Log } W = -5.256 + 3.052 \log \text{ TL}$ respectively. The estimated L-W relationship for male and female *S. commersonnii* were $\text{Log } W = -7.028 + 2.1246 \log \text{ TL}$ and $\log W = -6.031 + 1.124 \log \text{ TL}$ respectively. A negative allometric growth was reported for both sexes of *S. commersonnii*. However, positive allometric growth and negative allometric growth were reported for female and male *E. heteroloba* respectively. There was no significant difference ($P > 0.05$) between male and female regression co-efficient for both species. The size at first maturity (L_{50}) was, 74.2 mm and 76.3 mm for male and female *E. heteroloba* and 76.8 mm and 77.9 mm for male and female *S. commersonnii*. This study reports the results of the length- weight relationship, sex ratio and size at maturity of the two anchovy species. The findings of the study will be useful in the management of the Anchovy fishery. However, further studies related to stock status are recommended to ensure the sustainability of Anchovy resources in the West coast of Sri Lanka.

Keywords: *Encrasicholina heteroloba*, length-weight relationship, sex ratio, *Stolephorus commersonnii*,

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Temporal distribution of fish and shrimp fishery in relation to monsoonal patterns in the Rekawa Lagoon, Southern Sri Lanka

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Rekawa Lagoon is one of the important brackish water bodies covering 240 ha area on the Southern coast of Sri Lanka. It provides crucial ecosystem services, including food provision by serving fishing opportunities. Though, several studies have been carried out regarding fisheries aspects in Rekawa Lagoon, there is no recent fishery information available. Therefore, the study was designed to investigate the current status of the fishery with the monsoonal pattern in the Rekawa Lagoon. The five major landing sites around the lagoon were visited once a week to collect information on fish catch, gear type, and species composition from December 2020 to November 2021. From the total number of crafts operated, 40-60% were sampled at each sampling site. Gillnet (96%), cast net (2%), and fish kraals (2%) were identified as the major fishing gear operated within the lagoon, and they are mostly practiced by using non-motorized traditional boats (NTRB) or without crafts. There were 35 fish and 4 shellfish species that were recorded during the study period. The highest average monsoonal fish catch ($15,186 \pm 3296$ kg) was observed in the Northeast monsoon (Dec-Feb), whereas the lowest (4094 ± 539 kg) in the second inter monsoon (Oct-Nov), with a significant difference in catch with monsoon pattern ($F = 13.37$; $p < 0.05$). Among dominant species, *Penaeus indicus* contributed to 63% of the total catch, followed by *Oreochromis spp.* (12%), *Nematalosa nasus* (6%), *Tachysurus sp.* (5%), *Pseudarius gella* (3%), and *Stolephorus indicus* (1%) during the Northeast monsoon period. The main issues for the lagoon's fishery were the spreading of invasive aquatic plants (*Najas marina*) and filamentous algae (*Oscillatoria sp.*), increasing fishing pressure by using monofilament nets and illegal kraal, particularly during the Northeast monsoon and conflicts among fishes. It is necessary to implement long-term proper management strategies considering monsoonal impacts to improve and to ensure sustainable utilization of the fishery resources in the Rekawa Lagoon.

Keywords: fisheries management, monsoonal pattern, Rekawa Lagoon, seasonal variation

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CPUE standardization of *Amblygaster sirm* in small meshed gillnet fishery on the West Coast, Sri Lanka

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The small mesh gillnet fishery, the most popular small-scale fishery on the West coast of Sri Lanka is conducted year-round targeting small pelagics. The fishery is characterized by relatively smaller fishing vessels, multiple landing sites, multispecies catches and a large number of dependents. Small meshed gillnets on the West coast are widely operated with Outboard-engine Fiber Reinforced Plastic (OFRP) boats and the main target species in the fishery is spotted sardinella (*Amblygaster sirm*). There is a rapid increase in the OFRP vessels operating on the West coast fishery after the tsunami in 2004 and the addition of new vessels has largely contributed to increased fishing pressure on coastal species particularly spotted sardinella-like species. The present study was undertaken to standardize the Catch Per Unit Effort (CPUE) of spotted sardinella in the small meshed gillnet fishery on the West coast of Sri Lanka. Twenty years of data (2000- 2019) collected by the National Aquatic Resources Research and Development Agency (NARA) via small pelagic port sampling were utilized for CPUE standardization. A delta-lognormal model comprising of a Gaussian-based Generalized Linear Model (GLM) for positive catch rates and a Bernoulli-based GLM model for binary data of spotted sardinella were used. Six explanatory variables: year, fishing season, fisheries district, total fishing time, number of net pieces used, and gear operated depth were taken into the consideration for CPUE standardization. The response variable, the CPUE was expressed in terms of the total catch of spotted sardinella in kilograms per boat per hour. Two GLM models explained 17.5% and 23.2% of the total deviance respectively. A considerable variation in the annual and seasonal abundance indices of spotted sardinella was observed throughout the study period. The fluctuations in the abundance index were attributed to the population changes due to environmental variability and fishing-induced changes.

Keywords: CPUE, GLM, small meshed gillnet, spotted sardinella

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Spatial variation in the length – weight relationship and Fulton’s condition factor of two commercially important demersal fish species in Sri Lankan waters

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Fulton’s condition factor (K) and length-weight relationship (LWR) are widely used in fisheries biology for comparing the condition, fatness, well-being of fish and to determine the growth characteristics. The present study aimed to understand the spatial variation in the LWR and the K of *Lethrinus olivaceus* (Valenciennes, 1830) and *Lutjanus lutjanus* (Bloch, 1790) in Sri Lankan waters. The samples of *L. olivaceus* (n=260) and *L. lutjanus* (n=181) were collected from the ecosystem survey conducted in Sri Lankan coastal waters by R/V Dr Fridtjof Nansen from 24th June to 16th July, 2018. The LWR was estimated using the equation: $W=aL^b$ and K was determined using the equation: $K=100W/L^3$. The estimated LWR for *L. olivaceus* in the West and South regions were $W = 0.02L^{2.85}$ and $W = 0.02L^{2.87}$ and for *L. lutjanus* in the Northwest and West regions were $W = 0.01L^{3.03}$ and $W = 0.02L^{2.84}$ respectively. The mean K value was estimated at 1.31 ± 0.17 and 1.34 ± 0.12 ; 1.45 ± 0.16 and 1.57 ± 0.13 for the combinations of species and regions respectively as indicated above. The mean K of *L. lutjanus* population in the West region ($t_{153.20} = -5.51$; $p < 0.01$; CI = 95%) was significantly higher than their counterparts in the Northwest region. However, there was no significant difference in the K value for *L. olivaceus* ($t_{196.22} = -1.84$; $p = 0.07$; CI = 95%) in the two regions. Therefore, it can be concluded that there were better environmental conditions for the survival of *L. lutjanus* in the West region of Sri Lanka. The b values of LWRs suggested that *L. olivaceus* in both regions ($p < 0.01$) and *L. lutjanus* in the West region ($p < 0.01$) exhibited a ‘negative allometric growth’ while *L. lutjanus* in the Northwest region ($p < 0.01$) exhibited a ‘positive allometric growth’ pattern.

Keywords: allometric growth, Fulton’s condition factor, length-weight relationship, *Lethrinus olivaceus*, *Lutjanus lutjanus*

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Grouper (family:Epinephelidae) fishery on the Hambantota coast, Sri Lanka

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Grouper (Epinephelidae) are highly prioritized and prone to overfishing, due to longevity, late maturation, and spawning aggregation behaviour resulting in a high risk of extinction for several species. The present study was conducted from January to March 2020 by weekly to study the grouper landings in the Hambantota fisheries district. A total of 97 fishers were interviewed at three landing sites (Hambantota, Tangalle, and Kalamatiya) to obtain information about grouper catch, total catch, and true fishing time. The data gathered were entered into Microsoft Excel for analysis. The commonly used fishing gears were the bottom set longline and the bottom set gillnet. Nine species of groupers were recorded belonging to the genus *Cephalopholis* (*Cephalopholis formosa*, *C. sonnerati*) and *Epinephelus* (*Epinephelus bleekeri*, *E. chlorostigma*, *E. coioides*, *E. faveatus*, *E. longispinis*, *E. malabaricus*, *E. undulosus*). The highest ($p < 0.005$) average catch per unit effort was recorded in March (1.54 ± 0.62 kg/hr). In January and February average catch per unit efforts were 0.62 ± 0.11 and 0.91 ± 0.13 kg/hr. Therefore, March was recognized as the best grouper-catching month in the study period for the Hambantota district. Relatively smaller catch per unit effort values apparently indicate that the resource is currently at risk. Strengthening the catch monitoring programs and applying stronger management measures to grouper fisheries are recommended.

Keywords: catch per unit effort, catch statistics, fishers, grouper

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Inland Fisheries and Aquaculture

Effects of different dietary lipid levels for hybrid lemon fin barb (*Barbonymus gonionotus* ♀ × *Hypsibarbus wetmorei* ♂) larvae

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Hybrid lemon fin barb is developed by crossing silver barb (*Barbonymus gonionotus*, ♀) and lemon fin barb (*Hypsibarbus wetmorei*, ♂) to increase local carp aquaculture production in Malaysia. To control the over-exploitation of tasty wild lemon fin barb, the wild fish was crossed with silver barb by the Malaysian Department of Fisheries. In the present study, the effects of increasing dietary lipid levels were investigated for the larval stage of this fast-growing and delicious carp species. Five micro diets were formulated to contain 0, 4, 8, 12, and 16% dietary lipid levels. Three days after hatching, hybrid larvae were randomly allocated in fifteen 9-L tanks at the rate of 10 larvae L⁻¹. While the non-lipid diet lowered the survival and growth in hybrid larvae, weight gain, total length gain, specific growth rate and protein efficiency ratio of hybrid larvae fed with the 12% lipid diet increased ($p < 0.05$) after 20 days. The survival of hybrid larvae improved ($p < 0.05$) with 4 and 8% lipid diets. Increasing dietary lipid levels gradually increased the whole-body lipid content of hybrid larvae. The diet with 12% dietary lipid significantly improved ($p < 0.05$) EPA, DHA and n-3 fatty acid contents of hybrid larvae. The non-lipid diet led to shrunken hepatocytes while excessive dietary lipid resulted in lipid droplets in enterocytes and swollen hepatocytes of hybrid larvae. In conclusion, the optimum dietary lipid requirement for hybrid lemon fin barb larvae regarding maximum growth is correlated with 13.5% dietary fish oil.

Keywords: dietary lipid, hybrid lemon fin barb, larval growth, local carps

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Use of different carbon sources for the biofloc system during the early nursery stage of *Cyprinus rubrofasciatus*

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A study was conducted to assess the most suitable carbon source for the biofloc-based system to rear the early growth stage of *Cyprinus rubrofasciatus*. Three carbon sources; molasses (MO), rice bran (RB), wheat flour (WF), and their combinations; 1:1 mix of MO and RB (MORB), and 1:1MO and WF (MOWF) were tested during the study. A control (CON) was maintained without addition of a carbon source and all treatments were triplicated. Post-larvae with an average weight of 0.007 ± 0.004 g were randomly assigned in eighteen rectangular fiberglass tanks (2m x 1.5m x 1.5m) at 400 fish/m² stocking density and reared for 45 days. The water quality parameters of all experimental tanks were measured once a week. Fish in BFT (Biofloc Treatments) and CON treatments were fed twice a day, 5% of their body weight with commercially available fish feed (42% CP). The average weight of the fish reared in WF ($0.18 \text{g} \pm 0.34$), MO ($0.15 \text{g} \pm 0.4$), and RBMO ($0.16 \text{g} \pm 0.05$) treated BFT system were significantly higher ($p < 0.05$; one-way ANOVA) compared to the CON ($0.06 \text{g} \pm 0.02$). TAN concentration in the WF based BFT system ($2.91 \text{mg/L} \pm 0.5$) was significantly higher ($P < 0.05$) compared to the MO ($0.45 \text{mg/L} \pm 0.1$) and RBMO ($1.31 \text{mg/L} \pm 0.1$) treatments. The survival of post-larvae in MO treated tank was 87% and it was significantly high ($P < 0.05$) compared to other carbon sources, RBMO (82%), WFMO (74%), RB (72%), and WF (70 %). MO based BFT system showed significantly ($P < 0.05$) lowest nitrite-N ($0.22 \text{mg/L} \pm 0.1$) and the highest biofloc ($5.3 \text{mL/L} \pm 1.0$) volume than other treatments. When considering both survival and growth MO based BFT system is more suitable to rear *Cyprinus rubrofasciatus* post-larvae compared to that of WF, MOWF, and RBMO systems.

Keywords: biofloc system, *Cyprinus rubrofasciatus*, carbon source, post-larvae

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Protocol development for the sterilization technique and germination process for the *Aponogeton natans* seeds

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Aponogeton natans, *A. crispus*, *A. rigidifolius* and *A. jacobsonii* are *Aponogeton* species native to Sri Lanka. As the industry has a high demand for these species for aqua-scaping, vegetative propagation method could not achieve the prevailing market demand. Hence it is very important to develop proper micro-propagation techniques. *A. natans* seeds were selected as ex-plant and were thoroughly washed with liquid soap and then with 70% ethanol for 1 minute. Then the seeds were washed thrice with distilled water taken as the control (C) and 8%, 10% 15% NaOCl (Clorox) solution were taken as T1, T2 and T3 respectively. Seeds which had undergone all treatments were washed for 10 minutes with Distilled water, thrice. The seeds were cultured in Murashige and Skoog (MS) medium with some modifications: without sugar (T1), 15g/L Sucrose (T2) and MS medium with no modification (T3) and sterilized distilled water (C) as the control. After selecting the best medium, Ms Medium with Different growth hormone concentrations were tested for Benzyl Adenine Purine (BAP) 1 mg/L and Indole Butyric Acid (IBA) 0.5 mg/L (T₁), BAP 2 mg/L and IBA 0.5 mg/L (T₂), BAP 3 mg/L and IBA 0.5 mg/L (T₃) and BAP 4mg/L and IBA 0.5 mg/L (T₄) were taken as the treatments and the medium without hormone used as the control (C). All the treatment had ten replicates and each treatment consisted of one seed. All the experiments conducted separately. The results showed that T2 obtained the highest survival percentage (91.0±1.0%) in sterilization experiment and it was significantly different with other treatments. When choosing the best medium T3 obtained the highest survival (78.7±0.7%) which used only MS medium. When selecting best hormone combination T2 showed the highest survival percentage of 89.3±1.2% which was significantly different among all treatments. According to the results obtained the seeds of *A. natans* gave high percentage of germination by sterilizing with 10% NaOCl for ten minutes and better growth in MS medium with 2mg/L BAP and 0.5 mg/L IBA hormone combination.

Keywords: *Aponogeton natans*, germination, micro-propagation, seed, sterilization

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Growth performance and colour development of common Goldfish (*Carassius auratus*) fed with formulated fish feed incorporated with *Artemia* biomass

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Artemia nauplii are widely used as live feed in ornamental fish hatcheries globally. However, *Artemia* biomass, at present is an underutilized feed resource having high protein levels. They are discarded after the cyst collection. The present study was planned to investigate the importance of *Artemia* biomass as a feed ingredient on growth performance and colour development of common Goldfish *Carassius auratus*. *Artemia* biomass was collected from salterns of Lanka Salt Limited, Hambantota and dried using oven at 40 °C for 2 days and after being dried, *Artemia* biomass was grounded to make powder form to use as a feed ingredient. Formulated feed was prepared to incorporate 10% (Treatment 1), 20% (Treatment 2) and 30% (Treatment 3) of *Artemia* powder, and commercially available fish feed was used as the controller. Two-month-old 3 cm sized 12 individuals of goldfish fingerlings were stocked in each 2'×1'×1' size 12 glass tanks and fed with formulated feed four times per day according to 10% of fish body weight for 30 days. Weekly taken photographs were analysed using ImageJ software to determine Red, Green and Blue (RGB) colour intensities. Fish weight, and standard length of randomly collected 6 numbers of fish were measured once a week, and data were analysed using One-Way Analysis of Variance (ANOVA). All three-treatments that used the powdered *Artemia* biomass showed a significant difference in weight gain, length gain, and specific growth rate (SGR) ($P < 0.05$) compared with the control feed. It was observed that the highest weight gain was 5.06 ± 0.18 g and the highest SGR was 3.75 ± 0.07 in Treatment 3. The highest length gain recorded in Treatment 2 was, 1.32 ± 0.14 cm. After 30 days of culture period, a significant difference of colour intensity between the three treatments and the controller ($P = 0$) was observed. The present study concluded that 30% *Artemia* biomass incorporated feed was the most suitable feed for the growth and colour development of goldfish indicating the suitability of *Artemia* biomass as a feed ingredient in the ornamental fish industry.

