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(7th Research Symposium of the Ocean University of Sri Lanka)

PROCEEDINGS 2025

"Marine Sciences for Sustainable Ocean"

30th January 2026

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Forword

It is with great honour that I present the Proceedings of the 2nd International Symposium of the Ocean University of Sri Lanka, convened under the theme *"Marine Science for the Sustainable Ocean"*. This theme is particularly significant in the context of Sri Lanka's national development agenda, where the ocean is recognized as a critical driver of the country's Blue Economy, food security, environmental resilience, and socio-economic well-being.

As a maritime nation strategically located in the Indian Ocean, Sri Lanka possesses vast marine and coastal resources that support fisheries, aquaculture, maritime transport, tourism, renewable energy, and emerging sectors such as marine biotechnology and bio-prospecting. The sustainable development of these sectors depends fundamentally on sound marine scientific knowledge, evidence-based management, and innovation. In this regard, marine science plays a pivotal role in operationalizing the Blue Economy framework while ensuring ecosystem integrity, climate resilience, and intergenerational equity.

The 2nd International Symposium of the Ocean University of Sri Lanka served as a platform for the dissemination of research findings on sustainable ocean use. The collection of abstracts included in this proceedings book reflects a wide spectrum of disciplines pertaining to Fisheries, Ocean Sciences, Engineering, and management. Many contributions emphasize applied research, policy relevance, particularly within the tropical and Indian Ocean Context. These studies are essential for the national ocean-related activities, industry with global commitments, align with the SGD #14, life below water.

I extend my sincere appreciation to all contributing authors for their scientific research work and to the reviewers for their critical evaluations, which ensured the rigor and credibility of the published papers. I also acknowledge the dedication of the organizing committee, editorial board, and technical staff whose collective efforts made this symposium.

It is my sincere expectation that this proceedings book will serve as a useful reference for researchers and industry stakeholders engaged in the marine and coastal sectors. More importantly, it is hoped that the knowledge presented herein will support efforts in the advancement of a science-based blue economy in Sri Lanka.

Dr. M.F.M. Fairoz
Editor-in-Chief
Proceedings of the 2nd International Symposium of the Ocean University of Sri Lanka

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Contents

Message from the Vice Chancellor

It is my great pleasure to greet all participants of the Second International Research Symposium 2025 of the Ocean University of Sri Lanka, convened under the theme "Marine Science for a Sustainable Ocean."

This symposium represents far more than a showcase of scientific excellence, it serves as a vital platform for the exchange of ideas, expertise, and collaboration among researchers, academics, industry professionals, and policymakers engaged in ocean-based disciplines. At a time when our oceans face unprecedented challenges, sustainable solutions increasingly demand interdisciplinary and cross-sectoral approaches. Such interactions are essential for translating research outcomes into practical, impactful applications that address real-world needs. The abstracts compiled in this volume reflect the breadth and depth of research efforts contributing to the sustainable use, conservation, and innovative management of our marine and coastal resources. Each contribution advances our collective understanding and reinforces our commitment to ocean stewardship.

As Sri Lanka's national university dedicated to ocean sciences, the Ocean University of Sri Lanka is committed to fostering robust collaborations between academia, industry, and civil society, both nationally and internationally. Through such partnerships, we aim to bridge the gap between knowledge generation and its application in policy and practice.

I extend my sincere appreciation to all authors, reviewers, and members of the organizing committee whose dedication has made this symposium possible. It is my hope that the discussions and connections forged here will inspire future collaborations, strengthen existing partnerships, and contribute meaningfully to the global pursuit of marine science for a sustainable ocean.

Senior Prof. Nalin Ratnayaka
Vice Chancellor,
Ocean University of Sri Lanka

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Message from the Chairperson of the Symposium

It is with great pleasure and a deep sense of responsibility that I welcome you to the International Symposium for Ocean Research – 2025 (iSOR '25), proudly hosted by The Ocean University of Sri Lanka. This inaugural international symposium marks an important milestone for our university and reflects our growing commitment to advancing marine science, innovation, and sustainability at both national and global levels.

Guided by the theme "Marine Sciences for a Sustainable Ocean", iSOR '25 brings together scientists, academics, industry professionals, policymakers, and young researchers to address the urgent challenges facing our oceans. Climate change, biodiversity loss, overexploitation of resources, and environmental degradation demand science-based solutions, and this symposium provides a timely forum for sharing knowledge and strengthening interdisciplinary collaboration.

The symposium features 103 peer-reviewed research abstracts presented across diverse technical sessions, including Coastal and Marine Environmental Management, Fisheries and Aquaculture, Seafood Science and Technology, Marine Engineering and Technology, Oceanography and Hydrography, GIS and Remote Sensing, Maritime Transportation and Logistics, Sustainable Supply Chain Management, Fisheries Socio-economics and Marketing, and Marine Biotechnology. The quality and diversity of these contributions demonstrate the growing strength of ocean research communities in Sri Lanka and abroad.

The symposium was privileged to feature two eminent keynote speakers. Dr. Clare B. Embling delivered an inspiring keynote entitled *"From temperate to tropical seas: dynamic environmental drivers of top predators and prey and why they matter for conservation"*, offering valuable scientific perspectives on marine ecosystem dynamics. Senior Professor Tilak Hewawasam delivered a compelling address on "*Protecting Our Oceans: Strategies for Reducing Plastic Pollution from Inland Sources,"* presenting a forward-looking vision for sustainable ocean-based economic growth. Their presentations greatly enriched the scientific dialogue of iSOR '25 and set a strong foundation for future marine research and innovation.

I extend my sincere appreciation to the Vice Chancellor, Senior Professor Nalin Ratnayaka, for his leadership and continuous support, and to the organizing committee, editorial team, reviewers, sponsors, collaborators, and partners whose dedication has made this symposium possible. My gratitude also goes to all authors and participants for their valuable contributions and active engagement.

I trust that iSOR '25 will serve not only as a platform for presenting research, but also as a catalyst for long-term partnerships, innovative ideas, and impactful solutions for a sustainable ocean. May this symposium inspire us all to work together towards protecting and responsibly managing our marine resources for future generations.

Dr. H.M. Sarath M. Wijerathna
Chairperson of the Symposium/ iSOR-2025
Ocean University of Sri Lanka

Keynote Speech I

Protecting Our Oceans: Strategies for Reducing Plastic Pollution from Inland Sources

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Chairman, Central Environmental Authority (CEA), Ministry of Environment, Sri Lanka

Oceans cover over 70% of our planet and are crucial for sustaining life. They generate more than half of the world's oxygen and play a vital role in regulating Earth's temperature. However, the beauty and ecological balance of our oceans are increasingly threatened, primarily by plastic pollution. Marine animals often ingest plastic debris, leading to malnutrition, digestive blockages, or even death. Additionally, many marine creatures become entangled in abandoned fishing gear, which adversely affects their mobility and health. Plastics can absorb harmful chemicals that may then be transferred to marine organisms, subsequently entering the food chain. Microplastics, in particular, pose serious health risks to humans who consume contaminated fish or water.

Alarmingly, much of this pollution originates not just from coastal regions, but also from inland areas- a phenomenon known as inland plastic pollution. This occurs when waste generated far from coastlines makes its way into rivers, lakes, and eventually the oceans. Urban areas, where plastic products are extensively used, are significant contributors to this issue. Rain and flooding can wash plastic waste from streets and urban environments into waterways, further exacerbating marine plastic pollution.

To protect our oceans from inland plastic pollution, a multifaceted approach is essential. This includes enhancing waste management practices through sustainable methods, reducing reliance on single-use plastics, leveraging technology, and fostering community involvement. Initiatives such as the Circular Economy (CE) and Extended Producer Responsibility (EPR) provide comprehensive frameworks for managing plastic use and waste. CE promotes the sustainable utilization of resources, while EPR holds producers accountable for their environmental impacts. Together, these strategies can significantly reduce the influx of plastics into marine ecosystems and mitigate their detrimental effects on marine life. In Sri Lanka, the Central Environmental Authority is currently working to establish legal provisions for implementing EPR, aiming for more efficient waste management primarily to combat plastic pollution.

By understanding the sources and implications of plastic pollution, individuals, organizations, and governments can collaborate to implement effective solutions. The health of our oceans is intrinsically linked to the overall well-being of our planet, making it our collective responsibility to act now for a cleaner and more sustainable future.

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Keynote Speech II

From Temperate to Tropical Seas: Dynamic Environmental Drivers of Top Predators and Prey and Why They Matter for Conservation

Dr. Clare Embling,
Associate Professor of Marine Ecology, University of Plymouth, UK

Marine predators and their prey are shaped by environmental processes that vary across space and time, creating dynamic patterns of aggregation, movement, and interaction. Understanding how these processes operate, and how they differ between temperate and tropical systems, is essential for conserving marine ecosystems during this period of rapid environmental change. This keynote brings together research from temperate shelf seas of the North Atlantic and tropical systems of the Indian Ocean to explore how changing environmental conditions influence the distribution and behaviour of top predators and their prey, and how this knowledge can inform conservation. Drawing on studies of harbour porpoises in temperate waters, I show how prey availability, tidal processes, and oceanographic features structure predator distributions at fine spatial and temporal scales. Work on predator–prey coupling and fish aggregations over offshore banks further illustrates how interactions between seabed topography and dynamic ocean processes create predictable biological hotspots. These same mechanisms also provide a useful framework for understanding tropical systems. Using examples from the Chagos Archipelago in the tropical Indian Ocean, I illustrate how similar processes drive manta ray movements and pelagic fish aggregations. At fine spatial and temporal scales, tidal processes interacting with topography are shown to influence the foraging behaviour of manta rays, while at broader scales, climate–oceanographic drivers such as the Indian Ocean Dipole (IOD) affect when and where predator–prey aggregations occur through their influence on thermocline depth and current strength and direction.

Across both temperate and tropical systems, a consistent message emerges: top predators respond to interactions between oceanography and topography, and their effects on prey behaviour, rather than to static habitats alone. This has important implications for conservation. While fixed protected areas can safeguard key locations, their effectiveness depends on how well they capture the dynamic processes that underpin biological value. Comparing systems across latitudes helps identify common mechanisms that generate predator and prey aggregations, while also highlighting regional differences that matter for management. The keynote concludes by discussing how integrating dynamic environmental information with ecological and acoustic observations can strengthen conservation strategies for mobile marine species, from intensively used temperate seas to remote tropical ocean regions.

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Technical Session I

GIS and Remote Sensing Applications for Marine Sciences

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Impact on the shoreline due to the port city development off Colombo on the west coast of Sri Lanka

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Abstract

The west coast of Sri Lanka, like many other coastal regions worldwide, is subject to the complex interplay of natural processes and anthropogenic activities that influence erosion and accretion of shorelines. This research briefly summarizes a comprehensive analysis of shoreline changes along Sri Lanka's west coast, with a particular focus on the Colombo Port City region. The primary objectives were to assess the impact of Colombo Port City development on the surrounding coastline and to analyze key shoreline change metrics. 13 Google Earth Pro images were used with a consistent 500 m eye altitude in the concerned area. The Digital Shoreline Analysis System Tool in ArcGIS was used to evaluate shoreline metrics, including End Point Rate, Shoreline Change Envelop, Net Shoreline Movement, and Weighted Linear Regression Rate. The analysis considered a 150 m landward baseline and a 400 m maximum search distance in 10 km radius around Port City along the shoreline. The analysis results revealed a maximum erosion rate of 9.65 m/yr and a maximum accretion rate of 20.85 m/yr within the Port City and harbor area. Notably, the study found minimal shoreline impact within a 10 km radius around the Port City, with breakwater structures closely linked to observed accretion areas. The study considered the extension of a 5.4 km breakwater as part of the Port City project. The study demonstrates the minimal impact from the Colombo Port City development Project on shoreline dynamics. While erosion was primarily associated with landward-facing structures, accretion was influenced by breakwater structures, beach nourishments, and the port city and harbor expansion, extend the shoreline by approximately 6-7 km into the sea. However, the study identified the inconclusive nature of erosion at the Kalani River mouth because of natural phenomena. Overall, the port city project appeared to have a limited effect on shoreline in the West Coast.

Keywords: Shoreline; Breakwater structures; Accretion; Erosion

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Grain size distribution and sediment composition in Arugam Bay, Sri Lanka

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Abstract

This study examines the spatial variation in grain size distribution and sediment composition in Arugam Bay, southeastern Sri Lanka. A total of twenty-four surface sediment samples were collected from beach, low-water, and nearshore zones during March 2025. Grain size analysis was carried out using standard dry sieve techniques, and statistical parameters were calculated. Spatial distribution maps were generated using QGIS and Surfer software. Mean grain size values range from 0.78φ to 2.83φ, indicating sediments dominated by coarse to fine sand, with fine sand being the most prevalent fraction. Sorting values vary between 0.41φ and 1.56φ, classifying the sediments as well sorted to poorly sorted. Beach zone sediments are predominantly well to moderately well sorted, reflecting effective wave reworking under relatively stable hydrodynamic conditions, whereas nearshore sediments exhibit moderate to poor sorting, suggesting greater variability in wave and current energy. Skewness values range from –5.94 to 2.80, with most samples showing coarse to very coarse skewness, indicative of high-energy depositional conditions, while a few fine-skewed samples reflect localized low-energy settings. Kurtosis values (0.69–1.62) indicate mainly platykurtic to leptokurtic distributions, implying variable sediment supply and transport mechanisms. Mineralogical visual observations reveal quartz as the dominant mineral, accompanied by heavy minerals such as ilmenite, rutile, garnet. Spatial analysis indicates that relatively coarser sediments occur in shoreline sectors exposed to higher wave energy, whereas finer sediments accumulate in comparatively sheltered nearshore areas. Overall, Arugam Bay represents a dynamic mixed-energy coastal system controlled primarily by wave and current processes. This study provides a valuable baseline for future seasonal monitoring, coastal management, and erosion assessment in the region.

Keywords: Arugam Bay; Coastal processes; Grain size distribution; Sediment composition; Spatial analysis

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Assessment of shoreline changes along the coast of Oluvil harbour: an application of digital shoreline analysis system

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Abstract

Oluvil Harbour is a significant fishing and commercial harbour located on the southeastern coast of Sri Lanka, constructed in 2013 to promote regional economic development, enhance fisheries, and improve maritime infrastructure in the Eastern Province. The sandy coastline, influenced by moderate wave energy, previously maintained a stable shoreline through natural sediment transport driven by monsoonal wave patterns and longshore currents. However, the construction has unintentionally triggered significant shoreline changes and coastal dynamic issues in the surrounding environment. This has caused sediment accumulation to the south and continuous shoreline retreat to the north, threatening infrastructure and coastal vegetation. Moreover, sedimentation within the harbour basin has reduced navigability, limited vessel entry, and requires frequent, costly dredging to maintain operations. Therefore, this study aims to assess spatial and temporal variations in erosion and accretion around the harbour, covering a 20 km coastal stretch that extends 10 km north and south. Historical shorelines from 2010 to 2025 were digitized using Google Earth Pro and analyzed with the Digital Shoreline Analysis System (DSAS) in ArcGIS. Shoreline change metrics, including the Shoreline Change Envelope (SCE), End Point Rate (EPR), Linear Regression Rate (LRR), and Net Shoreline Movement (NSM), were evaluated along 215 transects, spaced approximately 100 m apart, across the study area. The mean SCE of 72.02 m highlights the significant shoreline shift between 2010 and 2025, indicating that the harbour has substantially altered the beach's original position. The NSM averaged –10.17 m, suggesting a general trend of shoreline retreat between the oldest and most recent shorelines, while the EPR and LRR recorded – 0.67 m/yr and – 0.76 m/yr, respectively, signifying a general long-term erosional trend. Among all transects, 42–47% showed erosion and 53–57% displayed accretion. Although the mean erosion rate (–2.29 m/yr) was higher in magnitude than the mean accretion rate (1.52 m/yr), the larger proportion of accretional transects indicates widespread but less intense sediment deposition compared to the more severe, localized erosion. Overall, the results show significant spatial variability in erosion and accretion, indicating that harbour construction has disrupted natural sediment transport along the coastline.

Keywords: Oluvil harbour; DSAS; Shoreline changes

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Shoreline changes along the Uswatakeiyawa coastal stretch, west coast of Sri Lanka

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Abstract

Coastal areas are essential ecosystems supporting human settlements, economies, and biodiversity, but shoreline changes pose significant challenges to coastal infrastructure and livelihoods in Sri Lanka. This study investigates shoreline changes along the 3 km stretch of the Uswetakeiyawa coast on the west coast of Sri Lanka from 2017 to 2025, using multi-temporal satellite images (10m resolution) and Geographic Information System (GIS) techniques. Nine years of Sentinel-2 atmospherically corrected satellite imagery with cloud coverage below 7% were acquired and processed using the Sentinel Application Platform (SNAP), and the Modified Normalized Difference Water Index (MNDWI) was applied to extract the shoreline (land-water interface). Subsequent Digital Shoreline Analysis System (DSAS) transect-based analysis across 60 transects at 50m spacing calculated Net Shoreline Movement (NSM), End Point Rate (EPR), and Linear Regression Rate (LRR). Major findings of the investigation indicate predominantly erosional coastline with a mean NSM of -21.8 m, mean EPR of -2.7 m/year, and mean LRR of -1.3 m/year. Spatial analysis showed that 92% of transects exhibited erosion, with the northern segment experiencing severe retreat up to -5.5 m/year, while the southern section showed localized accretion up to 2.3 m/year. This accelerated erosion, significantly higher than prior observations, is attributed to the combined effect of the 2012 beach nourishment sand and the regional sediment deficit caused by the Colombo Port City dredging during the study period. The study reveals that Uswetakeiyawa beach faces a persistent erosional threat, necessitating integrated management strategies such as beach nourishment, sand mining regulation, and monitoring networks. This research contributes to coastal science by offering a replicable methodology and a baseline for future studies, enhancing knowledge of tropical shoreline dynamics under climate and anthropogenic pressures.

Keywords: DSAS; GIS; MNDWI; Sentinel-2; Shoreline change; Uswetakeiyawa

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Humpback whale songs detected in the Chagos Archipelago, central Indian Ocean

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Abstract

Advancements in reliable and affordable passive acoustic monitoring (PAM) technologies are transforming the study of marine animals, particularly vocal species such as humpback whales (*Megaptera novaeangliae*). Humpback whales produce sounds year-round, with sexually mature males producing songs to attract females during the mating season. These songs are characterised by structured, repeated, rhythmic, and consistent patterns composed of units (the shortest continuous sounds), which are combined to form phrases. Repeated phrases generate a theme, and several distinctive themes together constitute a complete song, which can last for several hours. Long-term PAM recordings of humpback whale songs can be challenging to analyse manually. But advances in acoustic signal automation software show promise for efficient analysis of such large datasets. In this study, acoustic data were collected from two locations within the Chagos Archipelago: south of the Great Chagos Bank Atoll (GCB-South) and Middle Brother Island (MBI). Data were collected between 29th June and 10th October 2023 at GCB-South, and between 4th June and 29th September 2023 at MBI. An automated moan detector was used to automatically detect the songs in both sites using PAMGuard software. At GCB-South, humpback whale songs were detected between July and August, with 134 audio files (2.5% of the total 5,195 files) containing songs across 12 out of 109 recording days (10% of days). The detections exhibited a clear diel pattern, with peaks between 18:00 and 05:00 hours. At MBI, songs were detected in July, August, and September, with 47 audio files (1.2% of 4,025 total files) containing songs across 5 out of 84 days (6% of days). Unlike GCB-South, MBI detections were distributed across both day and night, showing no clear diel pattern. This study presents the first automated detection of humpback whale songs in the Chagos Archipelago using long-term PAM data, revealing diel and temporal variability in song occurrence. These findings suggest that the region may represent a potential breeding area for humpback whales. However, further year-round acoustic monitoring in these two sites is required to determine the full seasonal extent of humpback whale presence in the region.

Keywords: Passive acoustic monitoring; Chagos Archipelago; Humpback whale songs; automated song detection; PAMGuard

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Sea level trend around Sri Lanka and coastal vulnerability along the west coast of Sri Lanka

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Abstract

The coastline of Sri Lanka is becoming vulnerable due to accelerated sea level rise. This study focused on assessment of sea level trends around Sri Lanka and detailed coastal vulnerability of the west coast of Sri Lanka. Python and Geographic Information System (GIS)-based methodologies were applied during the study. Satellite altimetry data from 1993 to 2024 were acquired from the Copernicus Marine Environment Monitoring Service and were analyzed at six coastal locations. The Coastal Vulnerability Index (CVI) was calculated by integrating sea level trend, coastal slope, population density, and land use for 58 segments within a 300 m coastal buffer zone. Analysis of satellite altimetric data revealed that accelerated sea level rise of 3.8±0.4 mm/year along the west and 3.6±0.4 mm/year along the east coasts, approximately 12% and 11% above the global mean. Digital Elevation Models, population data, and national land use datasets enabled a comprehensive vulnerability assessment. Model results showed 6.9% of segments exhibit very high to high slope vulnerability (slopes < 1.2°), while 63.8% indicate moderate vulnerability. Population density (0-9,303 people/km²) analysis revealed extreme variation, with 41.4% of segments classified as high vulnerability. Land use assessment identified 29% of segments containing critical infrastructure with high vulnerability. Integrated CVI scores ranged from 1.41 to 6.93, classifying 6.7% as high vulnerability, 65% as moderate, and 28.3% as low vulnerability. High vulnerability areas were observed in urbanized zones where multiple risk factors converge. This study introduces a GIS-based Coastal Vulnerability Index framework that can be applied even in data or resource limited settings. The approach allows for identifying and prioritizing areas that need coastal protection, providing practical guidance for national-level adaptation planning.

Keywords: Coastal vulnerability; Land use; National adaptation planning; Satellite altimetry; Sea level rise

Technical Session II

Oceanography and Hydrography

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Grain size characteristics and spatial variability of beach sediments along the west coast of Sri Lanka

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Abstract

Coastal sediment characteristics help to explain shoreline energy and deposition. However, grain-size studies along Sri Lanka's west coast remain. The objective of this study is to investigate grain-size characteristics of surface sediments from five selected beaches in Bentota, Wadduwa, Wellawatta, Kepumgoda, and Chilaw along the west coast of Sri Lanka. Sediment samples were collected from beach faces of supralittoral, littoral and sublittoral along the transect at each site during March and May 2025. Nine samples were collected at each site, making a total number of 45 samples. Sediment grain size analysis was conducted using sieve analysis, and mean grain size, sorting, skewness, and kurtosis were calculated using the Folk and Ward graphical method. Results showed grain size range from medium to fine sand, with Bentota showing the finest sediments (2.50 φ ± 0.84 SD) and Wellawatta the coarsest (1.11 φ ± 0.09 SD), indicating a general northward coarsening trend interrupted at Chilaw (1.42 φ ± 0.41 SD). Skewness (−0.20 to 0.11) indicated near-symmetrical to fine-skewed distributions suggesting deposition under low-energy or calmer conditions, while kurtosis (1.53–1.79) showed leptokurtic curves. Sorting (0.41–0.85 φ) varied from moderately well-sorted at Bentota to poorly sorted at Kepungoda, these findings are reflecting where coarser, moderately sorted sands at Wadduwa and Kepungoda represent high-energy settings, and finer, well sorted sands at Bentota and Chilaw reflect low to moderate energy depositional environments. ANOVA and Kruskal–Wallis tests confirmed significant inter-site variability for mean size, sorting, and kurtosis ($p < 0.05$), whereas skewness showed no significant difference. A strong negative correlation between mean grain size and sorting ($r = -0.74$, $p < 0.001$) indicates that, in this study area, finer sediments tend to be better sorted due to consistent wave reworking and uniform sediment supply. The very weak negative correlation between mean grain size and skewness ($r = -0.012$, $p = 0.94$) indicates that skewness is largely independent of overall grain size trends across the study sites. Further studies that include seasonal sampling and nearshore hydrodynamic data would provide a more complete understanding of sediment transport along this coast.

Keywords: Beach sediments; Grain size; Sediment characteristics; Skewness; Sorting.

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Influence of grain size distribution on calcium carbonate and organic carbon in beach sediments along the west coast of Sri Lanka

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Abstract

Origin of beach sediments continuously interact with the anthropogenic activities, and natural factors that influence their composition. Understanding the relationship between grain size distribution, calcium carbonate ($CaCO_3$) and organic carbon (OC) composition is essential for interpreting coastal sediment dynamics. The objective of this study is to investigate the influence of grain size distribution on $CaCO_3$ and OC composition in beach sediments along the west coast of Sri Lanka. Five coastal sites Kalpitiya, Chilaw, Mount Lavinia, Bentota, and Galle were selected to represent diverse hydrodynamic and geomorphological conditions. A total 45 sediment samples were collected consisting of nine samples from each site, three from each low water, mid water, and high water levels during July- August in 2025. Grain size analysis was conducted using mechanical sieving, while $CaCO_3$ and OC were determined through acid-neutralization back-titration and the modified Walkley-Black method respectively. Non-parametric statistical analyses, including the Kruskal-Wallis test, Dunn's post hoc test, and Spearman's rank correlation were applied following the Shapiro-Wilk normality test. The results revealed a distinct downward fining trend in mean grain size with minimum φ 0.746 to maximum value φ 2.723, reflecting the dominant influence of southwest monsoon driven longshore transport. Significant spatial variations were identified for both $CaCO_3$ and OC, and Dunn's test highlighted notable differences in OC between Kalpitiya – Chilaw, Kalpitiya – Mt. Lavinia, and Chilaw – Galle, with higher OC levels at Kalpitiya and Galle. For $CaCO_3$, significant differences occurred among several site pairs, including Chilaw – Mt. Lavinia, Chilaw – Bentota, and Bentota – Galle, suggesting the influence of biogenic input and hydrodynamic sorting on carbonate accumulation. A moderate, statistically significant positive correlation between mean grain size and $CaCO_3$ confirmed that finer sediments contained higher carbonate fractions, whereas OC showed no significant correlation with either grain size or $CaCO_3$, indicating minimal organic retention. Overall, the findings emphasize that sediment texture governs carbonate distribution but exerts limited control on organic carbon storage along Sri Lanka's western coastline, providing essential baseline insights into coastal sedimentary processes and carbon dynamics in tropical monsoon dominated systems.

Keywords: Grain-size distribution; Calcium carbonate; Organic carbon; Beach sediments; Coastal dynamics

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Density, abundance and distribution of floating plastic debris in the high seas of the northern Indian Ocean

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Abstract

Floating Plastic Debris (FPD) is a pervasive threat to the world's oceans. It affects not only marine life but also the overall health of the ocean. Understanding the current state of this global issue and countermeasures are critical. However, despite a few global-scale surveys that estimate the abundance and distribution of FPD, studies covering the Indian Ocean (IO) are scarce. This study presents the first empirical data on density, abundance and spatial distribution of macro FPD on transit to, from, and within the northern end of the Ninety East Ridge (NER), located in the IO high seas east of Sri Lanka and south of the Andaman and Nicobar Islands. FPD were assessed through a systematic visual survey on board the SY Rainbow Warrior. The collected data were analysed using distance sampling in R (version 4.4.1) and visualised by producing Kernel density volume contours in QGIS. A Spearman's rank-order correlation test was performed to evaluate the contribution of boats and ships to the occurrence of FPD. The survey track covered a distance of 1,269.7 km over 10 days, equivalent to a total of 103 hours and 52 minutes of survey effort. The average density of FPD over the surveyed area was 6.34 items/km^2, resulting in a total abundance of 46,942 items. The Kernel density volume contours indicated that FPD is not evenly distributed, with hotspots (>70 items/km^2) covering only 0.3% of the study area. The average density estimate in this study was similar to or slightly higher than those reported in most other ocean basins worldwide. FPD concentration showed no significant correlation with the number of boats or ships observed ($p > 0.05$), indicating that they do not significantly contribute to FPD occurrence in the area. We expect that this data will provide a baseline for future comparisons of FPD pollution and contribute to global ocean models on FPD to help predict future changes in quantities and drifting patterns, while assisting in developing effective strategies to manage plastic pollution in the IO.

