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INTEGRATING GEOTHERMAL ENERGY INTO MALAYSIA'S RENEWABLE ENERGY MIX: BRIDGING SCIENCE, TECHNOLOGY AND SOCIETY

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Abstract

Malaysia is endowed with several low-temperature geothermal systems particularly in regions such as Sabah, Perak, Selangor and Kelantan. Although not suitable for conventional electricity generation, these geothermal resources hold considerable promise for direct-use applications that can support Malaysia's transition toward sustainable and decentralized energy systems. This paper presents assessment of selected geothermal fields in Malaysia with surface temperatures ranging between 30°C to 96°C, emphasizing their potential for use in greenhouse heating, aquaculture, eco-tourism, and district heating systems. Through geospatial analysis, geochemical surveys, and geophysical modeling, this study identifies key zones with feasible geothermal gradients and sustainable heat output. The evaluation integrates field measurements with subsurface geological interpretations to estimate the long-term reliability of these resources. Case studies from the Tawau-Semporna Peninsula (Sabah) and Ulu Slim (Perak) are presented to illustrate practical implementation scenarios. The analysis further explores socio-economic and regulatory factors that influence geothermal development in Malaysia including land use policy, environmental regulations and stakeholder engagement. A strategic framework is proposed to support policy-makers, industry stakeholders and academic researchers in prioritizing geothermal integration within Malaysia's broader renewable energy roadmap. This work contributes to the growing body of knowledge on tropical geothermal systems and demonstrates how low-enthalpy geothermal energy often overlooked in national energy planning, can play a significant role in localized sustainable development and climate resilience.

Keywords: geothermal energy, geochemical analysis, geophysical survey

WASTE CEMENT GROUT PROPERTIES IN GEOTECHNICAL ENGINEERING APPLICATIONS

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Abstract

The disposal of shelf life expired (SLE) cement raises critical sustainability issues in the construction sector. The grouting materials are essential for filling voids, reducing settlement and improving the load-bearing capacity of the ground in geotechnical applications. The prospective use of SLE cement as a binder in cementitious grout for moderately strong geotechnical applications is investigated in this work. The collected hardened waste cement was ground up and mixed with water cement (w/c) content with varying ratios in 0.5 (M1) and 0.6 (M2). While the hardened properties were tested using the ASTM standard for compressive and flexural strength, the fresh properties were evaluated using density and flowability. Whereas M2 type grout achieved 4.43 MPa (max.) flexural and 23.54 MPa (max.) compressive strength, M1 grout showed better results with 5.68 MPa (max.) and 33.51 MPa (max.) at 28 days. Flowability remained within the considerations for injectable grout. This study helps sustainable cementitious grouting practices by reducing cement waste and raw material consumption through efficient resource construction and valorisation.

Keywords: waste cement, cementitious grout, water-cement ratio, flowability, compressive strength

BIOMIMETIC SURFACES FOR ENHANCED WATER DROP NANOGENERATOR TRIBOELECTRIC PERFORMANCE

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Abstract

Climate change has increased global awareness of the need to reduce fossil fuel consumption, a major contributor to environmental degradation. Water drop-based triboelectric nanogenerators (TENGs) have emerged as a promising technology for harvesting renewable energy. However, their electrical performance requires enhancement for efficient operation. This study explores surface modification inspired by nature, a concept known as biomimetic technology to improve TENGs output. Natural surfaces with high surface areas, such as rice leaves with groove-like structures and taro leaves with micropillar patterns, were used as design models. These structures were replicated on the TENGs surface using a micro-milling CNC technique to increase contact area and enhance charge transfer efficiency. The TENGs devices were fabricated using polytetrafluoroethylene (PTFE) as the substrate and aluminium or copper conductive tape as electrodes. The devices were tested using a peristaltic pump at a flow rate of 70 mL/min for 10 seconds, with tap water as the droplet source. Surface area analysis based on geometric calculations revealed an increase from 400 mm² for the flat surface to 478 mm² for the groove structure (a 19.5% increase) and 588.1 mm² for the micropillar structure (a 47% increase). As a result, the micropillar structure produced the highest electrical output, with an average voltage of 10.8 V, average current of 13.7 µA, and power of 2.35 µW. These findings demonstrate that biomimetic surface structures can significantly enhance the electrical performance of water drop-based TENGs and contribute to the development of efficient, nature-inspired energy harvesting systems.