Keywords: *Artemia* biomass, *Carassius auratus*, colour development, growth performance, RGB values

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Easy, low-cost and rapid breeding technique for mass production of *Devario pathirana*; an endangered minor Cyprinid endemic to Sri Lanka

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Endemic endangered fish species *Devario pathirana* confines to Opatha-Rakwana area is an eye-catching top-minnow of high export demand but it is legally protected. It can earn foreign exchange through export and wild stocks can be enhanced if massive captive breeding is done. However, past studies reported it needs running water to spawn, which is costly and needs adequate space. Thus, a study was initiated in 2021 to develop an easy, rapid and low-cost breeding technique. Wild collected *D. pathirana* were successfully bred in a cement-still-water rounded out-door tank (0.9 m radius and 0.70 m height) with 85% submerged aquatic plants viz. *Valisnaria spiralis*, *Aponogeton crispus*, and *Nitella* sp. cover in 60 cm water depth neither with aeration, nor water circulation nor exchange nor removal of the parents. In breeding tank Dissolved Oxygen, water temperature, alkalinity and pH ranged from 5.8–7.5 mg/l, 19–21°C, 195–126 CaCO₃mg/l and 6.2 to 6.5 respectively. Sex ratio was 1:2 (female: male) and stoking density was 15 individuals/tank. All stages were reared in one tank. The visual observations proved that the fry, fingerlings and adults occupied respectively in *Nitella* plant, mid-column and closer to bottom indicating resource partitioning. *D. pathirana* was found as a serial spawner of 80 average fecundity but larval survival was 55%. All were fed twice a day and three different feed were given i.e. 22–25g chopped ox-heart for adults, 9–10ml of *Monia* for fry and 10–15g commercial feed for young. After three months average size was 3.0 cm with 0.28 g average body weight. Total production with five pairs was 225. The breeding environment was a replicate of their natural habitats thus they can easily be adapted into natural condition with no or little mortality. This is an easy, low-cost, simple and rapid method compared to other fish breeding methods. It supports in the wise use of threatened endemic fish species in the ornamental industry.

Keywords: captive breeding, *Devario pathirana*, endemic, outdoor still water tank, threatened

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Zootechnical performances of different carbon sources on biofloc microbial composition and effective water quality of Tilapia (*Oreochromis mossambicus*) culture systems

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Biofloc technology (BFT) promotes the growth of microbes in zero water exchange culture systems by adding adequate carbon to manage the existing nitrogen, which improves the water quality. The present study was carried out to evaluate the effectiveness of locally available different carbon sources on water quality in zero-exchange *Oreochromis mossambicus* culture systems and study the microbial composition of the most effective biofloc. Carbon treatments: Rice Bran (RB), Wheat Flour (WF), and Molasses (MOL) and the controls without a carbon source were allocated at random and duplicated in 1500 L fiberglass indoor tanks. Mixed-sex *O. mossambicus* fingerlings (3.6 ± 0.2 g) were added at a rate of 40 fishm^{-3} and fed 3% of their body weight. Except for the controls, all treatments were run with no water exchange and carbon was added at 15:1 carbon to nitrogen ratio. Dissolved Oxygen (DO), temperature and pH were monitored daily. Total Ammonia Nitrogen (TAN) was recorded once a week. One way ANOVA was used for data analysis ($P < 0.05$). Bacterial community analysis was done for the most performed RB biofloc. DNA was extracted using the DNeasy Powersoil kit. The 27F forward primer (5'-AGAGTTTGATYMTGGCTCAG-3') and 1492 R reverse primer (5'-TACCTTGTTAYGACTT-3') were used in the Polymerase Chain Reaction (PCR) (Y=C/T, M=A/C). The related bacterial community was identified by further sequencing. Treatments showed significantly low DO values (RB: $6.46 \pm 0.16 \text{ mgL}^{-1}$, WF: $5.94 \pm 0.22 \text{ mgL}^{-1}$, MOL: $6.76 \pm 0.22 \text{ mgL}^{-1}$) compared to controls ($7.38 \pm 0.15 \text{ mgL}^{-1}$), which indicated the presence of ongoing microbial metabolic processes. TAN values were lower in treatments (RB: $0.53 \pm 0.9 \text{ mgL}^{-1}$, WF: $0.62 \pm 0.13 \text{ mgL}^{-1}$, MOL: $0.40 \pm 0.07 \text{ mgL}^{-1}$) compared to controls ($1.38 \pm 0.27 \text{ mgL}^{-1}$). Proteobacteria (52.8%) was the most common bacteria phylum found in the RB sample, followed by cyanobacteria (40%). Proteobacteria have diverse metabolic pathways which help them to establish well in zero-exchange systems. Proteobacteria being the most prevalent, suggests that RB systems have better water quality control. According to the results BFT can be adapted to maintain water quality in zero-exchange Tilapia production systems.

Keywords: biofloc, molasses, rice bran, water quality, wheat flour

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Replacement of imported fish oil with locally made fish oil for economical supplementary feed formulation for Koi carp

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The study aimed to develop a nutritionally balanced cost-effective feed for Koi carp juveniles (*Cyprinus carpio*). Two trial feeds with crude protein 34% and crude lipid 7 %; diet D2 incorporated with local fish oil produced from fish offal and diet D3 incorporated with imported fish oil was prepared considering the nutritional requirements of juvenile stages of Koi carp. Imported commercial Koi carp feed JPD Yamato (Crude Protein 34 %, Crude Lipid 7%) available in the local market was used as the control feed (diet D1). A total number of 180 Koi carp juveniles of similar age and size of 0.27 ± 0.04 g (mean \pm SD) was equally and randomly distributed in nine glass tanks with a water capacity of 70 L at NARA Regional Research Center, Panapitiya. Each tank was randomly assigned with three replicates for three diets D1, D2 and D3. Fish was fed two times daily, 4% of body weight for the first six weeks (powder form) and two times daily, 3% of body weight for the second eight weeks (2 mm pellets). Weight measurements of fish in each tank were obtained biweekly to adjust the feeding ratio. The weight of total fish in each tank was measured separately at the end of the trial period and growth performance indices were evaluated. Diets D1, D2 and D3 did not show significant differences in the growth performance (final weight, weight gain and specific growth rate) of fish, the survival rates of fish and the Feed Conversion Ratio ($P > 0.05$). Estimated prices for diets D2 and D3 were LKR 224 and 265 respectively while the price of imported Koi carp feed was LKR 1400. The results indicate the possibility of use of local fish oil extracted from fish offal to manufacture cost-effective nutritionally balance formulated feeds for Koi carp juveniles.

Keywords: *Cyprinus carpio*, formulated feed, Koi carp

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Effect of garlic supplemented diet on growth performances, survival and disease resistance against *Aeromonas hydrophila* in guppy (*Poecilia reticulata*)

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This study investigates the effects of garlic incorporated commercial feed on the growth, survival and disease resistance of *Poecilia reticulata*. Three hundred (300) Guppy fingerlings with an average initial weight of 0.073 ± 0.022 g was introduced randomly into 12 fiber glass tanks (61x46x46 cm) in 4 groups, with 25 fish in each group. Garlic incorporated experimental diet was prepared incorporating 5% (Treatment 1), 10% (Treatment 2), 15% (Treatment 3) and 0% (control) of garlic powder to a commercially available fish feed. Fish were fed with each experimental diet at 5% body weight up to eight weeks and feeding levels were adjusted fortnightly, according to their mean body weight. At the end of the experiment, growth performances and survival rates were evaluated. Fish were challenged with *Aeromonas hydrophila* bacteria after eight weeks post feeding and percentage mortalities were recorded up to 10 days after post challenge and the histopathological observations were made. During the experimental period Dissolved Oxygen, Temperature and pH were monitored weekly and Ammonia, Nitrite and Nitrate were measured fortnightly. The significant highest mean Weight Gain (WG), (0.448 ± 0.042 g) was recorded in T3 whereas lowest (0.349 ± 0.029 g) in T0. The Feed Conversion Ratio (FCR) and Specific Growth Rates (SGR) were not significantly different within the treatments. Mortalities were not observed during the feeding trial, in all groups. Throughout the study, water quality parameters were within the acceptable levels for the fish growth. In the challenge study, lowest mortality rate was recorded in T3, (20%) and severe disease conditions were not observed in gut histological analysis conducted for all treatments. The best growth performance and survival rate were obtained in fish fed with 15% garlic powder incorporated diet.

Keywords: *Allium sativum*, growth performances, *Poecilia reticulata*

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An experimental culture trial to investigate growth performance of Pearl oyster, *Pinctada fucata* at sea cucumber farms in Palk Bay, Northern Province, Sri Lanka

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Akoya pearls are being extracted from pearl oyster, *Pinctada fucata* species which naturally exists in the Gulf of Mannar. At present, pearling industry of Sri Lanka is extinct due to over harvesting of pearls from natural pearl oysters. For pearl culture, culture sites should be naturally sheltered against strong waves, winds and current during monsoon period. Palk Bay was the nearby and most preferred location identified for pearl oyster ranching and sea cucumber farms were chosen concerning safety and to prevent poaching. Pearl oysters were (n=2700) collected from Silawathura, Gulf of Mannar (79°46'13.30"E, 8°41'4.23"N), 13 km from the coast and 10 m deep water. Samples were stocked in sea cucumber rearing farm in Erumaitivu (9°19'22.33"N, 80° 3'5.25"E) from November 2019 to February 2021. Nine floating rafts (1.5x1.5 m) were anchored in selected deep trenched sea cucumber farm and six plastic oyster boxes (40x30x26 cm) were tied up in each raft with triplicates (density and depth). Spats (15-30 mm dorso-ventral measurement (DVM)) and matured pearl oysters (40-58mm DVM) were separately stocked (25, 50 & 75 individuals / box) in three different depths (2,4&6 m). DVM, antero-posterior measurement (APM), Shell thickness (T) and weight (W) were collected using a manual vernier caliper and digital scale. Environmental parameters such as water temperature (29.0 ±2.5 °C), pH (7.99±0.03), Dissolved Oxygen (5.65±0.24 ppt) and Salinity (32.0±3.0 ppt). Chlorophyll concentration (1.89 mgm⁻³) and dissolved oxygen concentrations (5.89 ppt) were relatively high in months in October and November (after the Southwest monsoon period) and temperature (26.4 °C) and salinity (29 ppt) were low during the monsoon period. Average growth rate was recorded as 1.5 ± 0.8 mm/month (spat showed faster growth rate) and 20-35% mortality of spat and 15-25% mortality in adults were recorded. Significant growth (P ≤ 0.05) of spat were recorded in plastic boxes with stocking density of 25 individuals/box in 2 m depth. Palk Bay was identified as a suitable site for pearl oyster culture in Northern Province.

Keywords: culture growth, Palk bay, pearl oyster

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Effect of environmental conditioning using different aquatic plants on fecundity and hatching performance of *Barbus conchoni* (Rosy barb)

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The effect of three aquatic plants, *Cabomba caroliniana* (fanwort), *Hydrilla verticillata* (hydrilla) and *Ceratophyllum demersum* (hornwort) on the fecundity and hatching performance of *Barbus conchoni* (rosy barb) were studied under aquarium conditions. During the study 20 cm stems of each aquatic plant (n=6) were placed in breeding tanks with no enrichment for one week. Twelve breeding pairs of barb were placed in breeding tanks and allowed them to spawn. The fecundity, hatching rate and hatching time were determined. Spawning sessions were repeated at four weeks intervals until completion of three trials. The fecundity was significantly different among treatments ($P < 0.05$) while greater fecundity was observed with fanwort (196 ± 7) than hornwort (153 ± 5), Hydrilla (138 ± 4) and no enrichment (129 ± 6). But lowest hatching rate was observed with fanwort as 31% while 56%, 55% and 40% were recorded when using hornwort, Hydrilla and no enrichment. The hatching time was reduced to 48-72 hrs when using fanwort while hatching time of other treatments was recorded as 72-96 hrs. During the study, same breeding pairs were conditioned for 4 weeks in brood stock tank and same study was carried out. The results indicated that fecundity was significantly different ($P < 0.05$) and fecundity was increased as 224 ± 6 , 195 ± 8 , 162 ± 4 with fanwort, hornwort and hydrilla sequentially and total egg count was recorded as 149 ± 5 in no enrichment. Hatching rate of hornwort increased as 65% and hydrilla as 60%. But the lowest hatching rate was observed with fanwort (38%) while hatching rate in no enrichment tanks was 41%. Best hatching time was recorded in fanwort (48-72 hrs). Data indicates that under certain conditions, *Barbus conchoni* fecundity, hatching rate and hatching time were greater when brooders were conditioned with aquatic plants in broodstock and breeding tanks than in bare tanks.

Keywords: aquatic plants, *Barbus conchoni*, fecundity, hatching performance, Rosy barb

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Effect of different types of diets on the growth performances of Guppy with *Bacopa monnieri* plant in a combined system

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The recent expansion of freshwater aquaculture may require a large quantity of fresh water. The limited availability of freshwater resources has forced the rethinking of wise use of freshwater in the aquaculture sector to concern the water productivity. In this experiment, Guppy (*Poecilia reticulata*) fish combined with Lunuwila (*Bacopa monnieri*) plant creates a concept of a simple aquaponic system. A sixty-day feeding trial was conducted to investigate the effects of three commercial feeds, commercial fish feed (T1), commercial prawn feed (T2) and a 1:1 combination of fish feed and prawn feed (T3) on the growth performances of Guppy in simple floating raft aquaponic system with Lunuwila plant. Control (C1) was designed only with fish without the floating raft which was fed with the commercial fish feed same as T1. Control 2 (C2) was designed only with hydroponic components without the fish to compare the plant growth. Triplicate groups of guppy male juveniles were stocked in 12 indoor plastic crates, at a stocking density of 15 fish/tank. Fish fed using their respective diet at the rate of 5% of their body weight and growth performance was measured. Fish growth in Treatment 2 showed significantly high mean weight (0.46 ± 0.002 g); the lowest feed conversion ratio (1.21 ± 0.01), the highest feed efficiency ratio (0.83 ± 0.01) and the highest protein efficiency ratio (2.01 ± 0.02). The plant growth showed the significantly highest mean weight of plant (1.47 ± 0.02 g), the highest mean length (17.26 ± 0.63 cm), the highest number of leaves (26.00 ± 1.15) and the highest mean root length (7.43 ± 0.23 cm) in T2. Based on fish growth performance and plant growth parameters, T2 diet could take as the best diet among the treatments. Thus, the study revealed that the commercial prawn diet could be recommend for the co-cultivation of Guppy and Lunuwila plants in a simple floating raft aquaponic system.

Keywords: aquaponics system, fish feeds, growth performance, Guppy, Lunuwila plant

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Fishing efficiency of monofilament and nylon gillnets in two reservoirs in Sri Lanka

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Use of monofilament gillnets has been banned in the Sri Lankan reservoir fishery. This study was conducted in 2020 covering four monsoons in Kattakaduwa and Ridiyagama reservoirs to evaluate the fishing efficiency of monofilament and nylon gillnets for using 10 nylon gillnet pieces of two mesh sizes (8.4 cm and 12.7 cm) with 3 ply and 4 monofilament gill net pieces with the same mesh sizes. Experimental fishing trials were performed 12 hours in 33 days in parallel with the commercial fishing activities. After hauling nets, the harvested fish species were identified, and length and weight were recorded. In total, 206.41 kg of fish (52.56.2 kg and 153.85kg from nylon nets and monofilament nets respectively) was harvested. Wilcoxon test proved that there was no significant difference ($W=28807$, $p<0.05$) of fish catch per unit effort (CPUE) between nylon (1.07 kg net piece⁻¹, day⁻¹) and monofilament nets (3.24 kg net piece⁻¹ day⁻¹). CPUE for 8.4 cm mesh monofilament net was recorded as 1.55 kg net piece⁻¹ day⁻¹ while for the nylon net was 0.93 kg net piece⁻¹ day⁻¹. However, the analysis indicated that the CPUE of 12,7 cm mesh nylon gillnets (1.31 kg net piece⁻¹ day⁻¹) was significantly lower ($W=3705.5$, $p>0.05$) than that of monofilament gill nets (CPUE 3.71 kg net piece⁻¹ day⁻¹). Among the 15 fish species recorded *Labeo rohita* registered the highest catch (145.33 kg) while contributing 37.02% to the total catch. *Oreochromis sp.* (106.27 kg; 27.06%) and *Catla catla* (83.61 kg; 21.30%) also contributed to the total harvest of the experimental trials. Furthermore, 297 individuals were caught in monofilament gillnets while only 87 individuals were collected from nylon gillnets showing higher efficiency of the former. These preliminary results indicate that a comprehensive study of the impact of monofilament gillnets is needed to be carried out to make sound scientific recommendations on the gillnet fishery.

Keywords: CPUE, inland reservoirs, monofilament gill net, nylon gill net

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Aquatic Biotechnology and Animal Health



Species identification of leaping blenny fish in Southern and Western coasts, Sri Lanka

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Species identification is an integral step in fisheries management and conservation. There is a scarcity of information on the Family Blenniidae to show their presence in many parts of the tropics including the Northern Bay of Bengal. In this study, the mitochondrial COI marker was used to identify leaping blenny fish species on the Southern and Western coasts of Sri Lanka. Samples were collected from Tangalle, Matara (Pigeon Island), Unawatuna, and Ambalangoda to represent the Southern coast, and Beruwala, Panadura, and Negombo were chosen to represent the Western coastal belt. Fish samples comprising at least 30 fish were collected from each location and five randomly selected samples from each site were used for molecular biological identification. An approximately 650 bp region of the mitochondrial COI gene was amplified from the extracted DNA and was sequenced. The sequences obtained were analyzed using the BIOEDIT program and matched with barcoding data available in the National Center for Biotechnology Information (NCBI). Genetic distances and the phylogenetic relationships among species were analyzed using MEGA X software. Six species of leaping blenny fish were recorded and among them, *Alticus monochrus* was the most abundant blenny fish species that was found in the Southern and Western coastal areas. Other recorded species were *Entomacrodus striatus*, *Entomacrodus vermiculatus*, *Entomacrodus epalzeocheilos*, *Istiblennius dussumieri*, and *Alticus saliens*. *Entomacrodus vermiculatus* and *Istiblennius dussumieri* are site specific species. The phylogenetic tree showed that species belonging to the genus *Entomacrodus* were very similar to each other even though they have been found in different locations. The two specimens of *Alticus monochrus* found from different locations were very similar to each other. This study showed that though the same species are living in different locations they have not genetically diverged.