Keywords: At-sea survey; Floating Plastic Debris; Marine pollution; Ninety East Ridge; Northern Indian Ocean

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Spatial and temporal variability of mesoscale eddies and eddy kinetic energy in the northern Indian Ocean

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Abstract

The current investigations were carried out on the spatial and temporal variability of mesoscale eddies and Eddy Kinetic Energy (EKE) in the northern Indian ocean especially focusing on the Arabian Sea (AS) and Bay of Bengal (BOB) during 2023, emphasizing their correlations with wind stress, sea surface temperature (SST) and ocean currents. Using monthly averaged satellite-derived data from the Copernicus Marine Environment Monitoring Service (CMEMS), the study identified cyclonic and anticyclonic eddies, examining their seasonal distribution and intensity. The data processing and visualization were performed using MATLAB and RStudio, enabling high-precision spatiotemporal analysis of key parameters such as sea surface height (SSH), surface currents, wind stress and SST. The study revealed that the EKE in the AS ranged from 0.005 m^2/s^2 to 0.015 m^2/s^2 with total of 106 mesoscale eddies, while in the BOB, it varied between 0.002 m^2/s^2 and 0.015 m^2/s^2 with total of 83 mesoscale eddies during the whole year. EKE peaks were observed during the southwest monsoon with mean values of ~ 0.1 m^2/s^2 in the AS, driven by intensified wind stress (0.3 - 0.5 N/m^2) and strong current velocities and in the BOB ~ 0.06 m^2/s^2 mean EKE with wind stress of (0.2 - 0.3 N/m^2). A secondary peak emerged during the northeast monsoon with the wind stress of (0.1 - 0.2 N/m^2). Statistical analysis using a Generalized Additive Model (GAM) revealed that non-linear correlations, with EKE positively linked to current velocity and complex interactions with wind stress and SST. Wind stress values were highest at more than 0.5 N/m^2 during SW monsoon in the AS region, significantly influencing eddy generation. SST values ranged from 20 - 35°C in both positive and negative anomalies, with warmer SSTs associated with anticyclonic eddies and cooler SSTs with cyclonic eddies. These findings underscore the critical role of wind-driven processes in modulating eddy dynamics and ocean circulation patterns in the Northern Indian Ocean. They enhance the understanding of ocean-atmosphere interactions and provide insights relevant for climate studies, ocean modeling and marine resource management.

Keywords: Eddy Kinetic Energy (EKE); Generalized Additive Model (GAM); Mesoscale Eddies; Northern Indian Ocean; Sea surface temperature (SST)

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Diversity and abundance of coastal plankton in relation to some physico-chemical properties at selected sites, northern Jaffna Lagoon, Sri Lanka

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Abstract

This study evaluates the diversity and abundance of coastal phytoplankton and zooplankton in relation to key physicochemical properties at ten selected sites in the Northern Jaffna Lagoon (NJL), Sri Lanka. Plankton and water samples were collected during a single intensive survey on 5 July 2025. Phytoplankton were collected using a 10 µm mesh net and preserved in Lugol's solution, while zooplankton were collected with a 50 µm mesh net and preserved in 5% buffered formalin. Specimens were identified to the lowest possible taxonomic level and enumerated microscopically. Water samples were analyzed for nutrients, chlorophyll-a (Chl-a), total suspended solids (TSS), dissolved oxygen (DO), biochemical oxygen demand (BOD), and other physicochemical parameters. A total of 48 phytoplankton species (34 diatoms, 12 dinoflagellates, 1 green alga, and 1 cyanobacterium) and 26 zooplankton species were identified. Diatoms dominated the phytoplankton community, comprising 83.48% of the mean composition, followed by dinoflagellates (14.89%), green algae (2.08%), and cyanobacteria (2.08%). *Coscinodiscus* sp., *Stellarima* sp., and *Actinocyclus* sp. were the most abundant phytoplankton species. Phytoplankton and zooplankton abundance showed significant spatial variation (one-way ANOVA; $p < 0.05$). Hyper-eutrophic conditions were recorded at site JBP05 (near a waste disposal area), characterized by elevated pollution indicators: TSS (12.2 mg/L), BOD (4.67 mg/L), and phosphate-P (0.179 mg/L). This site exhibited a pronounced shift in community structure, with increased dominance of dinoflagellates (*Gyrodinium* sp.) and the presence of parasitic taxa (*Lagenisma* sp. and *Dissodinium* sp.). Plankton abundance showed strong and significant correlations with pollution indicators: diatom abundance correlated negatively with salinity ($r = -0.925$), while dinoflagellate abundance correlated positively with TSS ($r = 0.827$), BOD ($r = 0.776$), and phosphate-P ($r = 0.761$). In contrast, sites with lower anthropogenic influence were dominated by diatoms. The results demonstrate that anthropogenic activities, particularly near waste disposal and river discharge points, significantly alter plankton community structure in the NJL. The robust correlation between pollution indicators and plankton composition underscores the utility of plankton as sensitive bioindicators of environmental stress. This research provides foundational ecological data for the NJL, highlighting the urgent need for targeted management of pollution sources to safeguard the lagoon's ecological integrity and water quality.

Keywords: Diatom; Dinoflagellate; Jaffna lagoon; Physicochemical parameters; Sri Lanka; Zooplankton

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Assessing primary productivity in Negombo Lagoon, Sri Lanka

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Abstract

Negombo Lagoon is a critically important coastal ecosystem in Sri Lanka, supporting significant biodiversity and local livelihood. Primary productivity, the rate at which energy is fixed by phytoplankton, is a fundamental indicator of its ecological health. However, the lagoon faces increasing pressure from anthropogenic activities, making the assessment of its metabolic state crucial. This study aimed to quantify the rates of Gross Primary Productivity (GPP), Net Primary Productivity (NPP), and Community Respiration (R) in Negombo Lagoon, and assessed the spatial variation of these metabolic rates in relation to the prevailing salinity gradient. The study was conducted in July 2025. Surface water samples were collected from eight Sites representing a gradient from 8 – 30 PSU. Primary productivity was measured using the light-dark bottle method and dissolved oxygen concentrations were determined by Winkler's method. Metabolic rates were calculated in carbon units (mg C L^{-1} h^{-1}) and analyzed against salinity and temperature data. Preliminary results indicated significant spatial variability in primary productivity. Gross Primary Productivity (GPP) ranged from 0.17 to 0.73 mg C L^{-1} h^{-1}, with a mean of 0.39 ± 0.20 mg C L^{-1} h^{-1}, and site 4 identified as a distinct productivity hotspot. Sites influenced by freshwater inputs from the Muthurajawela marsh exhibited higher GPP and R compared to sites near the marine channel. Majority of the sites has been observed as autotrophic (5 of 8) showing P:R ratios >1. A moderate negative correlation was observed between GPP and salinity (Spearman's r_s = -0.40), indicating that higher productivity tended to occur in areas of lower salinity, though this relationship was not statistically dominant. The findings reveal that Negombo Lagoon is a moderately productive system with a complex metabolic structure, characterized by significant spatial heterogeneity. This highlights the need for zone-specific management strategies to maintain the ecological health of this vital ecosystem.

Keywords: Light-Dark bottle method; Negombo lagoon; Primary productivity; Spatial variability; Winkler's method

Technical Session III

Marine Engineering and Technology

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Feasibility study on generating electricity from the waste heat of marine engine exhaust using thermoelectric generator

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Abstract

The maritime industry continues to rely heavily on large two-stroke diesel engines typically reject approximately 30-40% of the fuel energy as exhaust heat, offering considerable potential for waste heat recovery to improve onboard energy efficiency and reduce greenhouse gas emissions. This study investigates the technical and economic feasibility of integrating a thermoelectric generator (TEG) system to recover exhaust heat from a 12,640 kW MAN B and W S60MC6 marine diesel engine and convert it into auxiliary electrical power. The research focused on designing an efficient TEG configuration, optimizing exhaust gas flow geometry, and evaluating overall system performance using computational analysis. The modeling assumed steady-state engine operation at nominal load, uniform exhaust gas properties, constant thermoelectric material characteristics, and simplified convective boundary conditions on both the hot and cold sides. The methodology involved thermoelectric material selection, conceptual exhaust pipe modifications using axial and radial baffles, and the design of a plate-type cold-side heat exchanger. Thermal-fluid simulations were conducted in ANSYS® to assess heat transfer behavior, temperature gradients, and exhaust backpressure under simulated operating conditions. Simulation results indicated that a combination of axial baffles in the exhaust pipe and a plate-type heat exchanger achieved an optimal balance between enhanced heat transfer and minimal backpressure. An optimized configuration comprising 1,440 thermoelectric modules was predicted to generate approximately 27.6 kW of electrical power, corresponding to about 5.1% of the available exhaust energy, while limiting the exhaust gas temperature reduction to approximately 8 °C. Parasitic losses, including thermal contact resistance, electrical conversion losses, and auxiliary pumping power, were not explicitly modeled and may reduce the net electrical output in practical applications. The findings confirm that TEG-based waste heat recovery offers a compact, modular, and solid-state solution suitable for marine environments, with advantages such as high reliability, low maintenance requirements, and retrofit capability. Practical integration challenges, including space constraints, engine-induced vibration, and thermal cycling, require careful consideration during system implementation. From an economic perspective, preliminary estimates suggest that fuel savings from recovered electrical power could result in a reasonable payback period, particularly for vessels with high annual operating hours. Overall, the proposed TEG-integrated exhaust energy recovery system demonstrates technical feasibility, practical applicability, and alignment with International Maritime Organization (IMO) energy-efficiency and decarbonization goals.

Keywords: Marine diesel engine; Waste heat recovery; Thermoelectric generator (TEG); Exhaust pipe modification; Plate-type heat exchanger.

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Design of an onboard waste heat utilization mechanism for field applications

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Abstract

A substantial fraction of the energy produced by internal combustion engines is dissipated as waste heat through exhaust gases, representing an underutilized energy resource. Recovering this thermal energy can improve overall system efficiency and reduce dependence on external energy inputs. In Sri Lanka, inefficient drying practices contribute to nearly 15% of annual post-harvest losses. Freshly harvested paddy typically contains 20-25% moisture, which must be reduced to about 13-14% for safe storage and long-term preservation. Conventional sun drying is weather dependent, labour intensive, and susceptible to contamination, while mechanical dryers are expensive owing to the use of fuel or electricity making them less feasible. Therefore, paddy drying presents an ideal case study area to investigate the applicability of utilizing onboard energy. Accordingly, this research focused on exploring the feasibility of recovering waste heat from exhaust gases by developing an onboard paddy drying system integrated into harvesters. As the initial stage, an onboard waste heat recovery mechanism was designed for a YANMAR AW82GV paddy harvester powered by a 4TNV98T diesel engine. The system employs a thermosyphon type heat pipe heat exchanger (HPHE) consisting of six copper heat pipes with water as the working fluid. This compact HPHE effectively transfers exhaust heat to the condenser section, where ambient air is heated and directed via a centrifugal blower. At an exhaust inlet temperature of 450 °C and a volumetric flow rate of 174 *l*/s, the HPHE achieved efficient phase change driven heat transfer, maintaining condenser outlet air temperatures between 50-60 °C, ideal for paddy drying. The numerical and thermal simulations were performed assuming steady-state engine operation, uniform exhaust gas properties, constant thermophysical properties, gravity-assisted heat pipe operation, and simplified convective boundary conditions. The simulations, conducted using ANSYS®, validated the drying performance of the system by confirming a reduction in paddy moisture content from 20-22% to 15-17% using the heated air stream generated by the HPHE. Furthermore, the compact, gravity-assisted configuration, together with the integration of a low-power blower, enhances the system's adaptability for field applications without requiring significant modifications. Overall, the proposed system demonstrates technical feasibility, practical relevance, and potential to reduce post-harvest losses while supporting sustainable agricultural practices.

Keywords: Internal combustion engine; Paddy drying; Thermosyphon heat pipe; Waste heat recovery

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Prototype development and performance testing of an integrated floating system for river and estuary plastic waste interception and collection

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Abstract

Plastic pollution in rivers and estuaries is a major contributor to marine litter, disrupting ecosystems, impeding navigation, and degrading water quality. Since a large portion of marine plastics originates from inland waterways, interception at the river and estuary level provides an effective mitigation strategy. This study presents the design, development, and testing of an integrated floating system for the collection of plastic waste in flowing water. The project aims to deliver a cost-effective, scalable, and environmentally compatible solution that operates efficiently without disturbing aquatic habitats or navigation. The proposed system integrates three core subsystems: a roller-type floating barrier for guiding and collecting debris, an image processing-based detection unit for the identification and removal of large objects, and an automated extraction mechanism for periodic debris removal. Notably, the image processing and automated extraction subsystems represent novel features that distinguish the proposed system from existing similar solutions globally. The roller type barrier, fabricated from lightweight, corrosion-resistant materials, ensures durability and unimpeded water flow. The detection unit enhances operational safety of floating barrier by enabling real-time monitoring and automated removal of large debris. A prototype was developed and tested in a controlled flow channel replicating riverine conditions. Analysis of key performance indicators, including debris capture capability, flow resistance, and energy consumption, indicated consistently high interception capability across different flow velocities. By responding to loading sensor signals, the automated extraction mechanism enables periodic removal of accumulated waste, minimizing clogging and sustaining continuous operation. Power consumption remains below 45-50 W for this prototype, indicating strong potential for integration with renewable energy sources such as solar power. The developed system demonstrates strong potential as a sustainable and technically viable approach to controlling plastic pollution in inland waterways. Its modular design, low energy demand, and operational flexibility make it suitable for diverse riverine and estuarine settings. Future improvements will focus on integrating artificial intelligence for autonomous operation, enhancing energy efficiency, and scaling the system for real-world deployment, supporting cleaner waterways and reducing marine litter inflow.

Keywords: Floating barrier system; Plastic waste interception; Prototype testing; River pollution control and estuary management; Autonomous waste collection with image processing

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Prototype development of a catamaran-based coastal plastic debris collection and interception system

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Abstract

Coastal plastic pollution has become a critical global environmental challenge, posing serious threats to marine ecosystems, navigation safety, fisheries, and tourism. Floating debris originating from land-based runoff and maritime activities continues to accumulate due to ineffective interception at the coastal interface. Coastal waters are of particular concern, as studies indicate that approximately 70-80% of marine plastic debris accumulate in these regions. In such environments, plastics are typically dispersed over wide surface areas, rendering conventional continuous collection systems such as conveyor belts or fixed skimmers inefficient, energy intensive, and economically impractical, especially under low or uneven debris loading. These challenges necessitate a targeted, energy-efficient, and adaptive debris collection solution tailored for coastal conditions. This study presents the design and prototype development of a remotely operated, catamaran-based coastal plastic waste collection system integrating a floating net barrier with an automated debris conveyance mechanism. The design objectives included high transverse stability, shallow draft capability, low power consumption, and operational simplicity. A twin-hull catamaran configuration was adopted to enhance buoyancy and stability while minimizing hydrodynamic resistance in shallow and wave-affected waters. The prototype is 2.0 m in length, 1.2 m in beam, and has a draft below 0.3 m, yielding a length-to-beam ratio of 1.67, within recommended limits for small catamaran workboats. Stability analysis showed a positive transverse metacentric height of 0.27 m, indicating adequate stability under calm to moderate conditions. The system design adheres to established small craft stability standards (ISO 12217) and considers relevant IMO guidelines (MSC.1/Circ.1283) applicable to non-SOLAS vessels. Lightweight HDPE hulls and coated aluminum structural components were employed considering corrosion resistance and low maintenance. Electric propulsion with high-torque gear systems enabled reliable net deployment. Prototype testing in simulated coastal waters evaluated debris capture efficiency, platform stability, and energy consumption. Results demonstrated effective debris collection, stable operation, and low power demand. Compared to fixed or large-scale systems, the design offers improved mobility, reduced cost, and suitability for shallow waters, providing a scalable foundation for future integration of autonomous navigation and renewable energy systems. This work represents a design-stage prototype which requires refinement through numerical analyses (CFD/FEA) and long-term field testing before full-scale deployment.

Keywords: Coastal cleanup; Marine debris interception and collection; Catamaran prototype; Floating waste collector; Energy-efficient design

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Novel oleophilic graphene-based material development for oil skimmers: a comparative study on surface functionalization and enhanced oil-water separation

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Abstract

Transportation, industrial operations, and harbour-related activities are major sources of oil contamination in aquatic environments, causing severe ecological damage and long-term environmental risks. Effective oil spill mitigation requires absorbent materials with high efficiency, strong oil selectivity, and minimal water uptake, particularly under marine and coastal conditions. However, conventional oil absorbing materials often exhibit limited absorption capacity, poor selectivity, and inconsistent performance, restricting their large-scale application. Although polyurethane (PU) sponges are attractive due to their low cost and ease of fabrication, their intrinsic oil absorption capability remains inadequate. While graphene-based surface functionalization has shown promise, systematic studies on the effect of graphene coating concentration across different petroleum products remain limited, highlighting a critical research gap. To address this gap, the present study focuses on fabrication and systematic evaluation of polyurethane (PU) sponges functionalized with graphene oxide (GO) and reduced graphene oxide (rGO). Pristine PU sponges were initially ultrasonically cleaned using ethanol and deionized water, followed by dip-coating in aqueous GO suspensions with concentrations ranging from 0.5 to 2 mg ml^{-1}. The coated sponges were subsequently chemically reduced using L-ascorbic acid as an environmentally benign reducing agent to obtain rGO-functionalized PU sponges. The absorption capacities of the fabricated sponges were assessed through absorption experiments using diesel, engine oil, kerosene, *n*-hexane, and water. The absorption experiments revealed a strong dependence of oil uptake capacity on the graphene coating concentration. The rGO-functionalized PU sponges exhibited maximum absorption capacities of 47.69 g g^{-1} for diesel and 31.67 g g^{-1} for engine oil at a GO concentration of 1 mg ml^{-1}, while kerosene showed its highest absorption capacity of 41.38 g g^{-1} at 2 mg ml^{-1}. In contrast, water absorption remained consistently low across all samples, with a minimum value of 4.94 g g^{-1}, demonstrating the strong selectivity of the fabricated sponges toward non-polar liquids. Compared to pristine PU sponges, the graphene-modified sponges showed a substantial enhancement in oil absorption capacity and selectivity. These findings confirm that graphene-based surface functionalization is an effective strategy to improve the oil absorption performance of PU sponges, highlighting their potential as low-cost and efficient absorbent materials for oil spill remediation applications.

Keywords: Coastal and marine pollution; Oil spill remediation; Oleophilic absorbent materials; Graphene-functionalized polyurethane sponge; Oil-water selectivity

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Feasibility and performance evaluation of hydrogen fuel cell integration into hybrid marine propulsion systems

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Abstract

The maritime industry contributes significantly to Global Greenhouse Gas (GHG) emissions due to its reliance on fossil fuel-based propulsion systems. To comply with the International Maritime Organization (IMO) 2050 decarbonization targets require propulsion solutions that reduce emissions without compromising operational reliability. This study evaluates the feasibility and performance of hydrogen fuel cell-based hybrid marine propulsion systems. The first objective involved a systematic evaluation of hydrogen fuel cell technologies using Analytical Hierarchy Process (AHP), Multi-Criteria Decision Analysis (MCDA), and Decision-Matrix Approaches. Selection criteria included efficiency, durability, safety, emission performance, and system integration complexity. Criteria weighting and scoring were derived from literature-based performance data and peer-reviewed articles relevant to marine operational conditions. Based on aggregated decision scores, Proton Exchange Membrane Fuel Cells (PEMFC) were identified as the most suitable fuel cell technology for hybrid marine propulsion. Under the second objective, a comparative environmental assessment of PEMFC-diesel hybrid systems against conventional diesel and battery-based systems was conducted. An Excel-based emission model developed in accordance with Intergovernmental Panel on Climate Change (IPCC) guidelines, employed fuel consumption data on Lower Heating Value (LHV) basis, standard marine diesel emission factors, and high-purity hydrogen assumptions. The analysis quantified CO_2, CH_4, and N_2O emissions to determine total CO_2-equivalent output. The hybrid configuration achieved a 15-25% reduction in CO_2 emissions relative to diesel-only operation, while eliminating onboard NO*x*, SO*x*, and particulate matter emissions during fuel cell operation. Optimal hybrid operation was observed at 75-85% engine load, based on combined efficiency characteristics and operational constraints of the diesel engine and fuel cell system. Overall, the findings confirm that PEMFC-based hybrid propulsion is technically viable and environmentally feasible for marine applications. The study suggests that broader implementation depends on hydrogen cost, lifecycle analysis, safety standards, regulatory frameworks, and refueling infrastructure development.

Keywords: Proton Exchange Membrane Fuel Cell (PEMFC); Hybrid marine propulsion; Hydrogen energy; Emission reduction; Maritime decarbonization

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Optimization of Darrieus combined with Savonius vertical axis wind turbines (vawt) using model–based approaches for offshore wind energy harvesting

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Abstract

The transition to renewable energy is accelerating as nations strive to reduce reliance on fossil fuels and address climate change, and offshore wind has emerged as a key contributor with better and stable wind resources compared to onshore sites. While Horizontal Axis Wind Turbines (HAWTs) dominate the market, their reliance on yaw systems, high maintenance needs, and poor performance in turbulent offshore conditions are issues. Vertical Axis Wind Turbines (VAWTs) have some advantages, such as omnidirectional wind collection, strength in structure, and simpler maintenance, but every model has its drawbacks: the Darrieus turbine, as aerodynamically efficient, suffers from poor self-starting, while the Savonius turbine enjoys excellent self-starting capability but low efficiency. In an effort to address this gap, this project designs a hybrid VAWT system with the integration of a Savonius rotor and a Darrieus rotor, optimized through QBlade simulations by adjusting blade angle, twist, and number of blades to ensure a high power coefficient (Cp) while minimizing the startup torque. The Savonius turbine with maximum overlap and curvature added low-speed startup torque, whereas the Darrieus turbine was best at high tip speed ratios (TSR). Structural validation under SolidWorks and shaft and bearing analysis confirmed mechanical dependability, with a freewheeling mechanism reducing drag penalties during high TSR conditions. The simulation outcome demonstrated stable self-starting capability, enhanced Cp, and operational stability, confirming the hybrid VAWT's worth as a robust and effective choice for offshore wind power.

Keywords: Hybrid VAWT; Self-starting performance; Offshore wind energy.

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Maritime Transportation, Logistics, and Supply Chain Management

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A comparative study, effect of port terminal service quality on customer satisfaction: special reference to public and private terminals, Port of Colombo, Sri Lanka

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Abstract

The public and private terminals at the port of Colombo are the predominant service providers of international maritime shipping logistics services in order to fulfill the needs and requirements of port customers. Only a few empirical investigations have been conducted in Sri Lanka that comparatively examine how port terminal service quality affects customer satisfaction by investigating customers who use both public and private terminals. Thus, to minimize the gap, this study aims to comparatively explore the effect of Port Terminal Service Quality on Customer Satisfaction in the Port of Colombo, using a deductive approach. The study's population consists of shipping companies and freight forwarders who have utilized both public and private terminals. Using a random sampling technique, data was gathered from 182 customers through structured questionnaires. The data collected was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). A substantial positive relationship was observed between customer satisfaction and the dimensions of independent variables of public terminal service quality, including outcomes, management, image, and social responsibility. Customer satisfaction was positively correlated with similar dimensions of the private terminal service quality, such as management, image, social responsibility, resources, and outcomes. Private terminals outperformed public terminals in terms of service quality and customer satisfaction. Image and social responsibility were highly significant positive relationships in the private terminal ($\beta = 0.473$) than in the public terminal ($\beta = 0.45$). The outcome was significantly more positive relationships in the public terminal ($\beta = 0.284$) than in the private terminal ($\beta = 0.159$). Management had moderately significant positive relationships in the public terminal ($\beta = 0.378$) than in the private terminal ($\beta = 0.344$). Resources were only a significant positive relationship in the private terminal ($\beta = 0.132$). The study's findings are essential to those working in the maritime and logistics industries to enable thoughtful decisions and measured modifications that enhance the quality of services.

Keywords: Port terminal service quality; Customer satisfaction; ROPMIS model

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The missing link: can Sri Lanka's multimodal future begin at Makumbura MMC

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Abstract

Multimodal transport systems represent a critical pathway to achieving sustainable urban mobility in developing economies. Globally, integrated multimodal hubs have demonstrated significant success: Delhi's multimodal network has reduced private vehicle dependency by 35%, while Singapore's integrated transport system achieves 75% modal shift through unified ticketing and digital infrastructure. In Sri Lanka, rapid urbanization has intensified transportation challenges, with vehicle registrations increasing by 8.5% annually, yet systematic comparative studies on multimodal hub effectiveness remain limited in local transport literature. The Makumbura Multimodal Center (MMC), established as Sri Lanka's first major multimodal passenger hub, offers an opportunity to examine whether such integration can address national sustainability goals. This research investigates Makumbura MMC's potential as a foundation for Sri Lanka's multimodal future through a mixed-methods case study approach. Primary data were collected via a commuter survey (n=60), a youth awareness survey (n=80, aged 18–30), two expert interviews, and direct observations. Secondary data included peer-reviewed literature from 2015–2025, JICA master plans, and transport policy documents. Key findings revealed that while Makumbura MMC improves connectivity between road and rail networks, it operates as an intermodal rather than true multimodal hub. Statistical analysis indicates 72% of commuters primarily use highway buses, 25% utilize rail, and only 40% understand multimodal transport concepts, compared to global awareness levels of 65–80% in developed systems. User satisfaction was moderate at 65%, significantly lower than international benchmarks (80–90% in comparable regional hubs). However, youth surveys showed encouraging support, with 79% aware of the MMC and 70% endorsing digital ticketing innovations. Critical gaps include absence of port and airport integration, lack of unified ticketing systems, and institutional fragmentation. When compared to international models, Makumbura's performance is constrained by governance silos and weak inter-agency coordination, mirroring challenges documented in emerging Asian transport systems. The research concludes that Makumbura MMC represents a significant but incomplete first step toward sustainable multimodal integration. To realize its full potential and align with Sri Lanka's 2030 sustainability agenda, the country must prioritize institutional coordination, implement smart ticketing infrastructure, and expand multimodal networks to regional centers. These interventions are essential for reducing transport sector emissions by 15–20%, improving accessibility, and establishing Sri Lanka as a regional leader in sustainable mobility

Keywords: Multimodal transport; Sustainability; Makumbura MMC; Urban mobility; Sri Lanka

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Emission reduction potential through shore power at the Port of Colombo: a sustainable solution for berthing vessels

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Abstract

The maritime shipping industry contributes significantly to global greenhouse gas emissions and local air pollution, with port operations representing a substantial portion through auxiliary engine operations of berthed vessels that rely on high-sulfur marine fuels. While shore power technology has demonstrated considerable emission reduction potential in developed regions, there remains a notable lack of context-specific research examining its feasibility and environmental benefits in South Asian ports. This study investigates the emission reduction potential of implementing shore power technology at the Port of Colombo, Sri Lanka's premier transshipment hub. The research employs a comparative scenario analysis methodology utilizing secondary data from multiple authoritative sources including IMO guidelines, Ceylon Electricity Board reports, and port operational statistics. Vessel traffic data were analyzed across five vessel categories (small feeder, medium container, large container, ultra-large container, and other vessels), with energy consumption estimated based on vessel-specific auxiliary power requirements ranging from 600-2,200 kW/h and berthing duration varying from 8-24 hours depending on vessel size. Emission calculations applied IMO Tier I-III standards for marine auxiliary engines with emission factors of 620 g CO_2/kWh, 10.5 g NO_x/kWh, 6.8 g SO_x/kWh, and 0.45 g particulate matter/kWh. Sri Lanka's weighted grid emission factor of 395 g CO_2/kWh was calculated based on the national energy mix comprising thermal coal (35%), thermal oil (15%), hydro (40%), wind (8%), and solar (2%). Results demonstrate that implementing shore power at Colombo Port would reduce annual emissions by 11,539.6 tonnes of CO_2 representing a 36.3% reduction, while achieving complete elimination of local air pollutants including 538.4 tonnes of NO_2, 348.7 tonnes of SO_2, 12.3 tonnes of PM_{10}, and 10.7 tonnes of $PM_{2.5}$, all showing 100% reduction.These findings provide evidence-based support for shore power implementation as a viable maritime decarbonization strategy in South Asian ports, with progressive improvement potential as grid renewable penetration increases toward national targets.