Keywords: energy harvesting, nanogenerator, biomimetics, water drop

AN EFFECTIVENESS STUDY OF COMPRESSED EARTH BRICK (CEB) REINFORCED WITH NATURAL FIBERS IN CONTROLLING NOISE LEVEL

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Abstract

This study explores the efficacy of combining banana stem fiber with compressed earth bricks (CEB) to lower noise levels, addressing the rising problem of noise pollution in residential areas and advancing sustainable building practices. Compressed Earth Bricks (CEB) are environmentally friendly building materials known for their low environmental effect and ability to regulate temperature. They are composed of clay, sand, and aggregates. The purpose of the study is to investigate the possibility of adding banana stem fiber to CEB to enhance its sound-insulating qualities and to recycle agricultural waste. Banana stem fiber was added to CEB samples in different weight percentages (0%, 1%, 2%, and 3%), while keeping the mix ratio at 1:1:3. The test for sound absorption was conducted using an impedance tube. With an NRC of 0.49, the data demonstrate that 3% banana fiber improved sound absorption. As high as 25 MPa, the samples' compressive strength satisfied the minimum BS 3921:1985 strength requirement. The study comes to the conclusion that banana fiber improves CEB performance without sacrificing strength, which helps create environmentally friendly soundproof construction.

Keywords: CEB, natural fibers, noise control

SINTERING BEHAVIOUR AND BIOACTIVITY OF B-TCP/MGO/TIO2 COMPOSITES FOR SAFER BONE SUBSTITUTES

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Abstract

In this study, the effect of sintering temperature on the sintering behaviour and bioactivity of β-tricalcium phosphate (β-TCP) reinforced with MgO and TiO_2 was investigated. β-TCP, MgO, and TiO_2 powders were mixed, pressed into Teflon moulds, and sintered at 1000 °C, 1100 °C, and 1200 °C for 2 hours. Physical properties, namely density and porosity, were analysed to evaluate the sintering behaviour, while compressive strength was measured to assess the mechanical performance of the β-TCP/MgO/TiO_2 composites. The bioactivity of the sintered samples was evaluated by immersion in simulated body fluid (SBF) for 14 days. X-ray diffraction (XRD) confirmed the retention of the β-TCP phase at all sintering temperatures, with characteristic peaks at 27.88°, 31.09°, and 34.50°. Sintering at 1200 °C produced the most favourable physical and mechanical properties, including high density (2.97 g/cm^3), superior compressive strength (14.98 ± 0.32 MPa), and lower porosity (5.87 ± 0.06%), compared to samples sintered at 1000 °C and 1100 °C. Meanwhile, scanning electron microscopy (SEM) revealed the initial formation of an apatite layer on the surface of β-TCP/MgO/TiO_2 samples after 14 days of SBF immersion at all sintering temperatures, indicating the material's bioactive potential. These findings suggest that β-TCP/MgO/TiO_2 composites possess phase stability, enhanced mechanical strength, and promising bioactivity, which may reduce the clinical risk of implant failure and improve patient outcomes in bone regeneration therapies. This research contributes to the development of advanced bioceramics aimed at enhancing the safety and effectiveness of orthopaedic and biomedical applications. This work highlights the role of sintering control in minimizing implant failure risk and enhancing the clinical safety of bioactive bone substitutes

Keywords: β-tricalcium phosphate, β-TCP/MgO/TiO_2, sintering temperature, compressive strength, apatite layer

SUSTAINABLE DOCOSAHEXAENOIC ACID (DHA) PRODUCTION USING PINEAPPLE OFF-CUTS LIQUID EXTRACT BY Aurantiochytrium sp. SW1

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ABSTRACT

Thraustochytrids, such as *Aurantiochytrium sp.*, are valued for producing docosahexaenoic acid (DHA, C22:6 ω-3), but the reliance on costly refined carbon substrates hinders their commercial viability. This study investigates the use of pineapple off-cut liquid extract (POCL), a byproduct of the pineapple canning industry, as a cost-effective substrate for producing DHA from *Aurantiochytrium sp.* SW1 (SW1). POCL are rich in sugars, amino acids, and trace elements, supporting SW1 growth and enhancing DHA production. Cultivation with POCL, alone or combined with other medium, increased DHA content by 15–36 % compared to traditional medium. Optimization using Response Surface Methodology (RSM) on key medium components (tryptone, monosodium glutamate, yeast extract) identified by *PlackettBurman* design further boosted DHA to 3.25 g/L , achieving up to 32% improvement. This study highlights POCL's potential as an economical substrate for sustainable DHA production.