Keywords: Blenniidae, conservation, diversity, phylogenetic

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First report on *Enterocytozoon hepatopenaei* (EHP) infection in Pacific whiteleg shrimp (*Litopenaeus vannamei*) cultured in Sri Lanka

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Microsporidian parasite *Enterocytozoon hepatopenaei* (EHP) that causes Hepatopancreatic Microsporidiosis (HPM) has emerged to be one of the most important pathogens in Asia for the exotic, cultivated Pacific Whiteleg shrimp (*Litopenaeus vannamei*). This parasite replicates in the hepatopancreas and the midgut. Infected shrimp exhibit reduced feeding and growth retardation. Since February 2022, some farms in the Puttalam district that have stocked *L. vannamei* post larvae (PL) originated from imported SPF broodstock reported retarded shrimp growth and white faeces. Therefore, live shrimp were sampled from fifteen affected farms (8-10 shrimp per farm) during the period from February 2022 to June 2022 to identify the etiology. A polyphasic diagnostic approach that included direct microscopy of faecal samples (wet mounts and smears stained with modified Trichrome stain), histopathological examination of internal organs (hepatopancreas and midgut), and a nested PCR targeting SSU rRNA gene of EHP was employed. History (slow growth apparent by 35-40 days post stocking, white floating fecal strings) and external examination findings (high size variation among shrimp) were suggestive of HPM. Wet mounts and stained smears of faeces showed spores suggestive of EHP. Histopathological examination revealed degeneration and necrosis in the hepatopancreas and midgut, and microsporidian spores in the tubular epithelial cells. PCR confirmed the presence of EHP in all fifteen farms tested, severe infection in six farms and a low-level infection in the rest. Bacterial co-infection with *Vibrio* species was also detected. This is the first report that confirmed the presence of EHP infection in *L. vannamei* shrimp cultured in Sri Lanka using a polyphasic diagnostic approach. Timely control and prevention measures including screening of PLs by PCR to confirm the absence of EHP prior to stocking and appropriate pond preparation between culture cycles should therefore be implemented to limit the impacts of this disease on shrimp production in the country.

Keywords: *Enterocytozoon hepatopenaei*, *Litopenaeus vannamei*, slow growth, white feces

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Presence of Whitespot syndrome virus and Infectious Hypodermal and Haematopoietic Necrosis virus in *Litopenaeus vannamei* shrimp aquaculture in North Western Province, Sri Lanka

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Considering the international market demand, high stocking density and growth rate, non-native shrimp species *Litopenaeus vannamei* (*L. vannamei*) has been introduced to Sri Lankan shrimp culture system. Trans-boundary movement of aquatic animals, has been recognized as a facilitator of introducing infectious diseases. Routine animal health monitoring is the major tool allowing the generation of information necessary for immediate action and mitigating the disease impact. Targeting the above, 100 shrimp samples were randomly collected on a monthly basis, from grow out ponds during the period January – December, 2021 from North Western province (Madampe, Thoduwawa, Kakkapalliya, Maikkulama, Wattakkaliya, Kahawtiawatte, Iranawila, Ambakandawila, Arachchikattuwa, Bogahawatte, Pulichchikulama, Madurankuliya, Karatupane, Bangadeniya, Meeoya, Udappuwa, Welihena, Welakkanna, Medawatta, Muthupanthiya, Mundalama), where the *L. vannamei* culture industry is concentrated and checked for the presence of White Spot Syndrome Virus (WSSV) and Infectious Hypodermal Hematopoietic Necrosis Virus (IHHNV) using molecular tools. Stocking densities of the selected grow out ponds were ranged from 25–100 (mean±SD: 49.45±9.80) and stocking duration ranged from 7–105 days (mean±SD: 56.62±25.65). DNA extraction and PCR were performed using IQ 2000™ Detection and Prevention Systems for WSSV and IHHNV as per manufacturer’s instructions. Out of the 100 samples tested for each virus, our findings indicate, 6% presence for WSSV with detected level of infection as indicated in system’s instruction manual, ranging from light (1%), moderate (4%), and severe (1%), whereas for IHHNV the presence was found to be 3% with levels of infection very light (2%) and moderate (1%). All samples tested positive for IHHNV were from the Thoduwawa area. The samples tested positive for WSSV were collected from the areas, Kakkapalliya, Maikkulama, Udappuwa, Iranawila and Thoduwawa. Co-infection of WSSV and IHHNV was not detected. As the data on infectious diseases of recently introduced shrimp species is limited in Sri Lanka, this study reports the presence of WSSV and IHHNV infections in *L. vannamei* culture in Sri Lanka.

Keywords: *L. vannamei*, Presence of IHHNV, Presence of WSSV

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Identity confirmation of *Scomberomorus guttatus* using molecular tools

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Indo-Pacific King Mackerel (*Scomberomorus guttatus*), commonly called spotted seer fish and Narrow-barred Spanish Mackerel (*Scomberomorus commerson*), the common seer fish, are two very closely related species. They are epipelagic fish which are caught from most of the coastal areas around the island. They are high-value food fish favoured very much by the people of Sri Lanka. They belong to the family Scombridae, which includes mackerels, tunas and bonitos. The distinction between *S. commerson* and *S. guttatus* is mainly in the pattern on the lateral side of the body and the tip of the 1st dorsal fin. The lateral surface of the adult *S. guttatus* has several rows of dark brown or silvery grey elongated spots, while a pattern of broken vertical bands can be seen in *S. commerson*. The tip of the first dorsal fin of *S. guttatus* has a more prominent white tip than that of *S. commerson*. But these features are not very clear in the juvenile stages of the fish, and this makes it difficult to distinguish them when they are in their juvenile stages. Identification of juvenile stages is important when samples are being taken for biological studies which need specimens of all stages. Therefore, the aim of the study was to confirm the identity of specimens collected for a biological study of *S. guttatus*, using genetic identification. The DNA of the samples was extracted using a standard phenol chloroform method and a region of approximately 650 bp of the mitochondrial COI gene was amplified and sequenced. The consensus sequences were used for the identification of the species and the specimens were confirmed as *S. guttatus*. The sequences showed that the variability between the individuals is very low with almost 100% similarity seen between the individual sequences.

Keywords: mitochondrial COI, molecular analysis, morphology, *Scomberomorus guttatus*

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Preliminary study on the use of molecular and morphological characters in the identification of Asian seabass (*Lates calcarifer*) in Sri Lankan waters

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Asian seabass (*Lates calcarifer*), commonly known as “Modha” or “Baramundi” is a commercially valuable teleost fish, classified under order Perciformes. It is widely distributed in tropical and subtropical areas of the Western Pacific and Indian Oceans. Modha is a popular fish species in aquaculture and has a high demand in the export market. However, there are no previous studies that have been carried out to study the nucleotide level variation of the species in Sri Lankan waters. The objective of this study was to study the nucleotide level variation of mitochondrion *cox1* gene sequences and to establish the DNA barcodes with the record of the morphological characteristics of taxonomic importance. A total of 21 fish samples were collected from Peliyagoda Central Fish Market, Colombo, Sri Lanka in 2021 and their morphological characteristics were recorded. Individuals with significantly different range of morphology such as total length 32.0-67.0 cm, maxilla length 4.0-8.5 cm, length of 1st dorsal fin base and 2nd dorsal fin base is 5.5-14.5 and 4.5-13 cm, body depth 9-18.5 cm, pectoral fin length 4.0-8.0 cm, and pelvic fin length 2.0-4.5 cm were present in the samples collected. DNA was extracted from muscle tissue samples of the 21 individuals and PCR reactions were carried out by using mitochondrial cytochrome oxidase subunit 1 (*cox I*) gene amplification primers (Fish F1 and R1). Ten sequences, with high percentage identity, were submitted to GenBank and accession numbers were obtained (OK493567 to OK493576). All *cox I* gene sequences showed 100% similarity with no SNPs. Even though different sized individuals were collected with a range of morphological character values, there was no nucleotide variation observed among individuals. However, in future it is planned to extend the study with a higher sample size and samples being collected from culture and wild population to get a better overall picture of *Lates calcarifer* populations in Sri Lanka.

Keywords: *cox I*, DNA barcoding, *Lates calcarifer*, morphology, Sri Lanka

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A Preliminary study on the presence of *Trypanosoma* spp. and *Babesiosoma* spp. in Mozambique Tilapia captured from Daduru Oya Reservoir

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Haemoparasites are a specific group of internal parasites that inhabit in the circulatory system of the host species causing significant damage, ultimately resulting in significant reduction of overall growth and reproductive performance. Most animal species, including fish, are frequently affected by haemoparasites, particularly with protozoans. *Trypanosoma* spp. and *Babesiosoma* spp. are considered the most common and important haemoparasites in freshwater fish. Many studies demonstrated that haemoparasitism caused by above two species has a deleterious impact on the growth rate of the fish. However, there is scanty or no information found on the presence of haemoparasitic diseases among fresh water fish in Sri Lanka. Hence to overcome this caveat, this preliminary study was conducted to identify haemoparasites in cultured freshwater fish, particularly in Mozambique Tilapia (*Oreochromis mossambicus*) in Daduru Oya reservoir in Sri Lanka. A total of 35 blood samples were obtained by directly puncturing the heart or the dorsal aorta of Mozambique Tilapia from five different captured fish collecting centers around Daduru Oya Reservoir. Within a day 8 to 9 fish samples were collected and the sample collection was done during the month of April 2022. Thin blood smears were prepared and stained with Leishman's stain and were examined using the light microscope under oil immersion. This study revealed the presence of *Trypanosoma* which consists of a spindle-shaped elongated body with tapered ends, and *Babesiosoma*, with rosette-shaped meronts, in the blood samples analyzed. The *Trypanosoma* was an extracellular haemoparasite, while the *Babesiosoma* was an intra-erythrocytic haemoparasite. The presence of these haemoparasitic infestations in Mozambique Tilapia is collectively 37.14%. The presence of *Trypanosoma* and *Babesiosoma* in freshwater fish (Mozambique Tilapia) was calculated as 14.29% and 22.86%, respectively. These preliminary results indicate the presence of haemoparasitic diseases in freshwater cultured fish from Daduru Oya Reservoir and warrants future investigations on the detrimental effects of haemoparasitic diseases for the development of the inland fisheries and aquaculture sector in Sri Lanka.

Keywords: Babesiosoma, freshwater fish, haemoparasites, Mozambique tilapia, Trypanosoma

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Fisheries Socio-economics and Marketing



Assessment of vulnerability of climate change on coastal fishery of Sri Lanka and adaptation strategies

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Coastal fishermen in Sri Lanka are facing various risks due to climate change. This research attempted to evaluate the vulnerability of the coastal fishery of Sri Lanka and to develop adaptation strategies. Primary data on relevant parameters for assessing climate change social vulnerability were collected from eight fisheries districts. Two hundred fishermen were selected for face-to-face interviews by using a pre-tested structured questionnaire. In addition to that eight focus group discussions were conducted with fisheries community leaders, office bearers of fisheries organizations, and relevant officers of various government institutes relevant in developing an adaptation plan. After assessing vulnerability the adaptation plan was prepared based on the adaptation toolbox of FAO. Through the brainstorming sessions of FGDs possible options were identified for an adaptation plan and appraised those options to implement practically. Storms and cyclones, flash floods, storm surges, beach erosion, inundated lowlands, and saltwater intrusions were identified as major climate change induced hazards which have a great impact on the coastal fisheries of Sri Lanka. The identified major climate-related risks for fishermen are life risk, reduce fish harvest, damage to boats, fishing gears, landing sites and other infrastructures, increase postharvest losses, reduce the number of fishing days, and increase the cost of production. The results showed that 67% of fishermen are highly exposed to climate-change induced hazards and extreme weather events and 61% of them are sensitive to those hazards and 34% have taken measures to adopt those hazards. Both fishing gear diversity and income diversity have negatively correlated with climate change vulnerability (spearman correlation -0.512** and -0.663**). Improving predictability and effectiveness of early warning systems, organizing volunteer disaster response teams to each landing sites, providing first aid kits, life jackets and other safety equipment for the fishermen, improving skills to response adverse weather events, constructing climate-smart infrastructure and designing boats to operate safely under adverse condition and introducing alternative livelihoods are recommended adaptation measures to minimize climate change vulnerability.

Keywords: exposure and adaptation, climate change, coastal fishery, sensitivity

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Application of a community-based management approach for sustainable governance of Ja-kotu fisheries in Sri Lanka

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Community-based fisheries management has a well-established and comprehensive range of management measures that have been implemented by the indigenous communities to effectively manage fishery resources in different regions of Sri Lanka. The institutional robustness of the community-based management systems of the Kraal (Ja-kotu) fisheries in Madu Ganga, Bolgoda Lake, and Jaffna lagoon in Sri Lanka were assessed for compliance with Ostrom's modified design principles through the utilization of their knowledge in resource management. Semi-structured questionnaire was used to interview 90%, 88% and 10% of fishers from Madu Ganga, Bolgoda lake and Jaffna lagoon and focus group discussions (n=10) were conducted over one year (2020) with the view of assessing the existing traditional fishery management practices and socio-demographic information of Ja-kotu fishers. The socio-demographic profile of Ja-kotu fishers in Madu Ganga, Bolgoda Lake and Jaffna lagoons indicated that most fishers (88%, 57% and 72%, respectively) were over-40 age group, respectively, with 41%, 43% and 54% of fishers in three lagoons having over 20 years of experience in fishing. Many (57%) in Bolgoda Lake have sufficient formal education (up to General Certificate of Education: Ordinary Level). Almost all fishers interviewed, 94%, 71% and 98% of fishers in Madu Ganga, Bolgoda Lake and Jaffna lagoon, stated that the ownership of the ja-kotu fishery was passed down from generation to generation. Individual fishers voluntarily monitor fishing activities and resources, and there were strong mechanisms to share the cost among fishers in three lagoons proportionally. Though there is no proper legislation to define user boundaries for Ja-kotu fishers in all lagoons, the multi-layer institutional structure of Ja-kotu fishers in the Jaffna lagoon was comparatively strong enough to support their own decision-making process. After declaring Madu Ganga as a Ramsar wetland site, the traditional community rights and institutional structures of Ja-kotu fishers are not supported by responsible fishing management. The customary institutions reconnoitre the general weakness of key interactions with organizations, suggesting that a community may need strong institutional support to face socioeconomic, political, and institutional challenges to govern some common pool resources.

Keywords: community-based management, fisheries management, Ja-kotu fishery, local ecological knowledge, Ostrom's design principles

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Utilization of inland fish resources and achievements through the co-management concept in tropical inland reservoir fishery, Bandagiriya, Sri Lanka

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The Bandagiriya reservoir is located in the Hambanthota district which is a water-stress experienced area in the dry zone of Sri Lanka. An effective fisheries management strategy is required in terms of sustainable utilization of inland reservoir fishery sustaining economic benefits to the rural community. The reservoir fishery was monitored from January-December 2019 at a major landing site. Data on the catch, fishing efforts and fishing durations were collected from 510 fishing boats. The analysis performed using catch and efforts statistics data in landed boats. A total of 15 fish species under six families were recorded; *Oreochromis sp* contributed 51% of the total catch. The catch per unit effort (CPUE) of 12.61 kg/boat day and the highest CPUE of 23.94 kg/boat day was recorded in August and September respectively (22.34 kg/boat day), whereas the least value of CPUE was 6.82 kg/boat-day in May. The CPUE showed a significant difference ($p < 0.05$) between months, mean monthly effort of 1171.58 kg/boat days. The fishing intensity and fisher density of the reservoir recorded in 2019 were 28.93 boat day $\text{ha}^{-1}\text{yr}^{-1}$, and 26.7 fisher km^{-2} respectively. Total annual fish production intended for unit extent was 74.40 $\text{kg ha}^{-1}\text{yr}^{-1}$. The present co-management strategies are set up based on the consensus of the society members, fisheries officers, and other administrative parties. The management strategies and efforts were used based on their customary management strategies while they used limited efforts to resources utilization. The limited fishing efforts and re-stocking programs may contribute to the existing production and utilization strategy of fish resources in certainly. Considering current management, its priorities and the current state of fish production; strictly restricting entry to fishing without membership, facilitating a specific plan to sustain their livelihood with some enthusiasm. These results imply that the reservoir fishery production is at the risk in certain extent, increasing efforts would be declined production in the future.