Keywords: Cold ironing; Maritime emissions; Port of Colombo; Port sustainability; Shore power

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The relationship between import customs tariff levels and seaborne trade in Sri Lanka: a time-series analysis

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Abstract

This study examines the causal relationship between import customs tariff levels and seaborne trade in Sri Lanka from 2000-2021 to provide a deeper understanding into how national tariff policies influence the exports, imports and vice versa. Annual secondary of Tariffs data from World Bank and Seaborne trade data from UNCTAD databases were sourced to conduct a time-series analysis by following a quantitative causal-comparative design. The Granger causality test was employed to determine causality and its direction between the two variables. The data set includes Sri Lanka specific weighted mean tariff rates and seaborne trade; export and import volumes in metric tons in thousands, which includes both the loaded and unloaded cargo volumes. After testing the stationarity of data, optimal lags were determined using the Schwarz Bayesian Information Criterion (SBIC) in a Vector Autoregression (VAR) model. Findings reveal that unloaded crude oil cargo volumes Granger-cause tariffs, indicating that tariff policy in Sri Lanka is reactive towards crude oil imports. Conversely, tariffs Granger-cause dry cargo unloaded, other tanker loaded and unloaded, and total unloaded cargo volumes, implying that tariff policy changes precede and can be associated with the following changes in these categories, in other words, sensitive to tariff changes. The descriptive analysis also points to Sri Lanka's ongoing trade deficit, where imports far exceed exports. Although most of the models met stability conditions, some VAR models exhibited instability and must be interpreted with caution. In summary, the results suggest that Sri Lankan tariff change is largely reactive responding to the external or local changes rather than proactive trade policy planning, with such polices focused mainly on import-oriented trade. The results emphasize the need for data driven tariff reforms and integrated policy frameworks with choreographed trade, fiscal, and trade policies to achieve resilient trade performance and economic stability.

Keywords: Granger causality; Seaborne trade; Sri Lanka; Tariffs

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Evaluating the effects of marine transportation on marine biodiversity along the southern coast of Sri Lanka

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Abstract

International trade and coastal development depend on marine transportation, but it also severely stresses marine biodiversity. This study evaluated how marine transportation affected marine ecosystems along Sri Lanka's southern coast, with particular attention to species diversity, habitat quality, and water quality. Four sites were selected to represent variation of maritime activity: Dondra (high vessel traffic), Tangalle (moderate activity), Hambantota (commercial port and shipping route), and Rekawa (low activity, control site). Fieldwork was conducted in 2023 from January to March. According to APHA (2017) guidelines, water quality parameters were measured, including temperature, salinity, pH, turbidity, dissolved oxygen (DO), and oil/grease concentrations. Underwater visual surveys were carried out using SCUBA and snorkeling to record fish abundance, coral cover, and benthic diversity. Hydrophones were used to record marine noise, and the Shannon-Wiener (H′) and Simpson's (D) diversity formulas were used to compute biodiversity indices. The associations between transportation intensity, water quality, and biodiversity parameters were assessed using statistical analyses such as one-way ANOVA and Pearson correlation. The findings showed that the concentrations of oil and grease, DO, and biodiversity indices varied significantly ($p < 0.05$) between sites. In addition to having lower DO and coral cover, Hambantota and Dondra had the highest oil and grease levels (3.4 ± 0.8 and 2.9 ± 0.5 mg/L, respectively). Hambantota had the lowest biodiversity ($H' = 1.73$) and Rekawa the highest ($H' = 3.21$). Coral cover decreased from 48% at Rekawa to 19% at Hambantota, and fish abundance decreased by 42% between high and low activity zones. Reduced species diversity and habitat quality were strongly associated with higher noise levels (92–118 dB) and turbidity. The results show that pollution, sediment resuspension, and acoustic disturbance caused by intensive marine transportation have a negative impact on marine biodiversity and water quality. To lessen effects and encourage sustainable marine transportation in Sri Lanka, the study suggests cleaner maritime technologies, integrated coastal zone management (ICZM), and the creation of marine conservation zones.

Keywords: Biodiversity; Marine transportation; Southern coast; Sri Lanka; Water quality

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Evaluating the impact of green supply chain practices on cost efficiency in shrimp aquaculture

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Abstract

Shrimp aquaculture is a vital component of Sri Lanka's seafood sector, contributing significantly to export earnings and coastal livelihoods. However, the industry faces rising production costs, environmental pressures, and increasing demand from international markets for sustainably produced seafood, posing challenges to long-term competitiveness. In this context, green supply chain management (GSCM) has emerged as a potential approach to improve environmental performance while enhancing cost efficiency. Despite growing interest, empirical evidence on the cost-related outcomes of GSCM adoption in Sri Lanka's shrimp aquaculture sector remains limited. This study therefore examines whether the adoption of GSCM practices is associated with improved cost efficiency among shrimp export firms. A mixed-method research approach was employed, using structured questionnaires administered to nine major shrimp export companies representing a substantial share of national exports. Supplementary information was obtained from secondary sources, including industry and policy reports. Data were analyzed using descriptive statistical techniques to assess patterns of GSCM adoption and perceived changes in cost efficiency. The findings indicate that wastewater treatment and renewable energy were the most widely adopted GSCM practices, while recyclable packaging showed limited uptake. Most respondents reported perceived reductions in energy use, water consumption, and waste management costs following GSCM implementation. Overall, approximately three-quarters of the surveyed firms indicated that GSCM practices contributed positively to their cost efficiency and export competitiveness. However, respondents also highlighted high initial investment requirements and limited technical capacity as key barriers to wider adoption. The study provides indicative evidence that GSCM practices can support both sustainability and cost efficiency in Sri Lanka's shrimp aquaculture sector. While the findings are exploratory in nature, they highlight the need for targeted policy incentives and technical support to encourage broader adoption. Further research using larger samples and objective financial data is recommended to strengthen empirical validation.

Keywords: Cost efficiency; Green supply chain; Shrimp aquaculture; Sustainability

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Prioritizing operational challenges in freight forwarding industry in Sri Lanka

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Abstract

The freight forwarding industry is essential for enabling international trade and connecting global supply chains, particularly in developing countries like Sri Lanka, where efficient logistics directly shape trade competitiveness and costs. Despite its importance, the sector faces persistent operational challenges that limit its effectiveness. This study explores these challenges through a perception based approach presenting a practical experience of practitioners who are directly involved in daily operations, regulatory compliance, and decision making. Data was collected from operational managers, supply chain managers, and other managers who are with direct responsibility for cargo movement from 183 licensed Class A freight forwarding companies registered with the Merchant Shipping Secretariat. Through an extensive literature review, 26 operational challenges were identified and assessed according to respondents' perceptions, with mean scores which was used only to rank challenges by perceived severity rather than to quantify actual costs or delays. Results show that documentation inefficiencies and customs clearance delay specially those caused by incomplete or missing documents and lengthy procedures are considered the most critical challenges. Moreover, Exploratory Factor Analysis grouped these 26 items into seven underlying factors to further examine interrelationships among the challenges and prioritized from most to least severe as perceived by practitioners such that: Operational and Regulatory Inefficiencies; Cost-Related Challenges; Governance Issues; Technological and Documentation Barriers; Service Delays; Documentation Errors and Terminal Cost Issues; and Transparency and Infrastructure Constraints. Accordingly, based on practitioners' perceptions, the study highlights that operational and regulatory inefficiencies are the most critical challenge faced by freight forwarders in Sri Lanka. The finding of this study suggests policymakers and managers on initiating activities in streamlining customs procedures, standardizing and digitizing documentation, improving inter agency coordination, and accelerating digital system adoption, which will support in enhancing the efficiency and strengthening Sri Lanka's trade competitiveness.

Key words: Operational challenges; Freight forwarding; EFA; Logistics Performance

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Impact of post implimentaion practices of ERP systems on firm's financial performance in the logistics industry: a management perspective

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Abstract

There is an ongoing debate on the impact of implementing Enterprise Resource Planning (ERP) systems on financial performances of business organizations. This debate is fueled by the fact that considerable amount of funds is required initially to implement an ERP system, and further, it takes time to appear the positive impact of ERP systems on financial aspect. However, counter arguments emphasise that implementing an ERP system speed up the process, save cost and time although it results in high initial cost and long payback period. This research is an attempt to contribute to this ongoing debate by focusing on the impact of post-implementation practices of ERP systems on the financial performances. This research limits its scope to the logistics industry in Sri Lanka covering shipping and freight forwarding companies in the Colombo district. The post-implementation practices are identified through the management perspective. Accordingly, technological competence, relationship with external experts, top management support, and strategic emphasis are considered as post-implementation practices. Net sales, Return on Investment (RoI), Return on Assets (RoA), and Earnings Per Share (EPS) are employed to cover the financial performances. A sample of 63 companies listed on the Export Development Board (EDB) website, all of which had implemented ERP systems for at least 03 years, was selected for the study. Data was collected from management-level employees. The study employs multiple regression analysis with post-implementation practices of ERP systems as the independent variable, and financial performances as the dependent variable. The results indicate that top management support and strategic emphasis have significant positive impact on financial performance, while technological competence and relationship with external experts show weaker and non-significant impact in the logistics industry. This research contributes to the ongoing debate on implementing ERP systems and its impact on financial performances. Accordingly, if the organization has the top management support and strategic emphasis, it can achieve positive impact on financial performances by implementing ERP systems in the logistic industry. Further, the findings support in understanding how ERP systems can be strategically managed to enhance financial performance. The findings highlight the importance of aligning ERP practices with organizational strategy and securing strong leadership support to optimize ERP outcomes.

Keywords: ERP; ERP Post-implementation practices; Financial performance; Logistics industry

Technical Session V

Marine Biotechnology

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Ciliate associations with *Holothuria atra*: exploring protozoan–host interactions and microbialization potential in marine biotechnology

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Abstract

Ciliates are ubiquitous protozoans in marine ecosystems and play essential yet understudied roles in host–microbe interactions. Among benthic invertebrates, sea cucumbers (Holothuroidea) harbor diverse microbial and protozoan assemblages, but their ecological and biotechnological significance remains largely unexplored. The present study aimed to investigate the presence, isolation, and growth dynamics of ciliates associated with the surface mucus of *Holothuria atra*, a widely distributed Indo-Pacific species of economic and ecological importance. Sampling was carried out between October 2024 and January 2025 at Paraviwella Beach, Tangalle, Sri Lanka (6°01'22"N 80°48'00"E). Specimens were collected from the rocky intertidal zone and maintained in aquaria under controlled conditions (temperature, salinity, pH, dissolved Oxygen). Ciliates were isolated from the external mucus and cultured in vitro using a basic nutritional medium. Microscopic observations were performed daily for 18 days, and isopropyl alcohol was applied to immobilize live specimens for enumeration. The resulting growth curves exhibited a bell-shaped pattern, representing distinct lag, exponential, and decline phases. Regression analyses ($R^2 = 0.5657$–0.9915) demonstrated strong correlations between time and growth rate, indicating reproducible proliferation patterns under controlled conditions. These findings confirm the successful isolation and sustained culture of ciliates from *H. atra* and provide the first detailed account of their growth kinetics in a Sri Lankan context. Beyond their ecological interest, such associations may represent early indicators of microbialization processes, where shifts in microbial or protozoan dominance reflect changes in host health and environmental balance. Understanding these protozoan–host relationships may inform biotechnological applications, including probiotic development, pathogen screening, and environmental biomonitoring in sea cucumber aquaculture.

Key words: Ciliates; Growth curve; *Holothuria atra*; Host interaction; Controlled conditions

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Exploration of versatile antibacterial performance of seaweed, *Dictyota sp*. A facile route for clinical viability

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Abstract

The escalating challenge of antibiotic resistance has prompted the search for novel antimicrobial substances with clinical and industrial viability. Many existing methods for producing antimicrobial agents are limited by their inability to be environmentally friendly, cost-effective, and clinically efficient. Although several studies report antibacterial activity of *Dictyota* sp., their interactions with other chemical agents remain unexplored. This study focuses on extracting antibacterial compounds from *Dictyota* sp. using an aqueous extraction approach, overcoming limitations of conventional techniques. Thiosemicarbazide is a well-recognized pharmacophore with antimicrobial relevance and high affinity for polar environments. Due to its aqueous solubility, it was conjugated with *Dictyota* extract to enable homogeneous distribution and explore alteration of antimicrobial activity. The extracts were characterized using FT-IR, UV-visible spectroscopy, and thin layer chromatography. Antibacterial activity was tested against *Staphylococcus aureus* and *Escherichia coli* using the well-diffusion method, with Cipromycin as positive control and sterile distilled water as negative control. Effects of pH, temperature, concentration and light were evaluated and data were statistically analyzed. *Escherichia coli* and *Staphylococcus aureus* were highly susceptible to *Dictyota* extract, with inhibition zones of 17.5 ± 1.0 mm and 16.83 ± 1.25 mm, respectively. While thiosemicarbazide is effective alone, its conjugation did not improve activity. Overall, aqueous *Dictyota* extract exhibits strong antibacterial activity comparable to Cipromycin. These findings support optimized aqueous extraction as a simple, eco-friendly approach for developing *Dictyota* based antibacterial agents and highlight the importance of accurate statistical analysis.

Keywords: Aqueous extraction; Antibacterial activity; *Dictyota* sp.; Thiosemicarbazide

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An integrative transcriptomic meta-analysis of the Nile tilapia gill response to different stressors

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Abstract

The fish gill is a critical interface with the aquatic environment, essential for respiration, ion regulation, and immunity. Although many studies detail the gill responses to specific stressors, an integrated understanding of its molecular defense mechanisms remains limited. This study performs a large-scale integrative transcriptomic meta-analysis to identify conserved and stressor-specific pathways in the gills of the Nile tilapia (*Oreochromis niloticus*), aiming to predict adaptability and resilience for use in selective breeding programs. We curated and re-analyzed publicly available RNA-seq datasets representing gills exposed to biotic (parasitic), osmotic (salinity), and chemical (alkalinity) stressors. Bioinformatic analysis included quality control, alignment, differential expression, and pathway enrichment. Our analysis revealed a highly conserved and specific response, identifying two core genes consistently regulated across all three distinct stress conditions, Tripartite Motif Containing 16 (TRIM16) and a previously uncharacterized protein. In contrast to this focused core response, unique transcriptomic signatures were delineated for each challenge; biotic stress modulated ion transport and signaling, osmotic stress altered lipid and organic acid metabolism, and chemical stress strongly influenced cellular respiration and energy production pathways. These findings provide a detailed molecular blueprint of the tilapia gill responses to environmental challenges. The identification of TRIM16 and a novel uncharacterized protein as universal stress markers presents robust candidates for monitoring fish health in aquaculture, facilitating breeding of resilient Tilapia strains.

Keywords: Aquaculture; Fish gill, Meta-analysis; *Oreochromis niloticus*; Stress response

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Genome-wide identification and functional annotation of microsatellite markers from *Geloina coaxans*

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Abstract

Geloina coaxans, commonly known as the mangrove clam, is an ecologically and economically important bivalve inhabiting Sri Lanka's estuarine and mangrove ecosystems. It supports local livelihoods as a food source and contributes to ecosystem functioning through filter feeding. However, limited genomic information has hindered the efforts to understand its population genetics which are essential for sustainable management and aquaculture development. This study aimed to identify and characterize novel microsatellite or simple sequence repeat (SSR) markers from the whole-genome sequence of *G. coaxans* and to functionally annotate associated genes. Whole-genome sequencing data (Accession: SRR27290333) were processed using a comprehensive bioinformatics pipeline. Quality control and trimming were performed with fastp, followed by de novo assembly using SPAdes. SSRs were identified with MISA, and gene prediction was conducted using BRAKER2 with the proteome of *Ruditapes philippinarum* as a reference. Functional annotation and Gene Ontology (GO) assignment were performed using InterProScan. Identified SSR loci were mapped to the annotated genome to determine those located within or near (100 kb) functional genes. A total of 9,419 SSRs were identified, from which 86 polymorphic markers were selected. Functional annotation revealed 32 markers associated with genes involved in transcription regulation, polymerase activity, metabolism, and stress responses. Several loci were linked to genes related to growth, immune function, and environmental resilience. Overall, this study provides the first functionally annotated SSR resource for *Geloina coaxans*, which can be immediately applied in population genetic analyses and serves as a foundation for future marker-assisted aquaculture management strategies.

Keywords: Aquaculture; *Geloina coaxans*; Genetic markers; Simple Sequence Repeats (SSR); Sri Lanka

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Investigation of the antibacterial effects of fungal endophytes isolated from a red seaweed collected from Akurala, Sri Lanka

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Abstract

Endophytic fungi and sea weeds, individually, have been reported as rich sources of a wide range of compounds with pharmaceutical properties. However, the ability of endophytic fungi associated with marine algae to produce novel bioactive secondary metabolites remains underexplored. This study aimed to isolate and evaluate the antibacterial properties of endophytic fungi obtained from a morphologically identified red seaweed belonging to the family Galaxauraceae, collected from the coastal area of Akurala, Sri Lanka. The seaweed was surface sterilized, fragmented, and implanted on potato dextrose agar (PDA) prepared with a 1:1 mixture of seawater and distilled water, supplemented with amoxicillin (50 mg/mL). Through successive subculturing, three pure fungal isolates were obtained. Morphological and biochemical analyses suggested that two isolates belonged to *Aspergillus* spp. (A-1, A-5) and one isolate belonged to *Penicillium* spp. (A-4). Using the agar disc diffusion method, the antibacterial activity of mycelial methanol extracts and ethyl acetate extracts of secondary metabolites were evaluated against *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, with ciprofloxacin (1 mg/mL) as a positive control and Dimethyl sulfoxide as the negative control. The ethyl acetate extract of A4 at 20 mg/mL exhibited significant antibacterial activity against *Staphylococcus aureus*, producing an inhibition zone of 1.055 ± 0.23 mm, whereas the methanol extract of A-4 at 7 mg/mL showed significant activity against *Bacillus cereus*, with an inhibition zone of 1.208 ± 0.26 mm, compared to the negative control's inhibition zones of 0 mm, respectively ($p < 0.05$). None of the isolates demonstrated antibacterial activity against *E. coli* or *Pseudomonas aeruginosa*. These findings suggest that red seaweed-associated *Penicillium* spp. represents a promising source of antimicrobial metabolites. Further studies on fungal identification, solvent optimization, and compound characterization are needed to translate these findings into a potential commercial application.

Keywords: Antibacterial activity; Endophytic fungi; Red seaweed; Secondary metabolites

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Mucus microbiota and coral health in southern Sri Lanka

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Abstract

Coral reefs are among the most diverse and productive ecosystems on Earth, playing a crucial role in marine environments by supporting biodiversity and providing habitats for numerous marine organisms. Coral mucus, a gel-like secretion continuously produced by coral polyps, serves as a vital interface between corals and their surrounding environment, fostering complex microbial communities that include bacteria and viruses. The mucus hosts a diverse assemblage of bacteria that play essential roles in coral health and ecosystem functioning, representing a potential source of bioactive compounds. However, limited information exists regarding the abundance of bacteria associated with the mucus of dominant coral species in southern Sri Lanka. This study aimed to quantify the abundance of mucus-associated bacteria in dominant coral species to assess coral health and explore potential links to coral mortality in southern Sri Lanka. Coral mucus samples were collected from three reef sites, Paraviwella (PV), Polhena (POL), and Weligama (WEL), to evaluate bacterial abundance in two key coral species: *Montipora* sp. and *Acropora* sp. Bacterial counts were quantified using epifluorescence microscopy and statistically analyzed through one-way ANOVA and descriptive analysis. Results revealed significant differences in bacterial abundance between *Montipora* sp. and *Acropora* sp. across the southern reef sites ($p < 0.005$). These findings highlight notable variations in mucus-associated bacterial abundance among dominant hard coral species, emphasizing species-specific health and stress dynamics. This study underscores the importance of monitoring bacterial abundance as a potential indicator of coral health, particularly in assessing the impacts of environmental stressors on coral reefs in southern Sri Lanka.

Keywords: Associated bacteria; bioactive compounds; Coral mucus; Coral reefs

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Role of pathogenically important microorganisms in organic matter degradation in northeast Sri Lankan coral reefs

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Abstract

Tropical coral reef ecosystems are among the most productive and biologically diverse habitats on Earth, sustained by the continuous cycling of organic matter originating from coral mucus, algal exudates, and terrestrial runoff. The degradation of this organic matter by heterotrophic and pathogenic bacteria is a critical microbial process influencing coral health and ecosystem stability. This study aimed to evaluate the activity of pathogenically important microorganisms during the degradation of organic matter in seawater collected from coral reefs in Northeastern Sri Lanka. Two seawater samples were collected from each of three reef sites namely Coral Island, Pigeon Island, and Small Island approximately one meter above the coral surface to minimize direct coral mucus influence on 19 October 2024. Biological parameters, including microbial plate counts and direct cell counts (under ambient environmental conditions), were monitored at three time points: 29 October, 6 November, and 5 December 2024. Statistical analysis using repeated-measures ANOVA revealed a significant decline in microbial colony counts over time across all sites (*Vibrio cholerae*, $p = 0.056$; *Vibrio parahaemolyticus*, $p = 0.01$; *Shigella*, $p = 0.01$). Three pathogenically important bacterial species were identified with *Vibrio* spp. dominating the initial phase of organic matter degradation, followed by a decline and subsequent increase in *Shigella* sp. activity during later stages. These temporal patterns suggest a succession of microbial activity during organic matter breakdown, possibly linked to shifts in nutrient availability and environmental conditions. This study highlights the potential ecological role of pathogenic bacteria in organic matter degradation within coral reef environments. The findings provide novel insights into the microbial processes that may influence coral reef resilience and health, offering a biotechnological perspective for microbial monitoring, reef management, and the development of early indicators of reef ecosystem change.

Keywords: Coral mucus; Organic matter; Pathogenic bacteria

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Marine bacteria as promising candidates for long-chain n-alkane degradation: a preliminary screening

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Abstract

Sri Lanka, being an island in the Indian Ocean and located along a major maritime route, faces continued risks of petroleum contamination. Long-chain n-alkanes, which form a substantial fraction of petroleum products, are highly saturated and hydrophobic, allowing them to persist in the environment and accumulate extensively in marine systems. The limitations of conventional clean-up methods highlight the need for sustainable remediation strategies, making bioremediation using native marine bacteria a promising approach, particularly for tropical marine ecosystems. Therefore, this ongoing study aimed to isolate and screen marine bacteria for their potential to degrade long-chain n-alkanes, contributing to the development of novel bioremediation strategies that are suitable for tropical marine environments. Seawater samples were collected from the waters of Dikkowita Fishery harbor, Sri Lanka, in July 2024 and subjected to selective enrichment using n-eicosane (C20:0) as the sole carbon source in Artificial Sea Water media. And each enrichment stage was carried out at 100 rpm at 27 ± 2 ºC for seven days. Following initial and third enrichment, distinct bacterial colonies were isolated on Artificial Sea Water agar. After the initial enrichment process, seven morphologically distinct bacterial strains were observed. The final enrichment yielded two distinct white colony morphotypes: one consisting of small, circular colonies, and the other consisting of large, circular colonies with a creamy texture. The bacterial isolates resulted from the final enrichment demonstrate their ability to expand in a hydrocarbon-stressed environment, strongly suggesting their potential as n-alkane degraders. While quantitative degradation assays using GC-MS are pending, this successful enrichment and isolation provide a favorable foundation for further work. Future molecular identification and quantitative assessment of alkane degradation characterization will evaluate the degradation efficiency of bacterial isolates. This work is a critical first step in developing novel, marine-derived bioremediation agents which are suitable for tropical marine ecosystems.

Keywords: Bioremediation; marine bacteria; n-alkane degradation; n-eicosane; petroleum hydrocarbon pollution

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Identification of mangrove fungi as a potential source of antioxidant properties in Negombo lagoon, Sri Lanka

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Abstract

Mangrove ecosystems are rich reservoirs of microbial diversity, offering untapped potential for bioactive compounds with pharmaceutical and industrial applications. This study aimed to explore the antioxidant potential of mangrove-associated fungi, *Aspergillus niger*, a cosmopolitan and filamentous fungal species isolated from the Negombo lagoon, Sri Lanka. *A. niger* is widely recognized for its robust metabolic versatility and ability to produce a broad range of secondary metabolites, including organic acids, enzymes, and phenolic compounds with known antioxidant and antimicrobial properties. Its adaptability to extreme environmental conditions, such as salinity fluctuations and nutrient limitations in mangrove habitats, enhances its biosynthetic potential and ecological resilience. The research focused on isolating and morphologically identifying *A. niger* from collected mangrove fungi, cultivating the selected isolate, and extracting its bioactive metabolites using ethyl acetate. The antioxidant activity of the ethyl acetate extract was assessed using DPPH radical scavenging, total phenolic, and total flavonoid assays. Quantitative analysis revealed that the extract contained 40.19 ± 36.43 mg GAE/g of phenolic compounds and 20.36 ± 6.42 mg RTE/g of flavonoids, demonstrating significant free radical scavenging activity. The DPPH assay further confirmed the extract's potent antioxidant capacity, with a maximum inhibition of 80.64% and an IC_{50} value of 31.65 µg/mL. Phytochemical screening of the ethyl acetate extract revealed the presence of terpenoids, tannins, and steroidal compounds, while saponins were absent. These bioactive metabolites not only underpin the strong antioxidant potential of *A. niger* but also reflect its ecological adaptability and stress tolerance mechanisms in the mangrove environment. The findings suggest that *A. niger* synthesizes antioxidant compounds such as phenolics and flavonoids as adaptive responses to oxidative stress, contributing to its survival in dynamic coastal ecosystems. This study emphasizes the pharmaceutical and biotechnological value of mangrove-derived fungi in Sri Lanka, demonstrating that *A. niger* is a promising natural source of antioxidants. By bridging ecological understanding with bioactive metabolite exploration, this research highlights the importance of conserving microbial diversity while promoting sustainable utilization of mangrove-associated microorganisms for health-promoting applications.