Keywords: *Aurantiochytrium* sp., docosahexaenoic acids, pineapple off-cut liquid extract

INVESTIGATING TROPICAL CYCLONE INTENSITY TREND VARIATIONS OF WESTERN PACIFIC OCEAN OVER 43 YEARS PERIOD

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Abstract

Tropical cyclone (TC) intensity is a critical factor in assessing storm development, behavior, and associated risks, typically measured by maximum sustained wind speed. The Western Pacific Ocean is among the most active basins for TC formation and is frequently affected by high-impact events due to intense storms and environmental influences such as the El Niño–Southern Oscillation (ENSO). To investigate TC intensity in this region, this study analyzes temporal trends based on three key metrics: occurrence, lifetime maximum intensity (LMI), and rapid intensification. Using the unified best track dataset covering the period 1980–2022, the analysis is divided into two phases: P1 (1980–2000) and P2 (2001–2022), to identify decadal-scale patterns and shifts. Results indicate a moderate increase in TC frequency during P2, with an annual average of 25.8 events, including approximately 5 major TC events per year. This supports the classification of the Western Pacific as one of the most active basins. An increasing trend in major LMI during P2, accompanied by a decreasing trend in major TC LMI duration, suggests that weaker storms are evolving into stronger systems, although major TCs tend to sustain their peak intensity for shorter periods. The frequency of rapid intensification events in the Western Pacific peaked in 2015, with 14 occurrences, largely influenced by ENSO phases, highlighting the role of large-scale climate oscillations in modulating TC intensity.

Keywords: tropical cyclone intensity, climatic trend, western Pacific ocean

THE PROJECTION OF LOW-LEVEL WIND CIRCULATION OVER MALAYSIA USING HighResMIP CMIP6 GCM

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Abstract

Rainfall distribution in the tropics is strongly modulated by atmospheric wind circulation. Understanding its future changes is essential as climate shifts alter monsoon onset, retreat, duration and intensity, which affect precipitation dynamics and hydrological cycles. This study investigates future projections of wind circulation over Malaysia using updated high-resolution Coupled Model Intercomparison Project Phase 6 (CMIP6) General Circulation Models (GCMs). Five High Resolution Model Intercomparison Project (HighRESMIP) GCMs with 25 km horizontal resolution were utilised to evaluate low-level wind changes. Taylor diagrams and Monte Carlo statistical analysis were used for model evaluation and significance tests. Multi-model ensemble (MME) identified as the most capable of simulating low-level wind patterns compared to individual models and is then used for projections. Results indicate notable seasonal shifts in wind circulation, including a projected weakening of the Southwest Monsoon (June–July–August) and reduced influence of the Northeast Monsoon on rainfall over the east coast of Peninsular Malaysia and Sarawak. This research aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 13 (Climate Action) and SDG 15 (Life on Land). This work supports adaptive strategies for a region vulnerable to monsoon-driven extremes by elucidating future wind and rainfall trends, thus contributing to climate resilience planning.