Keywords: co-management, inland fishery, re-stoking, sustainable

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The impact of the COVID-19 pandemic on Sri Lanka's fin fish exports to its main trading partners; the United States and the European Union

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The emergence of the Covid-19 pandemic has brought up a new challenge to the global fish trade. Identification of the effects of this new challenge to the global fish trade is critical for Sri Lanka to take actions to sustain the market and manage resilience in such uncertain periods. The consequence of the Covid-19 disease outbreak on Sri Lanka's finfish exports to its key trading partners, the United States of America (USA) and the European Union, is the focus of this study (EU). The time series data for Sri Lankan fin fish exports (HS 4-digit level) to the United States and the European Union were gathered from the United Nations commodity trade (UN-COM Trade) database between January 2017 and March 2022. This study used structural break point analysis of time series data, followed by time series regression with the Covid19 impact as a dummy variable. EVIEWS statistical software version 10 was used to analyze the data. Total fin fish exports to the United States dropped by 56.5% in 2020 and 72.5% in 2021 compared to 2019. However, in the European market, Sri Lankan fish exports increased by 7% and 28% in 2020 and 2021, respectively, compared to 2019. This study discovered a structural change in finfish trade flow to the USA in April 2020. The Covid-19 dummy was statistically significant in the time series regression, with a coefficient value of (-71.93) in USA trade flow which implies that Covid-19 has a negative impact on finfish trade to the USA. However, no statistically significant impact from Covid19 was found in the case of finfish trade to the EU. However, it advised to investigate the country-specific product sensitivity at the individual product level in future research.

Keywords: Covid 19, Fin fish, fish trade, Sri Lanka, structural change

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Freshwater food fish consumption preference among people in Uva Province: A case study from Badulla and Monaragala districts, Sri Lanka

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Freshwater food fish is one of the main protein sources of the Sri Lankan community. The importance of identifying the popular fish species consumed as food by the community was understood and the present study was conducted to identify the freshwater food fish consumer preference by the community in Uva Province. A self-administered questionnaire was prepared and distributed among 1000 individuals selected randomly from Badulla and Monaragala districts. Among the various types of freshwater food fish species, *Oreochromis* sp. (76.84%) followed by *Catla catla* (35.78%) were the most preferred exotic fish species, while *Cirrhinus mrigala* (3%) was the fish with the lowest demand. Other indigenous food fish species such as *Puntius* sp., *Channa* sp., *Anabas testudineus* and *Anguilla* sp. were least considered due to their low availability in the market. Nutritional level (75%), consumption pattern (32%) and food security (17%) were the major factors regarded in freshwater fish consumption. Taste and easy access were governing factors for fish consumption. Retail shops, mobile shops and fish landing sites were the most popular, second most popular and least popular access points for freshwater fish, respectively. There was no significant difference between gender and fish preference in both districts. A positive linear relationship was found for frequency of fish purchase with monthly income and expenditure. *Oreochromis* sp. was the only fish species available throughout the year. A higher percentage of the community (77%) showed awareness of the nutritional value of freshwater fishes. There were no significant differences ($P>0.05$) between socio-demographic factors and fish consumer preferences. Both districts showed high preferences for *Oreochromis* sp. and *Catla catla*. This study reveals that *Oreochromis* sp. and *Catla catla* are the most preferred species out of 8 species by the community, and developing cultural techniques for higher productivity through the local aquaculture sector is vitally important.

Keywords: consumption preference, freshwater food fish, Nutrients, *Oreochromis* sp

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An analysis of gender roles in small-scale coastal fisheries in Negombo and Chilaw fisheries districts of Sri Lanka

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The small-scale coastal fishery is recognized as a major subsector for sustaining livelihoods in fisheries industry and it is diverse in gender roles. The objectives of this study were to identify gender roles in productive, household and community activities and to examine constraints in gender empowerment in the three aspects: active fishing, dry fish processing, and marketing. This study was conducted in Negombo and Chilaw. A socio-economic survey was conducted using semi-structured questionnaire from 60 fishing households based on non-probability, convenience sampling method. Field data were analyzed using SPSS statistical package and Harvard Analytical Framework was used for gender role analysis. Study results found that majority of fishermen (41.7%) belonged to 41-50 age category while majority of fisherwomen (35%) were belonged to 31-40 age category. Though seagoing fishing was a male-dominated activity, more than 33% of fisherwomen supported their fishing activities. Fisher women engaged in pre-harvest and post-harvest activities including net clearing (56.7%), net loading (36.7%), net mending (25%), repairing nets (40%), sorting fish (51.7%), dry fish making (31.7%) and fish selling (60%). Study results revealed that fisherwomen provided more contribution in household management including preparing meals (86.7%), cleaning (91.7%) and washing clothes (80%). Further, some important decisions were made jointly by husband and wife such as financial management (40%), education of the children (33.3%) and borrowings from financial institutions (56.7%). 51.7% of fishermen participated in fisheries community organizations while both husband and wife jointly participated in weddings (95%), funerals (90%) and religious functions (78.3%). Low fish catch, high cost of fishing gears were major issues faced by fishermen while fisherwomen faced constraints such as lack of recognition for women's work and gender discrimination in wage labour. It is recommended to concern gender roles into fisheries policies for the well-being of small-scale coastal fishing communities in Sri Lanka.

Keywords: empowerment, gender roles, small scale coastal fisheries, well-being

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Aquatic Post Harvest Technology



Microbiological quality of exported seafood in Sri Lanka

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The fisheries sector plays a vital role in Sri Lanka's social and economic status with approximately 1.3% contribution to the national Gross Domestic Production. Tuna species such as Yellowfin tuna and Bigeye tuna have the highest export demand in Sri Lanka. Seafood products such as prawns, crabs, squid, cuttlefish, lobsters, and sea cucumber are other varieties relished by the export industry. As raw fish and seafood need to meet appropriate microbial quality standards to eliminate potential health hazards before export, the current study was conducted to assess the microbiological quality of frozen/chilled raw seafood exported from 2020 to 2022. A total of 172 samples, including raw fish (n= 105), prawns (n=30), crabs (n=10), and marine molluscs (n=27) were assessed for Aerobic Plate Count (APC), *Escherichia coli*, *Vibrio cholerae*, *Vibrio parahaemolyticus*, *Salmonella* and *Listeria monocytogenes*. Microbiological analysis of the samples was done in an ISO 17025 accredited laboratory and the results obtained were compared against ICMSF standards for microbiological analysis: principals and specific application to determine microbiological quality. Out of 172 samples tested for APC, 85% of the samples resulted in $<5 \times 10^5$ CFU/g, the maximum recommended bacterial count for good quality seafood. Fourteen per cent (14%) of samples detected values between 5×10^5 - 10^6 CFU/g, and 1% of samples exceeded 10^7 CFU/g; the maximum recommended bacterial counts for marginally acceptable quality seafood. *E. coli* was detected only in 33% of samples. Out of positive *E. coli* samples, 98% of samples showed <11 MPN/g levels, the maximum recommended *E. coli* count for good quality seafood. Only 2% were between 11-500 MPN/g, and none exceeded 500 MPN/g, the maximum permissible level of *E. coli* for marginally acceptable fish and seafood. *V. parahaemolyticus* was detected in 8% of the samples out of 77 total samples tested. None of the samples was positive for *V. cholerae* (n=125), *Salmonella* (n=172) and *L. monocytogenes* (n=110). Results of the current study indicate an acceptable level of microbiological quality of fish and seafood samples exported from Sri Lanka.

Keywords: export, fish, microbiological quality, seafood

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Controlling histamine forming and spoilage bacteria on fish contacting surfaces by using selected commercial disinfectants

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The presence of bacteria on fish contacting surfaces possesses a risk of cross contamination of fish and reducing their quality. Therefore, this study was aimed to evaluate anti-microbial activity of selected commercial disinfectants used in the fish processing factories and some multiday fishing boats against *Klebsiella aerogenes*, *Morganella morganii* and *Pseudomonas* spp. which were isolated from fish contacting surfaces. *K. aerogenes* and *M. morganii* are known as high histamine formers and *Pseudomonas* spp. is considered as a spoilage bacterium although they form low amounts of histamine. A quantitative suspension test was used to assess the efficacy of selected disinfectants following an exposure time of 5 minutes at different concentrations. Disinfectants used in this study contained triclosan (A), quaternary ammonium compounds (B), hydrogen peroxide (C) and sodium hypochlorite (D) as active agents. Bacterial suspensions were prepared by transferring 18 hours of bacterial cultures into Trypticase Soy Broth (TSB) to obtain a five-hour log phase culture to achieve a microbial population of 10^6 - 10^8 CFU/mL. Cultures were transferred to tubes containing test products and kept for 5 minutes. After the exposure time, 1 mL of each challenged sample was added to 9 mL of neutralizing broth tubes and plated on Trypticase Soya Agar (TSA). Plates were incubated at 37°C for 24 hours. Product A with triclosan did not show much inhibition. Products B, C and D showed <10 CFU/mL counts for the manufacturer recommended concentrations (i.e., A-5%, B -0.1%, C-0.5% and D-5%) with a >5 log₁₀ Reduction Factor (RF). Comparison of RF of each disinfectant revealed that there is a significant difference ($p < 0.05$) between A and other disinfectants (B, C, D). The bacterial counts were increased with the decreasing concentrations of the disinfectant. According to obtained results, commercial disinfectants with quaternary ammonium compounds (20–25%), hydrogen peroxide (8-35%) and sodium hypochlorite (5-10%) can be recommended to clean fish contacting surfaces to minimize contaminations rather than cleaning with detergents alone.

Keywords: disinfectants, fishery industry, *Morganella morganii*, *Klebsiella aerogenes*, *Pseudomonas* spp.

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Evaluation of quality and shelf life of carrageenan and pectin incorporated vegan gummy candy

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Carrageenan is a type of sulfated galactan polysaccharides found in the cell walls of several red seaweed species. It was extracted from *Kappaphycus alvarezii* which was harvested in the Mannar District. Carrageenan exhibits anti-coagulant, anti-tumor, anti-thrombotic, anti-viral, and immuno-modulatory properties. Commercially available gummy candy was made up of gelatin and it is not consumed by the vegan people. Therefore, the objective of the study was to formulate carrageenan and pectin incorporated vegan gummy candy as a novel food. Carrageenan and pectin were incorporated in different ratios to produce vegan gummy candy with the proper texture and sensory properties. The two best vegan gummy candy formulas were screened by sensory analysis. The proximate, physiochemical properties, and shelf life at room temperature (30-35 °C) and refrigerated conditions (4 °C) were determined for selected candies. Results of the sensory analysis showed that candy produced from the combination of carrageenan 10 g + Pectin 5 g, water 250 mL, citric acid 0.5 g, liquid glucose 75 mL, sugar 250 g, and rose water 8.4 mL were significantly accepted by the panelists as the first choice. Pectin 10 g + Carrageenan 5 g, water 250 mL, citric acid 0.5 g, liquid glucose 75 mL, sugar 250 g, and rose water 8.4 mL were significantly accepted by the panelists as the second choice. The highly preferred vegan gummy candy has a pH of 4.18, total soluble solids of 72%, and water activity of 0.771. According to the proximate analysis pectin (10 g) added vegan gummy candy was selected as the best one because it contains lower moisture and fat content than the carrageenan (10g) added sample. Based on proximate and sensory analysis pectin (10 g) added sample was considered the best one. This study concluded that the produced vegan gummy candy could be considered as an alternative to commercially available candy by ensuring the texture and nutritional properties.

Keywords: carrageenan, pectin, sensory evaluation, shelf life, vegan gummy candy

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Seafood-based papads incorporated with *Ulva fasciata* and *Sardinella gibbosa* dried fish powder

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Papad is a popular “ready-to-fry” traditional snack in Asian cuisine and can be consumed as a direct snack or as an appetizer. The development of seafood papad as a snack, incorporating underutilized *Ulva fasciata* and *Sardinella gibbosa* to improve the nutritional composition and the sensory properties, was the expected objective of this study. Conducting a sensory evaluation on *Ulva* powder added papads (2%, 4%, 6%, 8% & 10%, w/w), 2% and 4% *Ulva* percentages were preferred in the product development. Evaluating the sensory properties, treatments for the final formulation were discovered and the wheat flour and *Ulva* powder weight combinations at 22% and 4% respectively, the particle size of the *Ulva* powder at 355 microns and the drying method mechanical-drying at 55–60°C for 15–30 min were the optimum conditions for the fish powder (4%) added seafood papads. Then proximate and physiochemical analysis (DPPH scavenging activity (DPPH %), Total Phenol Content (TPC), water holding and oil holding activities, pH, Chromameter values, texture analysis, physical and frying qualities, fatty acid profiles, and shelf-life) were analysed. The proximate results obtained for commercial, control and selected products were 12.37±0.31, 10.97±0.44, 11.68±0.21 moisture%, 17.43±0.50, 25.56±1.34, 28.63±0.68 protein%, 19.14±2.61, 10.66±0.46, 8.23±1.14, carbohydrates%, 0.75±0.10, 6.61±0.52, 7.21±0.36 free-fat (Soxhlet extraction, solvent-Petroleum ether) %, 2.90±0.18, 12.16±0.71, 10.80±0.30 total-fat%, 6.95±0.10, 5.11±0.10, 5.82±0.08 ash% and 36.91±0.27, 34.24±1.17, 37.88±1.67 crude fiber%, respectively. A significant difference (p<0.05) was observed for protein and fiber content in developed papads. DPPH % and TPC were higher in selected papad (80% methanol extraction). The unsaturated fatty acids (Oleic acid 3.00-3.50% and others) are present only in seafood papads. No microbial presence was observed after one month of storage (too few to count). Collectively, dried powders of *Ulva fasciata* and *Sardinella gibbosa* have improved the nutritional and sensory properties of both control and selected papads.

Keywords: Papads, seafood, snack, *Sardinella gibbosa*, *Ulva fasciata*

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Effect of natural preservatives on the quality and shelf life of Maldivian fish powder with *Amblygaster sirm*

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Fish has been a highly nutritious and widely available source of nourishment for people since the dawn of time. *Amblygaster sirm*, the spotted sardinella, also known as northern pilchard is a reef-associated marine species of sardinellas in the herring family. Recent interventions in the fish processing business that use natural substances based on phytochemicals are gaining traction in terms of increasing shelf life, reducing preservative use, and improving the quality and safety of fisheries products. Salting and drying is the common method that is used for fish preservation which is especially called “Maldivian fish”. Normally the Maldivian fish is made of tuna fish. The significantly preferred Maldivian fish powder treated with lemon grass has a pH of 5.39, water activity of 0.56 and Total Volatile Base-Nitrogen of 33.26. According to the proximate analysis, the Maldivian fish powder contains 57±0.014% moisture content, 5.45±0.13% ash content, 12.28±1.71% fat content and 20.29±0.71% protein content. This study concluded that the Maldivian fish powder prepared using lemongrass and fish could be a suitable treatment by ensure the quality and shelf life of the product

Keywords: *Amblygaster sirm*, Maldivian fish powder, natural preservative, shelf life

Determination of formaldehyde, TVB-N and TMA in Skipjack tuna and Indian scad caught from multiday boats in Sri Lanka

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This study was conducted for quantitative analysis of formaldehyde content, the levels of total volatile base nitrogen (TVB-N) and Trimethylamine (TMA) of Skipjack tuna (*Katsuwonus pelamis*) and Indian scad (*Decapterus russelli*) fish samples, collected from three different fisheries harbours in Sri Lanka (Mirissa, Tangalle, and Kudawella), from multiday boats. Multi-day boats normally carry out fishing for around 60 days at once, and the samples were graded based on the number of days the catch was being caught (0-20, 20-40, and 40-60 days: A, B, and C respectively). The control samples were collected from single-day boats. The formaldehyde content was observed by UV-Vis spectrophotometer, absorbance at 412 nm using Nash reagent in conjugation with Trichloroacetic acid (TCA) extraction. The TMA and TVB-N contents were analysed using steam distillation and Dyer's (1945) colorimetric method. The formaldehyde contents of fish ranged between 0.024 and 0.163 mg/kg. The values were higher in Kudawella C grade Skipjack tuna and Indian scad samples, the values were 0.157 and 0.163 mg/kg respectively. Significantly high levels of formaldehyde were detected in the samples obtained from the harbours than in the control sample (0.035 mg/kg and 0.046 mg/kg for Skipjack tuna and Indian scad respectively). The concentration of TMA in Skipjack tuna ranged from 12.69 - 15.46 mg/100g and in Indian scad ranged from 13.27-25.51 mg/100g during the 40-60 days of storage time in multiday fishing boats, while TVB-N levels over the same storage period and conditions ranged from 31.29 - 40.11 mg/100g for Skipjack tuna and 28.75 - 57.5 mg/100g for Indian scad. All the results obtained were below the acceptable formaldehyde content (5 mg/kg). According to the research findings, Skipjack tuna and Indian scad fishes stored for up to 40 days in multiday boats from these harbors were at an acceptable level in terms of the formaldehyde content and TMA and TVB-N contents.