Keywords: Antioxidant activity; *Aspergillus niger*; Bioactive metabolites; Mangrove fungi; Natural

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Developmental toxicity assessment of *Xylocarpus granatum* bark extract using zebrafish (*Danio rerio*) embryos

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Abstract

This study evaluates the developmental toxicity of *Xylocarpus granatum* bark methanol extract on zebrafish (*Danio rerio*) embryos, focusing on survival rates, hatching success, heart rate, somite formation, and tail formation. Limited systematic toxicological studies have hindered pharmaceutical development despite widespread traditional use, comprehensive safety data remain limited, necessitating systematic toxicological evaluation for pharmaceutical development. Zebrafish embryos, due to their genetic similarity to humans and transparent development, serve as an established model for vertebrate developmental toxicology. The study employed 20 embryos per concentration group, testing five extract concentrations (1, 10, 50, 100, and 200 µg/mL) alongside a negative control (E3 medium) and a positive control (1% DMSO). Following OECD Test Guideline 236 with modifications, embryos were exposed for 96 hours at 26°C with observations recorded at 24-hour intervals. Results demonstrated minimal toxicity across all tested concentrations, with survival rates maintained at 95-100% compared to progressive decline to approximately 80% in positive controls by 96 hours. Hatching success remained ≥95% for all treatment groups, with only minor reduction at 50 µg/mL. Critical morphogenetic endpoints including somite formation (90-100%) and tail formation (95-100%) were consistently preserved across concentrations. Heart rate analysis showed significant changes over time but remained unaffected by extract concentration, confirming normal cardiac development across all treatment groups. Notably, treated groups exhibited apparent protective effects compared to negative controls at later time points. These findings establish *Xylocarpus granatum* bark extract's favorable safety profile with wide therapeutic margins, supporting further preclinical development. However, no concentration-dependent adverse effects on heart rate or morphogenesis were observed, indicating excellent biocompatibility and safety margins suitable for therapeutic applications.

Keywords: Developmental toxicity, OECD 236, *Xylocarpus granatum*, Zebrafish

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Identification of endophytic fungi isolated from the bark of *Rhizophora apiculata* in the Negombo Lagoon, Sri Lanka.

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Abstract

Mangroves are crucial coastal ecosystems that act as buffers between land and sea, supporting rich biodiversity and providing ecological services. Fungal endophytes are microorganisms living within plant tissues without harming the host. Mangrove endophytic fungi can produce metabolites with antimicrobial and antioxidant properties, suggesting their potential as alternative sources of pharmaceutically valuable compounds. Among Sri Lanka's mangrove species, *Rhizophora apiculata* is ecologically and economically significant but understudied regarding its fungal associates. This study aimed to isolate and identify fungal endophytes from the bark of *Rhizophora apiculata* sampled at four stratified sites within Negombo Lagoon, Sri Lanka, over a three-month period from March 2025. From each site, two healthy trees were sampled. The outer bark was carefully removed, and inner bark samples (~2 cm^2) were aseptically obtained and transported promptly. Samples were surface sterilized using distilled water, 70% isopropyl alcohol, and 2% sodium hypochlorite to eliminate epiphytic fungi before endophyte isolation. A total of 96 bark segments (24 segments per site) were cultured on potato dextrose agar to obtain fungal colonies. Identification to genus level was based on colony morphology and microscopic characteristics. A total of 88 fungal isolates from six genera were obtained: *Alternaria*, *Aspergillus*, *Cladosporium*, *Fusarium*, *Mucor,* and *Penicillium*. The majority of isolates (85.23%) belonged to the phylum *Ascomycota* (*Alternaria*, *Aspergillus, Cladosporium, Fusarium,* and *Penicillium*), while 14.77% belonged to the phylum *Mucoromycota* (*Mucor*). *Fusarium* sp. showed the highest bark colonization frequency (40.63%), while *Cladosporium* sp. had the lowest (1.04%). These findings provide baseline data on mangrove-associated fungal endophytes in Sri Lanka, highlighting their ecological significance and offering insights for conservation of fungal biodiversity, potential biotechnological exploitation, and future bioprospecting of novel fungal metabolites in mangrove ecosystems. Although identification was based on morphological and microscopic characteristics, incorporating molecular analyses could enhance taxonomic accuracy.

Keywords: Bark; Endophytic fungi; Mangrove plants; Negombo lagoon; *Rhizophora apiculate*

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Phytochemicals and antioxidant potential in halophytes, *Xylocarpus rumphii* seed extracts, and the traditional medicine 'Gopalu guliya'

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Abstract

Phytochemicals are secondary metabolites in plants that often possess significant antioxidant activity. To determine the most effective use of compounds it is important to identify the best combinations that exhibit high synergistic antioxidant effects as well as phytochemical Screening. Halophytes, *Xylocarpus rumphii* which is traditionally known as 'Kontalaun' is a medicinal plant in Sri Lanka with high potential health benefits and rich in bioactive compounds. It is used as the main ingredient to prepare the well-known Ayurvedic medicine called 'Gopalu guliya'. This study aimed to compare the phytochemical composition and antioxidant activity of three preparations of *X. rumphii* seeds, including preparation methods enhance phytochemical diversity and antioxidant activity. Three samples, extracted using rotary evaporator, respectively the Methanol seed extract, cow milk boiled Seed extract and extract of 'Gopalu guliya' used for standard qualitative phytochemical analysis methods and total antioxidant activity was calculated based on the DPPH scavenging activity, Total phenol content and total flavonoid content. The highest total antioxidant activity ranging from 79.92 ± 2.56 to 91.46 ± 3.25 (µg/mL) was recorded for the seed extract boiled with Cow milk and the lowest total antioxidant activity was recorded in the normal seeds extract ranging between 54.81 ± 1.87 to 62.35 ± 2.14 (µg/mL). The sample 'Gopalu guliya' demonstrated moderate to high antioxidant activity, with values between 73.68 ± 3.02 to 84.72 ± 2.81(µg/mL). The phytochemicals test was done for six phytochemicals including Saponin, Tannin, Terpenoid, steroidal ring, steroidal nucleus and the presence of cardiac glycosides. According to the obtained results, Seed extract boiled with cow milk had presence of all six tested phytochemicals while other two samples only showed positive results for three phytochemicals Saponin, Terpenoid and Tannin. These findings suggest that boiling the seeds with cow milk enhances the release and detectability of a wider range of phytochemicals, likely due to heat-assisted extraction and interactions with milk's lipid, protein matrix. This broader phytochemical profile may also explain the higher antioxidant activity observed in the milk boiled sample. Thus, the traditionally prepared sample showed higher phytochemical richness and antioxidant potential, confirming its ethnomedicinal use. These results support the potential use of traditionally prepared *X. rumphii* formulations in pharmaceutical applications.

Keywords: Halophytes; Phytochemical Screening; Total antioxidant effect; *Xylocarpus rumphii*

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Comparative parasitological analysis of two commercially important edible fish species in Batticaloa Lagoon, Sri Lanka: *Etroplus suratensis* and *Arius maculatus*

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Abstract

Parasitic infections represent a major challenge in wild and cultured fish populations, affecting host health, growth, and survival as well as reducing the quality of fishery products. This study preliminarily investigates the prevalence, intensity of parasites infecting two locally consumed lagoon fish species, *Etroplus suratensis* (pearl spot) and *Arius maculatus* (catfish), collected from selected locations in the Batticaloa Lagoon, Sri Lanka between January and March 2025, covering the late northeast and early inter-monsoon seasons. A total of 91 live fish specimens (39 pearl spot, 52 catfish) were examined through both external and internal parasitological surveys. *E. suratensis* was exclusively infected by the copepod ectoparasite *Ergasilus* sp., showing a high prevalence of infection (73%) and the infection intensity reaching up to 29 parasites per fish. In contrast, *A. maculatus* harboured a more diverse community of parasites, including *Ergasilus* sp., *Lamproglena* sp. (copepod), *Acanthocephalus* sp. (acanthocephalan) and *Clinostomum* sp. (helminth), with an overall parasitic prevalence of 53%. Statistical analysis (ANOVA) revealed no significant variation in parasitic infection across the study period ($p > 0.05$), whereas both host and parasite species showed significant effects on infection prevalence and mean intensity ($p < 0.05$). Among the reported parasites, *Ergasilus* sp. was the most dominant species on both fish. The Chi-square test further confirmed no significant difference ($p > 0.05$) in infection prevalence between the two host species. The findings suggest that infection patterns are primarily determined by host and parasite species rather than temporal changes within the lagoon ecosystem. This study provides valuable baseline information for understanding parasite ecology in two locally important edible wild fish species and emphasises the need for long-term and seasonal monitoring to assess the potential impacts on fish health and fisheries management.

Keywords: Catfish; Lagoon; Parasite; Pearl spot; Prevalence

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Dynamics of bacterial transition in skipjack tuna along the supply chain from Kudawella fisheries harbor to retail vendors in southern Sri Lanka

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Abstract

This study focuses on the bacterial transition in skipjack tuna; *Katsuwonus pelamis,* between two critical points of the seafood supply chain: the fisheries harbor and vendor, while mainly highlighting dynamics of bacterial contamination. Skipjack tuna is a very valuable and commercially significant species. But it is highly vulnerable to microbial spoilage and contamination by pathogenic bacteria. This can be influenced by unhygienic handling and storage practices throughout the supply chain. In this preliminary study, samples were collected from three skipjack tuna (n = 3) during November 2024, resulting 18 gill and skin swab samples from Kudawella Fisheries Harbor and Naotunna Fish Stall. Selected pathogenic bacteria included *Vibrio cholerae, Vibrio parahaemolyticus, Shigella* sp. and *Escherichia coli*, organisms frequently associated with seafood-borne illnesses. Culturing on Thiosulfate-Citrate-Bile Salts-Sucrose (TCBS) and Xylose Lysine Deoxycholate (XLD) agar media after swabbing enables both preliminary differentiation of four bacterial species based on colony colour and quantification through enumeration of colony-forming units (CFU). Results showed a notable growth in bacterial load at the vendor compared to the harbor. Among all, *Shigella* sp. was the most dominant bacterial type (17267 CFU/ml), followed by *Vibrio cholerae* (5550 CFU/ml), *Vibrio parahaemolyticus* (5317 CFU/ml) and *Escherichia coli* (4583 CFU/ml). Bacterial counts (CFU) were analyzed using factorial ANOVA within the Generalized Linear Model (GLM) framework. It was disclosed bacterial type and location remarkably influenced CFU counts and gill and skin regions did not show any notable differences. The findings of this study bring out the importance of improved hygienic practices during transportation, handling storage and marketing practices in order to minimize bacterial proliferation while ensuring seafood safety. These findings point out important insights into transitions of microorganisms and provide practical recommendations that are valuable for seafood quality control enhancement.

Keywords: Bacterial transition; Pathogenic bacteria; Skipjack tuna; Supply chain

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Morphometrics, feeding ecology, and reproductive characteristics of the striped snakehead (*Channa striata*) from the lower Nilwala river, Sri Lanka

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Abstract

The Striped Snakehead (*Channa striata*) is an ecologically and economically important freshwater predator in Sri Lanka, yet detailed information on its growth patterns, reproductive biology, and feeding ecology is limited. This study aimed to investigate these aspects in population inhabiting the lower Nilwala River (5.9672° N, 80.5506° E) in southern Sri Lanka. Fresh specimens (n = 38) were obtained from local fish vendors selling fish captured along a 5 km stretch of the lower Nilwala river using multifilament gill nets (2-inch mesh) and hook-and-line methods during early morning and late evening hours from 2023 to 2025. Out of 38 individual the sex of 32 individuals was successfully determined (19 males and 13 females) based on gonadal examination. The key morphometric parameters of the sample of 32 fishes including standard length (SL), total length (TL), body weight (BW), ovary length (OL), and ovary weight (OW) were measured. Males exhibited a mean standard length (SL) of 42.6 ± 5.3 cm and a total length (TL) of 48.1 ± 8.3 cm, while females showed 38.9 ± 3.0 cm SL and 44.5 ± 4.0 cm TL. Both SL and TL differed significantly between sexes (Mann–Whitney U test, $p = 0.048$ and $p = 0.024$, respectively). However, body weight did not differ significantly ($p = 0.099$) between males (1155.2 ± 305.8 g) and females (937.8 ± 148.3 g The mean ovary length and weight were 8.2 ± 1.1 cm and 18.7 ± 2.7 g, respectively. The length–weight relationship (LWR), estimated using log transformed linear regression, indicated negative allometric growth in both sexes (males: $W = 0.6060 \times SL^{2.01}$, $R^2 = 0.95$; females: $W = 0.7978 \times SL^{1.93}$, $R^2 = 0.78$; $p < 0.01$), suggesting favorable environmental conditions and adequate prey availability. Female specimens had a gonadosomatic index (GSI) of 1.96 ± 0.20%, indicating active gonadal maturation and reproductive readiness. Gut content analysis conducted using microscopic observations revealed that *Channa striata* primarily exhibits a carnivorous diet, consisting mainly of fish (*Heteropneustes fossilis*, *Anabas testudineus*; 18.75%), crustaceans (6.25%), and amphibians (3.13%). Additionally, 21.88% of individuals consumed other food materials, 34.38% had mixed diets including the above categories, and 15.63% had empty stomachs. These results confirm that *Channa striata* serves as an apex-predator in freshwater ecosystems and provide insights into its reproductive capacity and feeding strategy.

Keywords: Allometric growth; Diet composition; Freshwater predator; Gonadosomatic index; Length–weight relationship

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Comparative evaluation of locally-produced nursery feed for swordtail (*Xiphophorus helleri*) with three commercial Aqua feeds

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Abstract

The high cost of imported ornamental fish feeds limits small-scale aquaculture in Sri Lanka, highlighting the need for locally formulated, nutritionally balanced alternatives. However, empirical studies assessing the nutritional performance and physiological effects of locally formulated ornamental fish feeds compared to imported commercial diets are scarce. Therefore, this study aimed to evaluate the growth performance, pigmentation enhancement, and liver function of swordtail (*Xiphophorus helleri)* fed with a newly developed locally formulated nursery feed (T1), compared with three commercial feeds. A locally produced nursery feed was formulated using fishmeal as the main protein source, supplemented with plant and animal-based ingredients, fish oil, vitamin–mineral premix, essential amino acids, and additives. Fish were reared for two months and fed twice daily, at a rate of 5% of their body weight. Growth performance was evaluated using final weight, weight gain, daily weight gain, specific growth rate (SGR), feed conversion ratio (FCR), and survival rate. Final weight (0.68 g), weight gain (0.51 g), and daily weight gain (8.48 mg day^{-1}) differed significantly among diets (ANOVA, $p < 0.05$), with fish fed feed T4 exhibiting the highest growth performance. Feed conversion ratio was lowest in T4 (1.55 ± 0.17), indicating more efficient feed utilization, while specific growth rate and survival did not differ significantly among diets ($p > 0.05$). The total carotenoid concentration was significantly higher in fish fed the locally formulated feed (T1) (3.62 µg/g) compared to T2–T4 (ANOVA, $p = 0.001$), indicating enhanced pigmentation. Hepato-Somatic Index (HSI) values did not differ significantly among treatments (ANOVA, $p = 0.61$), indicating stable liver function. These findings indicate that while some commercial feeds (T4) achieved superior growth, the locally formulated nursery feed (T1) supported acceptable growth, improved pigmentation, and stable liver function. Therefore, locally formulated nursery feed (T1) shows potential as a cost-effective alternative or supplementary feed for small-scale ornamental fish aquaculture in Sri Lanka. The study was limited to a single live bearer species; hence, further evaluations with egg-layers and longer trials are recommended to validate broader applicability.

Keywords: Locally formulated fish feed, Swordtail (*Xiphophorus helleri*), Growth performance, Feed conversion ratio (FCR), Pigmentation (carotenoid content)

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Effects of aqua – soil particle size on the growth performance of *Anubias barteri var. nana* 'Petite' and *Microsorum pteropus* (Java Fern)

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Abstract

Substrate characteristics play a critical role in the successful cultivation of aquatic plants, as both physical properties, such as particle size, and chemical composition can influence nutrient availability, root anchorage, and overall plant growth. In ornamental aquaculture, optimizing substrates is crucial for enhancing the cultivation of slow-growing but commercially valuable species. *Anubias barteri var. nana* 'Petite'(Anubias) and *Microsorum pteropus* (Java Fern) are among the most widely traded ornamental aquatic plants; however, their slow growth rates present challenges for large-scale production. This study was conducted to determine the effects of aqua-soil particle size on the growth performance of these species under controlled aquarium conditions. The experiment followed a Completely Randomized Design (CRD) with four treatments, which used different particle sizes, using the average particle size for each treatment as T1 (5 mm), T2 (10 mm), T3 (15 mm), and C1 (control with normal soil). Each treatment had three replicates, each containing two plants of both species. Growth parameters measured biweekly included the number of leaves, leaf length, and rhizome length, while initial and final plant wet weights were recorded to assess biomass gain. Soil pH, water pH, temperature, and turbidity were monitored regularly. Data were analyzed using SPSS 16 version, one-way ANOVA, and the results revealed significant differences ($p < 0.05$) among treatments for all growth parameters in both plant species. Considering the Anubias plant, T3 recorded the maximum number of leaves (13.00 ± 0.58), leaf length (2.88 ± 0.21 cm), rhizome length (4.29 ± 0.17 cm), and biomass gain (1.02 ± 0.05 g). Similarly, Java fern showed the best growth performance in T3, with the highest number of leaves (10.00 ± 0.52), leaf length (6.53 ± 0.24 cm), rhizome length (4.18 ± 0.19 cm), and wet weight (0.71 ± 0.04 g). In contrast, control (C1) consistently showed the lowest growth across all parameters. This study revealed that 15mm aqua-soil particles significantly enhanced the growth of both selected species. In conclusion, aqua soil substrate particle size is a key determinant in improving growth performance slow-growing ornamental plants.

Keywords: *Anubias barteri var. nana* 'Petite'; Aquatic plants; Aqua-soil substrates; Ornamental Aquaculture; *Microsorum pteropus* (Java Fern)

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Growth response of *Rotala rotundifolia* to cow dung, vermiwash, and commercial nutrient solutions under controlled aquatic conditions

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Abstract

The growth response of *Rotala Rotundifolia* to different fertilizer regimes was evaluated under controlled aquatic conditions using an experimental aquarium system. The study was conducted over a six-week period to assess the effects of four treatments: a negative control (no fertilizer), a commercial nutrient solution (Albert Solution) as a positive control, fresh cow dung, and vermiwash. Each treatment consisted of three replicate aquaria (n = 3), and each aquarium was standardized with an initial plant biomass of 5 g comprising 12 stems and 60 leaves. All aquaria were maintained under identical light, temperature, and aeration conditions. Fertilizers were applied uniformly at a concentration of 250 mg L^{-1}. Water quality parameters, including temperature, pH, and dissolved oxygen, were monitored weekly and maintained within suitable ranges for aquatic plant growth. Plant growth was quantified weekly by measuring shoot length, fresh weight, number of stems, number of leaves, and leaf length. Data were analyzed using one-way analysis of variance (ANOVA) to evaluate differences among treatments, with statistical significance determined at $p < 0.05$. After six weeks, all fertilized treatments exhibited significantly greater growth compared to the negative control. The commercial nutrient solution produced the highest mean values across all measured parameters, followed by cow dung, while vermiwash resulted in comparatively moderate growth responses. The enhanced performance observed in the cow dung treatment relative to vermiwash may be attributed to the gradual release of macro- and micronutrients from decomposing organic matter, providing sustained nutrient availability for plant uptake. In contrast, vermiwash, being a liquid extract, may supply nutrients in lower concentrations or for a shorter duration. The initial nutrient composition of cow dung and vermiwash (e.g., ammonia, nitrate, nitrite, and phosphate concentrations) was not quantified in this study, which limits direct comparison among fertilizer types and represents a key limitation. Overall, the findings indicate that cow dung has potential as an effective organic fertilizer for promoting the growth of *R. rotundifolia* under controlled aquatic conditions, while highlighting the need for future studies incorporating nutrient profiling and detailed assessment of fertilizer composition.

Keywords: Aquatic plant growth; Aquascaping; Biomass accumulation; Fertilizer regimes; *Rotala rotundifolia*.

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Assessment of cuttlefish bone waste production in Negombo Coast, Sri Lanka

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Abstract

Cuttlefish bone, a fisheries by-product with recognized commercial value in international markets, is often discarded in Sri Lanka due to limited awareness. This study was conducted to assess the production of cuttlefish bone waste in the Negombo coast during the period from June to August in 2025. This study further aimed to identify current cuttlebone usage patterns, evaluate stakeholder awareness of its economic value, and gather suggestions for improved management and value addition. Data were collected through semi-structured interviews (n = 100) with fishermen, fish sellers, processors, and exporters selected across 13 fisheries divisions in Negombo using structured questionnaires. The collected data included occupation of respondents, quantities of cuttlebone produce, existing utilization practices and awareness levels about cuttlebone. Data analysis was conducted applying descriptive statistical methods. Based on quantity estimates, weekly cuttlebone production among sellers amounted to approximately 50.5 kg. Of this, 67% were sold, while 33% were discarded. This indicates that nearly one-third of the available cuttlebones are wasted. Approximately 25% of respondents discarded cuttlefish bones, 35% sold them for limited uses such as Ayurveda treatment, bird feed, and jewelry mold making, and 40% both sold and discarded cuttlebones depending on demand. Exporter interviews revealed a strong international demand of 300 - 400 kg per week, compared to a local supply capacity of only about 50 kg per week, highlighting a significant supply gap. Awareness levels varied among stakeholder groups; exporters and jewelry makers demonstrated higher awareness, while most fish sellers showed uncertain. The study concludes that cuttlefish bone waste in Negombo represents a significant untapped economic opportunity. Enhanced awareness programs, improved collection and processing practices, and strengthened market linkages are recommended to convert cuttlefish bone waste into a value-added export commodity.

Keywords: Awareness; By product; Cuttlefish bone; Discarded; Waste

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Obstacles encountered by small-scale shrimp producers in Sri Lanka and suggested approaches for sustainable growth

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Abstract

This study investigates the complex difficulties faced by small-scale shrimp farmers in Sri Lanka and evaluates integrated strategies to promote sustainability in the industry. Data were collected from January to December 2024 across the Northwestern and Eastern Provinces through semi-structured interviews with 45 small-scale farmers. The research employed a qualitative approach, incorporating data from stakeholder interviews, discussions with experts such as researchers, aquaculture specialists, and government representatives, as well as reviews of relevant research papers, reports, and policy documents. Additionally, a fundamental simulation analysis using actual farm-level data and stakeholder input was conducted to assess the potential effects of the proposed sustainability framework. Recurring disease outbreaks, inadequate biosecurity knowledge, and limited extension services significantly increase production risks. Challenges like poor seed quality and weak market links increase farmer risks. Current research treats economic, disease, and governance issues separately, limiting holistic solutions. Simulation shows that integrated strategies can improve profitability and reduce risks. Key interventions include cost stabilization initiatives, specialized biosecurity training, enhanced extension services, and cooperative marketing approaches. The study highlights the critical need for collaboration among government bodies, research organizations, and farmer groups to develop unified strategies addressing systemic challenges. The main causes of reduced production and profitability are unstable feed and energy costs, disease outbreaks due to poor biosecurity, limited quality seed access, and weak extension support. Simulation results show that cooperative marketing, better extension services, improved biosecurity, and cost stabilization can increase productivity and stabilize income. These actions support rural livelihoods, promote sustainable sector growth, and contribute to national food security by ensuring reliable, affordable shrimp production.

Keywords: Sustainability; Small Scale Producers; Disease outbreaks; Biosecurity

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The status of silky shark (*Carcharhinus falciformis*) landings in Sri Lanka

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Abstract

Sri Lanka possesses a sea area nearly eight times larger than its land area, providing rich marine resources that contribute significantly to national protein supply and economic development. The Silky shark (*Carcharhinus falciformis*) is one of the most dominant shark species landed as bycatch across various fishing gears in Sri Lanka. Due to increasing exploitation and unsustainable fishing practices, this species is currently listed as Vulnerable. This study investigates the status of Silky shark landings in Sri Lanka from 2017 to 2023 using data from the Indian Ocean Tuna Commission (IOTC) to analyse production trends, gear-wise contributions, and length-frequency distributions, thereby assessing the size structure of landings. Sharks contributed approximately 2% to the total large pelagic fish production during the study period, while silky sharks accounted for 39% of total shark landings. Silky shark production peaked between 2018 and 2019, reaching nearly 60 metric tons (MT) from gillnet catches within the Exclusive Economic Zone (EEZ). Total shark production across all gears similarly peaked in 2018–2019 at around 120 MT before declining after 2019, likely due to the implementation of conservation and management measures. Length-frequency analysis indicated a high proportion of juvenile landings, demonstrating the predominance of bycatch in multiple gears. The most notable pattern was observed in 2020, where the FLL (longline) gear in the EEZ landed large numbers of juveniles, alongside a significant reduction in landings from ring nets. Overall, the study highlights a substantial decline in silky shark landings in recent years, suggesting that unsustainable fishing practices particularly gillnets and longlines have negatively impacted the species' population. Improved management actions, including gear restrictions, sustainable fishing practices, and strengthened monitoring of silky shark catches, appear to have contributed to reducing mortality and juvenile exploitation. These measures are essential for conserving biodiversity and promoting sustainable shark fisheries in Sri Lanka through continued collaboration.

Key words: Average length; Bycatch; Production; Silky sharks; Sri Lanka

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Effects of selected submerged aquatic plants on the growth and survival of guppy fry (*Poecilia reticulata*)

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Abstract

Freshwater ecosystems rely heavily on submerged aquatic plants, which play a vital role in maintaining water quality, providing shelter, and supporting the growth of fish fry. Understanding how these plants influence ornamental fish, such as guppy (*Poecilia reticulata*), is essential for improving small-scale aquaculture practices and enhancing fry survival and growth under controlled conditions. This study evaluated the effects of selected submerged aquatic plants on the growth performance and survival of guppy fry over a seven-week period. Four treatments, each with three replicates, were established: a control without vegetation, *Hydrilla verticillata, Cabomba caroliniana*, and *Ceratophyllum demersum,* with planted tanks receiving a standardized biomass of 20 g. Thirty, two-week-old fry were stocked per tank in glass aquaria (capacity:10 L) and fed cultured bread worms during the first three weeks, followed by commercial micro-pellets for the remaining four weeks of the experimental period. Weekly measurements of water-quality parameters, including pH, temperature, total dissolved solids, electrical conductivity, and ammonia, confirmed stable and optimal conditions for fry development. Growth metrics: body weight, total length, specific growth rate (SGR), and survival percentage were recorded weekly. Data were analyzed using one-way ANOVA with Tukey's post-hoc test ($p < 0.05$) and visualized using GraphPad Prism software. Fry reared with *Ceratophyllum demersum* achieved the highest final mean weight (0.056 ± 0.005 g), total length (0.96 ± 0.03 cm), SGR ($2.33 \pm 0.12\%$ per day), and survival ($60 \pm 9\%$), significantly outperforming other treatments. *Hydrilla verticillata* yielded the lowest growth and survival, while *Cabomba caroliniana* treatments displayed intermediate, statistically similar performance. Tanks with *Ceratophyllum* also maintained slightly more stable pH and the lowest ammonia accumulation, suggesting superior water-quality regulation through ammonia uptake and buffering. These findings demonstrate that submerged macrophytes, particularly *Ceratophyllum demersum*, enhance fry rearing by improving water quality, providing shelter, reducing stress, and supporting optimal growth and survival. The study highlights the potential of *Ceratophyllum demersum* as a sustainable, low-cost, and environmentally friendly solution for ornamental guppy culture.