Keywords: CMIP6, HighResMIP, monsoon, projection, wind

TEMPORAL VARIABILITY AND MASS CONTRIBUTIONS TO SEA LEVEL RISE IN THE SOUTH CHINA SEA

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Abstract

This study examines spatial and temporal variations in mean sea level trends, variability, and mass-driven contributions in the South China Sea (SCS) over the past three decades, alongside their links to major climate modes. Using 30 years of satellite altimetry, 20 years of GRACE data, and climate indices, three key objectives were pursued. First, mean sea level trends reveal a basin-average rise of 4.01 ± 0.34 mm/year from 1993 to 2022. Second, analysis of 2003–2022 data shows an altimetry-based sea level trend of 3.93 ± 0.63 mm/year, with mass-driven contributions from GRACE contributing 2.09 ± 0.30 mm/year, accounting for approximately 53% of the total rise. Mass contributions are most prominent in the northern and central SCS regions. Third, empirical orthogonal function analysis highlights the strong influence of the Oceanic Niño Index (ONI), Pacific Decadal Oscillation (PDO), and Indian Ocean Dipole (IOD) on interannual and decadal sea level variability. Correlations indicate ONI's strongest effects in the Philippines, Sulawesi, and Celebes Seas ($r > 0.8$), PDO impacts the central SCS and Luzon Strait broadly ($r > 0.8$), while IOD shows moderate influence near the western SCS and Malacca Strait ($r = 0.6–0.8$). These findings enhance understanding of SCS sea level dynamics and support improved regional sea level projections under climate variability and change.

Keywords: sea level rise, trend, variability, manometric, South China Sea

MAPPING THE LANSCAPE: A BIBLIOMETRIC ANALYSIS OF SMEs' RESILIENCE IN CLIMATE CHANGE

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Abstract

Small and Medium Enterprises (SMEs) are widely acknowledged as key contributors to economic growth and employment worldwide. However, their limited adaptive capacity makes them highly vulnerable to the impacts of climate change. This study conducts a bibliometric analysis to systematically map the existing literature on SMEs' resilience in the face of climaterelated risks. Using data extracted from the Scopus database and visualized through VOSviewer, this analysis highlights publication trends, leading contributors, emerging themes, and existing research gaps. The results reveal increasing scholarly attention to the topic in recent years, with predominant focus areas including supply chain resilience, green innovation, environmental management, and sustainability transitions. However, significant gaps persist in terms of developing-country representation, integration of digital resilience strategies, and policy-oriented frameworks. The findings offer valuable insights for future research directions and inform policymakers, SMEs, and academic communities on enhancing SME resilience in the context of global climate challenges.

Keywords: climate risk, SMEs, review, study trend

INTEGRATED ANALYSIS OF EXTREME SEA LEVEL AND RIVER DISCHARGE: UNCOVERING COMPOUND FLOODING PATTERNS IN MALAYSIA

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Abstract

Compound flooding, resulting from the interaction of two or more flood drivers leads to a severe impact that is greater than a regular flood. This study analyzed Extreme Sea level (ESL) using hourly sea level data from 17 tide gauge stations and river discharge using model data from CEMS GloFas (Global Flood Awareness System). This study also analyzes the relationship between extreme sea levels and river discharge patterns along the Malaysian coast, which is influenced by different climate modes which are Oceanic Nino Index (ONI), Southern Oscillation Index (SOI), and Multivariate ENSO Index (MEI). Using extreme statistics, Kendall's rank correlation, and joint occurrence method, sea level and river discharge datasets were analyzed to assess and map the dependence between extreme sea level and high river discharge. Key findings reveal strong monsoonal-driven correlations between river discharge and ESL on the East Coast (e.g., Geting, $r = 0.56$), with climate modes significantly modulating flood severity. Spatially, the East Coast (Kelantan, Terengganu) was identified as a high-risk hotspot due to shallow topography and concentrated rainfall. This study addresses two objectives: (1) to explore the relationship between extreme sea levels and river discharge, and (2) to evaluate the influence of climate modes. This research establishes the integrated framework for compound flood risk assessment in Malaysia by demonstrating via spatial and temporal climate-river-sea synergies toward the flood. The outcomes directly inform adaptive coastal management and nature-based mitigation strategies for vulnerable regions.