Keywords: formaldehyde, Indian scad, Skipjack tuna, TMA, TVB-N

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Effect of drying techniques on physio chemical properties of semi refined and refined carrageenan extracted using *kappaphycus alvarezii*

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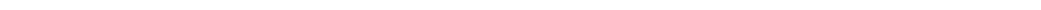
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Carrageenan is a polysaccharide derived from red algae (seaweed) with economic potential in a wide range of industries including, pharmaceuticals, food, cosmetic, printing and textile. Carrageenan is a primary extracted product of seaweed farming of *Kappaphycus* species and *Eucheuma*, accounting for more than 90% of global output. *Kappaphycus alvarezii* is the most common kappa carrageenan source. At present Carrageenan extracted from *Kappaphycus* receives a lot of attention due to its economic potential and its wide range of applications. The yield and quality of carrageenan mainly depend on extraction method. The effect of different drying techniques on the physiochemical properties of carrageenan and semi refined carrageenan which was digested with alkaline treatments were evaluated. The seaweed was dried using three types of drying methods; oven drying (temperature of 40 °C), sun drying and drying using a solar dryer. The quality of end products was analysed by determining physiochemical parameters such as yield, gel strength, viscosity, water activity and proximate composition. There is a significant difference in the yield, gel strength and viscosity of oven drying and the other two drying techniques. Semi refined and refined extracted carrageenan from solar dried method recorded, moisture: 3.70, 9.3% ash: 19,16% protein: 1.34,1.29%-, carbohydrate: 74.84, 61.19%, sulfates: 16.8, 15.35%, gel strength: 1530 g/cm² ,1811 g/cm², pH:9.69, 9.3 and yield:90.32%, 55% respectively. All the values are compatible with the European and Asian standards. The appearance was tiny light yellowish in both solar dried and sun-dried semi refined and refined carrageenan. A high protein content was observed in carrageenan in oven dryer than the other two methods. The solar dried semi refined carrageenan showed a higher gel strength, yield and other textural properties than oven drying sample. It can be concluded that most profitable and suitable drying methods for processing semi refined and refined carrageenan was drying using solar dryer and sun drying. This finding suggested that the drying techniques has an effect on physiochemical properties of carrageenan mainly.

Keywords: carrageenan, *Kappaphycus alvarezii*, oven drying, profitable, solar drying

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Oceanography and Hydrography



Hydrodynamics of Lankapatuna coastal lagoon on the East coast of Sri Lanka

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Lankapatuna coastal lagoon in Trincomalee District, Sri Lanka which is known as choked lagoon cover 13 km² water surface area, shallow with a maximum depth 2 m, widest point is approximately 2 km. Tidal fluctuation was measured manually and current velocity was measured using RCM 10 instrument during the ebb and flood at both the lagoon mouth and head. The analysis was conducted to quantify tidal amplitude, choking effect, phase lag, residence time and water exchange in the lagoon during the North East Monsoon (NEM) and First Inter Monsoon (FIM). The satellite altimetry data was used from AVISO for the analysis of sea level from 2007 to 2021 on the East coast of Sri Lanka. Verugal-aru and Uppu-aru are major freshwater feeders; Verugal-aru had a dominant flow velocity of 12.05 ms⁻¹ during NEM, whereas the Uppu-aru stream had no significant flow, which had an impact on lagoon water quality. The maximum tidal ebb and flood current flow rate were measured as 55.6-29.7 m³/s during NEM and 66.1-71.1 m³/s was during FIM. The recorded tidal range in the open sea was 60 cm while in the lagoon mouth was 14 cm and the head of the lagoon is 6 cm. The emphasized phase lag from lagoon mouth to head (6 km) is about 3-2 hr. The average residence time deviated from 4.6 to 14.3 days to overturn lagoon particles at once varying with river flux and wind. The formation of sandbars, siltation, variation of river discharge, and water exchange between the lagoon and sea, lead to an increase the residence time, choking effect and poor water quality. Therefore, it is recommended to facilitate water exchange in the lagoon for sustainable utilization of its resources through lagoon management process.

Keywords: choking effect, residence time, phase lag, water exchange

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Study of sea level variation in the East coast of Sri Lanka

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The sea level records provide unique scientific evidence to quantify the global warming impact that threatened the low-laying coastal habitats of island state countries. The astronomical forces, meteorological forces, and anthropogenic activities are foremost for the sea level variation. This abstract discusses the different frequencies of the sea level signal and their properties. The historical time series sea level data were obtained from the National Aquatics Resources Research and Development Agency (NARA), Sri Lanka under the global sea level monitoring project jointly conducted with Intergovernmental Oceanographic Commission (IOC), satellite observations were obtained from European Centre for Medium-Range weather forecasts (ECMWF), and Archiving, Validation and Interpretation of Satellite Oceanography data (AVISO) from 2007 to 2021. The analysis was conducted using MATLAB and Panoply-NASA software to determine Powers Spectral Density (SPD), harmonic constituents, de-tiding for isolation of residual, and statistical calculations. The resulted form factor (F) was 0.3614 within the range of 0.25 - 1.5 which included two high tides (56 cm) and two low tides (22 cm) per day with different strengths under the micro-tidal category in the Trincomalee port. The most dominant tidal constituents were semidiurnal lunar (M₂) 0.083 cph (30°Phr) frequency with 95% of significant level. The maximum seasonal signal was recorded from November to December while the minimum during August to September. The seasonal sea level variation in Trincomalee was between 8-22 cm. The maximum seasonal signal in the Southern and West coasts was slightly later than on the East coast and had a similar amplitude. The satellite-derived positive sea level trend was 3.05 mm/yr on the East coast and an unequally positive trend around the country. The recorded maximum extreme sea level height was less than 1 m during the last decade. The policy planners on coastal resources and disaster management need to be concerned to prevent and mitigate the vulnerability of coastal communities to ocean-based hazards.

Keywords: sea level, seasonal, sea level rise, tide, extreme height

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Development of potential fishing ground forecast for Skipjack tuna gillnet fishery of Sri Lanka

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Skipjack tuna (*Katsuwonus pelamis*) is one of the most important fish species in the Sri Lankan gillnet fishery. Skipjack tuna inhabits the epipelagic zone (shallower than ~100 m) and is associated with warm water (>28–29 °C). Understanding the oceanographic factors that affect fish distribution is essential to find out the possible fishing grounds. It is possible to use near-real-time oceanographic information from satellite remote sensing to predict potential fishing grounds of Skipjack tuna. The objectives of this study were to investigate the connection of Skipjack tuna fishing grounds with environmental factors in the Northern Indian ocean using fishery logbook data and oceanographic parameters. Skipjack tuna catches from the gillnet fishery of Sri Lanka (-2 S to 12 N, 75 E to 90 E) from the 2016-2019 period were matched with Sea Surface Temperature (SST), Sea Surface Salinity (SSS), Chlorophyll-*a* and other relevant oceanographic parameters from satellites and in-situ data from Copernicus Marine Environment Monitoring Service (CMEMS) during the study period using statistical modelling (Generalized Additive Model). The one-variable model using SSS and SST had the highest explained deviance (6.08% and 4.9%). A multi-criteria model was developed to predict potential fishing grounds using SST and SSS data from the product GLOBAL ANALYSIS FORECAST PHY 001 024 provided by the CMEMS. The model provides a 5-day fishing ground forecast. Models were developed using the R statistical program language (version 4.0.3) and ArcGIS Pro 2.9.3. The prediction model results were validated with fishermen's feedback, logbook and vessel monitoring system data. Experimental potential fishing ground advisories for skipjack tuna are produced three times a week and disseminated to fishers via WhatsApp.

Keywords: forecast, Generalized Additive Model, gillnet fishery, R, Skipjack tuna

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Determination of the wind energy potential in Mirissa, on the Southern coast of Sri Lanka, using Weibull distribution

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Sri Lanka is currently facing an unprecedented struggle to meet the daily electricity demand of roughly 2,600 MW. Therefore, as a potential solution with regards to power generation, stakeholders of the renewable energy sector have proposed a long-term policy decision to increase renewable energy generation to 70% by 2030. On this basis, we have examined wind data to assess the wind potential of one selected site in Mirissa, Sri Lanka as a renewable energy source that is commercially viable in Sri Lanka. The in-situ wind data were collected from the meteorological station at Mirissa over a period of three years, from 2019 to 2021, measured using a cup anemometer at a height of 10 m. The annual wind energy potential of the location was evaluated based on the Weibull probability density function, and the Weibull scale and the shape parameters was calculated as 3.62 ms⁻¹ and 1.60 respectively. The average wind speed and wind power density were estimated to be 3.21 ms⁻¹ and 102.20 kWh respectively. Furthermore, the analysis of the wind speeds and seasonal wind roses revealed a maximum wind power density of 376.82 kWh generated during the South West monsoon season and a wind power density of 121.40 kWh during the North East monsoon. The calculations of this study were based on the turbine type RegenVensys 82™ with a rotor diameter of 82 m, the largest rotor diameter commercially used in Sri Lanka at the present context. Based on this study, an estimated 0.39 % of the existing daily electricity demand could be generated using a single turbine. An average of 800 kWh capacity is generated by each turbine on the operational wind farms, Seguwantinu, Nirmalapura and Vidatamunai located in Mullipuram, Puttalam, along the North Western coastal belt of Sri Lanka. Furthermore, a developing wind turbine farm should be able to generate an average wind capacity of 700 kWh per turbine to be economical attractive. Therefore, we can conclude Mirissa, Sri Lanka as a potential economical detrimental area to install a wind farm based on the average wind power capacity of 102.20 kWh. Nevertheless, further assessment of the area is required to conclusively determine its prospects for wind power generation.

Keywords: electricity demand, power crisis, renewable energy, Weibull distribution, wind potential

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Assessment of Indian Ocean Dipole influence on rainfall and temperature in the Southern coast of Sri Lanka

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The Indian Ocean Dipole (IOD) plays an important role as the major climate driver in the tropical Indian ocean. IOD is defined as the Sea Surface Temperature (SST) anomaly difference between tropical West Indian ocean and tropical Southeast Indian ocean (Saji et al., 1999). This forms around June and reaches the peak in October, then starts to fade (Saji et al., 1999). Sri Lanka is experiencing a significant change in precipitation and atmospheric temperature with the influence of IOD. The high resolution in-situ time series data of rainfall and atmospheric temperature in 2019 was obtained from Mirissa meteorological station and the monthly Dipole Mode Index (DMI) was used from National Oceanic and Atmospheric Administration (NOAA). The regression and co-relation analysis were conducted to determine the relation between DMI and rainfall/temperature. Month lead analysis reveals that the significance between the IOD phase and the rainfall is prominent ($r=0.7420$) two months after the IOD phase occurs. Hence current IOD state will affect rainfall of Southern coast of Sri Lanka after two months. At the same time atmospheric temperature shows prominent ($r = 0.7500$) significance with the IOD phase after three months. Hence current IOD state will affect temperature of Southern coast of Sri Lanka three months later. The last quarter of 2018 and 2019 were indicated positive IOD. The IOD peak recorded in October 2019 was synchronized with the signal of rainfall recorded during December 2019. According to the outcomes of the positive IOD peak in October 2018, the coldest monthly temperature (26.35°C) was observed in January 2019. IOD shows positive (negative) relation with cumulative monthly rainfall (temperature), hence rainfall increases (decreases) during positive IOD (negative IOD), and the temperature increases (decreases) with negative IOD (positive IOD). The results of this study can be used to improve productivity in agriculture, tourism, disaster prevention, mitigation, and rainfall forecasting.

Keywords: atmospheric temperature, IOD, month lead analysis, rainfall

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Seasonal variability of sea surface temperature from 2003 to 2021 in the Exclusive Economic Zone of Sri Lanka

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The climate of Sri Lanka is mostly dominated by regional scale wind regimes belonging to the Indian ocean monsoon system. Thus, four major climatic seasons can be identified as the First inter-monsoon (1st-IM) (March-April), Southwest monsoon (SWM) (May-September), Second inter-monsoon (2nd-IM) (October-November) and Northeast monsoon (NEM) (December-February). Sea Surface Temperature (SST) is also considered a strong climate change indicator. This study investigates the spatial variation of SST in the Exclusive Economic Zone (EEZ) around Sri Lanka during these four climate seasons by sub-dividing the EEZ into five “Sea Regions (SR)” as Northern, Eastern, South-eastern, Southwestern and Western based on the boundaries of climate zones on land and monsoon patterns. Four satellite images per month were collected every year from 2003 to 2021, using Moderate Resolution Imaging Spectroradiometer (MODIS)-Aqua and Terra Level-2 11 μ m daytime SST data. Geocode attachment and reprojection of the MODIS dataset were done using SeaDAS 7.5.3. ArcGIS 10.8 was then used for image processing and data extraction. Results show that, during NEM, Eastern SR, from all other SRs records the minimum average SST value ($25.87\pm 0.26^{\circ}\text{C}$) for the past 19-year period. The minimum average SST ($25.10\pm 0.25^{\circ}\text{C}$) during the SWM has been recorded in the Southwestern SR. During the 1st IM period, South-eastern SR has recorded the minimum SST value ($27.88\pm 0.16^{\circ}\text{C}$) while the minimum average SST value ($25.84\pm 0.32^{\circ}\text{C}$) during the 2nd IM period is also observed in the Southwestern SR. However, throughout the year, with related to all four monsoon seasons, the North-western SR shows the maximum average SST ($26.98 \pm 0.22^{\circ}\text{C}$ in NEM, $26.67\pm 0.14^{\circ}\text{C}$ in SWM, $28.82\pm 0.29^{\circ}\text{C}$ in 1st-IM and $26.88\pm 0.36^{\circ}\text{C}$ in 2nd-IM). From 2003 to 2021, the average SST was maximum ($27.38\pm 0.15^{\circ}\text{C}$) in the North-western SR and minimum ($26.34\pm 0.92^{\circ}\text{C}$) in the Southwestern SR. These variations of SST could be mostly associated with monsoon winds, upwelling and circulation in the Indian ocean.

Keywords: MODIS, monsoons, remote sensing, sea surface temperature

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Prospecting potential offshore sand resources as an alternative sand, Weligama, Sri Lanka

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Sand is considered one of the main raw materials in the construction industry. In addition, it is also being used as a filling material in land reclamation and beach nourishment projects. However, due to rapid escalation in the construction industry and other development projects, the demand for river sand has grown enormously resulting in a shortage of supply. Depletion of river sand due to over consumption has indirectly created numerous environmental problems. Therefore, offshore sand is currently utilized as an alternative to river sand. This project was aimed to study the offshore area of Weligama (~32 km²) as a potential source of construction sand. The approximate depth of the site was 10-30 m while the distance from the coastline was 2.5 - 6 km. The survey was planned to assess major three components namely grain size characterization, sediment thickness and sediment properties of the study area. A total number of 25 grab samples were analysed for grain size following Folk and Ward classifications (1957). The median (D₅₀) was 3.5 to 0.12 ϕ and the majority of the samples were moderately sorted (S.D 0.64-1 ϕ). The heavy mineral content varied from 0.12 to 0.3% by weight and two minerals; Ilmenite and Garnet were identified through microscopic examination. The average chloride percentage was comparatively high (2.6%) by the weight of the sand while the recommended range is 0.075%. However, appropriate remedies could be accommodated to reduce the chloride content. Sub-bottom profiler was used to determine the sediment thickness. The average thickness of the sediment varied from 0.5 - 2.5 m while the total estimated sand volume was 24 Mm³. Despite some locations with excessive shell and coral fragments, the site is suitable for excavation for construction sand in terms of sand properties and volume.

Keywords: grain Size, offshore sand, sediment thickness

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Ocean acidification in the Bay of Bengal

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Increased atmospheric CO₂ proportionately enhances ocean acidification. The global averaged ocean pH is 8.1 and its change is -0.0181 ± 0.0001 decade⁻¹, while pH level reduction rate in the Bay of Bengal (BoB) is reported as around 0.08 per year. Ocean acidification in the BoB exert potential impact on its biodiversity and ecosystem functioning, in turn fisheries resources. The study was aimed at assessing the decadal changes in the pH level of the BoB by comparing measurements from repetitive sampling locations, occupied by the “R/V Roger Revelle” in late April 2007 and “R/V Dr. Fridtjof Nansen” in July 2018 respectively. pH, temperature, salinity and dissolved oxygen data were subjected to process using MATLAB software and contour maps were prepared in order to identify the ocean acidity and contributing factors for it. During the survey in 2007, the pH was in the range of 7.42 to 8.12, while an elevated range recorded during 2018 (7.46 to 8.26). In both surveys, surface layers were more basic and gradually acidified with depth. The variation in the pH range could be attributed the seasonal variation, where the former survey was conducted during the first Inter Monsoon, when the water mixing is limited and stratification is stronger. Higher pH and low salinity values in the upper 200 m water column in both surveys seems to be associated with relatively high river influx into the BoB from Bramaputras and Ganges. The later survey (2018) was conducted during the peak Southwest Monsoon (SWM), when the SWM Current is established steady to transport the more basic water from Arabian sea and upwelling water into the BoB and the riverine discharge into the BoB is reduced. It implies that the intra seasonal pH change in BoB is stronger than the impact on the pH due to climate change.

Keywords: acidification, Bay of Bengal, cruise data, Indian ocean, monsoon

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Variability of grain-size distribution, beach slope and wave action on the sandy beaches of Western coast of Sri Lanka

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On sandy beaches, the coastal erosion and sediment transport processes are greatly influenced by the wave action and sediment grain size distribution. This study involved a thorough investigation of beach sediment samples on the swash zone and berm crest along the coastal stretch between Beruwela and Chilaw in the Western coast of Sri Lanka. Moreover, the impacts of this intense reclamation, mega sand mining, and interventions on the prevailing sandy beaches were poorly known. The variability of grain-size distributions, beach slopes, and their connection to wave dissipation was assessed in order to fully grasp the implications. Altogether 60 beach samples were collected during two surveys conducted in October 2021 (summer profile) and March 2022 (winter profile). The study contrasts the median grain size values (D50) of beach samples, beach slopes and near-shore wave power. The corresponding wave power (KW/m) at 15 m depth was determined using SWAN based wave transformation model. In comparison to the winter profile, the beach slopes of the summer profile is narrower, steeper, and coarser in D50. In most of the transects, D50 values of the swash zone are coarser than the corresponding berm crest values. Indicating that the sand is coarser in the South than the North of Colombo, D50 values for the coastal stretches of Beruwela-Colombo and Colombo-Chilaw are, respectively, 0.8 to 1.6 mm (coarse-very coarse) and 0.2 to 0.8 mm (medium-coarse). This feature is found to be associated with the spatial variance of wave energy in the western coast of Sri Lanka. Consequently, the outcomes of this grain size distribution can be used to evaluate coastal morpho dynamics and the potential effects of intervention on the coastal environment.