Keywords: *Ceratophyllum demersum*; Growth performance; Guppy fry; Submerged aquatic plants; Survival rate

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Coastal fisheries status at Mutwal Fishery Harbor, Colombo 15

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Abstract

The Mutwal fishery harbor is one of the major fishery harbors in Colombo 15, Western Province. The objective of the study was to identify and document the species composition and quantity of marine species landed in the harbor. The study assessed the quantitative characteristics of marine catches and fishing efficiency at Mutwal fishery harbor, over a 60-day sampling period from February to April of 2025. Data were collected through daily observations of landings from all arrivals, recording catch weights, fishing effort, and gear types. Descriptive and inferential analyses were conducted using SPSS and Minitab, including the Kruskal–Wallis and Wilcoxon Signed Rank tests at a 95% confidence level. Three major fishing gears were identified: gill nets (75.61%), trawling nets (12.85%) and hook and line (11.54%). The total recorded fish catch was 6646.05 kg in the study period, comprising 82.32% target species and 17.68% bycatch. A total of 232 species representing 77 families were documented, dominated by *Carangidae*, *Lactariidae*, and *Scombridae*. Hook and line fishing exhibited the highest selectivity, producing 22.38 ± 2.22 kg of target catch per day with negligible bycatch (1.89%). Drift gill nets yielded 73.96 ± 4.56 kg per day with a moderate bycatch of 15.75%, whereas trawling produced only 1.19 ± 0.34 kg of target catch but a high bycatch rate of 84.85%, indicating poor selectivity. Catch per unit effort (CPUE) values ranged between 0.64 and 3.95 kgh^{-1} (mean = 1.60 ± 0.64). The target catch contributed most of this value (mean = 1.30 ± 0.60 kgh^{-1}), while bycatch CPUE averaged 0.28 ± 0.17 kgh^{-1}. Temporal analysis revealed a general decline in total catch and CPUE during March, followed by a slight recovery in early April. A weak but statistically significant positive correlation was observed between target catch and bycatch ($r = 0.399$, $p < 0.01$), indicating that both are influenced by similar factors such as gear type and fishing effort intensity. This study evaluates ecological and technical characteristics of Mutwal Fishery Harbor, revealing high diversity, significant bycatch, and gear-driven impacts, emphasizing selective fishing practices for sustaining small-scale fisheries.

Keywords: Bycatch; Catch per unit effort; Gear selectivity; Marine fisheries assessment**;** Species composition

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Carbon footprint in longline fishery of Dikovita fishery harbour, the west coast of Sri Lanka

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Abstract

Fisheries contribute significantly to greenhouse gas (GHG) emissions through the combustion of fossil fuels. This study aims to assess the carbon footprint of the longline fishery operated at Dikovita Fishery Harbour on the west coast of Sri Lanka, focusing on fuel consumption in the harvesting phase. The analysis was conducted in accordance with the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (Tier 2 approach). Primary data were collected from log-book data, fuel refill records, and Vessel Monitoring System (VMS) in longline fishing vessels operated by the harbour between September 2024 and March 2025. The total fuel consumption during the harvesting phase of the longline fishery was 922,330 L, averaging 8,090.61 ± 226.87 L per trip, and a total fish catch of 649,518 kg with a mean of 5,697.3 ± 260.51 kg per trip (n = 114). The mean voyage distance per vessel was 8,351.65 ± 515.91 km (n = 20), resulting in an average carbon footprint of 21,682.85 ± 608.01 kg CO_2e per trip, which is equivalent to 3.83 kg CO_2e/kg of fish and 2.60 kg CO_2e/km. The financial cost of emissions was estimated at 406.6 LKR per kg of fish. Correlation analysis showed that catch size accounted for only 8.84% of the variation in fuel consumption, suggesting a weak relationship. Voyage distance accounted for 66.76%, revealing a strong linear relationship, while Fishing duration explained 14.34%, indicating a relatively weak association with fuel consumption. This study emphasises the importance of reducing CO_2 emissions in the fisheries sector while highlighting the need for rules and regulations on pollution control, along with practical measures to minimise emissions.

Keywords: Carbon footprint; Longline fishery; IPCC guidelines; Fuel consumption

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Isolation and characterization of chitosan from cuttlefish bone collected from the eastern and western coasts of Sri Lanka

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Abstract

Cuttlefish (*Sepia pharaonis*) processing along Sri Lanka's coastal regions generates a considerable amount of cuttlebone waste, particularly from the Western and Eastern coasts. This discarded by-product poses environmental concerns yet represents a promising alternative raw material for biopolymer production. Chitin extracted from cuttlebone can be converted into chitosan, a biodegradable, biocompatible, and non- toxic polysaccharide widely used in pharmaceutical, agricultural, food, and wastewater treatment industries. This study aimed to isolate and characterize chitosan extracted from cuttlebones obtained from the West and East Coast, focusing on a comparative evaluation of biochemical and functional properties to determine the industrial applications. Cuttlebone samples were subjected to sequential chemical treatments, including demineralization, deproteinization, decolorization, and deacetylation processes. The extracted chitosan was analyzed for total yield, moisture content, ash content, water absorption capacity (WAC), and oil absorption capacity (OAC) using standard analytical protocols. Results indicated that chitosan yield was significantly higher in samples from the East Coast (EC) (95.2 ± 0.6%) than from the West Coast (WC) (88.07 ± 0.87%). High moisture content was observed in WC (19.38 ± 2.22%) than that of EC (12.19 ± 0.97%). Both samples exhibited low ash contents (EC: 3.02 ± 0.79%; WC: 3.01 ± 0.55%), close to the acceptable standard (< 3%), indicating high purity and stability. Functional analysis showed that EC chitosan had a significantly higher WAC (421.63 ± 3.06%) than WC (400.88 ± 0.66%), within the standard range. OAC values did not differ significantly between EC (294.86 ± 2.24%) and WC (250.23 ± 58.93%), both within the standard range, reflecting balanced hydrophilic and lipophilic characteristics. The OAC was greater in EC than in WC. Overall, EC yielded more chitosan, while both EC and WC samples demonstrated favorable functional properties, confirming that cuttlebone waste can be effectively transformed into a high- quality biopolymer. This promotes waste valorization, environmental sustainability, and supports the development of a circular bio economy in Sri Lanka's seafood processing sector.

Keywords: Biopolymer; Chitosan; Deacetylation; Biochemical properties; *Sepia pharaonic*

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Effect of different feeds on colour enhancement in endemic cherry barb (*Puntius titteya*) under controlled conditions

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Abstract

This study investigated the efficacy of different dietary formulations on enhancing red pigmentation in the endemic Cherry Barb (*Puntius titteya*), a species native to slow-moving streams of south-western Sri Lanka (Gampaha, Colombo, Kegalla districts), through a six-week controlled feeding trial. Four diets were evaluated: T1 (Control: 100% ox heart, used as a baseline control diet), T2 (60% ox heart + 40% commercial fish pellet), T3 (60% ox heart + 30% commercial pellet + 10% carrot powder), and T4 (60% ox heart + 40% commercial colour-enhancing pellet). Notably, the carrot powder in T3 provided natural carotenoids and additional nutrients (protein and minerals); carotenoids are expected to be the principal factor enhancing pigmentation, although synergistic effects with other dietary components cannot be ruled out. Sixty juvenile fish (initial total length 0.4–1.2 inches) were randomly distributed across 12 tanks (5 fish/tank, 3 replicates/treatment) maintained under stable water conditions (temperature: 25.58 ± 0.58 °C, pH: 6.69 ± 0.16, dissolved oxygen: 6.5 mg/L). Colour intensity was quantified biweekly using standardized digital image analysis (ImageJ software) (images captured under consistent lighting) with RGB pixel extraction from predefined body regions. Results demonstrated that dietary supplementation significantly influenced red Chroma development. The T3 treatment yielded the highest mean red-channel intensity (219.55 ± 4.23; unitless RGB value), significantly surpassing the control (T1: 201.77 ± 2.1; $p < 0.05$). One-way ANOVA revealed significant treatment effects on red channel values ($F [3, 44] = 8.92$, $p < 0.001$), with Turkey's post-hoc test confirming T3's superiority over T1 and T4. All carotenoid-supplemented groups exhibited dominant red pigmentation (red > green > blue; $p < 0.01$). These findings substantiate that natural carotenoid sources, particularly carrot powder, effectively enhance ornamental fish coloration while reducing dependency on synthetic pigments. This approach offers a sustainable strategy for value addition in ornamental aquaculture, supporting both conservation and commercial objectives for this endemic species.

Keywords: *Puntius titteya*; Colour enhancement; Carotenoid supplementation; Digital image analysis; Ornamental aquaculture

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Development of a low-cost Arduino-based temperature and pH control system for domestic aquariums

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Abstract

Ornamental fishkeeping is a rapidly expanding global hobby and small scale industry in Sri Lanka and worldwide. Most high value species are particularly sensitive to temperature and pH, which must be tightly controlled to avoid stress, poor growth and mortality. While large scale farms increasingly use automated water quality systems, most domestic aquaria still rely on manual monitoring, and commercial multi parameter controllers remain costly. This study aimed to; design a low-cost Arduino-based system for automatic temperature and pH control in a domestic aquarium compared with commercial units and evaluate its performance and suitability for small scale ornamental aquaculture. A prototype system was developed using an Arduino Uno, DS18B20 digital temperature sensor and a low cost pH electrode with interface module. A 100 W submersible heater, air pump and two peristaltic dosing pumps (acid/base) were controlled via a relay module. A 16×4 I2C LCD provided real time display, and data were logged at 1-min intervals to a computer. Experiments were conducted in a 56 L glass aquarium partitioned into a rearing chamber and a five-chamber regulation loop for heating, cooling, dosing, sensing and pumping. A simple on off control algorithm regulated temperature around 30 °C and maintained pH within 7.0–8.0 using diluted phosphoric acid and sodium bicarbonate solutions. Heating (from 28° C to 30 °C), 12 h steady-state stability, spatial uniformity, cooling (from 34°C to 30 °C) and dynamic pH corrections (pH 9→uper limit; pH 6→lower limit) were tested in triplicate. The system raised water temperature from 28 °C to 30 °C in 79.7 ± 2.1 min and maintained 29.5 ± 0.3 °C over 12 h, with a fluctuation range of 1.0 °C and spatial variation ≤0.5 °C. Cooling from 34°C to 30 °C required 150 min. pH was reduced from 9 to 8 in 9.3 min and increased from 6 to 7 in 35 min, maintained between 7 - 8 for most of the experimental period with minimal overshoot. The total hardware cost (~LKR 27,580) was substantially lower than that of comparable commercial units. The developed system can rapidly restore and stably maintain temperature and pH within acceptable ranges for ornamental fish, demonstrating its suitability as an economical, adaptable platform for domestic and small scale aquaculture.

Keywords: Arduino automation; Aquarium control system; pH regulation; Temperature monitoring

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Discovery of LptD immunogenic determinants using in silico approaches for vaccine design against *Aeromonas hydrophila*

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Abstract

Aeromonas hydrophila is a major bacterial pathogen responsible for severe disease outbreaks and economic losses in aquaculture. Increasing reports of multidrug resistance among circulating strains highlight the urgency for alternative control measures such as vaccines. Lipopolysaccharide (LPS) biogenesis is essential for structural stability, pathogenicity, and antimicrobial resistance of Gram-negative bacteria, and the outer membrane protein LptD plays a central role in the final translocation of LPS to the bacterial surface. Because it is highly conserved, surface exposed, and functionally important, LptD represents a promising candidate for epitope-based vaccine development. This study aimed to identify immunogenic epitopes of the LptD protein using an immunoinformatics-based approach for multi-epitope vaccine design. Epitope prediction for cytotoxic T lymphocytes (CTL), helper T lymphocytes (HTL), (IEDB MHC tools), and linear B cells was performed using established immunoinformatics databases and prediction servers (ABCpred and BCPred servers). Secondary and tertiary structure analyses were performed, followed by molecular docking to assess epitope–MHC interactions The LptD protein showed vaccine potential, supported by predicted outer membrane localization, a signal peptide, absence of transmembrane helices, and a non-allergenic, non-toxic profile, along with hydrophilic physicochemical properties. From 250 screened peptides, three CTL epitopes, one HTL epitope, and three linear B-cell epitopes were identified as non-allergenic and non-toxic. Secondary structure prediction revealed dominance of coils and extended β-strands, while B-cell propensity profiling indicated accessible, antigenic, and flexible surface regions. Tertiary modelling and refinement produced a stable 3D structure with an improved C-score of 0.60 and RMSD of 0.345. Molecular docking showed binding affinities between key epitopes and representative MHC molecules, including −246.83 (HLA-B08:01), −180.26 (HLA-B58:01), and −190.58 (HLA-DRB1*15:01). In summary, this study provides a systematic immunoinformatics-based framework for identifying antigenic determinants of LptD and presents a promising multi-epitope vaccine candidate against *A. hydrophila,* supporting future experimental validation and vaccine development in aquaculture.

Keywords: *Aeromonas hydrophila;* Aquaculture; Epitope; Immunoinformatics; Multi-epitope vaccine

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Bioinformatic characterization of vaccine-potential epitopes in the fimbrial protein 1 (Fima) of *Aeromonas hydrophila*

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Abstract

Aeromonas species are one of the most important bacterial pathogens in aquaculture, causing recurrent disease outbreaks and substantial economic losses in cultured fish. The emergence of antibiotic-resistance of Gram-negative, *Aeromonas hydrophila* strains has highlighted the need for effective prophylactic strategies, particularly effective vaccines. However, identification of suitable vaccine targets involved early host colonization is still incomplete. Fimbrial adhesion proteins are surface-exposed virulence factors that mediate bacterial attachment to host tissues and play a crucial role in the establishment, colonization, and initiation of infection, making them attractive vaccine targets. In this study, an immunoinformatic approach was employed to identify potential T [Cytotoxic T Cells (CTL) and Helper T Cells (HTL)] and linear B cell epitopes from the *A. hydrophila* adhesion-related fimbrial protein 1 (AhFimA) for multi-epitope vaccine design. AhFimA was selected from *A. hydrophila* extracellular vesicle proteomic data, based on predicted antigenicity and functional relevance. The protein was predicted to consist of 179 amino acids (19.03 kDa) and a theoretical isoelectric point (pI) of 4.74. Subcellular localization analysis indicated that AhFimA is an outer membrane protein, lacking transmembrane helices, and in silico analyses predicted it to be non-allergenic (AllerTOP v2.0) and non-toxic (ToxinPred). CTL epitope prediction (NetCTL v1.2) produced 21 candidates (threshold at 0.75), of which three were retained after screening for antigenicity, allergenicity, toxicity, and immunogenicity. HTL epitope analysis yielded two strong candidates, while linear B-cell epitope prediction identified three promising sequences with the highest score values (>0.8). Selected CTL, HTL, and B-cell epitopes were in silico assembled with suitable linkers, and a 15s ribosomal protein L7/L12 adjuvant to enhance immunogenicity, and docking analyses demonstrated predicted stable interactions with MHC class I and II molecules. These findings suggest that AhFimA contains immunologically important regions with the potential to induce protective immunity against *A. hydrophila*, warranting further investigation through *in vivo* studies.

Keywords: *Aeromonas hydrophila*; AhFimA; Aquatic pathogens; Immunoinformatics; Multi-epitope vaccine

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Marine polychaete ecology with respect to the formation of sand structure in the rocky shore in Tangalle

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Abstract

Marine polychaetes create reef-like cubic structures using sand grains and shell fragments, significantly affecting sediment stability and enhancing organic matter accumulation in shallow reef ecosystems in Sri Lanka. This study investigated the sand structures present along the Paraiwella coast in Tangalle to determine the polychaete *Phragmatopoma sp* responsible for sand tube formation. Random sand structures and polychaete samples were collected from field observation, and sample collection was done from October to December 2024. This study measures the general morphological characteristics, polychaete biomass, and organic matter content within the sand structures. Also, the surface area of the sand tunnels was compared to the normal area, rocky area, and sea grass bed area determine the polychaeta density. Taxonomic identification conformed to gene-level information of the polychaeta worm as *Phragmatopoma sp.* The worm biomass (*p*-Value = 0.000) differed significantly between locations. Organic matter content (*p*-Value = 0.690) in sand structures showed no significant variation across locations, confirming their structural role in habitat formation. Furthermore, research is recommended to explore factors influencing worm distribution and the biology and ecology of the rocky reef in Tangalle.

Keywords: Coastal ecosystem; Marine polychaeta; Rocky shore; Sediment stability; Tube worm.

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Distribution and abundance of zoanthids in Pareviwella Reef, Tangalle, Sri Lanka

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Abstract

Zoanthids, an important group of benthic cnidarians, contribute to marine biodiversity and reef habitat stability. However, studies on their distribution and abundance in Sri Lankan waters remain limited. This study performed from November of 2024 to March of 2025 to determine the distribution and abundance of dominant zoanthid species along the Pareviwella Reef, Tangalle, Sri Lanka. Data collection involved random quadrat sampling (30 quadrats, each measuring 50 × 50 cm;0.25 m²) along 15m transects at three stations within the study area ,where percentage cover of each species was recorded. Five zoanthid species were recorded, namely *Zoanthus cf. sansibaricus*, *Palythoa mutuki* (green and brown forms), *Palythoa tuberculosa*, and *Zoanthus sansibaricus* (green form). Zoanthid abundance (percentage cover per m^2) differed significantly among stations (one-way ANOVA, $F = 52.58$, $p < 0.001$). Station 3 exhibiting the highest mean abundance (12.67%), followed by Station 2 (6.03%), and lowest at Station 1 (4.06%). Tukey's post hoc test confirmed that Station 3 differed significantly from Stations 1 and 2 ($p < 0.001$), while no significant difference was observed between Stations 1 and 2 ($p = 0.07$). Shannon–Wiener diversity index (H′) values indicated that Station 2 had the highest species diversity (H′ = 1.75), followed by Station 1 (H′ = 1.67) and Station 3 (H′ = 1.24). Habitat characteristics recorded within quadrats showed spatial variation among stations, with coral rubble more prevalent at Stations 1 and 2, while macroalgae were more common at Station 3. Additionally, aquarium studies examined zoanthid physiological responses under controlled conditions. The findings establish a baseline for future ecological assessments and conservation efforts in Sri Lanka's coastal ecosystems. Understanding zoanthid distribution patterns is essential for evaluating the impact of environmental factors and anthropogenic activities on reef-associated communities.

Keywords: Benthic cnidarians; Pareviwella Reef; Species abundance; Species distribution; Zoanthids

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Coral rubble-associated in-fauna abundance at Pareviwella Reef, Tangalle, Sri Lanka

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Abstract

Coral rubble habitats, resulting from reef degradation, serve as crucial microhabitats supporting diverse infaunal communities. In the southern region of Sri Lanka, the Pareviwella Reef in Tangalle is characterized by distinctive coral formations and supports potentially unique infaunal assemblages. However, current scientific literature lacks comprehensive data on the abundance and taxonomic diversity of infauna associated with coral rubble in this area. This study aimed to assess the abundance and diversity of infauna associated with coral rubble at Pareviwella Reef, Tangalle, Sri Lanka. 20 random Coral rubble samples, each approximately 1 kg, were collected manually during low tide using a hand scoop from a 150 m × 20 m study area. In the laboratory, infauna was extracted using water immersion and identified under a microscope based on morphological characteristics. The specimens were categorized into six phyla: Arthropoda, Annelida, Mollusca, Echinodermata, Nematoda, and Platyhelminthes. The diversity and abundance of infauna were notably distributed among different phyla, with arthropods being the most dominant group (41%), followed by annelids (23.06%), echinoderms (15.64%), nematodes (15.30%), mollusks (2.98%), platyhelminths (0.06%), and a small percentage of unidentified species (1.97%). Statistical analyses, including normality tests and one-way ANOVA ($P < 0.001$), revealed significant differences in abundance among phyla. The Infaunal Trophic Index (ITI) was calculated to assess organic enrichment levels, indicating a moderately enriched environment. (ITI) scores, range from 239.13 to 263.01, this means all samples shows Higher ITI values (more than 225). It means low organic enrichment and cleaner environment in the Pareviwella coral reef area. These findings show the ecological importance of coral rubble in reef habitats, which support marine biodiversity and highlight the need for their conservation. Further research is recommended to explore seasonal variations in infaunal diversity and their correlation with environmental factors.

Key words: Coral rubble; Fauna diversity; Infaunal abundance; Pareviwella reef; Infaunal Trophic Index

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Study of potentially dangerous marine vertebrates, Tangalle, Sri Lanka

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Abstract

Rising recreational activities have increased encounters with dangerous marine animals, but there has been limited research in Tangalle, Sri Lanka. This study identifies key species, assesses occupational risks, and evaluates injuries, protective measures, and treatments, focusing on six medically important species: stonefish (*Synanceia verrucosa*), lionfish (*Pterois volitans*), puffer fish (*Tetraodontidae Sp*), stingrays, sea snakes (*Elapidae Sp*), and moray eels (*Muraenidae Sp*) at Tangalle beach from October 2024 to January 2025 with Structured questionnaire survey was conducted with 160 participants from four occupational groups: coastal workers, residents, students, and tourists. The study used convenience sampling and a pre-tested questionnaire on demographics, encounters, injuries, and first-aid. Field observations confirmed species identification. Data were analyzed using IBM SPSS 22, applying the Friedman test for encounters and injury patterns, with comparisons of treatments and protective gear. Comparison of occupation and encounters showed significant differences between the four occupational groups ($\chi^2 = 27.49$, $p = 0.00$), with coastal workers showing the highest encounters while residents and tourists had the lowest. Regarding occupation and injury-causing species (Stonefish, Lionfish), coastal workers were predominantly injured by Lionfish ($\chi^2 = 6.66$, $p = 0.036$). Hot water immersion was the most common treatment method, followed by vinegar application for comparison between occupation and Lionfish injuries ($\chi^2 = 23.5$, $p=0.00$). Occupational comparison for Stonefish treatment methods revealed significant differences ($\chi^2 = 22.56$, $p=0.00$), with hot water immersion being predominant. No significant difference was found between occupation and protective gear usage ($\chi^2 = 1.36$, $p = 0.505$). The study emphasizes the urgent need for community awareness on proper first aid, better access to medical care, usage of protective gear, and systems for monitoring envenomation. These findings provide critical baseline data for improving coastal safety.

Keywords: Marine envenomation; Occupational hazards; First aid protocols; venomous fish; Coastal safety

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Community awareness of marine biodiversity conservation: a preliminary study in Hikkaduwa marine protected area

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Abstract

Sustainable management of marine ecosystems demands more than ecological planning; it requires meaningful community understanding and participation. Effective marine conservation depends on how well coastal communities understand and relate to the ecosystem they depend on. Therefore, understanding public awareness and views allows policymakers to prioritize initiatives more effectively, ensuring they are well received and successfully implemented. However, research to examine public awareness of marine biodiversity conservation in Sri Lanka is limited. This study attempted to fill the gap by examining factors influencing public familiarity with marine biodiversity conservation among the community in Hikkaduwa Marine Protected Area, Sri Lanka. A questionnaire survey was conducted from November to December 2024, involving 150 individuals, including local residents, visitors, fisherfolk and tourist operators, who participated through convenience sampling technique. Data was analyzed using binary logistic regression and additionally a chi square test was used to assess the association between demographic factors age, gender and familiarity with marine biodiversity conservation. Findings revealed that awareness of Marine Protected Areas, dependence on marine resources, education levels and concern for marine environmental issues influenced familiarity ($p < 0.05$). In contrast, demographic factors such as age and gender had limited influence, suggesting that conservation knowledge transcends traditional social boundaries when local relevance is high. Additionally, concern for local environmental problems such as reef degradation and pollution was closely associated with increased conservation awareness, highlighting the importance of locally observable impacts and perceived relevance. The study reinforces the need for community oriented, ecosystem-based approaches that involve communities not only as beneficiaries but as informed stewards. For long-term sustainability, conservation strategies must bridge scientific goals with local realities through inclusive and context-sensitive engagement.

Keywords: Awareness; Community; Marine biodiversity conservation; Marine protected areas

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Volunteer-led ex-situ sea turtle conservation in urban beaches: a two-year comparative study from Colombo District, Sri Lanka

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Abstract

This study examines sea turtle nesting activity and conservation outcomes along the urban coastline of the Colombo District, Sri Lanka, during two consecutive nesting seasons (2024–25). Using a two-year comparative observational design, the study evaluates nesting ecology and conservation outcomes, providing quantitative evidence for the effectiveness of volunteer-led, citizen-science interventions in urban coastal ecosystems. Night patrols were conducted during the primary nesting season from January to March each year across four urban beaches (Dehiwala North, Dehiwala South, Mount Lavinia and Wellawatte in 2024) by trained volunteers from The Pearl Protectors in collaboration with the Sri Lanka Coast Guard. Standardized nightly patrols were carried out over 79 nights in 2024 and 84 nights in 2025, involving a total of 340 trained volunteers. Data collection followed standardized protocols, including GPS-based nest mapping and documentation of nesting activity, clutch size, lunar phase, tidal conditions, artificial light levels, and human disturbance. All viable nests were relocated ex-situ to protected hatcheries in accordance with national fisheries regulations. A total of 332 nests containing 35,593 eggs were conserved across both years, with nesting increasing from 130 nests (14,204 eggs) in 2024 to 202 nests (21,389 eggs) in 2025, representing a 55% increase in nesting frequency and a 50.5% increase in eggs protected. Mean clutch size showed a slight decline from 110 eggs in 2024 to 106 eggs in 2025, although further statistical analysis is required to determine the significance of this difference. Nesting activity exhibited a strong temporal association with lunar illumination, peaking during the full and first quarter moon phases, primarily between 23:00 h and 01:00 h. Field observations suggest that brighter lunar conditions may facilitate offshore orientation and nesting emergence in *Lepidochelys olivacea*, whereas artificial lighting from coastal infrastructure acts as a deterrent to nesting behavior. Despite improved conservation outcomes, persistent anthropogenic pressures, including artificial lighting, coastal erosion, and unregulated beachfront development, continued to negatively affect nesting success, particularly at Mount Lavinia and Dehiwala South. The expansion of volunteer participation from 130 individuals in 2024 to 210 in 2025, combined with improved coordination with enforcement agencies, contributed to more consistent monitoring coverage and enhanced data reliability. These findings demonstrate that structured community-based conservation programs can generate measurable conservation gains even within high-disturbance urban environments and offer a scalable model for urban sea turtle conservation across the Indian Ocean region and other resource-limited coastal settings.