Keywords: climate modes, compound flooding, extreme sea levels, malaysian coast, river discharge

DETERMINISTIC SUB-SEASONAL TEMPERATURES FORECASTING IN PENINSULAR MALAYSIA

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Abstract

Skilful sub-seasonal temperature forecasting is essential for bridging the gap between weather and seasonal monitoring. This study evaluates deterministic biweekly maximum temperature forecasts associated with the Madden–Julian Oscillation (MJO), El Niño–Southern Oscillation (ENSO), Indian Ocean Dipole (IOD) indices, and meteorological variables over Peninsular Malaysia. Maximum temperature at 10 m from the European Centre for Medium-Range Weather Forecasts Reanalysis version 5 (ERA5) is used to train and validate Extreme Gradient Boosting (XGBoost) models for week-1 and week-2 forecasts. Model performance is assessed using Spearman correlation and root mean square error (RMSE), with climatology and persistence forecasts serving as baselines. Results show that XGBoost improves forecast in week-1 with correlations ranging from 0.75 to 0.77, compared to 0.66 to 0.73 for persistence. For week-2, XGBoost achieves correlations between 0.74 and 0.75 outperforming persistence forecasts which range from 0.65 to 0.66. This study highlights the potential of machine learning approaches for heatwave monitoring and early warning systems in Malaysia.

Keywords: temperature, sub-seasonal forecasting, XgBoost, machine learning

EFFECTS OF INTENSIFIED LAND USE CHANGES ON MAMMALS' DIVERSITY AND ASSEMBLAGES IN TASIK CHINI, PAHANG

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Abstract

Tasik Chini UNESCO Biosphere Reserve, undergoing ecological recovery following prolonged mining and land-use changes. Mammals are particularly sensitive to such alterations due to their reliance on stable habitats. This study assessed mammal diversity across landscapes surrounding a formerly-mined area to identify sustainable land-use patterns that support biodiversity. A land-use map was generated using supervised classification in ArcGIS, and camera traps were deployed across five land cover types: Melai Forest (forest), PPTC (builtup and agriculture), and Lakeside (cleared land and water body). Functional groups based on diet (herbivore, omnivore) were used to evaluate species responses. Species richness and diversity were highest in Melai Forest (12 species; Shannon index, H′= 1.976) and Lakeside (6 species; H′= 1.529), and lowest at PPTC (3 species; H′= 0.9999). Omnivores were recorded across all sites, particularly in mixed-use landscapes, while herbivores were more dependent on forested areas. Generalized Linear Mixed Model (GLMM) analysis revealed that herbivore richness was significantly associated with forest cover ($p< 0.001$) and negatively influenced by cleared land ($p< 0.001$) while omnivores show no land-use variable significantly explained richness, although waterbodies showed a weak positive trend ($p= 0.160$). These findings suggest herbivores depend more heavily on natural vegetation, while omnivores adapt better to modified landscapes. The absence of carnivores may reflect low detectability or small population sizes in Tasik Chini. Study underscores the role of vegetated habitats in sustaining herbivore communities, which essential for reestablishing trophic balance. Forest regeneration and agroecological mosaics approaches are practical strategies for promoting mammal diversity in post-extractive ecosystems.

Keywords: terrestrial mammals, land cover, habitat restoration, camera trapping, sustainable land use

PROJECTIONS OF FUTURE SEA LEVEL RISE, STORM SURGE AND SURFACE WAVES OVER THE COASTAL AREAS OF MALAYSIA

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Abstract

Over the past century, the global mean sea level has risen at an average rate of ~1.7 mm/year, with the rate of rise accelerating to 3.2–3.7 mm/year over the last 20–30 years. Both tide gauge and satellite altimetry data from Malaysia's coastal regions indicate a slightly higher regional mean sea level rise rate of 3.5–4.5 mm/year. As global temperatures continue to increase due to anthropogenic activities, further sea level rise is projected in the coming decades. The magnitude of this rise will depend on future warming levels, which are largely determined by the effectiveness of societal efforts to mitigate greenhouse gas emissions. The impacts of mean sea level rise can be exacerbated by changes in storm surges, low-level atmospheric circulation, tidal characteristics, and extreme surface wind waves. Collectively, these factors alter the risk of coastal inundation in Malaysia, threatening coastal communities, livelihoods, and infrastructure. Therefore, a comprehensive risk assessment is needed, accounting for the combined effects of mean sea level rise, extreme storm surges, tides, and wind waves. In this presentation, a simplified assessment framework for coastal inundation risk is introduced. The framework incorporates IPCC AR6 regional sea level projections, extreme value analysis from a global storm surge and tide model, and Malaysia's national wave hindcast data. Finally, the implications of sea level rise for inundation in Malaysian coastal areas will be discussed.