Keywords: beach slopes, berm crest, grain-size, swash zone, wave power

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GIS and Remote Sensing Applications for the Aquatic Environment

Shoreline changes of sea turtle nesting beaches along the Southern coast of Sri Lanka

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Out of seven species of sea turtles in the world, Hawksbill (*Eretmochelys imbricate*), Olive Ridley (*Lepidochelys olivacea*), Green Turtle (*Chelonia mydas*), Loggerhead (*Caretta caretta*), and Leatherback (*Dermochelys coriacea*) are nesting in different beaches along the Southern coast of Sri Lanka. The characteristics of the shoreline determine the nesting behaviour of sea turtles. Therefore, the study focused on the estimation of shoreline changes at nine selected turtle nesting beaches for a period of 17 years from 2005 to 2021. Sentinel-2 high resolution satellite images were used to study the changes in shoreline using GIS (Geographic Information System) and remote sensing techniques. Digital Shoreline Analysis System (DSAS) in ArcGIS was applied to calculate the rate of shoreline change. Ground-truthing was conducted by field observations and drone images from a 48MP inbuilt camera of DJI Mavic Mini over 20 m from the ground for the year 2022. The results revealed that the average coastal erosion rates as $-1.34 \pm 0.36 \text{ m yr}^{-1}$ in Palatupana (2005-2021), $-0.05 \pm 0.21 \text{ m yr}^{-1}$ in Ussangoda (2009-2021), $-0.41 \pm 0.95 \text{ m yr}^{-1}$ in Rekawa (2006-2020), $-0.20 \pm 0.19 \text{ m yr}^{-1}$ in Mirissa (2010-2021), $-1.98 \pm 0.35 \text{ m yr}^{-1}$ in Bundala (2009-2021) and $-0.78 \pm 0.54 \text{ m yr}^{-1}$ in Kosgoda (2005-2021). Average coastal accretion rates were recorded as $2.82 \pm 2.23 \text{ m yr}^{-1}$ in Godawaya (2005-2020), $0.66 \pm 0.85 \text{ m yr}^{-1}$ in Kalametiya (2009-2021) and $0.39 \pm 0.73 \text{ m yr}^{-1}$ in Habaraduwa (2011-2021). Bundala had the highest average erosion rate while Godawaya had the highest average accretion rate. Therefore, sea turtle nesting habits in Palatupana, Ussangoda, Rekawa, Mirissa, Kosgoda, and Bundala coastal areas could be negatively affected by erosion. Godawaya, Kalametiya, and Habaraduwa coastal areas could be positively affected by accretion.

Keywords: accretion, erosion, GIS, sea turtles, turtle nesting

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Analysis of the impact of built environment growth in coastal zone – a case study in West coast of Sri Lanka

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Coastal ecosystems are naturally evolved to maintain environmental sustainability with the support of mangroves, swamps, sand bars and coastal vegetation. However, the spread of built environment over the natural environment has caused destruction of such ecosystems and environmental degradation thereafter. In order to achieve sustainable development in the coastal zone, the resources in coastal areas should be carefully managed, while conserving the environment in the best way possible along the 1,700 km coastline of Sri Lanka. Identifying the impacts of shoreline constructions and impacts of built area growth are the main objectives of this study. A 30 km long coastal stretch from Moratuwa to Kalutara with a landward width of 1 km was chosen as the study area. Coastline variations over the period between 2004 and 2021 were analyzed using satellite imagery available on Google Earth in order to find the impacts of shoreline constructions. Digitized shorelines were exported to ArcGIS and analyzed shore area variations to identify the contribution of revetments, groynes and breakwaters towards coastline stability. In order to analyze the built area growth of the study area, supervised classification was performed using ‘maximum likelihood’ technique in ArcGIS on georeferenced images extracted from Google Earth from 2004 and 2021. The analyses found significant growth in both features; installment of shoreline structures and built area development within the considered coastal area. It was noted that shoreline constructions have increased the shore area and stabilized the coast in many places. With respect to built-up area analysis, it was noted that the least urbanized areas have a natural coastline while the coastlines in densely built-up areas have been heavily engineered by shoreline structures. The analyses showed that the natural character of the coastline is under threat of disappearing due to the growth of the built environment.

Keywords: built environment, coastal zone, GIS, shoreline structures

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Application of multi-criterion GIS model for the zonation of Puttalam Lagoon for oyster culturing

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Oyster beds located in intertidal waters serve as an important economic resource to the coastal communities and provide many essential functions to the coastal environment. Anthropogenic factors such as coastal development and associated waterway usage significantly alter the size and health of oysters. The study was conducted with the aim of identifying the most suitable areas for oyster culturing, brood stock growing and depuration for effective conservation and management of oyster beds in Puttalam lagoon. A multi-criterion site suitability model was developed using the Geographic Information System (GIS) including environmental and physical parameters such as water quality including microbiological (Total coliforms, Faecal coliforms, *Escherichia coli* (*E.coli*), *Salmonella*, *V. cholerae*, *V. parahaemolyticus*), physio chemical parameters (pH, salinity, temperature) and heavy metals (Mercury (Hg), Cadmium (Cd), Lead (Pb)). Sediment, depth, existing oyster beds, access to the road and canal outlets (from urban and aquaculture ponds) was also considered for the study. Eight sampling locations were selected for the microbiological and heavy metal analysis and twenty locations for physio chemical parameters. Monthly samples were taken for microbiological and physicochemical parameters and quarterly for heavy metal analysis for two years i.e., 2017 and 2018. Weighted Overlay Analysis (WOA) was performed by overlaying classified layers of all considered parameters stated above. During WOA, a weight was assigned for each individual parameter as obtained by Analytical Hierarchy Process (AHP) technique. Suitability classes were categorized as most suitable, moderately suitable and not suitable. The analysis showed that 81 hectares in the Northern part of Puttalam Lagoon are covered by oyster beds. Out of which 9.7 sq.km is the most suitable area for brood stock growing while 17.4 sq.km and 12.5 sq. km are for oyster farming/culturing and depuration respectively.

Keywords: GIS, oyster culturing, Puttalam lagoon, site suitability, multi-criterion

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Seagrass habitat mapping in Dikwella coastal waters of Sri Lanka based on Drone (UAV) techniques

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Unmanned Aerial Vehicles (UAVs) are increasingly being used to accurately map and monitor marine shallow-water habitats as an alternative to more expensive and time-consuming traditional approaches. Seagrass beds are among the world's most diverse landscape structures of shallow-water estuarine/marine environments and play a significant role in carbon sinking. Therefore, a study was designed to accurately map selected seagrass beds in Dikwella coastal water (5.959082091977045, 80.68556006622465) in the Southern coast of Sri Lanka. A DJI Mavic air 2 drone consisting of a 48 MP camera and a 1/2-inch CMOS sensor was used for image capturing. Surveys were conducted in the early morning and late afternoon to lessen the glare and sparkle's impact on the photographs. Litchi Mobile app version 2.14.0 was used for GPS path creation for image capturing. As drone settings of the image capturing mission, height, image taking interval, curvature, and speed were set to 20 m, 1.5 s, 0°, and 5 ms⁻¹, respectively. Image overlapping percentage was considered when determining drone flying speed and the image capturing interval. In this study, a 70% image overlapping level was maintained. The Drone pictures were pre-processed to create the orthomosaic map. To acquire the optimum underwater habitat extraction, image categorization was performed in ArcMap 10.8 using the extract by value tool. Hundred GPS points were acquired for ground truthing and accuracy testing. The results showed that Extract classification offered 96% overall accuracy and 87.95% kappa accuracy. Based on the results, the seagrass coverage in the total study region was 1.99%, and it was estimated as 273.96 m², with respect to the total ground area of 13745 m². *Halodule pinifolia* was the most abundant seagrass species at the selected location. According to the low seagrass concentration, proper protection and conservation measures are highly recommended.

Keywords: aerial photography, benthic surveys, conservation, seagrass

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Mapping aquaculture potential areas in flood-prone areas of Nilwala river basin in Matara, Sri Lanka

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The present study was aimed at identifying aquaculture potential in flood-prone areas of the Nilwala river basin in Sri Lanka. The five most flooded DS divisions of the Matara district; Thihagoda, Malimbada, Athuraliya, Matara, and Kamburupitiya were focused for the study. Land use maps of Matara DS division produced by the Department of survey Sri Lanka in 2016 and Inundation area maps of Nilwala Ganga basin were produced for the flood that occurred in May 2017 by the Department of Irrigation Sri Lanka were overlaid to create new digital maps for aquaculture potential areas in flood-prone areas of Nilwala River basin. Aquaculture potential concerning land use patterns was calculated employing Arc GIS 10.2 software. The study identified the highest aquaculture potential areas in the Matara DS division (9.64 km²) followed by Thihagoda (6.25 km²), Athuraliya (2.13 km²), Malimbada (2.08 km²), and Kamburupitiya (1.53 km²) respectively. The total area with aquaculture potential in the study site was 21.63 km² representing about 22% of the total flooded area in five DS divisions. The highest aquaculture potential areas were in abandoned paddy lands (10.52 km²) followed by marshlands (7.38 km²), rivers & canals (2.6 km²), and minor reservoirs (0.59 km²). A total of 3.92 km² of marshy land in the Matara DS division, 5.06 km² of abandoned paddy lands in the Thihagoda DS division, 0.42 km² of minor reservoirs in the Kamburupitiya DS division, and 1.0 km² of rivers and canals in the Thihagoda DS division were identified high aquaculture potential areas. Present findings will help decision-makers and fish farmers sustainably use the unutilized resources and overcome the challenges in fish farming in flood-prone areas of the Nilwala river basin, Sri Lanka.

Keywords: aquaculture, flood-prone, GIS, Nilwala river basin

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**Aquatic Environment
Conservation, Management
and
Climate Change**

Assessment of heavy metal pollution in upper and lower catchments of Kelani River basin, Sri Lanka

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Kelani River is the second largest watershed in Sri Lanka and the major water source for Colombo District which is the most industrialized city in the country. Kelani River is deteriorated in many ways and also could be polluted with heavy metals that can bioaccumulate through food webs and cause chronic toxicity to humans and other organisms. Therefore, the present study was conducted to determine the heavy metal pollution of Kelani River by determining the heavy metal concentration in the upper and lower catchments. Sampling was carried out in 26 locations of the both catchments, and sample was collected once in three months for a duration of one year, from May 2019 to May 2020. The locations were selected based on industrial discharge, anthropogenic activities, catchment characteristics and land use practices. The collected samples were analysed using Inductive coupled plasma mass spectrometry. Heavy metals, such as Aluminium (Al), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg) and Zinc (Zn) were selected for the study as they are most important pollutants which effect aquatic environment and fish. According to the results, only the metals of Al and Zn were detected and other metals were below the lowest detection limit of Cd-0.001 mg/L, Cr, Cu, Pd - 0.01 mg/L, Hg-0.0005 mg/L. Also, Cd, Cr, Cu, Pb, Hg, and Zn were within the stipulated drinking water standards (Central Environmental Authority, 2019) in both catchments. Level of Al was exceeded the recommended limit in some locations. The heavy metals in the surface water of the upper river basin varied between Al, 0.01-0.5 mg/L, and Zn, 0.02-0.04 mg/L, and lower river basin Al, 0.02-2.56 mg/L, and Zn, 0.03-0.05 mg/L. Maximum Al concentration was detected as 2.56 mg/L in adjacent to Ambathale area in the lower catchment and the value exceeded the recommended limit of 0.2 mg/L. The elevated concentrations of Al and Zn in the lower regions of the river including the demolition of the natural balance of the Al in Ambathale area possibly could due to the industrialized activities. Therefore, this study provides the valuable information to take immediate actions to protect Kelani river basin from heavy metal pollution and strongly expresses the necessity of establishing strategic plans to limit the sources of heavy metals in lower region of Kelani river basin.

Keywords: aluminium, heavy metal pollution, Kelani river basin, surface water

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Accumulation of heavy metals and polyaromatic hydrocarbons in water, sediment and fish in Bolgoda Lake, Sri Lanka

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Bolgoda Lake is an important wetland ecosystem with high biodiversity and socio-economic value including fisheries. However, the lake has been increasingly polluted with contaminants from industrial, automobile, and domestic sources of waste since the recent past. Heavy metals and polyaromatic hydrocarbons (PAHs) have been used extensively to determine the urban pollution impacts on the aquatic environment. Consuming contaminated fish may cause serious health risks in the local community. Therefore, this study focused on assessing the accumulation of heavy metal (loid)s and PAHs in selected food fish species, water and sediment of this aquatic ecosystem. Total of 07 heavy metals (As, Cd, Cr, Cu, Hg, Pb, and Zn) and 16 PAHs designated as 'priority pollutants' by United States Environmental Protection Agency (USEPA) were analysed for two edible fish species *Mystus gullio* and *Mugil cephalus* (n=30), water and sediment samples from 05 sampling locations for three months period in south-west monsoon in 2018. The metal (loid) levels were analysed using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and PAHs were analysed using Gas Chromatography–Mass Spectrometry (GC-MS). According to the results, none of the PAHs were detected in analysed water (Limits of Quantitation, LOQ<0.001 mg/L), sediment (LOQ<0.001 mg/kg) and fish tissue (LOQ<0.001 mg/kg) samples. Zn (mean±SD: 0.55±0.96 mg/L) and Cu (0.04±0.03 mg/L) were detected in 40% of the analyzed water samples and mean levels were within the standard limits according to Ambient Water Quality Regulations, No. 01 of 2019 for aquatic life. However, As (LOQ <0.02 mg/L), Cd (<0.005 mg/L), Cr (<0.01 mg/L), Pb (<0.04 mg/L) and Hg (<0.001 mg/L) were not detected in any of these analyzed water samples. Metal (loid)s namely Cr (15.0±6.5), Cu (7.5±4.8), Pb (8.3±4.5) and Zn (29.9±18.1) mg/kg were detected in sediment samples and the current levels were found to be less than that of the previous studies conducted in 2007 and 2013 in Bolgoda Lake. Hg (0.12±0.05), Cu (1.38±0.60), and Zn (34.17±57.40) mg/kg were detected in fish tissues and was below than both the maximum standard limits defined by European Union No. 1881/2006 and fish product export regulation No.1528/7, 2007. Overall results of the study revealed that although Bolgoda Lake was subjected to heavy metal pollution, the level of contamination in food fish, water and sediment had not yet been reached to a harmful level for aquatic organisms and human consumption. Maintenance of relevant quality standards of effluent water released into the lake and continuous investigations on metal pollution could possibly protect this sensitive aquatic ecosystem from further degradation.

Keywords: heavy metals, polyaromatic hydrocarbons, Bolgoda Lake

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Present status of pollution based on water quality in Kudawella and Puranawella fishery harbours, Southern coast of Sri Lanka

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The impact of fishery harbours on food and economic security is significant and pollution of them can cause environmental damage and harm to public health. However, limited studies have been carried out to assess the pollution status of fishery harbours in Sri Lanka. Therefore, this study investigated the severity of pollution levels in Kudawella and Puranawella fishery harbours in relation to water quality and suggests possible pollution control measures to prevent water pollution in harbours. Physio-chemical parameters and biological parameters including microbial contamination and plankton composition were examined from seven sampling locations in each harbour from January 2020 to December 2021 and analysis was performed using standard methods prescribed for seawater analysis (Strickland and Parson, 1968) and APHA, 2012. Results revealed that the mean pH, Electrical Conductivity, and Salinity were within the standard limits for harbour waters. However, mean Biological Oxygen Demand (8.1 ± 4.5 ; 5.4 ± 1.1 mg/L), Chemical Oxygen Demand (926.8 ± 92.8 ; 720.1 ± 162.5 mg/L), and Oil & Grease (16.7 ± 4.8 ; 11.1 ± 0.9 mg/L) in two harbours were over the environmental quality standard values prescribed by Central Environmental Authority of Sri Lanka. Microbiological studies revealed that both harbours were contaminated with fecal coliform and *E-coli*. In addition, *Tropidoneis* sp, *Pleurosigma* sp, *Protoperidium* sp., *Chaetoceros* sp, *Thalassiosira* sp., *Actinoptylus* sp., *Chaetoceros* sp., *Coscinodiscus* sp., *Fragilaria* sp. *Navicula* sp. were identified as the most abundant phytoplankton species within the two harbours. Kudawella fishery harbour subjected to higher chemical, oil, and microbial pollution than the Puranawella fishery harbour. PET bottles and poly sac bags pose a serious threat to Kudawella harbour and fibers from damaged boats may cause severe problems for both harbours. Therefore, long-term monitoring is essential to evaluate the pollution status of these fishery harbours and public awareness on wastewater treatment and improved sanitation facilities are essential to maintain the harbour environment properly.