Keywords: *Lepidochelys olivacea*; Urban ecology; Citizen science; Volunteer conservation; Nesting ecology

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Six-month monitoring of *E. coli*, total coliform, and environmental factors in Pasikuda and Arugam Bay

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Abstract

Monitoring coastal water quality is crucial for the protection of public health, especially in tourism-dependent regions. This study evaluated *Escherichia coli* and Total Coliform concentrations in coastal waters at Pasikuda and Arugam Bay over a six-month period (January–June, 2025) and compared their relationship with key physicochemical parameters. Water samples (n = 7 per location) were collected on a monthly basis and analyzed for temperature, pH, electrical conductivity, turbidity, and dissolved oxygen (DO). Microbial analysis was conducted using the membrane filtration method. The mean values of the factors showed clear seasonal variations. Pasikuda samples exhibited higher microbial loads during January and March (*E. coli*: 37 CFU/100 mL and 62 CFU/100 mL; Total Coliform: 135 CFU/100 mL and 99 CFU/100 mL respectively) compared to May (*E. coli*: < 1 CFU/100 mL). Whereas the March sample from Arugam Bay, recorded the highest microbial contamination (*E. coli*: 19 CFU/100 ml; Total Coliform: 116 CFU/100 mL), while May sample showed almost negligible levels. Dissolved Oxygen was observed generally higher in June (Pasikuda: 8.2 mg/L; Arugam Bay: 3.8 mg/L), coinciding with reduced bacterial counts. Findings highlight temporal variability in microbial contamination influenced by environmental conditions, possibly linked to tourist activity, rainfall, seasonal tourist influx, Precipitation pattern and tidal flushing. The results suggest that routine monitoring, especially during peak contamination months, is necessary to mitigate health risks and maintain safe recreational water quality standards.

Keywords: Coastal water quality; *Escherichia coli*; membrane filtration; physicochemical parameter; total coliform

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Research gaps and policy needs for a sustainable blue economy in Sri Lanka

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Abstract

The Blue Economy promotes the sustainable use of ocean and coastal resources to support economic growth, social equity, and ecosystem health, and is increasingly important for island nations such as Sri Lanka. Despite its significance for national development, fisheries, and coastal livelihoods, the implementation of a sustainable Blue Economy in Sri Lanka remains constrained by governance, data, and policy challenges. This study presents a systematic review of Blue Economy–related research in Sri Lanka to identify key knowledge gaps and policy needs affecting coastal and marine management. The review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, a transparent and structured approach for identifying, screening, and analyzing relevant literature. A total of 35 peer-reviewed and open-access publications published between 2015 and 2025 were selected from Google Scholar, ResearchGate, and MDPI databases. Studies were included based on relevance to Sri Lanka, focus on marine or coastal management, and alignment with Blue Economy principles, while non-English, non-peer-reviewed, and unrelated studies were excluded. The analysis shows that 43% of the reviewed studies primarily focused on fisheries and resource conservation, while only 17% addressed governance and institutional coordination, and less than 10% incorporated ecosystem service valuation or marine spatial planning. Based on these patterns, four major research gaps were identified: limited application of community-based governance approaches, insufficient interdisciplinary integration across ecological, economic, and institutional domains, weak incorporation of ecosystem service valuation in planning processes, and inadequate availability of disaggregated local-level socioeconomic data. Policy analysis further revealed fragmented institutional responsibilities, weak enforcement of environmental regulations, and poor alignment between national development strategies and coastal conservation priorities. To bridge these divides, the study calls for a unified national Blue Economy policy framework that promotes cross-sectoral coordination, evidence-based decision-making, and adaptive management. Strengthening partnerships among researchers, policymakers, and local communities is essential to ensure inclusive, science-driven, and climate-resilient governance of Sri Lanka's coastal and marine resources. Such integration will accelerate the nation's transition toward a truly sustainable Blue Economy.

Keywords: Blue economy; Coastal management; Policy gaps; Sri Lanka; Research–Policy Integration

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Spatial distribution of sandcastle worm (*Phragmatopoma* sp.) across inshore and offshore sites at Pareiwella coral reef, Sri Lanka.

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Abstract

Sandcastle Worm (*Phragmatopoma* sp.), a reef-building Polychaete, constructs rigid sand-grain mounds that form patchy reef-like structures, serving as indicators of ecological presence and potential influence on the benthic environment. While its adhesive biochemistry is well documented, its ecological role in shaping benthic assemblages and modifying substrate conditions in Sri Lanka's shallow marine ecosystems remains understudied. This study aimed to examine spatial variation in sediment mound distribution of sandcastle worms between inshore and offshore sites. Fieldwork was conducted from 29 November to 12 December 2024, during which three randomly laid transects were established across Pareiwella Reef to ensure spatial coverage of the study area. Each transect (20 m long) was laid perpendicular to the shoreline and divided into two segments: the inshore site (first 10 m) and the offshore site (next 10 m) for comparative sampling. Quadrat sampling (0.5 × 0.5 m^2) was conducted while snorkeling. Within each quadrat, spatial distribution was quantified as the percentage cover of sandcastle worm sediment mounds relative to total quadrat area, and *in situ* water quality parameters temperature (°C), salinity (ppt), pH, and dissolved oxygen (mg L^{-1}) were recorded to characterize ambient reef conditions. The Mann–Whitney U test was applied to determine spatial differences in worm mound cover between inshore and offshore sites. Sandcastle worm mound cover was significantly higher at inshore sites (median = 2.29%, mean ± SD = 2.25 ± 1.13%) than at offshore sites (median = 0.42%, mean ± SD = 0.82 ± 1.02%), according to the Mann–Whitney U test ($p < 0.05$). At the inshore site, mean environmental parameters were: temperature = 30.6 °C, salinity = 31.0 ppt, pH = 8.20, and dissolved oxygen = 8.30 mg L^{-1}. The study demonstrates that sandcastle worm sediment mounds were significantly more abundant at inshore sites of Pareiwella Reef, revealing clear spatial variation in their distribution. This indicates that inshore areas may be more vulnerable to sandcastle worm influence than offshore sites. These findings highlight the importance of considering site-specific benthic interactions when managing shallow reef habitats and planning conservation strategies.

Keywords: Inshore and offshore sites; Pareiwella coral reef; Sandcastle worm (*Phragmatopoma* sp.); Spatial distribution.

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Assessment of microplastic contamination in *Sepia pharaonic* from the western coastal waters of Sri Lanka

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Abstract

Microplastics (MPs) are an increasingly prevalent global pollutant due to the growing accumulation of plastic waste in marine environments, where it persists and fragments into smaller particles. Plastic accumulation, especially MPs, threatens the socioeconomic value and biodiversity of marine resources. Although studies on MP ingestion in finfish and invertebrates are increasing, studies on contamination in demersal cuttlefish remain limited. This study focused on Pharaoh cuttlefish (*Sepia pharaonic*), a dominant, and commercially important cuttlefish in the western coastal waters of Sri Lanka which are abundant during peak fishing seasons in March to April. Fifty-five individuals, including three replicates per location, were collected from five landing sites: Negombo, Chilaw, Colombo, Panadura, and Kalutara. Gill, digestive tract, and muscle tissues (0.5–2.0 g wet weight) were digested using 10% (w/v) KOH at 50 °C for 48 hours. Fourier Transform Infrared Spectroscopy (FTIR) was used to identify the polymer types of MPs. A total of 468 MP particles were found: 209 (46.44%) in the digestive tract, 152 (33.78%) in gills and 89 (19.78%) in muscle. Negombo exhibited the highest MPs abundance (114 particles), with MPs predominantly detected in the digestive tract (48.80%), followed by the gills (32.50%) and muscle tissue (18.70%). In contrast, Chilaw recorded the lowest MP abundance, accounting for 17.59% of the total MPs detected. Dominant MP size ranges varied among tissues, measuring 0.02–1.00 mm in the gills, 0.08–2.50 mm in the digestive tract, and 0.02–0.40 mm in muscle tissue. Blue, black and red were the most frequently observed MP colours, with the digestive tract of Pharaoh cuttlefish collected from Negombo exhibiting the highest proportion of black MPs (17.83%). Across all sampling sites, black and blue MPs consistently dominated the digestive tract samples. MPs in edible muscle tissue indicate potential human exposure through seafood. This study provides important baseline data on MP contamination in *S. pharaonis* from Western Province of Sri Lanka, demonstrating significant ingestion across tissues. The findings emphasize the vulnerability of this high-value species to plastic pollution and the importance of long-term monitoring to support ecosystem protection and seafood safety.

Keywords: Microplastics; Cuttlefish; Marine pollution; Western coastal waters; Seafood safety

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Framing the 'blue economy': a thematic analysis of official Sri Lankan coastal development policies (2010–2024)

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Abstract

The Blue Economy has emerged as a central framework for coastal and marine development, seeking to reconcile economic growth with environmental sustainability and social well-being. In Sri Lanka, this framework has been widely integrated into national policy discourse; however, limited scholarly attention has been given to how the Blue Economy is framed within official policy documents and how such framings shape governance priorities and the positioning of coastal communities. Addressing this gap, this study examines the discursive construction of the Blue Economy in Sri Lanka's coastal development policies between 2010 and 2024, with particular attention to implications for governance and community participation. Using qualitative thematic analysis, eight nationally significant policy documents were selected based on their relevance to coastal and marine resource management and their influence on national development planning. These include the *National Fisheries and Aquatic Resources Policy (2018), Coastal Zone and Coastal Resource Management Plan (2018-2023), Blue-Green Economy Strategy (2021-2030), National Adaptation Plan for Climate Change Impacts (2016-2025), National Maritime and Logistics Policy (2023), National Physical Planning Policy and Plan (2017-2050), National Environmental Policy, and the Fisheries Sector Development Strategy (2018-2025)*. The documents were systematically coded using NVivo software to identify dominant narratives related to economic development, environmental governance, community participation, and resilience. The analysis identifies three dominant policy frames. First, an economic growth-centric framing emphasizes infrastructure expansion, investment, and global competitiveness. Second, environmental stewardship as regulatory compliance positions sustainability primarily as a procedural obligation rather than an integrated governance principle. Third, communities as beneficiaries rather than stakeholders frames coastal populations as passive recipients of development outcomes rather than active decision-makers. Collectively, these framings reflect a developmental-statist governance orientation that prioritizes economic productivity over social equity and participatory governance. The findings underscore the need for policy reforms that move beyond growth-oriented narratives by embedding participatory governance mechanisms, recognizing community agency, and integrating ecological limits into coastal planning. By demonstrating how policy language shapes governance priorities and power relations, this study contributes empirical insight into the political dimensions of the Blue Economy and highlights pathways toward more inclusive and sustainable coastal development in Sri Lanka.

Keywords: Blue Economy; Coastal governance; Policy framing; Thematic analysis; Sri Lanka; Community participation.

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Evaluation of microplastic abundance in coral: a comparative study of *Montipora* sp. and *Pocillopora* sp. in Pareiwella coral reef, Sri Lanka

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Abstract

Microplastics (MPs) contamination is widespread in different marine compartments and is a growing global concern, yet their presence in coral tissues remains underexplored in many countries, although MPs are known to trigger coral bleaching, severe tissue damage, reduce food intake, decrease skeletal growth and alter photosynthetic performance. This study investigated the MPs abundance and characteristics in tissues of *Pocillopora* sp. (n=9) and *Montipora* sp. (n=9) corals from Pareiwella coral reef. Coral fragments ranging from 2 to 5 cm in size were carefully obtained from the colonies using coral cutter. Microplastics were extracted from coral tissues through a modified sequential chemical digestion protocol involving 30% H_2O_2 followed by KOH with vacuum filtration. The average MPs abundance was significantly higher in *Pocillopora* sp. (12.11 ± 9.47 items g^{-1}) than in *Montipora* sp. (1.67 ± 1.32 items g^{-1}) as determined by the Mann-Whitney test (p-value < 0.05). MPs accumulation in *Pocillopora* sp. can be attributed to branching growth morphology, which increases the surface area and particle entrapment. In contrast, *Montipora* sp. reducing the MPs accumulation due to foliaceous structure promotes streamlined water flow. The role of coral morphology in MP enrichment and the vulnerability of branching coral forms to plastic pollution were highlighted by these findings. The study emphasizes the need for continued monitoring of coral-MP interactions and supports the hypothesis that coral reefs can act as long-term sinks for marine microplastics.

Keywords: Coral tissues; *Montipora* sp.; Microplastics; *Pocillopora* sp.; Growth morphology

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Evaluation of the marine green macroalgae *Caulerpa racemosa* as a natural food colorant: consumer preference analysis and optimization of extraction method

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Abstract

Synthetic food colorants which are extensively used in food industry are economical and provide stable coloring. However, they pose significant health risks due to their potential toxicity, such as inhibition of the immune system, cardiovascular disease, and potential carcinogenicity. The aim of this study was to explore the possibility of *Caulerpa racemosa* as a natural food coloring with consumer acceptability compared to artificial coloring substances and optimizing extraction procedures for ultimate acceptability. Invasive macroalgae *Caulerpa racemosa* (Sea grapes) provides a unique chance for managing conservation, and environmental/food safety problems through its utilization as a natural colorant source. Samples of fresh *C. racemosa* were collected from rocky shores along Southern Sri Lanka at Tangalle. Four experimental protocols were employed: (1) powder concentration optimization at 0.1%, 0.2%, and 0.5% (W/W) levels; (2) comparison of ethanol [93%(V/V)], chlorophyll extraction with synthetic colorant; (3) optimization of seawater extracted Sea grapes powder against potassium phosphate buffer extraction; and (4) direct use of chopped extract test. Jelly dessert was utilized as test food matrix, and sensory testing was conducted using 30 untrained panelists and a nine-point hedonic scale. Statistical comparison utilized MINITAB 19 computer program using one-way ANOVA and two-sample t-tests at $\alpha = 0.05$ significance level. Powdered *C. racemosa* concentration (0.1-0.5%) showed non-significant differences in consumer acceptability in all sensory attributes ($p > 0.05$). Artificial colorants, on the other hand, showed significantly higher consumer preference than ethanol-chlorophyll extracts for flavor, aroma, appearance, texture, and overall acceptability ($p < 0.05$). Seawater extraction yielded superior results compared to buffer extraction for appearance, texture, and total acceptance ($p < 0.05$). Direct chopped extracts were conflicting in nature, with artificial color agents being preferred for taste, odor, and appearance, but matching texture acceptance. While *C. racemosa* can be used as a potential natural colorant source, current extraction processes should be optimized to avoid common marine taste and odor profiles which limit consumer acceptance. The study establishes groundwork protocol for natural coloring agent development and requires more effective processing protocols to incorporate improved organoleptic features.

Keywords: *Caulerpa racemosa*; invasive species utilization; marine green macroalgae; natural food colorant; sensory evaluation

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Spatiotemporal heterogeneity of water quality in Chilaw Lagoon: anthropogenic hotspots and monsoonal forcing

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Abstract

Chilaw Lagoon, located on Sri Lanka's northwest coast, is a small, tide-influenced coastal ecosystem that sustains fisheries, aquaculture, and mangrove habitats. However, it is increasingly affected by anthropogenic and hydrological pressures. This study aimed to assess short-term spatiotemporal variations in water quality, to identify key environmental drivers, and provide a scientific basis for sustainable management. During the period, from May to October 2024, covering the southwest monsoon and early post-monsoon period, fifteen physicochemical and biological parameters (pH, temperature, salinity, turbidity, dissolved oxygen, electrical conductivity, total dissolved solids, total suspended solids, BOD, COD, nitrate-N, nitrite-N, ammoniacal-N, orthophosphate, and chlorophyll-a) were measured across eleven stations using in-situ monitoring. Subsequently, laboratory analysis was carried out following APHA (23rd Edition) standards. Principal Component Analysis (PCA) and the Kruskal–Wallis test was used to explore variability and spatial contrasts. PCA revealed that salinity, turbidity, and dissolved/particulate solids were the dominant factors shaping water quality, while nutrient enrichment influenced localized deviations. The Kruskal–Wallis test detected significant spatial differences for nitrate-N ($p = 0.010$), salinity ($p = 0.001$), DO ($p = 0.001$), and BOD ($p = 0.009$), reflecting marked heterogeneity linked to tidal exchange and land-use gradients. Aquaculture-dominated areas exhibited elevated nutrients and Chlorophyll-a concentrations, indicating localized eutrophication risk. Temporally, intensified monsoonal runoff during June–July resulted in reduced salinity and increased turbidity and nutrient concentrations, intensifying spatial contrasts between marine and brackish zones. Overall, the findings demonstrate that Chilaw Lagoon's water quality is shaped by the interaction of tidal processes and human activities. Targeted management through stricter aquaculture, effluent regulation, watershed controls, and continuous monitoring is essential to mitigate nutrient stress, preserve biodiversity, and ensure the lagoon's ecological resilience.

Keywords: Chilaw Lagoon; Water quality; Coastal lagoons; Spatiotemporal variability; Eutrophication; Aquaculture impacts; Monsoon runoff

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Comparative assessment of water quality in brush park and adjacent mangrove habitats: a study in Negombo estuary

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Abstract

Brush parks are a traditional, low-technology fishing practice in Sri Lanka that creates artificial fish habitats using submerged branches in shallow waters. These structures provide shelter, feeding, and spawning grounds for fish; however, their use is gradually declining. This study assessed the ecological value of brush parks by comparing water quality between brush park areas and adjacent mangrove habitats in the Negombo Estuary. A five-month survey was conducted at three sites: Katunayake, Thalahena, and Pitipana. Monthly water samples were collected in triplicate and analyzed for nutrient concentrations (nitrate and phosphate), biochemical oxygen demand (BOD_5), and chemical oxygen demand (COD). *In situ* measurements of dissolved oxygen (DO), pH, temperature, and conductivity were also recorded. Statistical analyses were performed using Minitab 17. Mean phosphate concentrations were lower in brush park areas (0.13 ± 0.04 mg/L) than in adjacent mangrove habitats (0.18 ± 0.03 mg/L). Similarly, nitrate levels were lower in brush parks (0.31 ± 0.35 mg/L) compared to mangroves (0.80 ± 0.66 mg/L). Lower values of BOD_5 (1.95 ± 0.95 mg/L) and COD (0.54 ± 0.43 mg/L) were also recorded in brush parks compared to mangrove areas (3.06 ± 0.88 mg/L and 1.31 ± 0.18 mg/L, respectively). Dissolved oxygen concentrations were slightly higher in brush parks (7.46 ± 0.87 mg/L) than in mangroves (6.99 ± 1.33 mg/L), although the difference was not significant. Water temperature was marginally higher in brush parks, while mean pH values were similar between the brush parks (7.39 ± 0.60) and mangroves (7.57 ± 0.56), with some temporal and spatial variation. Conductivity was marginally, though not significantly, higher in brush parks than in mangroves. Overall, brush park areas exhibited comparatively better water quality than adjacent mangrove habitats, indicating their potential as favorable fish habitats. Given increasing pressures on mangrove ecosystems, conserving and promoting traditional brush park fishing may support sustainable fisheries while contributing to estuarine ecosystem health.

Key words: Brush parks; Water quality; Mangroves; Negombo estuary

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Molecular insights into genetic diversity, connectivity, and cryptic lineage of giant clams (*Tridacna*) in Sri Lanka

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Abstract

Giant clams are among the most charismatic coral reef invertebrates and are the largest living bivalves in the ocean. They play vital ecological roles in coral reef ecosystems but are increasingly threatened by both anthropogenic and natural pressures. Some species have already been reported as locally extinct. Consequently, several *Tridacna* species are listed under the IUCN Red List of Threatened Species and CITES Appendix II. Despite their ecological importance, giant clams in Sri Lanka remain poorly studied, leaving major gaps in knowledge regarding species composition, distribution, and genetic structure. This study presents the first molecular assessment of *Tridacna* populations in Sri Lanka, offering new insights into their genetic diversity and connectivity. Non-lethal mantle tissue samples (~1 cm) were collected from 123 individuals across seven reef sites around the island and preserved in absolute ethanol. DNA was extracted and sequenced for the mitochondrial cytochrome c oxidase subunit I (COI) gene. Genetic diversity and population differentiation were assessed using F-statistics, and haplotype networks were constructed to examine population structure. Results revealed an uneven distribution, with the highest abundance along the northeastern coast. All sampled individuals formed a monophyletic clade that was distinct from but closely related to *T. noae*. This relationship was strongly supported by 100% bootstrap confidence, indicating the presence of a cryptic *Tridacna* lineage in Sri Lanka. A total of 63 haplotypes were identified, with high haplotype diversity (0.86–1.00) and low to moderate nucleotide diversity (0.01–0.02). Overall AMOVA indicated very low genetic differentiation among sample sites (F_{st} = 0.02, $p > 0.05$), and pairwise Φ_{ST} comparisons were not significant ($p > 0.05$). These results suggest panmixia, likely driven by seasonal monsoon-related currents around the island. This pattern was consistent with the weak structure observed in the haplotype network. However, limited sampling in the northwest and southern regions may have obscured finer-scale genetic structure. Collectively, these findings provide the first molecular evidence of a novel *Tridacna* lineage in Sri Lanka and highlight the urgent need for targeted conservation and management strategies at both local and regional scales to support global *Tridacna* conservation efforts.

Keywords: Cryptic Species; DNA barcoding; Evolutionarily Significant Units (ESUs); Population Connectivity; *Tridacna noae*

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Assessment of mega plastic pollution along the northern section of Crow Island Beach, Sri Lanka

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Abstract

Plastic pollution is a major threat to marine and coastal ecosystems worldwide, with notable ecological, economic, and aesthetic impacts, especially in Sri Lanka. This study provides an overview of a quantitative and statistical evaluation of mega plastic accumulation along the northern sector of Crow Island Beach, near the Kelani River Estuary (6.973° N, 79.868° E), covering an area of approximately 0.45 km^2 and a 900 m shoreline. Cleanup and monitoring data were obtained from Clean Ocean Force**.** Solid waste was systematically collected four times per month along the study site over a five-year period (July 2021-September 2025)**.** During each cleanup event, all collected debris was weighed using standardized procedures, and the total mass was recorded in kilograms. The compiled dataset was subsequently analyzed using descriptive and inferential statistical methods**.** Plastics were categorized into polyethylene terephthalate (PET) bottles, yoghurt cups/spoons, and other plastics, measured by total mass (kg). PET bottles were the dominant category (77.4 ± 3.8%), followed by other plastics (16.6 ± 2.9%) and yoghurt cups/spoons (6.0 ± 1.2%). Results showed significant interannual variation in total plastics mass (one-way ANOVA, $p < 0.05$), with the highest accumulation in 2022 (6 025 kg) and the lowest in 2025 (2 690 kg). Elevated plastic deposition during the COVID-19 pandemic period (2021-2022) was linked to the increased use of bottled beverages and disposable packaging materials. Seasonal t-tests indicated significantly higher accumulation during the southwest monsoon (May-September) than the northeast monsoon (December-February) ($t = 3.41$, $df = 8$, $p < 0.01$), reflecting enhanced riverine discharge and surface runoff. The Plastic Abundance Index (PAI) averaged 0.04 kg m^{-2}, while the Clean Coast Index (CCI) was 473.13, categorizing the site as extremely polluted. These findings suggest that monsoonal dynamics, pandemic-related waste, and land-based discharges are key drivers of mega plastic accumulation at Crow Island. The study underscores the urgent need for integrated coastal waste management strategies, including source reduction, community awareness campaigns, improved waste collection at riverine entry points, and community-based cleanup initiatives.

Keywords: Coastal pollution; Crow Island beach; Mega plastics; Monsoonal variation

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A quantitative assessment of marine debris pollution with special reference to disposable plastics along the southern coast of Sri Lanka

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Abstract

Marine debris is one of the major environmental issues affecting coastal and marine ecosystems, and it is primarily composed of durable, non-biodegradable plastics. Waste accumulations along shorelines are evident due to the increasing use of single-use plastics and their improper disposal. Focusing on disposable plastics, this study provides a comprehensive quantitative assessment of marine debris pollution along Sri Lanka's southern coastline, choosing several beaches and comparing the abundance of different types of marine debris during weekdays and weekends. Four impacted beaches in the Southern province accordingly, Hikkaduwa, Gin Thota, Pareiwella and Kirinda were chosen as study sites. Rekawa beach was considered as the control site. Debris were collected from thirty quadrats ($1m^2$) along each of the three 30-meter transects that were positioned perpendicular to the shoreline at each site. A precision balance with an accuracy of ±0.01 g was used to weigh, count, and classify all of the items collected according to the material type. Across all-study sites, a total of 35,143 debris items were recorded. Plastics were by far the most prevalent material, accounting for 91.4 % of the total composition. Metal and glass fragments constituted 6.7%, fishing-related debris 9.5%, fabric and textile waste 7.8%, rubber materials 23.9%, and plastic fragments 31.9%. Kirinda recorded the highest mean debris density, while Pareiwella showed the lowest ranging from 0.47 to 2.96 items per one m^2. A one-way ANOVA statistical analysis revealed significant variation ($p < 0.05$) in debris density among sites during weekends (holidays), which corresponded with peaks in fishing and tourism activity, whereas weekly (working days) variations were not statistically significant the ubiquity of plastics highlights their persistent and pervasive nature in marine environments. Site-specific differences in debris composition were associated with variations in fishing intensity, waste management efficiency, and tourism pressure. The findings underscore the need for enhanced coastal waste management practices, regular cleanup campaigns, increased community awareness, and more sustainable tourism regulations to protect Sri Lanka's coastal ecosystems.

Keywords: Coastal management; Marine debris; Plastics; Pollution; Southern Province

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Seagrass species composition, canopy height and percentage cover across selected sites in the northern region of Batticaloa Lagoon, Sri Lanka

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Abstract

Seagrasses are the only marine flowering plants that live entirely submerged in shallow, sheltered coastal environments. They form ecologically important meadows that provide habitat for marine fauna, stabilize sediments, and contribute to climate change mitigation. In Sri Lanka, research on seagrass ecosystems is limited, and data for Batticaloa lagoon remain scarce. This study presents the first assessment of seagrass in Batticaloa lagoon, a significant coastal ecosystem on the Eastern coast of Sri Lanka. The study was conducted in January 2025 at three selected study sites in the Northern part of the lagoon. At each site GPS coordinates were recorded, and 25 m transects were laid perpendicular to the shore. Within each site, nine quadrats were randomly placed. Canopy height estimation was done by measuring the total blade length of ten randomly selected individual seagrasses within the quadrat and calculating their mean heights. Seagrass percentage cover was visually estimated in triplicate. For species identification non-destructive samples were collected. Across all sites, *Halodule pinifolia* was identified as the dominant seagrass species, while *Halophila ovalis* occurred only in small, patchy distributions at Site 3. The One-way ANOVA test indicated a significant difference in canopy height across three study sites ($p = 0.041$). Further conducted post-hoc analysis revealed that site 3 canopy height was significantly lower than the other two sites (mean = 7.52 cm). Average percentage cover of *H. pinifolia* was 59%, 57%, and 54% at site 1, 2, and 3 respectively. One-way ANOVA revealed that there is no statistically significant difference in percentage cover among study sites ($p = 0.966$). The uniform percentage cover indicates stable habitat conditions across the study sites. This study provides baseline data on species composition and spatial coverage of seagrass in Batticaloa lagoon, offering vital data for future monitoring, conservation and management of these ecologically valuable coastal habitats.

Keywords: Batticaloa lagoon; *Halodule pinifolia; Halophila ovalis*; Seagrass; Seagrass composition

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Climate change adaptation in coastal tourism businesses from Pitipana to Kochchikade, Negombo, Sri Lanka.