Keywords: sea level rise, coastal inundation, climate change, climate risk assessment

STATUS OF CORAL REEF FISHES IN THE NORTHERN OF LANGKAWI, KEDAH, MALAYSIA

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Abstract

Coral reef fishes play an important role in the coral reef ecosystem such as algae grazer to support coral reef growth and development. However, in the northern part of Langkawi, the documentation and understanding of coral reef fishes remain limited due to several interrelated factors such as low coral cover, high sedimentation and high turbidity. This study aims to determine the species diversity and abundance of coral reef fish in Northern Langkawi, Kedah. Fish surveys were conducted using visual census techniques via SCUBA at 13 sampling locations in northern Langkawi Island, namely Pulau Anak Datai, Pulau Dangli Barat, Pulau Dangli Timur, Pulau Gasing Barat, Pulau Gasing Timur, Pulau Pasir Barat, Pulau Pasir Timur, Hutan Palas, Tanjung Hulur, Selat Datai, Pantai Andaman, Teluk Tok Mat, and Pantai Golf. A total of 58 fish species from 17 families were identified. The Pomacentridae family recorded the highest number of species with 11, followed by the Apogonidae family with seven species while Centriscidae, Haemulidae, Scaridae, Scorpaenidae, and Zanclidae families each recorded only one species. The total fish biomass across all 13 locations averaged 756.92 g/m². The S8 site at western Pulau Dangli recorded the highest biomass at 276.06 g/m² and the lowest was site S11 at eastern Pulau Gasing, at only 1.43 g/m². The Coral Health Index (CHI) values ranged from 0.002 to 0.55, with S8 western Pulau Dangli having the highest value (0.55) and S11 eastern Pulau Gasing the lowest (0.002). Coral fish diversity at S2 Tok Mat and S8 western Pulau Dangli was the highest, based on diversity index values, indicating these locations had high species richness, relative abundance, and evenness. In contrast, diversity at S5 Pantai Andaman and S11 eastern Pulau Gasing was the lowest. The total number of species recorded was higher compared to other islands in Langkawi waters, such as Pulau Payar, although most study sites were dominated by Pomacentridae fish. Low coral reef fish diversity observed along Teluk Datai indicates low coral cover in the area and a lack of key indicator reef fish families such as Chaetodontidae and Scaridae, which may suggest declining reef health. The low abundance of targeted commercial fish species also indicates uncontrolled fishing pressure in the study area. Therefore, further studies and monitoring of reef fish assemblages are recommended to better understand the dynamics of coral reef fish communities in Langkawi Island for the development of sustainable management and enforcement strategies.

Keywords: coral reef fish, diversity, abundance, northern of Langkawi

CHECKLIST OF CORAL REEF FISHES AT PULAU SERI BUAT, PAHANG

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Abstract

Assessment of the reef fish population status is vital for effective ecosystem management, thereby ensuring the sustainable utilization of coral reef resources. Therefore, this study aims to determine the species occurrence of reef fishes at Pulau Seri Buat islands. Fish surveys were conducted using visual census technique during SCUBA at 8 sites around the islands. A total of 85 species from 21 families were identified. Family Pomacentridae has the highest diversity with 25 species observed, followed by Labridae (9 species), Apogonidae (7 species), Gobiidae (7 species) and Serranidae (6 species). Other family observed were Chaetodontidae, Nemipteridae and Scaridae with 4 species each, followed by Caesionidae and Siganidae with 3 species each. Family Pempheridae and Pomacanthidae recorded 2 species each, while the remaining 9 families (Centriscidae, Dasyatidae, Haemulidae, Holocentridae, Lutjanidae, Mullidae, Muraenidae, Synodontidae, and Tropterygiidae) only recorded 1 species each. The islands were mainly dominated by Pomacentridae fishes and the scarcity of key indicator reef fish families such as Scaridae, Chaetodontidae may be an indication of deteriorating reef health. Lack of predatory reef fishes (family Serranidae, Lutjanidae and Haemulidae) were also observed and may indicate high fishing pressure in the Pulau Seri Buat vicinity. Further investigations and monitoring of the reef fish assemblages in Pulau Seri Buat are recommended to better understand the dynamics of the reef fish community. This information will be crucial in developing sustainable marine resource management strategies and enforcing them.