Keywords: fishery harbour, Kudawella, pollution, Puranawella, water quality

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Analysis of heavy metal accumulation of water, sediment, and selected food fish species of brush park fishery in Negombo estuary, Sri Lanka

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Heavy metal contamination mainly due to anthropogenic activities in aquatic ecosystems has become an emerging environmental issue and impact on bio-accumulation specially in marine, brackish water, and freshwater bodies. The brush park is a manmade semi-encloser environment which is one of the important fishing methods and significantly contributed to the yields in the Negombo estuary. This study was carried out to assess the concentration of As, Fe, Cu, Cd, Pb, and Hg in the water and sediment in selected locations peripheral to the brush park fishery area. The muscle tissues of six selected food fish species of *Scylla serrata* (Mud crab), *Liza parsia* (Gold spotted mullet), *Karalla dussumieri* (Dussumier's ponyfish), *Eetroplus suratensis* (Pearlspot), *Caranx sexfasciatus* (Bigeye trevally), and *Lutjanus russellii* (Russell's snapper) from selected one brush park fishery in Negombo estuary were also analyzed for the heavy metals. The heavy metal assessment was carried out by using the Inductively Coupled Plasma-Mass Spectrophotometry with microwave-assisted digestion, and metal concentration were expressed as a mg/kg in wet weight basis. The mean concentration ($\mu\text{g/L}$) of As, Cu, Fe and Pb in water were 3.71 ± 1.87 , 14.42 ± 6.99 , $9,047.67 \pm 4077.96$, and 4.78 ± 2.34 respectively. Cd and Hg were not detected. In sediments, the average concentrations (mg.kg^{-1} - dry weight basis) of As, Cu, Fe, Cd, Hg, and Pb were 6.25 ± 4.02 , 3.98 ± 2.61 , $15,043.50 \pm 10,779.90$, 0.02 ± 0.01 , 0.01 ± 0.01 , and 2.04 ± 1.20 respectively. *E. suratensis* was shown the highest concentration of heavy metal for As, Fe, Cu, Cd, Hg, and Pb as 10.79 ± 1.56 , 171.33 ± 20.50 , 0.46 ± 0.11 , ND, 0.16 ± 0.01 and 0.05 ± 0.01 (mg.kg^{-1} - dry weight basis) respectively and fish species order lowest to highest were followed as *C. sexfasciatus* < *S. serrata* < *K. dussumieri* < *L. russellii* < *L. parsia* < *E. suratensis*. According to the results, the concentration of six heavy metals in fish tissue were lowest to highest indicated as Cd < Pb < Hg < Cu < As < Fe. Most of the metal levels in water were not beyond the maximum tolerable limits given by the Central Environmental Authority of Sri Lanka, and *S. serrata* has exceeded the tolerable limits provided by European Commission No. 1881/2006. However, the findings urge for continuous monitoring and management of polluted effluent discharge into the productive estuarine ecosystems.

Keywords: brush park fishery, heavy metals, Negombo estuary, sediments

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Present Status of mangroves and sea grasses in the upper Western border of Puttalam Lagoon, Sri Lanka

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A study was conducted in 2021 to gather baseline information on species composition, density and diversity of mangrove and seagrass ecosystems and structural parameters of mangroves in the upper Western border of the Puttalam Lagoon, which is a potential area for coastal development. Belt transect method was employed to measure the diameter at breast height (DBH), height, density and diversity of mangroves. Seagrass coverage was obtained at four sampling stations (Uchchimunai, Bottuwadiya, Kirimudal and Mohottuwaram) where 50 m transects were deployed perpendicular to the shore and two quadrat samples were obtained haphazardly within every 5 m distance from the both sides of the transects. Seven true mangrove species belonging to five families were identified during the survey. Additionally, the Important Value Index (IVI) indicated that *Rhizophora mucronata* IVI=136.60 and *Ceriops tagal* IVI=130.63 were structurally most important. *Thespesia populnea* and *Phoenix* sp. were the most abundant mangrove associates. Also, the results revealed that mangroves were dominated by small sized trees, showing 70% of them with thin stems (<10.0 cm) and 54% of height of the mangroves were <1.0 m; hence the structural complexity of the forest (CI=0.16) was low. The calculated values for Shannon diversity index, evenness and dominance were 1.22, 1.01 and 0.57 respectively. These values depicted that the mangrove forests were dominated by few major species; coincided with low species diversity. The seagrass coverage of the study area was *Oceana serrulata* (13.92%), *Cymodocea rotundata* (12.93%), *Enhalus acoroides* (9.22%), *Halodule uninervis* (2.08%), *Thalassia hemprichii* (11.68%), *Halophila decipiens* (0.07%) and *Halophila ovalis* (0.16%). The estimated values for Shannon diversity index ranged from 1.03 to 1.45 and evenness ranged from 0.64 to 0.81. This study revealed that the area is an ecologically important and effective plans are essential to conserve the seagrass and mangrove ecosystems while considering future developments.

Keywords: diversity, mangroves, Puttalam Lagoon, seagrass, species coverage

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Community structures, above ground biomass and blue carbon stocks assessment of mangrove species in tropical mangrove forest, Panama Lagoon, Sri Lanka

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Mangrove ecosystems can be considered as pools of carbon stocks as a result of sequestering, carbon stored in biomass and underlying sediments. This study assessed species diversity, community structures, and blue carbon potential and carbon dioxide equivalent in a tropical mangrove forest, Panama lagoon, Sri Lanka. The line transect method was systematically used perpendicular to the shoreline from the water margin to landwards. The survey was conducted in 24 field plots (10 m × 10 m) of 8 transects that were placed in the forest strata randomly. A total of 2100 trees representing 9 true mangrove species under 6 families from a total transect area of 0.24 ha, *Rhizophora mucronata*, *R. apiculata*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *B. sexangula*, *Acanthus illicifolius*, *Exoecaria agallocha*, *Pemphis acidula*, *Lumnitzera racemosa* were recorded. The *Avicennia marina* was the dominant species followed by the *R. mucronata*. The highest plant density of 4096 trees ha⁻¹ was recorded by *R. mucronata* followed by *A. marina* of 2646 trees ha⁻¹ and the lowest density was recorded by *B. gymnorrhiza* (145.83 trees ha⁻¹). The highest basal area of 240.61 m²ha⁻¹ was recorded by *A. marina* followed by *R. mucronata* (90.36 m²ha⁻¹). The highest IVI was recorded by *A. marina* (109.87) followed by *R. mucronata* (89.73). The lowest value of Shannon diversity index was obtained in plot 5 (H'=0.81) whereas the highest value was obtained in plot 1 (H'=1.49). The statistical analyses ANOVA performed revealed there were no significant differences among other plots (p>0.05). The biomass estimation was carried out using a common allometric equation (AGB=0.251ρDBH^{2.46}). The highest above-ground biomass (720.89 Mg ha⁻¹) was recorded by *Avicennia marina* contributing to the highest blue carbon amount of 346.02 Mg C ha⁻¹ followed by *Rhizophora mucronata* (225.02 Mg C ha⁻¹) with living above-ground blue carbon of 108 Mg C ha⁻¹, *Lumnitzera racemosa* (44.89 Mg C ha⁻¹), *Exoecaria agallocha* (65.51 Mg C ha⁻¹), *Bruguiera sexangula* (49.92 Mg C ha⁻¹) and *Bruguiera gymnorrhiza* (6.10 Mg C ha⁻¹). The total mangrove surveyed area of 0.24 ha with a total living above-ground biomass of 1292.63 Mg ha⁻¹ contributed to the living above-ground blue carbon of 620.46 Mg C ha⁻¹ with stored carbon dioxide equivalents of 2277.09 Mg CO₂eha⁻¹. Understanding of blue carbon potential from mangrove forests could be used to preserve sustainably; those ecosystems may have a positive impact on sinking anthropogenic CO₂ in the environment.

Keywords: blue carbon, carbon equivalents, community structures, mangroves

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Analysis of performance disparity between Membrane Bioreactor (MBR) and Sequencing Batch Reactor (SBR) technologies in treating landfill leachate

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In solid waste dumps, the production of leachate and pollution of aquatic bodies is a serious problem. Before being released into the environment, the generated leachate must be properly treated. It can be treated using several physicochemical and biological approaches, as well as their combinations. The performance of the membrane bioreactor (MBR) and sequencing batch reactor (SBR) technologies in treating landfill leachate was examined in this study to identify the suitable technology for Sri Lanka. MBR models with a working capacity of 7.5 L and SBR models with a volume of 16.5 L were set up in the lab and fed with landfill leachate collected from the Karadiyana dumpsite. The leachate with a Chemical Oxygen Demand (COD) in the range of 2100 - 2800 mg/L, Biochemical Oxygen Demand (BOD₅) in the range of 260 - 320 mg/L, Total Organic Carbon (TOC) of 651 - 287 mg/L and Total Nitrogen (TN) of 475 ± 127.62 mg/L were fed to above reactors. The two treatment systems were evaluated for 60 days and analyzed for the removal efficiencies of BOD₅, COD, Total Organic Carbon (TOC) and Total Nitrogen (TN). In SBR, the removal efficiencies of BOD₅, COD and TOC were 76%, 65%, and 59%, respectively. Nevertheless, the MBR showed a superior performance with removal efficiencies exceeding 95% for BOD₅, 88% for TOC, and 80% for COD. TN removals were below 60% in both systems. The SBR technology offers flexibility in cycle time and sequence, however, its performance is constrained when considering land fill leachate associated with substantial variations in quality and quantity. The MBR technology improved removal efficiencies considerably.

Keywords: landfill, leachate, membrane bio reactor, sequencing batch reactor, wastewater treatment

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The relationship between corals and reef fish on the Eastern coast of Sri Lanka

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Coral reefs are diverse ecosystems that provide habitats for various fish communities, therefore, this study focused on investigating the relationship between corals and reef fish in Pigeon Island Reef (PIR), Parrot Rock Reef (PRR), Adukkuparu Reef (AR), Kayankerni Reef (KR), and Passikudah Reef (PR) on the Eastern coast of Sri Lanka in 2020. 30 of 30 m long, Line Intercept Transects (LIT) and Fish Belt Transects (FBT) of each site were used simultaneously to investigate the corals and reef fish respectively. Altogether 101 coral species under 16 families and 272 reef fish species under 35 families were verified. The highest (48.81%) and lowest (6.34%) relative abundance of fish species was found respectively at KR and AR. The highest Shannon-Weiner Index (3.68), Simpson's Index (0.96), and Pieolu's evenness (0.55) for reef fish were recorded in PRR while the highest fish richness (181) was recorded in PIR. The lowest fish diversity (0.66) was recorded at PR. Coral species exhibited the highest Shannon-Weiner Index (3.38), Simpson's Index (0.93), and species richness (58) at PRR, but the highest Pieolu's evenness (0.74) at PR. Coral species showed significant ($p < 0.05$) positive correlations with fish species at the KR, AR, and PRR, but there were no significant correlations at PIR and PR. Among all sites, the coral family Dendrophylliidae showed strong positive correlations with fish families of Pomacentridae ($r=0.855$) and Blennidae ($r=0.906$). Coral families Alcyoniidae ($r=0.797$), Plumulariidae ($r=0.760$), Mussidae ($r=0.772$), and Poritidae ($r=0.643$) had moderate positive correlations with the fish family Lutjanidae. Coral family Acroporidae had also a moderate positive correlation ($r=0.575$) with fish family Pomacanthidae. Coral family Agaricidae had moderate positive correlations with fish families of Pomacentridae ($r=0.556$), Haemulidae ($r=0.544$), Pseudochromidae ($r=0.579$), and Holocentridae ($r=0.548$). Anthropogenic and natural threats would have significant impacts on both parties. Therefore, strategies for the conservation and management of both corals and reef fishes are mandatory.

Keywords: coral-fish interaction, live coral cover, reef fish habitats, tropical reefs

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Effect of water quality on fish mortality of brackish water cages at Munnakkaraya area in Negombo Lagoon

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Negombo Lagoon is considered as a highly bio sensitive ecosystem which has numerous interactions with fishery practices and aquaculture. In recent years, aquaculture practices using brackish water floating cages were emerging. The study was conducted to investigate reasons behind the mass mortality of fish in Negombo Lagoon. Fin fish samples and water samples were collected from ten sites in Munnakkaraya area where Sea bass cages were located. Number of dead fish was recorded with respect to the cultured species. Abnormalities of internal organs in collected fish samples were investigated. Dissolved oxygen (DO), pH, salinity, Biochemical Oxygen Demand (BoD) and turbidity were measured using portable meters. Total 3,889 number of Sea bass (*Latus calcarifer*) with 7,466.5 kg, 3,110 of Grouper (*Epinephelus analogus*) with 6,420 kg and 1,594 of Red snapper (*Lutjanus argentimaculatus*) with 5,659 kg of fin fish mortality were recorded. Red patches on gills and lesions with hemorrhages were visible in different parts of collected fish samples. Negative discoloration in liver, no enlargement of spleen and kidney were observed through dissection. According to the water quality analysis, pH (8.25 ± 1.04), DO (8.05 ± 1.23 mg/l), BOD (8.23 ± 2.43 mg/l) and turbidity (20 NTU) were favorable except salinity (0 ± 0.02 ppt). Sudden salinity depletion led towards unfavorable environmental conditions for cultured fish. The study revealed that the reasons for massive fish kill was due to the combination effect of crowding stress, suffocation and sudden depletion of water salinity in the area where brackish water cages were located. Furthermore, heavy rainfall which may contribute towards higher freshwater input towards Negombo Lagoon caused the sudden depletion of salinity. Further studies needed for monitor the impact of climatic changes towards lagoon water quality and recommended to revise culture cycles of selected fish in cage culture.

Keywords: cage culture, fish kill, water quality

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Preliminary study on assessment of physicochemical characteristics of water in Deduru Oya Basin

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Deduru Oya originates in the central hills of Sri Lanka and flows most of its length through the North Western Province, which is affected by flash floods for a short period and with low flow of water for a long period. This study assessed the physicochemical characteristics of surface water of the river. Twenty-five locations were chosen from the upper, middle and lower catchments representing the wider area of North Western Province. The sampling locations were selected based on wastewater and sewage disposal points, irrigation channels, and shrimp farm outlets to collect samples during the Dry (D) and Wet seasons (W) in 2021. in-situ parameters (water temperature, turbidity, Dissolved Oxygen (DO), pH, Electrical Conductivity (EC) and Total Dissolved Solids (TDS)) and Nitrite, Nitrate, Ammoniacal nitrogen, Orthophosphate, Chemical Oxygen Demand (COD) and heavy metals (Mercury, Arsenic, Lead and Cadmium) were analysed following standard methods. Results revealed that mean pH (D:7.7±0.2; W:7.5±0.2), DO (D:5.9±1.4; W:6.2±0.7) mg/L, BOD (D:3.4±2.2; W:1.9±0.9) mg/L, Nitrite (D:0.017±0.05; W:0.024±0.06) mg/L, Nitrate (D:0.034±0.06; W:0.04±0.06) mg/L, Ammonia (D:0.134±0.106; W:0.15±0.14) mg/L, Orthophosphate (D:0.050±0.11; W:0.059±0.11) mg/L, TDS (D:170.7±102.7; W:139±101.5) mg/L, EC (D:287.8±180.8; W:233±165) µS/cm and heavy metals were found within the acceptable limits of ambient water quality standards stipulated by relevant authorities (Central Environment Authority, 2019). Lead (Pb) was found only in the samples collected from the Kurunegala area in both seasons (D:3; W:4 µg/L). Whereas arsenic (As) was recorded in Nikaweratiya (D:3 ; W:1 µg/L) and Chilaw (D:2; W:1 µg/L). The mean COD levels in all sampling locations were above the standard limits and varied from D:232±107.7 to W:179.7±113.9 mg/L. Domestic, agricultural and industrial discharges to the adjacent water resources could be the main reason for higher COD levels. Thus, results of this study can be used as a baseline data and further studies are recommended to identify the variations of physicochemical characteristics of water quality in the river basin.

Keywords: Deduru oya basin, physicochemical characteristics, water quality

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Synthetic rubber waste: the stealthy occurrence of an overlooked category of microplastics in marine and coastal environments of Sri Lanka

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The health and environmental consciousness of the scientific community concerning plastic waste has increased vastly over the years and has motivated several reviews in policies and legal frameworks in Sri Lanka. However, addressing the issue of marine pollution by microplastics demands more attention to overlooked contaminants and their sources. This study provides evidence for the occurrence of synthetic rubber waste as an important category of microplastics that ultimately result in marine pollution. A total of 60 samples were collected from January, 2020 to December, 2021 based on a random sampling of road dust and surface coastal sand in Colombo, surface waters around the Kelani River mouth, and surface waters from off Colombo, to examine the presence and the potential sources of microplastics originating from synthetic rubber. Microplastics in the size range of 0.1–5 mm were examined in this study. Samples were subjected to wet sieving over 5 mm mesh, and density separation using Sodium chloride. Particles were examined using Microscopy and Fourier transform infrared spectroscopy. The results reveal that about 7–23% of microplastics on average were synthetic rubber. The river outfall and coastal waters appear to be more polluted by synthetic rubber microplastics compared to offshore waters ($p < 0.05$). The chemical composition and morphological characteristics of particles in road dust and out-falling river water exemplified similarities, and indicate a likelihood of generation from the wearing process of automobile tyres. Synthetic rubber was common among smaller particles, indicating a weighty inverse relationship between occurrence levels and particle size ($p < 0.05$). More insights on the generation, occurrence, and fate of road waste and synthetic rubber microplastics are required, while the spatial and temporal variations in occurrence levels that show associations to the rainy and dry seasons should be further explored. The improvement of infrastructure to mitigate contamination of watercourses by road waste is a considerable approach to curtail this issue. However, the effectiveness of such preventive measures must be examined against similar systems that have been implemented in other countries.