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Abstract

Negombo, a major coastal tourism center, is increasingly threatened by rising sea levels, extreme weather events, and coastal erosion, letting both infrastructure and livelihoods at risk. This study investigated the climate change adaptation strategies employed by coastal tourism businesses in Negombo and assessed their contribution for sustainable coastal management. Employing a mixed method approach and a simple random sampling technique, primary data were gathered through a structured questionnaire within three weeks and survey involving 182 tourism businesses, including hotels, restaurants, tour operators, and water-sport providers. Data were analyzed using descriptive statistics, non-parametric tests, and regression models. The findings indicated that extreme weather, such as strong winds and heavy rainfall, as the severest climate related threat, whereas slower processes such as sea level rise and erosion are having lesser impact. Awareness of climate change impacts is generally low, as over (70%) of participants showed limited understanding. Adaptation measures are mostly undeveloped as (64.8%) of businesses reported no adaptation efforts, only (16.5%) engage in ecofriendly practices, and (2.2%) participate in ecosystem-based activities such as mangrove restoration and sustainable practices. Although most rely on government driven hard infrastructure solutions such as seawalls and groins. Most proportion are unaware of these structures. Adaptation effectiveness was rated poorly at the mean score of 1.45 out of 5. Overall, (79.7%) recorded financial limitations and (58.2%) recorded insufficient government support as the main obstacles for implementing adaptation measures. Hotels and restaurants showed considerably higher awareness and adaptation effectiveness than tour operators, water sport providers and small-scale rooms and restaurants. These results highlight a significant deficiency in long term climate resilience planning within Negombo's tourism industry. Businesses tend to focus on immediate operational risks while overlooking gradual, long term climate threats. Limited cooperation among stakeholders and low involvement in sustainable initiatives further reduce adaptive capacity. Further, the currently available policies on climate change adaptations are not practically implemented. Hence this study emphasis the need of raising awareness, embedding climate adaptation into long-term business planning, encouraging ecosystem-based solutions and tax relief programs.

Keywords: Adaptations; Climate change; Coastal tourism

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Community structure and diversity of macrobenthos: a comparative study on two sandy beaches of the western coast, Sri Lanka

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Abstract

Sandy beach ecosystems are experiencing increasing anthropogenic pressure globally, yet macrobenthic community responses remain poorly understood, particularly in tropical regions. This comparative study examined macrobenthic communities at two sandy beaches namely Negombo Beach Park (7.23775° N, 79.84015° E) which is a popular tourist destination and disturbed by various anthropogenic activities and Sarakkuwa Sandy Beach (7.11235° N, 79.84230° E), a relatively undisturbed site, during January and February 2025. Three sites from each beach were randomly selected and sediment core samples were collected using a cylindrical PVC core along 20 m line transects at 2.5m intervals. At the end of the study 27 sediment core samples were collected from each beach per month resulting in a total of 108 sediment samples over two months for macrobenthic analysis. Species identification was performed using standard keys and photographic collections. Abundance, species richness, evenness, effective species number, and Alpha (α) and Beta (β) diversities were determined. A total of 34 macrobenthic species were identified from both sites. The Negombo Beach Park consisted 95% Molluscan (26.67% Gastropods, 68.33% bivalves), 3.33% Arthropoda (Crustaceans), and 1.67% Annelida (Polychaeta). In Sarakkuwa, 91.85% Molluscan (64.44% Gastropods, 27.41% Bivalves), 4.44% Arthropoda (Crustaceans), and 3.70% Annelida were recorded. Evidently, mollusks dominated both beaches (92.82%; 52.82% Gastropods and 40% bivalves), followed by Arthropoda (4.10%) and Annelida (3.08%). Sarakkuwa Sandy Beach exhibited higher Shannon diversity (H′ = 2.79) and total abundance (8,249.74 ind./m^3) compared to Negombo Beach Park (H′ = 2.49; total abundance 3,666.55 ind./m^3). Mann-Whitney test confirmed significant differences in Shannon diversity between the two beaches (p = 0.000). Simpson's diversity indices showed higher values at Sarakkuwa (Ds = 0.92) compared to Negombo Beach Park (Ds = 0.85). Sarakkuwa supported specialized predatory gastropods (*Partecosta* sp., 1344.40 ind./m^3, 16.30%) and sensitive indicator species including amphipod crustaceans such as *Aoridae* sp. and *Talitridae* sp., while Negombo beach Park showed extreme dominance by the stress-tolerant bivalve *Gafrarium pectinatum* (1283.29 ind./m^3, 35%). Beta diversity analysis revealed remarkable species turnover between sites (Jaccard similarity = 0.15 and Sorensen's similarity = 0.25) indicating distinct community assemblages despite geographic proximity. The findings confirm that anthropogenic factors impact on the coastal macrobenthic ecosystems, supplying vital foundational data for strategic coastal resources management.

Keywords: Alpha diversity; Anthropogenic impacts; Beta diversity; Macrobenthos; Sandy beach ecology; Species composition

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Microplastic contamination in coastal seaweeds and seawater: a comparative assessment from Beruwala and Dikwella, Sri Lanka.

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Abstract

Microplastic (MP) pollution poses a major threat to marine and coastal ecosystems, and coastal seaweeds can serve as effective bioindicators of such contamination. This study aims to assess coastal MP pollution using seaweeds as bioindicators at two coastal areas. Three seaweed species, *Sargassum sp.* (SP), *Sargassum crassifolium* (SC), and *Caulerpa lentillifera* (CL), were selected based on morphological identification. Seaweed and associated seawater samples were collected during the first inter-monsoon period (March-April) 2025, from two coastal areas of Sri Lanka, Beruwala and Dikwella. A total of 24 samples of seaweed (18) and seawater (6) were collected from three sites in each coastal area. Two grams of dried seaweed from each sample were digested using Fenton's reagent, followed by density separation with saturated NaCl and vacuum filtration through 1.2 µm glass microfiber filters. Seawater samples (300 mL) were filtered directly using the same type of filter. MP extracted from both seaweed and seawater was quantified and characterized using a stereo microscope and further visualized using Nile Red staining. Mean (MP) concentrations in seaweed from Beruwala were 1.33±0.58 particles/g for SP, 1.50±0.50 particles/g for SC, and 0.83±0.29 particles/g for CL. In Dikwella, MP concentrations were higher: 2.00±1.32, 2.33±0.76, and 1.33±1.04 particles/g for SP, SC, and CL, respectively. Mann-Whitney U tests indicated no significant differences between sites, and Kruskal-Wallis tests showed no significant differences among species ($p > 0.05$), although SC accumulated the most MPs at both sites (Beruwala: 40.91%; Dikwella: 41.18%). In Beruwala, fibers and fragments dominated (45% each), while in Dikwella, fibers (46%) and fragments (32%) were most abundant; filaments and foams were also present. Seawater samples showed similar total MP abundance at both sites, with fibers dominating (42% in Beruwala, 50% in Dikwella), and black (46%) and blue (29%) particles were the most frequent in both seaweed and seawater samples. Overall, MP abundance was slightly higher in Dikwella than in Beruwala, with black and blue fibers and fragments dominating, possibly reflecting inputs from fishing materials, synthetic gear, and textiles. This baseline study provides data for Sri Lankan coasts and highlights the need for improved monitoring, best practices, and stronger policies to reduce plastic pollution and protect coastal ecosystems.

Keywords: Bioindicators; Coastal ecosystems; Microplastics; Seaweed; Sri Lanka

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Exploring eco-anxiety among undergraduates of ocean university of Sri Lanka: a qualitative study of emotions and coping strategies

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Abstract

Despite growing global awareness of ecological crises, limited research has explored the emotional experiences and coping mechanisms of undergraduates in Sri Lanka, where climate vulnerability is high. Eco-anxiety, characterized by distress related to environmental degradation, manifests through complex emotional and behavioral responses that require culturally contextualized understanding. This study employed a phenomenological qualitative approach to examine the emotional responses of undergraduates of Ocean University of Sri Lanka to ecological crises and to identify the coping strategies they adopt to manage anxiety and other negative emotions related to environmental crises. Semi-structured interviews were conducted in June 2025 in person with 20 undergraduates (n = 20) who participated voluntary after an open invitation, with each interview lasting 20-30 minutes to get comprehensive responses. Audio recordings were transcribed verbatim and analyzed using thematic analysis in NVivo 15 software. The analysis revealed three key emotional themes: (1) heightened emotional distress and environmental threat perception encompassing anger, frustration, fear, uncertainty, shock, and distress; (2) moral emotions and self-reflection, including guilt, regret, responsibility, and empowerment; and (3) emotional sorrow and empathic connection with nature characterized by sadness and helplessness. Four coping themes emerged: (1) adaptive and problem-focused coping involving active environmental engagement and information-seeking; (2) avoidance and psychological distancing through intentional detachment from distressing content; (3) emotion-focused coping, including emotional regulation and distraction activities such as music, art, and nature exposure; and (4) socially supported coping through interpersonal communication with friends and family. These findings demonstrate that Ocean University undergraduates experience multifaceted emotional responses to environmental crises ranging from distress to empowering moral responsibility. While social support emerged as the predominant coping strategy, students employ diverse mechanisms combining proactive engagement, emotional regulation, and occasional avoidance. Eco-anxiety is therefore not merely debilitating but may trigger ethical awareness and pro-environmental behavior under the conditions of adequate coping resources that are culturally relevant. The study underscores the need for culturally responsive interventions by universities and mental health professionals, which validate students' emotions, strengthen adaptive coping mechanisms, and transform environmental distress into constructive climate action within the Sri Lankan context. Future studies could adopt more systematic sampling methods to increase the representativeness of the sample.

Keywords: Coping strategies; Eco-anxiety; Ecological crises; Emotional responses

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Distribution and abundance of microplastics in beach sediments around beaches of the Kelani River estuary, Sri Lanka

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Abstract

The microplastics (MP) pollution has become one of the major threats to marine and coastal environment, especially in urban settings. This study quantified MPs in beach sediments from selected areas around the Kelani River estuary, Sri Lanka. Sediment samples were gathered from four beach sites around the Kelani River estuary. Two sites on the right bank, and two sites on the left bank of the river, all within 2 km of the estuary mouth. Each site used a 50 cm x 50 cm quadrat for surface sediment collection (2 cm depth), with nine samples per site (total n=36). Density separation was carried out using NaCl solution (1.2 g cm^{-3}), followed by chemical digestion using 30% of hydrogen peroxide. The samples were filtered through 0.45 µm membrane filter to isolate MPs. The filter paper was examined under the stereo microscope at 40× magnification. The number of MPs were counted in sediment samples. Microplastic concentrations vary from 94.19 to 163.38 particles/kg of dry sediments. The average microplastic abundance was 118.10 ± 4.09 particles/kg of dry sediments. Microplastic composition was dominated by fragments and fibers, concentration was 83.74±1.86 and 28.96±3.67 particles/kg, respectively, while other types (pellets, films, foams) were minor (<5%). Color analysis showed blue as the most prevalent (57.17 ± 1.81 MPs/kg), followed by black (27.61 ± 1.66 MPs/kg) and red (23.28 ± 2.50 MPs/kg). Fragments and fibers accounted for about 71.47% and 24.60% of identified microplastic types. The size distribution showed that 88.43% of microplastics were microscopic (<1 mm), 8.15% ranged 1-4 mm, and just 3.42% exceeded 4 mm, predominantly tiny, persistent particles. Findings of the study indicate evidence of the presence of MPs in beach sediments around the Kelani River estuary, which needs immediate precautionary measures to mitigate the MPs contamination. The study underscores the need for regular monitoring of MPs in marine and coastal environment and highlights the importance of implementing strategies to mitigate plastic pollution.

Keywords: Beach sediments; Fibers and fragments; Human health; Microplastics (MPs); Kelani River.

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A comparative assessment of traditional and modern fishing practices in Negombo Lagoon, Sri Lanka

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Abstract

Negombo Lagoon is a shallow estuarine ecosystem located on the west coast of Sri Lanka (approximately 7°12′N, 79°50′E), covering about 3,100 ha and supporting important fisheries-dependent livelihoods. This study presents a comparative quantitative assessment of traditional and modern fishing practices in the Negombo Lagoon, with particular emphasis on economic performance, catch efficiency, ecological impacts, and community acceptance. A structured quantitative survey was conducted among lagoon fishermen, categorizing respondents into two groups: modern fishing gear users (n = 74) and traditional fishing gear users (n = 26). Common fishing gear types included gill nets, long lines, and drift nets, with modern fishing methods accounting for approximately 74% of total fishing effort. Key indicators such as monthly income, total catch, and Catch per Unit Effort (CPUE) were analyzed using two-sample t-tests in Minitab. Results indicated that modern fishing practices generated significantly higher short-term economic benefits, with average monthly income of modern gear users (LKR 58,277) being nearly five times higher than that of traditional fishermen. Modern methods also recorded significantly higher CPUE (16.01 kg/effort) and average catch (92.94 kg) compared to traditional practices (4.90 kg/effort and 23.37 kg, respectively) ($p < 0.05$). However, modern fishing practices were associated with significantly greater negative ecological impacts ($p < 0.05$). In contrast, traditional fishing methods, including stake nets and beach seines, were found to be more selective, environmentally sustainable, and socially acceptable within local fishing communities. The study highlights a clear trade-off between short-term economic efficiency and long-term ecological sustainability. These findings emphasize the need for effective fisheries management interventions, including regulation of fishing gear, promotion of sustainable fishing practices, and community-based co-management approaches, to ensure balanced and sustainable utilization of fisheries resources in the Negombo Lagoon.

Keywords: Catch Per Unit Effort (CPUE); Fisheries management; Modern fishing; Negombo Lagoon; Sustainability; Traditional fishing

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Assessment of abundance and distribution of abandoned, lost, or otherwise discarded fishing gear (ALDFG) along the Colombo District coastline of Sri Lanka

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Abstract

Abandoned, Lost or Otherwise Discarded Fishing Gear (ALDFG) contributes significantly to global plastic pollution; however limited studies have examined its extent in Sri Lankan coastal areas. This study was conducted in September 2025, during low tide in the southwest monsoon, to assess the abundance and distribution of ALDFG along ten accessible beaches on the Colombo District coastline of Sri Lanka. The selected beaches were Crow Island, Galle face, Wellawatta, Dehiwala, Mount- Lavinia, Ratmalana, Angulana, Lunawa, Moratuwa, and Egoda Uyana. At each beach, three 100m transects were surveyed using the Standing-Stock survey method following the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Shoreline Survey Field Guide. The density of ALDFG items ranging from 2.5 cm to 30.48 cm in length was evaluated. Ropes, net fragments, buoys, and floats were the most commonly observed ALDFG items, while fishing lures, fishing lines, cables, rigifoam box pieces and other items were less frequently recorded. The highest ropes density was observed at Mount-Lavinia (1.09 items/m^2), whereas the highest density of net fragments was recorded at Angulana (1.37 items/m^2). Among all beaches, Wellawatta recorded the highest overall ALDFG density (3.144 items/m^2), while the lowest densities were observed at Egoda Uyana and Galle face (0.433 items/m^2). One-way ANOVA revealed no significant difference in ALDFG distribution among the ten beaches ($P = 0.439$). This study provides baseline information on the abundance and spatial distribution of ALDFG along the Colombo District coastline and offers an approach for identifying potential sources and impacts of ALDFG. The finding contributes essential groundwork for developing targeted waste management strategies and policy interventions to address marine plastic pollution in Sri Lanka.

Keywords: Abandoned; Lost and Discarded fishing gear (ALDFG); Marine plastic; Coastal pollution; Ghost gear; Fishing gear

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Microplastic contamination of commercial ice used in fishery industry in the western province, Sri Lanka

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Abstract

Microplastic (MP) pollution in fisheries is an emerging environmental concern, particularly in commercial ice used for fish preservation. Commercial ice, which has its principal use in the fishery sector, are important as food preservation sources. The present study investigated the presence and characteristics of MPs in commercial ice at Negombo, Dikkowita, Beruwala and Panaduara fishery harbor. Ice sampling was conducted from February to April 2025 across selected harbors. Samples were obtained from three major commercial ice factories and from multiday fishing boats using factory-produced ice. Six samples per harbor were collected, including factory-originated ice and boat ice after transportation. From each sampling point, one liter of ice was collected, extracted and analyzed for colors, and types of MPs. MP contamination was dominant across all sites, with fragments being the most abundant MP type in both boat and factory ice samples. Negombo fishery harbor exhibited the highest MP concentration in both types of samples: 125.0 ± 47.6 MPs/L in boat ice and 110.7 ± 41.3 MPs/L in factory ice. The total microplastic concentrations were slightly lower in Beruwala (boat ice: 122.2 ± 9.3 MPs/L; factory ice: 69.3 ± 16.7 MPs/L) and Dikkowita (boat ice: 95.8 ± 30.4 MPs/L; factory ice: 85.0 ± 32.1 MPs/L), with Panadura harbor showing the lowest levels (boat ice: 66.9 ± 10.5 MPs/L; factory ice: 54.5 ± 15.4 MPs/L). In terms of MP colors, black MPs were the most common, followed by blue, red, transparent, and yellow MPs, with brown MPs being the least abundant. One-way ANOVA showed no significant difference in mean microplastic concentrations between factory and multiday boat ice samples (p = 0.132); however, higher concentrations were observed in boat ice (102.5 ± 36.7 MPs/L), indicating possible contamination during transportation, handling, and storage. These findings emphasize the need for improved monitoring and regulation of commercial ice handling practices to reduce microplastic pollution in fisheries.

Keywords: Commercial ice**;** Fishery Harbors; Microplastics; Water quality

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Baseline assessment of benthic habitat and reef fish community structure at Coral Island, Trincomalee, Sri Lanka

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Abstract

Coral Island is a biodiversity-rich coral reef ecosystem located near the Irakkandy Bridge in Trincomalee, northeastern Sri Lanka. Despite its ecological importance, the reef is exposed to multiple threats, including tourism pressure, unsustainable resource harvesting, and thermal stress. To date, the area lacks quantitative information on species composition, benthic habitat structure, and spatial coverage necessary to assess its current condition and inform conservation and management decisions. This study addresses this knowledge gap by providing baseline ecological data for Coral Island. Field surveys were conducted between May and July 2025 using Line Intercept Transect (LIT) and belt transect methods along six 25 m transects at 0.5-5 m depth contours during low tide. Benthic cover was quantified, and reef fish abundance and community composition were assessed. Eight major benthic categories were identified, with live hard coral contributing 44% of total benthic cover, followed by coral rubble (25%) and dead coral (18%), indicating a moderate reef condition. In contrast to shallow reef zones (0.5–2 m), higher proportions of dead coral were observed at deeper depth contours (3–5 m), potentially reflecting partial recovery following a bleaching event recorded in May 2024. A total of 16 coral species representing eight families were documented, dominated by Acroporidae and Poritidae, particularly *Acropora formosa*, *A. hyacinthus*, and *Montipora digitata*. Signs of coral disease were observed in shallow-water colonies, possibly associated with black fungal infections. Reef fish assemblages comprised 285 individuals representing 32 species across 13 families. The community was strongly dominated by Pomacentridae (damselfishes), accounting for 81% of total abundance, followed by Labridae (4%), Chaetodontidae (4%), and Acanthuridae (4%). Shannon–Wiener diversity indices indicated moderate species richness but low evenness, suggesting numerical dominance by resilient taxa and potential ecological imbalance. The high abundance of damselfishes likely reflects a combination of habitat complexity and localized environmental stress. Collectively, Coral Island supports diverse coral and reef fish assemblages but shows partial degradation from past bleaching and ongoing fishing pressure. These results underscore its conservation importance and the need for inclusion in Sri Lanka's marine protected area network, with targeted long-term monitoring to enhance reef resilience and biodiversity.

Keywords: Biodiversity assessment; Coral diseases; Line intercept transect, Marine protected areas; Reef health

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Linking mud shrimp catch rates and market price dynamics in the Poruthota artisanal fishery

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Abstract

Shrimp is a highly nutritious, protein-rich seafood, and an important source of income for many coastal communities in Sri Lanka. The artisanal shrimp trawl fishery at the Poruthota traditional catamaran harbour employs dugout canoes, mainly targeting *Metapenaeus dobsoni* and *Parapenaeopsis coromandelica*, both commonly referred to as "mud shrimp" by trawler fishers. This study aimed to evaluate the relationship between mud shrimp catch and market prices during the second inter-monsoon period in Poruthota, Negombo. Data were collected from 39 fishing trips of randomly selected traditional dugout canoes in Poruthota, through daily field visits from October to December 2024. Catch-per-unit-effort (CPUE), fishing hours, and daily shrimp prices were recorded, and the study period was categorized into early, middle, and end phases of the second inter-monsoon. Since catch-per-unit-effort (CPUE) and price data were not normally distributed, Spearman's rank test was applied. Analyzed results revealed a significant, moderate negative correlation between CPUE and shrimp price (Spearman's $\rho = -0.534$, $p < 0.001$), indicating that higher catches led to lower prices due to increased supply. This pattern was most noticeable during the middle phase ($\rho = -0.659$, $p = 0.014$), while no significant relationship was observed during the early ($\rho = 0.349$, $p = 0.266$) and end phases ($\rho = 0.234$, $p = 0.420$). These findings highlight how seasonal patterns and market dynamics jointly influence shrimp catches and pricing. Bad weather during the monsoon season limited fishing, while better weather led to higher shrimp catches, which in turn caused prices to drop. This study demonstrates that understanding these links helps to fishery management decisions, market planning, and livelihood stability of artisanal shrimp fishers in Poruthota, Negombo.

Keywords: Fishing effort; Market trend; Monsoon; Sailboat; Shrimp trawler

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Study of identifying affected factors on the consumers' purchasing behavior of canned fish in the Matara city area, Sri Lanka

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Abstract

As consumer behavior continues to evolve significantly, instant food items such as canned fish have become increasingly popular and widely consumed. This growing demand has intensified competition within the industry. As a result, companies should prioritize customer satisfaction and meet consumer needs in order to effectively influence their purchasing decisions. This study aimed to examine the factors influencing consumers' decisions to purchase canned fish products. The independent variables in this study include product characteristics such as price, brand, packaging, nutritional information, and taste, as well as socio-economic factors like age, gender, education level, occupation, and monthly income of consumers. These factors were hypothesized to influence the dependent variable, which is the consumers' purchasing decisions regarding canned fish products. Primary data were collected through an online survey using a structured questionnaire to achieve the study objective. There was not any sampling frame for the study. So, convenience sampling technique was applied single there was not any idea about sampling frame of the study. Then, the Chi-square test was employed to analyze the data. The results of this study indicated that level of education, nutritional value and product taste significantly affected purchasing decisions for canned fish products. These findings serve as important indicators and valuable insights in promoting the canned fish product. The findings of the study indicate that companies should recognize that improving the nutritional profile of canned fish, raising awareness of its health benefits according to the education level of the community are essential steps to satisfy consumer needs and expand market reach

Keywords: Instant food; Purchasing decision; Canned fish; Nutritional profile; Education and awareness.

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Social self-image of fisherwomen: a case study of Rekawa fishing community in southern Sri Lanka

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Abstract

The social self-image of a fisherwoman is conceptualized as a mental picture formed based on psychological perceptions of her identity as a fisherwoman, which is shaped over time by a combination of internal and external factors. Recognition of such factors would support the development of social self-image in a positive direction. Improving social self-image can lead to greater self-esteem and overall well-being with empowerment. This study aims to examine the factors that contribute to the development of a positive social self-image among fisherwomen. A total of 160 fisherwomen from Rekawa, Southern Sri Lanka, were selected using a purposive sampling technique. A pre-tested, structured questionnaire was used to collect data in December 2024 with the consent of the participants. Perceptions of fisherwomen regarding their contributions to the economy, food security, social responsibility, decision-making power, and environmental concern were measured using a five-point Likert scale. A binary logistic regression and descriptive statistics were used to analyze the data. A majority of fisherwomen (65.6%) were engaged in fishery-related activities such as net mending, fish processing, and selling. Although a positive social self-image was reported by the majority of respondents (88.5%), no significant impact was shown by socio-demographic factors such as age and education level on the self-image. The results showed that being a major decision-maker in the family ($p < 0.05$), spending their earnings to cover basic household expenses ($p < 0.05$), and being an active member of a community-based organization ($p < 0.05$) positively affect their social self-image. However, domestic violence faced by the fisherwomen due to their husbands' regular liquor consumption ($p < 0.05$) was detrimental to their social self-image. In conclusion, fisherwomen's contribution to the household economy, possession of family decision-making power, and holding social responsibilities in their community positively contribute to shaping their social self-image. Empowering fisherwomen through skills training and family counselling can enhance their status and well-being. This study provides policymakers with insights for initiating gender-focused interventions in coastal communities.

Keywords: Decision-making power; Domestic violence; Household economy; Social responsibilities

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Assessment of fish waste production in the dry fish industry, Negombo, Sri Lanka

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Abstract

The traditional dry fish industry in Negombo, Sri Lanka, plays a significant role in sustaining coastal livelihoods and local food systems; however, systematic evidence on fish waste generation, handling, and disposal practices within this sector remains limited. Addressing this research gap, the present study quantitatively assesses fish waste production during dry fish processing and qualitatively examines prevailing waste disposal practices to support the development of sustainable waste management strategies. A mixed-methods research design was employed, integrating quantitative and qualitative approaches. The study was conducted from June to August 2025, and purposive sampling was used to select 100 respondents directly engaged in dry fish processing activities. Primary data were collected through structured interviews, questionnaires, and field observations. The results indicated that the average daily fish handling volume was 3,612.50 kg, generating approximately 1,162.37 kg of fish waste per day, corresponding to a waste generation ratio of 0.367 kg of waste per kilogram of fish processed. Considerable variation was observed in fish waste disposal practices: 38% of respondents disposed of waste into the sea, 27% utilized it as organic fertilizer, 31% sold fish waste to animal feed manufacturers, and 4% employed other informal methods, including burial and uncontrolled dumping. As a waste reduction intervention, the installation of a fish waste crushing machine was evaluated, and an efficiency improvement of 10.32% was recorded, based on the machine's processing capacity and the reduction in waste volume requiring final disposal. The findings highlight the predominance of informal waste management practices and underscore the urgent need for improved infrastructure, technology adoption, and stakeholder awareness to minimize environmental impacts. Overall, the study provides empirical evidence to support the implementation of practical and sustainable fish waste management systems that enhance environmental protection and socio-economic sustainability within the dry fish industry of Negombo, Sri Lanka.

Keywords: Dry fish processing; Fish waste; Sustainable waste management; Waste disposal practices

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Gender-based occupational segregation in the fisheries sector in Negombo, Sri Lanka

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Abstract

Women play a vital role in sustaining the coastal economy, their contributions often go unrecognized and undervalued. This study explores the patterns, causes, and consequences of gender-based occupational segregation in the fisheries sector of Negombo, Sri Lanka. Using a qualitative–descriptive research design, data were collected from 100 respondents (64% male, 36% female) across 13 fisheries divisions in Negombo area through structured questionnaires and semi-structured interviews. The study, conducted from June to August, 2025, employed both descriptive statistics and qualitative content analysis to examine numerical trends alongside community perspectives. Findings reveal a distinct gendered division of labor: men dominate sea-based and higher-income fishing activities such as deep-sea fishing and beach-seine operations, while women are largely confined to low-income, land-based tasks such as removing fish from nets and drying them on mats. Notably, 77% of respondents reported unequal pay for similar work such as *ma-dal* (beach-seine) pulling, separating fish from nets, and processing dried fish within the village or along the beach. Among them, 96% identified gender and 98% identified job type as the main factors contributing to these wage disparities. The persistence of this segregation is strongly linked to traditional beliefs, cultural taboos surrounding women and the sea, heavy family responsibilities, and perceptions of physical limitations. Moreover, 71% of participants highlighted the lack of institutional support programs for women in fisheries, underscoring systemic gaps. Overall, the study concludes that occupational segregation in Negombo's fisheries sector is reinforced by interconnected economic, social, and cultural barriers. Addressing these inequalities demands gender-sensitive policies, fair wage structures, and targeted initiatives to expand women's access to skills, technology, and stable employment. Ensuring inclusive participation is not only essential for women's empowerment but also for the long-term sustainability of Sri Lanka's fisheries sector.