Keywords: diversity, reef fish, Pulau Seri Buat

REEF COMMUNITY OF PULAU MERTANG, JOHOR

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Abstract

Pulau Mertang is located on the east coast of Peninsular Malaysia. A reef health assessment to gauge the present health condition of the coral reefs was carried out at three small islands of Mertang. Underwater surveys for benthic and fish communities, using the Point Intercept Transect and the Underwater Visual Census methods respectively, have been conducted in 2024. A total of 100 scleractinian corals species and six non-scleractinian corals genera were recorded during this study. The most dominant scleractinian coral was *Acropora muricata*, followed with *A. grandis* and *A. abrolhosensis*. One new record of scleractinian corals in the east coast of Peninsular Malaysia was discovered in Mertang waters i.e., *Hydnophora pilosa*. Live coral cover for these isles ranged from 41.67% to 57.45%. Fifty-one species of reef fish were also recorded during this study, in which Pomacentridae dominated most of the reef sites. Fish biomass across the sites ranged from 49.69 g/m2 to 374.29 g/m2. The reef health condition was assessed using the two-dimensional Coral Health Index. About 33% of coral reefs were in degraded condition. Overall, the reefs surrounding Pulau Mertang were in fair condition, however, if without proper management, it might move towards degraded reefs. This study may be relevant to improve and strengthen the management and protection of coral reef areas in these isles.

Keywords: live coral cover, fish biomass, Coral Health Indeks, marine protected area

DERIVING FISHING AREAS USING VMS DATA OFF PAHANG WATERS

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Abstract

The identification of fishing areas is fundamental to sustainable fisheries management and marine spatial planning. Vessel Monitoring System (VMS) data which keeps track of high frequency information on the position of fishing vessels provides insight for defining fishing areas. This study presents a spatiotemporal framework for deriving fishing activity zones using VMS data. A total of 17,541 VMS signals from a purse seine vessel operating off the coast of Pahang, Malaysia, between February and December 2022 were analysed. Positional records were filtered based on vessel behaviour indicators, including speed (< 4 knots), changes in bearing (turning angles), and short distances between successive points, which are indicative of gear deployment. The resulting analysis identified fishing areas primarily concentrated 40–65 nautical miles offshore, with peak activity observed in March. This would probably be related to the fisher's behaviour in adapting to success when fishing. The framework offers a foundational approach for integrating VMS data into the spatial management of fishing zones in Malaysian waters.

Keywords: VMS, fishing activity, fishing behaviour, spatio-temporal activity, Pahang waters

MULTI-OMIC CHARACTERISATION OF MANGROVE SEDIMENTS ACROSS PENINSULAR MALAYSIA REVEALS DEPTH-STRUCTURED CARBON TURNOVER

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Abstract

Mangrove sediments are globally significant carbon sinks, yet the microbial and chemical mechanisms that underpin their carbon storage remain underexplored. In this study, we employed an integrated multi-omic approach, combining 16S rRNA amplicon sequencing, shotgun metagenomics, and untargeted LC-MS metabolomics, to characterise microbial communities and their functional potential across three Malaysian mangrove ecosystems. A total of 33 sediment samples were collected at various depths, revealing distinct microbial and metabolic profiles associated with depth and site. Despite compositional differences driven by pH, salinity, and sediment texture, microbial carbon metabolic functions were largely conserved, indicating a strong degree of functional redundancy. Desulfobacterota and Chloroflexota dominated the carbon fixation and methane metabolism pathways, while metabolomics revealed depth-enriched metabolites associated with glycolysis, pyruvate metabolism, and lipid metabolism. Canonical correspondence analyses linked microbial functional shifts to environmental gradients, with surface layers supporting more active carbon turnover. These findings highlight a depth-stratified yet functionally resilient microbiome-metabolome network that supports stable carbon cycling in tropical mangrove sediments. This multi-omic framework enhances our mechanistic understanding of microbial-mediated carbon sequestration and informs future conservation and climate mitigation strategies.