Keywords: marine debris, marine pollution, microplastics, road waste, synthetic rubber

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Personal Protective Equipment pollution driven by the Covid-19 pandemic at selected beaches in Colombo District

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The COVID-19 pandemic has severely induced significant changes in Personal Protective Equipment (PPE) usage with the potential for negative impacts on the environment and human health and it brought an extra burden to conventional solid waste management practices in coastal areas. This study was designed to assess the PPE abundance and distribution in Crow Island, Galle Face, Mount Lavinia, Wellawatte, and Moratuwa beaches in Colombo District during the Covid-19 pandemic from March to July 2022. The PPE such as surgical masks, KN95 masks, cloth masks, sanitizer bottles, and gloves were collected along the beach within 20 m of the intertidal zone on each beach in early mornings and late evenings before cleaning the beach. The data analysis was carried out using Microsoft Excel, Statistical Analysis System (SAS). One-way ANOVA was performed. The statistical analysis depicted that the abundance of the PPE items varied significantly 0.003 and significantly higher abundance of PPE was reported in Wellawatte. The mean PPE for all beaches is 129.2 per 20 m. The higher amount of PPE is reported 56.8 of mean \pm standard deviation and on lowest number of PPE were recorded in Galle Face beach giving the mean $-74.2 \pm$ standard deviation. Considering the recommendation, necessity of ensure the proper awareness of safe management of COVID-19 waste according to the government regulations and should implement the actions immediately at all levels of society and individual responsibility is needed to control the improper disposal of used PPE. Yet, there should be a monitoring program on the residue levels of these impacts to solve in the specially to marine environments.

Keywords: beaches, Colombo District, Covid –19, personal protective equipment, surgical masks.

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Preliminary assessment of zooplankton assemblages in Puttalam Lagoon, Sri Lanka

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Puttalam Lagoon is located in the North-Western Province of Sri Lanka and it is the second largest lagoon in the country. Zooplankton is a sensitive tool for assessing environmental conditions in coastal lagoons. The objective of this preliminary study was to assess the diversity and composition of the zooplankton in the lagoon. Zooplankton samples were collected at randomly selected fifteen sampling sites once in July, 2017. Samples were collected hauling method using 100 µm nylon plankton net one-meter depth from surface of the lagoon and concentrated plankton samples (100 mL) were preserved using 5% formalin until analysis. In the laboratory, quantitative analysis was carried out through sub-sampling techniques using a Sedgwick rafter cell. Observations of the zooplankton were carried out under mid-power (×400) of the compound microscope. Species were identified to the nearest possible taxonomic level using the standard taxonomic guides and diversity index of zooplankton was calculated. Altogether 37 zooplankton species were identified covering eight phyla (Arthropoda, Annelida, Chordata, Ciliophora, Mollusca, Nematoda, Protozoa, and Rotifera). Maxillopod a is the most abundant class (18 species) which included Copepods and Branchiopoda. The highest abundance (1388 total individuals/ml) of zooplankton was observed at the Western part of the lagoon where less human disturbances were seen. The lowest abundance (172 total individuals/ml) of zooplankton was recorded at the sampling sites of the Eastern part of the lagoon adjacent to upper Puttalam town area. The Shannon diversity index of 1.47 indicates lower species diversity in the lagoon during the study period. Further study should be carried out simultaneously with water quality and seasonal changes to correlate with alterations in the surrounding environment.

Keywords: diversity index, coastal lagoon, environmental conditions, zooplankton

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Present status of the shallow reef patches at the Bar Reef Marine Sanctuary, Sri Lanka: 2021

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The Bar Reef Marine Sanctuary (BRMS) has been subjected to various natural and anthropogenic stressors for decades and notable fluctuations in live hard coral (LHC) cover has been observed over the past years. A steady increase in the HC cover was observed up until 2011 and thereafter it was evident that the degradation of the existing coral cover had accelerated remarkably. To assess the current status, a preliminary survey was conducted at the shallow reef patches of BRMS in February 2021 to investigate the diversity and the abundance of existing coral species. Line intercept transects (LITs), 50 m in length were deployed randomly between the depths of 1.5 m to 3.0 m and subsequent coral rubble (CR = 48.8%), non-partial dead coral (DC = 8.6%), macroalgae (MA = 13.4%) covers and other substrate types (O = 29.2%) were recorded. Total mortality in LHC species (0% cover) was observed during the preliminary survey, and was also evident that the structural integrity of the DCs was severely depleted, creating extensive unconsolidated rubble fields in the vicinity. A negligible proportion of new coral recruits (less than 1%) of *Acropora* sp. was observed at the study site. Moreover, an abundant overgrowth of seaweed *Stoechospermum polypodioides* was visible in all sampling sites whereas the occasional occurrence of *Halimeda opuntia* and *H. macroloba* were also evident in small numbers. Contrary to the 1998 mass bleaching event which recorded a 40% increment of LHC cover in shallow reef depths within a five-year period, our results suggest that no such recovery was observant even after five years from the 2016 bleaching event. Hence the reef should receive immediate attention and restoration measures should be implemented to enhance the reef resilience to speed up recovery.

Keywords: bar reef marine sanctuary, live hard coral cover, line intercept transect, mass bleaching events, reef recovery

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Microplastic contamination on selected beaches in Sri Lankan coastline due to X-Press Pearl ship disaster

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Microplastic are emerging contaminants in the environment and it has many impacts on different sectors such as marine environment, rivers, reservoirs, soil, sediment, plants, fish, etc. Frequent maritime disasters have increased in the recent past in the Indian Ocean. Recently, X-Press Pearl ship disaster on 20 May 2021 caused unprecedented plastics and pellets discharge into the 6-7 km off –Pamunugamuwa coastal waters in Sri Lanka and circulated around the island. More than 1,750 tons of plastic pellets and 9,700 tons of epoxy resins were spilled creating a momentous impact on the sensitive coastal environment. Therefore, this study is focused on analysing and quantifying the microplastic contamination and samples were collected (0.5*0.5 m quadrat) from 26 selected beaches from Pesalai, Mannar to the Kirinda area. The study was comprised of a “rapid survey” on plastic pellets distribution in the beach surface prior to the clean-up operation (26-31.05.2021). In addition, microplastic contamination in beaches were examined through spatial distribution (after clean-up operation started) using the method introduced by WESTPAC, and vertical distribution (buried) of plastic pellets (after clean-up operation started) up to 0.9 m depth in each sampling locations using a core sampler. Characterization of the polymers of the microplastics was carried out using ATR-FTIR. Correspondingly, the Pellet Pollution Index (PPI) was calculated for different sampling locations and ranked the polluted beaches. Coastal shoreline stability and buried microplastic (plastic pellet) impact on the coastal ecosystem was studied. The rapid survey results revealed that, the highest PPI recorded in the Sarakkuwa beach area which is more than 14768 pellets/ m² before the clean-up operation started. There were some sampling locations recorded as uncontaminated within the study sites. The highest PPI calculated after clean-up operation for spatial and vertical samples (after clean-up operation started) were 384.6 pellets/m² and 5028.8 pellets/m³ respectively. ATR-FTIR analysis results illustrate that there are more than six types of polymers identified including; Low-Density Polyethylene (LDPE), High-Density Polyethylene (HDPE), Epoxy resin, Polyethylene Terephthalate (PET), Polypropylene (PP), Cyclic Olefin Copolymer. Some microplastics (pellets) were buried under the sand even up to 0.9 m. It reflects that there is a high possibility of these pellets washed off into the sea during the monsoon period especially in unstable coastal beach areas.

Keywords: contamination, FTIR, microplastics, pellets, X-Press Pearl ship

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Air-layering of endangered mangrove *Scyphiphora hydrophyllacea* in Kadolkele-NARA Regional Research Center of Sri Lanka, towards its conservation

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Scyphiphora hydrophyllacea is considered as a non-viviparous evergreen shrub belonging to genus *Scyphiphora* (family: Rubiaceae). After self-pollination, growing of resulted seeds to a plant is limited under natural environment. In order to address this research gap, an attempt was made to investigate the possibility of applying air-layering on endangered *S. hydrophyllacea* which introduced to Kadolkele mangrove reserve. Two culture media were used for the investigation with six replicates. Healthy branches of *S. hydrophyllacea* were selected and a ring bark of about 2.5cm width was removed. Commercial rooting hormone powder (0.3% Indole 3 butyric acid; IBA) was applied before wrapping along the wounded portion. Selected culture media; mangrove soil, mangrove soil with coconut coir (2:1 ratio) were moistened with brackish water and strapped with polythene sheet. The rooting response was monitored constantly. Root initiation was first observed after 6–7 weeks. Approximately 25% of air-layered branches produced roots or root initials within 6-13 weeks. Compared to branches air-layered with mangrove soil, which air-layered using mangrove soil + coconut coir (2:1 ratio) had more root initials. Compared to mangrove soil medium + IBA treatment, IBA treatment + mangrove soil + coconut coir (2:1 ratio) was more successful in producing roots. Nearly 33.3% of the branches produced root initials in untreated mangrove soil medium, and 37.5% in untreated mangrove soil with coconut coir (2:1 ratio) medium. However, these root initials were unable to develop up to roots and disappeared with the time. Only hormone treated air-layered branches showed the continuous development of root initials up to roots. Under experimental level, hormone treatment for air layering of *S. hydrophyllacea* is a successful propagation method. Further studies can be extended to evaluate the adaptability of air-layered plant up to an independent mature shrub under natural environment for successful conservation.

Keywords: air-layering, IBA treatment, *Scyphiphora hydrophyllacea*

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Assessment of physico-chemical parameters of water in Negombo lagoon during COVID-19 pandemic

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Negombo Lagoon is a shallow basin located between 79°48'57"-79°52'4"E and 7°5'56"- 7°12'29"N on the West coast of Sri Lanka. Industrial and domestic pollution sources could adversely affect on water body. The prevalence of the COVID-19 pandemic minimized fisheries activities and the pandemic may affect to the quality of lagoon water. Therefore, this study aimed to determine the changes of physico-chemical parameters of water, during COVID-19 outbreak. The study was carried out monthly from March to August 2021 in twelve randomly selected sampling locations. Water Temperature (WT), pH, salinity, Electrical Conductivity (EC), turbidity, Dissolved Oxygen (DO), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), oil and grease, Chemical Oxygen Demand (COD) and nutrients (NH₄-N, NO₃-N, NO₂-N and PO₄⁻³-P) were determined as outlined in Standard Methods for Examination of Water and Waste Water (APHA, 2012). Data were analysed using Minitab 14 statistical software. Mean values of WT (29.50±0.85 °C), pH (7.64±1.05), salinity (23.50±1.42 ppt), DO (7.25±1.45 mg/l), BOD (20.50±2.45 mg/l), EC (32.24±3.45 mS/cm), turbidity (8.45±1.65 NTU), TDS (32.50±2.46 mg/l), TSS (10.65±0.45 mg/l), oil and grease (5.24±0.45 mg/l), NO₃-N (0.35±0.01 mg/l), NO₂-N (0.25±0.05 mg/l), PO₄⁻³-P (0.24±0.05 mg/l), NH₄-N (0.24±0.05 mg/l) and COD (325±10.54 mg/l) were within the range of the tolerance limits for coastal water standards of the Central Environmental Authority. Results of One-way ANOVA revealed that there was no significant difference (p<0.05) in measured physico-chemical parameters of lagoon water during the COVID-19 pandemic besides in BOD values. This study can be considered as a baseline for future studies on evaluating the effect of lagoon fishery in Negombo during the COVID-19 pandemic.

Keywords: COVID-19, Negombo lagoon, physico-chemical parameters

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Avoiding haphazard restoration of mangrove habitats: an evidence synthesis for a better ecosystem-based management

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Mangrove restoration is popular in the coastal regions as a way of mitigating habitat degradation and biodiversity conservation. However, most of these projects are implemented in a haphazard manner, leading towards project failures. In Sri Lanka, evaluation studies on mangrove restoration suggest that future interventions shall be controlled and guidelines on best practices shall be widely available. Complimenting that, this study pools information through a qualitative systematic review on the best practices of mangrove restoration for better decision-making in ecosystem-based management. Key information from primary research articles (n=22) has been gathered by indexing. Evidence is unavailable to confirm that there are negative impacts from haphazard restoration, but project failures. Restoration sites should be away from areas of coastal erosion, climate and weather impacts (36%). Restoration projects associated with aquaculture development are more likely to be successful compared to an isolated plantation (5%). Mangroves planted in ecologically engineered areas grow to be more complex with higher species richness (5%). Mangroves have different tolerance to factors such as planting season, topography, soil condition, salinity and tidal inundation, hence species selection according to their preference is important (10%). Some mangrove species thrive in successional systems and their diversity is at the highest level when there is an intermediate ecological disturbance. Therefore, deliberate interventions are needed to facilitate that. Increasing population size by both natural and artificial regeneration is recommended to surpass the invasion by foreign species. Level of community inputs drives political support for successful restoration projects. Coastal managers shall be provided with basic knowledge on the practices of coastal restoration for successful results. It is recommended to monitor the progress of previous restoration projects and transfer information to guide successful future projects. Overall, mangrove restoration shall be considered as a process within a socio-ecological system, which needs to be embedded into policy level.

Keywords: best practices, socio-ecological systems, habitat restoration, mangroves

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Assessment of soil and water characteristics of the Tubificids worm's natural habitat in the Central province, Sri Lanka

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Tubificid worms are used in the ornamental fish industry as a live feed mainly for brooders. The present study was carried out with the objective of determining the primary soil characteristics, including total organic matter content, texture, soil pH, and depth while water characteristics such as dissolved oxygen, pH, and Ammonia content favourable for Tubificids worms' abundance. Three sites were investigated representing the most abundant place where Tubificids worms are found in the Central province, by the data collected from wild Tubificids worm collectors. At each site, three sample plots (5x5 m) were established at a 2 m distance from each, and samples were collected from six points in each plot in a random manner from October 2021 to December 2021. According to the data collected from wild Tubificids worm's soil conditions, the soil texture of the two sites was identified as sandy soils and the other site as loamy sand (Based on the U.S. Department of Agriculture (USDA) soil classification system). The highest mean organic content was observed as 3.53% within three sites considered as productive soil. There is a significant difference in the depth of soil where worms were abundant in the three sites ($P < 0.05$, One-way ANOVA) with the highest value of 4.5 ± 0.4 cm. Although there is no significant difference in both soil pH and water pH in the three sites ($P > 0.05$, One-way ANOVA), slight variations were recorded with the highest value of 7.2 ± 0.3 and 7.5 ± 0.4 respectively. The minimum dissolved oxygen concentration observed within the three sites was recorded as 3.2 ± 0.2 mg/L with the highest ammonia concentration of 4.0 ± 0.1 mg/L. Thus, there were variations in the range of soil and water characteristics including soil texture, depth of soil, Ammonia content, and dissolved oxygen where worms were abundant within three sites.

Keywords: abundant place, physico-chemical parameters, Tubificids worms

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Diversity of marine sponges and associated organisms in the coastal waters of Allaipiddy, Velanai Island, Sri Lanka

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In addition to their habitat building capacity, marine sponges have been studied for their bioactive compounds in recent years. However, data on diversity of sponges in the coastal waters of Northern Sri Lanka is scant. Therefore, the present study was carried out to identify the diversity and distribution of marine sponges and associated organisms from the coastal waters of Allaipiddy (9.613011°N, 79.966529°E), Velanai Island of Sri Lanka. The sampling area was limited to 20 m from the coast line and samples were collected from 20 x 20 m transect by hand picking method during April 2021. Sponge species identification was performed based on morphological characteristics, spicule preparations and histological sectioning with the aid of available taxonomic keys and were validated against World Porifera Database. In the present study, eight species of Class: Demospongiae were recorded representing five orders, eight families and eight genera. Identified species were *Haliclona caerulea*, *Callyspongia diffusa*, *Tedania anhelans*, *Dysidea fragilis*, *Gelliodes incrustans*, *Amorphiniopsis fenestrata*, *Mycale tenuispiculata* and *Sphēciospongia inconstans*. Observations revealed that all the sponge species showed close association with sea grass species such as *Enhalus acoroides* and *Thalassia hemprichii* and algae species *Padina pavonica*, *Sargassum polycystum* and *Jania* sp. Sponge – algae and sponge-sea grass associations in the form of sponge encrusting on algae and sea grass also recorded. Macro invertebrates such as brittle star species: *Ophiactis savignyi* and *Ophiothela* sp.; sea cucumber: *Synaptula recta*; polychaetes: *Sabella* sp. and *Nereis* sp.; amphipods; and a diatom *Coscinodiscus* sp. were recorded from the spongocoel as well as on the outer surface of most of the sponge species. A sponge species *T.anhelans* showed sponge-sponge association with other sponges *H.caerulea*; and *C.diffusa*. Results indicate that, *S. inconstans* is the most common sponge species. The results from the present study indicate the ecological significance of marine sponges in Allaipiddy as they support the life of many other organisms.

Keywords: algae, Demospongiae, encrusting sponge, macro invertebrates, sea grass

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