Keywords: Gendered division**;** Inequalities; Institutional support; Negombo's fisheries sector; Occupational segregation

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Operational characteristics and sustainability challenges of small-scale dry fish and Maldives fish processing in Kudawella, Sri Lanka.

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Abstract

Small-scale dry fish and Maldives fish production represent a significant cottage industry within the coastal communities of Kudawella, Gandara, and Kottegoda in southern Sri Lanka. Despite these communities' substantial contribution to the national protein supply, empirical data regarding the industry's current status, challenges, and operational constraints remain limited. This study addresses this knowledge gap through a case study of Kudawella fishing community using a pre-tested, closed-ended questionnaire (n = 30) to collect demographic data, production information, industry challenges and waste management practices, with descriptive analysis conducted in Microsoft Excel. The workforce demonstrated gender equity, with 73%, 23% and 4% possessing secondary, primary, and tertiary education respectively, while age distribution reveals 87% of participants were below 60 years. Product specialization data indicated that the majority of producers (60%) focused exclusively on Maldives fish production, followed by 27% who engaged in dual production of both varieties, and 13% who specialized exclusively in dry fish processing.. Primary species utilized included Indian Mackerel: *Rastrelliger kanagurta* (100%), Skipjack Tuna: *Katsuwonus pelamis* (83%), Rainbow Runner: *Elagatis bipinnulata* (20%), Yellowfin Tuna: *Thunnus albacares* (17%), and Titan Triggerfish: *Balistoides* sp (13%). Major processing methods were sun drying (100%), salting (97%), smoking (80%), and oven drying (47%). Monthly individual production ranged from 100- 5000 kg, with 80% operating from residential premises and 20% utilizing external facilities. They primarily targeted local markets, though some engaged middlemen to facilitate broader market access. Critical constraints include inadequate raw fish quality, insufficient storage facility, adverse weather conditions, limited drying space, pest infestations, insufficient technical training, and market volatility. Environmental degradation resulting from inadequate waste disposal practices and management infrastructure has become a critical concern. Therefore, evidence-based waste management interventions, including treatment methods and value addition strategies, are recommended for achieving sustainable industrial development and long-term ecological viability.

Keywords*:* Coastal communities; Coastal pollution; Dry fish production; Value-added products.

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The impact of tourism on traditional fishery families in Weligama-Palaana Fishery Village, Sri Lanka

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Abstract

Weligama-Palaana, a fishing village in Sri Lanka, is historically known for *Ma-Dal* (Beach Seine) fishing. Since the 2004 tsunami, many families have shifted to small-scale fishing using catamarans, while livelihood pressures have led some to continue using unsustainable gear. The rise of surf tourism has introduced dual livelihoods, as the younger generation increasingly work as surf instructors or in hospitality during the peak tourism season (December to April) in Southern Sri Lanka. This study examines how the transition to tourism affects the livelihoods of traditional fishing families in Weligama-Palaana. The snowball sampling method was used to select 75 individuals across the Palaana sub-areas (South, North, and West), and data were collected using a pre-tested structured questionnaire. Marginal interaction effects ($p = 0.055$, Minitab 2019) indicated potential geographical variations in responses to the questions, although larger-scale validation is necessary. These findings collectively demonstrated the multifaceted impacts of tourism. It provided short-term economic gains while challenging the long-term economic, cultural, and environmental sustainability of fishing communities in Weligama-Palaana. Furthermore, the study revealed that nearly 80% of participants are not willing for their children to pursue fishing, indicating a major generational shift in the traditional practice of fishing for livelihood. A conflict of interest was evident, with 75% of respondents agreeing that tourism-related businesses, such as beach restaurants, have created boat parking issues and limited access to essential spaces for fishery-related g operations. The community strongly perceived the need for awareness programmes concerning sustainable recreational fishing. The study underscores the need for strategic initiatives such as coastal zoning, community-based co-management, livelihood integration between fisheries and tourism, and awareness programmes on sustainable and responsible recreational fishing to balance economic benefits with long-term social, cultural, and environmental sustainability.

Keywords: Beachseine fishing; Small-scale fisheries; Surf tourism; Livelihood diversification

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Evaluating the livelihood status of the inland fishing community of Victoria Reservoir, Sri Lanka, with reference to Covid-19 pandemic period

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Abstract

This study focused on the inland fishing community of Victoria reservoir in the Kandy district, Sri Lanka, primarily assessing the current livelihood status of the fishermen in relation to the recent Covid-19 pandemic. A total of 50 fishermen were selected among the 102 registered fishermen using the random sampling method, representing all ten landing sites of the reservoir. Primary data were collected through a pre-tested, structured questionnaire survey. Secondary data were gathered through the published literature. The data analysis was carried out using the Wilcoxon Signed-Rank Test in addition to descriptive statistics. The study findings revealed statistically significant differences ($p < 0.05$) in multiple socio-economic and environmental aspects of the fishery in the Victoria reservoir over time. The perception that fishing provides a stable income has significantly declined ($p < 0.05$), leading to greater financial instability among fishers. A significant decline ($p < 0.05$) in fish prices and a notable increase ($p < 0.05$) in fishing gear maintenance costs were observed. This economic pressure has contributed to a shift toward aquaculture ($p < 0.05$). The study indicated a significant decline ($p < 0.05$) in access to training and education. The majority (74%) stated that training and education opportunities were not sufficient to improve fishery-related skills. The perception of fishing as a viable career has also declined ($p < 0.05$), possibly due to economic uncertainties, declining fish stocks, and policy gaps. A significant increase ($p < 0.05$) in sedimentation levels has been observed, primarily due to excessive livestock grazing, which leads to soil erosion. Illegal fishing, a major cause of declining fish stocks, has significantly declined over time ($p < 0.05$) due to stricter enforcement and fisher licensing. However, continuous monitoring is necessary to prevent a resurgence of illegal fishing activities. In conclusion, better management strategies and community empowerment are needed to support the livelihood development of the inland fishing community in the Victoria Reservoir. Introducing training programs targeting women to produce value-added fish products and skill development programmes for the younger generation to repair fishing gear and vessels are suggested as modes of livelihood diversification.

Keywords: Aquaculture; Fishermen; Illegal fishing; Livelihood diversification; Training programs

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Employability and economic outcomes of graduates of Ocean University of Sri Lanka emphasis on fisheries economics and marketing

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Abstract

The Ocean University of Sri Lanka, initially established as the National Institute of Fisheries and Nautical Engineering, has evolved into the leading higher education institution in Sri Lanka, aiming to advance human resources in fisheries, marine, and maritime sectors. To produce graduates who are capable of driving innovation and sustainability in the blue economy of Sri Lanka, the university launched several degree programmes, including B.Sc. programs in Fisheries and Marine Science, Coastal and Marine Resources Management, Oceanography, Maritime Transportation Management Logistics, Marine Engineering, and the BTech in Aquaculture and Seafood Technology. A total of 175 graduands were selected from graduate cohort in 2024, to examine the employability patterns, distribution of income, and job satisfaction. The data were collected by using an online questionnaire survey, and responses were analyzed using both descriptive statistics and a two-way ANOVA to assess the combined influence of gender and degree program on employability and income levels. Results revealed that 33% (n = 58) of graduates were employed, while 67% (n = 117) remained unemployed. Approximately, 81% were occupied in private-sector organizations, 9% in semi-government institutions, and 3% in the public sector among employment. The income distribution expressed that most employed graduates earned between Rs. 26,000 and Rs. 75,000 per month, with approximately 11% earning above Rs. 100,000 primarily in managerial, export-aligned, and fisheries enterprise roles. The two-way ANOVA results indicated a significant main effect of the degree program ($p < 0.05$) on income, demonstrating that graduates from Aquaculture and Seafood Technology and Fisheries and Marine Science programs attained higher income levels due to greater alignment with industry demands in coastal engineering, seafood value addition, and export operations. The findings highlighted the effectiveness of Ocean University's academic framework in supporting employment within fisheries and maritime sectors. This study emphasizes the requirement of curriculum enhancement to integrate with modern world technology and entrepreneurship to further strengthen the graduates' competitiveness and contribution to the blue economy in Sri Lanka.

Keywords: Employability; Economics; Graduate; Marketing; Ocean university

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Assessment of rural fisheries organizations in supporting self-sustaining culture-based fisheries in selected perennial reservoirs in Batticaloa district, Sri Lanka

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Abstract

Culture-Based Fisheries (CBF) are a central component of Sri Lanka's inland fisheries policy, aimed at improving rural livelihoods and promoting self-sustaining fish production in perennial reservoirs. Although national-level progress is evident, there is limited empirical understanding of how Rural Fisheries Organizations (RFOs), the primary community institutionsare structured and perform towards self-sustaining systems. Therefore, this study assessed the socioeconomic conditions, governance capacity, and institutional performance of RFOs in six perennial reservoirs (Rugam, Kittul, Wadamunai, Karadiyankulam, Kunjankalkulam, Pulugunava)in Batticaloa District, Sri Lanka. Data were collected from 85 fishers between March and October 2024 using a saturation-based sampling approach and employing several Participatory Rural Appraisal tools, including resource mapping, Venn diagrams, problem ranking, and historical timelines. Results revealed consistent structural vulnerabilities across all reservoirs, including incomes below the national poverty line, low education levels (with up to 75% having no schooling), and high household expenditures dominated by food costs (50–56%). Fishing remained the primary livelihood for most households, limiting diversification, and increasing sensitivity to ecological and market fluctuations. Institutional assessments showed apparent differences among RFOs. Major and medium reservoirs (Rugam, Kittul, Wadamunai) maintained more formal governance systems, including defined rules, stricter sanctions, and organisedmonitoring groups. Minor reservoirs (Karadiyankulam, Kunjankalkulam) relied more on informal social norms, community bonding, and moderate rule enforcement. Revolving fund mechanisms also varied where Kittul and Rugam reservoirs have adopted fixed annual contributions to stabilise revenue, while others continue to use per-kilogram levies, making financial stability dependent on seasonal harvests and market conditions. Resource monitoring wasstrongest in Rugam and Vadamunai, while Pulugunava required additional surveillance due to wildlife conflict and illegal fishing. Stakeholder perceptions highlight NAQDA as the most trusted institution, largely due to its leadership in regulatory matters, assistance with stocking, and technical guidance. Law enforcement agencies are consistently rated poorly for their low responsive rates. RFO performance satisfaction is highest in Karadiyankulam and Kunjankalkulam, and lowest in Pulugunava. Overall, the study demonstrates that while RFOs provide an operational governance framework, socioeconomic vulnerability, uneven institutional capacity, and reservoir-specific challenges limit progress toward fully self-sustaining CBF systems. Strengthening financial governance, improving co-management coordination, and enhancing livelihood resilience are essential to achieving self-sustaining inland fisheries development in Batticaloa, Sri Lanka.

Keywords: Batticaloa, Culture-based fisheries, Perennial reservoirs, self-sustaining

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Effectiveness of the 13 years guaranteed education programme

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Abstract

According to the Global Competitiveness Index, Sri Lanka ranked 68th out of 141 countries in 2019. Within South Asia, Sri Lanka ranks low in terms of competitiveness. Sri Lanka is now transitioning from factor-driven development to efficiency-driven development; Therefore, efficient technical and vocational education and training (TVET) is essential to move up the value chain. In 2022, 166,418 students were trained under vocational training courses in Sri Lanka, a rise from 124,419 in 2020 and 144,919 in 2021. A significant number of students, approximately 41% female, were engaged in technical and vocational education at the 39 colleges in the country in the 2022. The objectives of this study were to investigate the participation of students in vocational training courses under the 13-year continuing education program, to study the attendance percentage and dropout rates of the participating students and to investigate the employability rates of those who successfully complete the courses. The current employment rate of students in the Marine Welding Technology course in the maritime and technical industry is over 92%. Around 53% of lifeguard course students are103mployyed as lifeguards in the local tourism industry and related sectors, while 35% are employed overseas. About 28% of the students who have completed the outboard motor mechanics course are employed in related institutions in Sri Lanka, 15% are employed abroad, and about 30% are employed in other nonrelated industries. The average attendance of students in Marine Welding Technology course at the time of appearing for the final examination was 78%, while the average attendance of students in lifeguard course at the same time was 73%, and the average attendance of students in out board motor mechanics course was 75%. Dropout rates of students in Marine Welding Technology course at the time of appearing for the final examination was 10%, while the lifeguard course at the same time was 13%, and the dropout rates of students in outboard motor mechanics course was 17%. The results indicate that employment in Courses Marine Welding Technology course and lifeguard course is satisfactory, while further research is needed into employment opportunities in outboard motor mechanics course. About 90% of the students who participated in this 13year guaranteed program were O/L failures and had a high reluctance to learn in the classroom. Therefore, their participation in this program has been more effective in terms of employment rates.

Keywords: 13 year guaranteed program; effectiveness; Marine welding technology course; lifeguard course; outboard motor mechanics course.

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Evaluate fisheries and maritime training programs at the Ocean University of Sri Lanka: an extended mixed-methods study

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Abstract

The Ocean University of Sri Lanka plays a vital role in developing professionals for the nation's maritime industry. The effectiveness of its fisheries and marine training programs in meeting labour market demands and maintaining uniform quality across regional centres has not been recently evaluated. The literature's lack of information on the caliber and alignment of maritime training in Sri Lanka reflects a broader research gap regarding the current labour market dynamics and goals within the South Asian region. Therefore, this study aims to fill this gap by systematically assessing program effectiveness, relevance, and institutional capacity to support future improvements in maritime education. Specifically, it evaluates how well Fisheries and Maritime programs offered by the Ocean University of Sri Lanka (OCUSL) align with labour market demands, student satisfaction, and institutional infrastructure. Initiated in 2024 and extended through 2025, the research employs a mixed-methods design integrating both quantitative and qualitative approaches. The research design intended to examine regional variations in program delivery, identify stakeholder perceptions, and highlight the strengths and weaknesses of current training outcomes. Data collection was conducted using a structured Likert-scale questionnaire administered to 146 students across eight regional centres, complemented by interviews with selected university staff and industry managers. The two data strands were integrated during the analysis phase through triangulation, allowing quantitative trends to be interpreted alongside stakeholder perspectives. The study identified clear regional disparities in program delivery, particularly in the availability of practical training facilities and modern equipment across regional centres. Key gaps were found in job relevant skills, including limited exposure to modern fishing technologies, maritime safety practices, and essential soft skills demanded by industry. Infrastructure limitations were shown to restrict effective hands on training, resulting in a mismatch between graduate competencies and current labour market expectations. To address these issues, the study recommends targeted curriculum revisions, upgrading training infrastructure, and strengthening collaboration with industry partners to ensure the continued relevance and quality of fisheries and maritime education in Sri Lanka.

Keywords: Fisheries and maritime training; Maritime education; Program evaluation; Labour market alignment; Ocean University of Sri Lanka.

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Fish consumption patterns and socioeconomic factors influencing dietary practices in northern coastal communities of Sri Lanka

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Abstract

Fish is a dietary staple in Sri Lanka and provides an important source of animal protein. This study aimed to assess household fish consumption patterns and the socioeconomic factors influencing dietary practices in the Northern coastal districts of Jaffna, Mullaitivu, and Mannar. A household survey was conducted in July 2025 using a structured questionnaire and purposive sampling method among 197 households selected from occupied housing units in Jaffna (100 of 203,401 households), Mannar (50 of 32,005 households), and Mullaitivu (47 of 30,553 households). Respondents represented a diverse range of livelihood categories, including fishing, daily wage labor, government and private-sector employment, as well as other occupations, with the majority of households earning less than LKR 50,000 per month. About 74.4% purchased fish from local markets. More than 85% of households consumed fish at least 2–3 times per week. Around 5% consumed fish daily, 43.1% consumed fish on 4–6 days per week, and 45.2% consumed fish on 2–3 days per week. The mean monthly household expenditure on fish was LKR 9,925 across all three districts. Trevally, Indian mackerel, and sprat were the most commonly consumed species. A notable decline in fish consumption was reported across districts, mainly due to rising prices and reduced availability. High prices affected intake in Jaffna (64%), Mannar (48%), and Mullaitivu (46.7%), while availability issues were more common in Mullaitivu (28.3%) and Mannar (25.5%). Children's mean daily fish intake, collected as part of the household questionnaire through a child-specific consumption item, ranged from 86.41 g in Jaffna to 99.04 g in Mannar and 95.24 g in Mullaitivu. Traditional cooking methods were predominant, with fried (36%) and curried (30%) preparations being the most commonly consumed by children. Overall, while income constraints and market availability largely explain variations in fish consumption, long-standing dietary practices such as regular fish-based meals and traditional cooking methods also shape household and child fish intake in northern coastal communities of Sri Lanka.

Keywords: Fish consumption patterns; Socioeconomic factors; Dietary practices; Coastal communities; Northern region

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Fish consumption behaviors among school children in coastal and inland areas: a case study in Chilaw and Kurunegala, Sri Lanka

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Abstract

Despite the recognition of the importance of nutritional status for school-aged children for a healthy life, less attention has been paid to investigating the determinants of fish consumption, thereby improving the intention to consume fish among school-aged children. This research attempted to fill this gap by conducting a comparative study on fish consumption behaviour among school children in two distinct educational zones (coastal vs. inland) of the North Western Province in Sri Lanka. Twelve schools were randomly selected from the Chilaw and Kurunegala zones. A convenience sample of 720 Grade 10 students were selected for the survey. A pre-tested questionnaire was used to collect primary data from the students from January to February 2024. Data were analysed by using a binary logistic regression model and descriptive statistics. The majority (56% in Kurunegala and 59% in Chilaw) preferred to consume both marine and freshwater fish compared to fishery-related products such as canned fish, dried fish, and Maldives fish. Over 50% of the students consumed fish more than two days per week. Students preferred devilled fish to the usual Sri Lankan fish curries. Among the respondents, 48% of the students intended to improve their fish consumption behaviour. Findings revealed that certain factors, such as parents' encouragement, use of social media to raise awareness of the importance of fish consumption, preference for different types of fish, and fish-included snacks, increase the likelihood of improving the intention to consume fish among school children. However, living in a coastal or inland area and gender did not show any significant impact on their fish consumption behaviour. Our findings offer insights into encouraging fish consumption among schoolchildren through parental influence and social media to foster healthier dietary habits. In conclusion, this research highlights the need for region-specific nutritional programs in Sri Lanka, particularly those aimed at promoting fish consumption among schoolchildren to support a healthier life.

Keywords: Healthy life; Parental influence; Social media; Students

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Application of Alderfer's work motivation theory on employee performance: a case study from a seafood processing company in Puttalam district, Sri Lanka

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Abstract

Scholarly literature shows that motivated employees perform well and support to reach the organizational goals. Therefore, organizations need to understand the factors that motivate employees to meet the expectations of their job performance. There is a dearth of literature investigating the effect of employee motivation on the employees' performance in the Sri Lankan seafood processing industry. Investigating employee motivation within this context could provide valuable insights into the unique challenges, motivators, and strategies for enhancing employee engagement and satisfaction within the seafood industry. This study draws inspiration from the Alderfer's Existence-Relatedness-Growth needs theory as a conceptualized frame to measure the motivational factors on the job performance intention of employees in a seafood export company in Sri Lanka. Using a pre-tested questionnaire, we interviewed a convenience sample of 200 workers from December 2023 to January 2024. The items used to measure the constructs in the questionnaire were taken from the literature and measured using a five-point Likert scale. We hypothesized that existence needs in terms of pay and fringe benefits, relatedness needs with peers and supervisors, and growth needs are positively related to the employees' performance intention. We applied Cronbach's Alpha Reliability Analysis, Exploratory Factor Analysis, and multiple regressions to analyse data using SPSS software. The results revealed that only existence needs (pay) and relatedness needs (supervisors) significantly ($p < 0.05$) affected the employees' performance intention. Our research findings highlight the pivotal impact of pay and superior support on employee performance, advocating for a strategic focus on these aspects to boost employee motivation within the company.

Keywords: Existence-Relatedness-Growth needs; Job performance; Seafood processing industry

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Comparative study on the production and sensory evaluation of *Jaadi* using garcinia and tamarind

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Abstract

Jaadi is a traditional fermented fish product popular among coastal communities, mainly in the Southern Province of Sri Lanka. It is typically prepared using *Garcinia cambogia* as the primary acidulant with salt, which enhances flavor and preservation. This study aimed to explore the potential of tamarind (*Tamarindus indica*) as an alternative acidulant in *Jaadi* preparation and to compare the sensory attributes of *Jaadi* made with Garcinia and tamarind. Two *Jaadi* samples were prepared using skipjack tuna under identical fermentation conditions, with only the acidulant varying. Fish were cleaned, cut into pieces, and divided into two 1 kg samples. Based on fish weight, a 3:1 ratio of salt to Garcinia was applied to one sample and a 3:1 ratio of salt to tamarind to the other. The ingredients were layered in separate containers, sealed, labeled, and allowed to ferment at room temperature (27–30 °C) for two months. After fermentation, both *Jaadi* samples were cooked separately under identical conditions using the same quantities of raw materials. Sensory evaluation was conducted with 30 untrained panelists, assessing appearance, odor, taste, texture, and overall acceptability using a 9-point hedonic scale. Data were analyzed using a Two-Sample *t*-test to determine statistical differences between the two types of *Jaadi*. Results indicated no significant difference ($p > 0.05$) between tamarind-based and Garcinia-based *Jaadi*. This suggests that tamarind can serve as a suitable alternative acidulant without compromising sensory quality. The findings are particularly useful in areas where Garcinia is less available or more expensive. Further studies are recommended to evaluate nutritional composition, biochemical properties, and shelf-life of both types to enhance commercial viability. This study contributes to the preservation and diversification of traditional fermented fish products in Sri Lanka by promoting innovation alongside traditional practices.

Keywords: fermented fish*; Garcinia cambogia*; *Jaadi*; sensory evaluation; *Tamarindus indica*

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Optimizing traditional Maldive fish production in southern Sri Lanka

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Abstract

Maldive fish, a culturally significant dried product derived from skipjack tuna (*Katsuwonus pelamis*), is widely used in southern Sri Lankan cuisine, particularly in sambols and curries. Traditional processing, which involves boiling tuna in saltwater for 1–2 hours followed by smoking and sun-drying, is inefficient and associated with nutrient loss (up to 20% protein degradation), high energy consumption, and histamine formation, thereby compromising product quality and safety. This study aimed to optimize the cooking stage of Maldive fish production by comparing boiling, steaming, and pressure cooking, with emphasis on sensory attributes, processing efficiency, and product quality. Fresh skipjack tuna (3 fishes per 250g) was subjected to boiling (1–2 h), steaming (1–1.5 h), or pressure cooking (20 min), followed by smoking (1–3 days) and sun-drying (4–7 days). Sensory evaluation was conducted with 30 untrained panelists using for all samples, 9-point hedonic scale to assess visual appearance, color, odor, taste, texture, and overall acceptability. Data were analyzed using one-way and two-way ANOVA. Results indicated a significant effect of cooking method on sensory scores ($p < 0.05$), with pressure cooking achieving the highest overall acceptability (7.43 ± 1.25), followed by steaming (7.21 ± 1.37) and boiling (6.33 ± 1.72). These findings suggest that pressure cooking offers a more efficient and acceptable alternative to traditional boiling. Future studies should incorporate nutritional profiling and microbiological assessments to strengthen methodological rigor and ensure product safety, thereby supporting sustainable improvements in regional Maldive fish production practices.

Keywords: *Katsuwonus pelamis*; Maldive fish; Optimization; Sensory evaluation; Skipjack tuna.

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Chitin yield and properties from shrimp shells in earthen versus lined pond aquaculture systems

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Abstract

The extraction of chitin from *Litopenaeus vannamei* shells cultured in earthen and liner pond systems in Sri Lanka was investigated. Shells from both sources were cleaned, dried, grinded to small particles to be processed using varying concentrations of HCl and NaOH for the first step as demineralization and the second step as deproteinization in chemical analysis. The study compared the yield and physicochemical properties of the extracted chitin. Liner ponds yielded 43.3% chitin compared to 40.5% from earthen ponds, and $p = 0.815$. However, the t-test showed no significant differences in the properties of chitin. The ash content ($p = 0.305$), water binding capacity (WBC, $p = 0.061$), fat binding capacity (FBC, $p = 0.124$), and degree of acetylation (DA, $p = 0.782$) were consistent between the two sources. FTIR spectroscopy confirmed this structural similarity. The spectrum for both chitin types displayed the characteristic amide I band at 1651 cm^{-1}, which is attributed to the C=O stretching vibration of the acetyl groups and amide II band at 1552cm^{-1}, which contribute N – H and is a definitive signature of the chitin polymer. Shell waste from earthen and liner pond aquaculture can be used interchangeably as chitin feedstock, simplifying waste stream management for processors without compromising biopolymer quality.

Keywords: Aquaculture waste; biopolymer; Shell waste valorization; Chitin yield; Pacific white shrimp

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Development of a seaweed-based cheese product optimized to Sri Lankan taste using *Gracilaria verrucosa*

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Abstract

Seaweed grows abundantly around the coastal areas of Sri Lanka. Even so, due to seaweed consumption is rare in Sri Lanka as a results of ignorance of its health benefits. As a solution, the research aims to develop a seaweed based cheese using *Gracilaria verrucosa* sp. and evaluate its nutritional, physicochemical, textural, microbial, and sensory properties, and encourage seaweed consumption in the country. The seaweed *G. verrucosa* samples used for the study were obtained from a seaweed export company located in Kelaniya, Sri Lanka. To develop this cheese, an extract of the *G. verrucosa* was combined with fresh milk and natural flavoring ingredients, and the traditional cheese making method was adapted to suit Sri Lankan tastes. As a result of this study, the findings Proximate analysis showed 77.30% moisture, 7.5% protein, 3.4% fat, 2.3% ash, 9% carbohydrates and sugar not detected. The final product was free from Escherichia coli, arsenic, cadmium, lead, and mercury within mercury an aerobic plate count of 7.4×10^6, ensuring the products safety for consumption. The developed seaweed cheese was subjected to sensory evaluation by a panel for the attributes appearance, color, aroma, texture, taste, flavor and overall acceptability using nine-point hedonic scales. The findings suggest that incorporating *G. verrucosa* into cheese products not only improves nutritional value. The relatively high protein and carbohydrate content combined with low fat levels make this product a healthy alternative to traditional cheese. The final result was *G.verrucosa* based cheese offers a nutritious, safe, and appealing food option, contributing to both dietary health and the sustainable development of seaweed utilization in Sri Lanka.

Keywords: *Gracilaria verrucosa*; Seaweed cheese; Sensory evaluation; Human consumption; Microbial analysis

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