Keywords: carbon metabolism, microbiome, mangrove, metagenomics, metabolomics

HORIZONTAL CORE VARIATION OF MICROBIAL PROFILES IN HALOPHILA BECCARII SEDIMENTS

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Abstract

In recent years, *Halophila beccarii*, a species native from South to Southeast Asia, has been facing a steep decline in population. However, coastal development and modernization activities along the Malaysian coast poses a continuous threat to the species. The microbiome interacts with the *Halophila beccarii* roots in enhancing nutrient uptake, protecting the seagrass against pathogens and in promoting growth. This study employed 16S rRNA gene amplicon sequencing to characterize and compare the dominant soil bacterial taxa in Sungai Melayu and Tanjung Bungah seagrass meadows. We also compared the profiles of vegetated and unvegetated sediments to elucidate the influence of seagrass presence in the composition of microbial communities. Our results reveal that across core variation was not strongly exhibited in the microbial profiles of both sampling locations. A total of 45 bacterial phyla were detected in the samples. We found that Proteobacteria, Bacteroidota and Myxococca exhibited similarity in abundance with Proteobacteria emerging as the dominant phylum. Consequently, the alpha diversity of the microbiome remained consistent across the two locations, highlighting the resilience and adaptability of the microbial communities across diverse environmental conditions. However, the microbial phyla Sva0485, a carbon metabolizer, showed significance difference in between vegetated and unvegetated sediments elucidating that Sva0485 may be more sensitive to changes in seagrass-derived carbon availability compared to the other phyla. This study provides a foundation for subsequent analyses of environmental drivers and ecological interactions for seagrass ecosystem services and informing effective conservation strategies.

Keywords: bacterial profile; marine sediment; microbial composition; seagrass conservation; seagrass sediment

THE PALEOBATHYMETRY OF THE PERMIAN RADIOLARIAN SILICEOUS-CHERTY ROCKS FROM POS BLAU, GUA MUSANG, KELANTAN

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Abstract

Radiolarians, siliceous planktonic protists abundant in Permian oceans, serve as valuable proxies for reconstructing paleo-water depths. While inherently open-ocean dwellers, their sedimentary record provides critical insights into paleobathymetry through assemblage composition, sedimentological context, and comparisons with associated fauna. Studies indicate Permian radiolarian siliceous-cherty rocks primarily accumulated in deep-marine settings, often below the calcite compensation depth (CCD) where carbonate dissolution prevailed, allowing siliceous ooze dominance. These deposits are characteristic of pelagic environments including ocean basins, continental slopes, and deeper parts of seamounts. However, radiolarians also occur in shallower-water sediments, transported downslope or preserved in restricted basins with specific oceanographic conditions, conducive to silica preservation. Faunal analyses suggest certain Permian radiolarian taxa may have had depth-related ecological preferences. A total of 5 localities of siliceous-cherty sequences containing radiolarian fossils were discovered in Pos Blau, Gua Musang. Based on the fossil composition, these sequences are dated from the Early Permian to the Middle Permian. The palaeobathymetry investigation of the radiolarian-bearing siliceous-cherty rocks in Pos Blau was determined using the water depth zones model developed by Xiao, Suzuki, and He (2017). The study results shows that these rock sequences were deposited in the upper intermediate depth settings (350 m to 450 m) and shallow depths (150 m to 300 m).

Keywords: paleobathymetry, Permian radiolarian, Siliceous-cherty rock, Pos Blau

SEDIMENTOLOGICAL AND GEOCHEMICAL CHARACTERIZATION OF THE MIDDLE-UPPER TRIASSIC SEMANTAN FORMATION: IMPLICATIONS FOR PETROLEUM RESERVOIR AND SOURCE ROCK POTENTIAL IN CENTRAL PAHANG, MALAYSIA

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Abstract

The Middle-Upper Triassic Semantan Formation, extending from Temerloh and Jerantut to Kemayan in central Pahang, Malaysia, demonstrates significant potential as both a reservoir and source rock within petroleum systems. Sedimentological analysis indicates a deep-water fan depositional environment dominated by a sand-rich submarine fan system, comprising facies such as conglomerate, pebbly sandstone, amalgamated sandstone, laminated sandstone, mudstone-dominated heterolithics and shale/mudstone. These facies exhibit both fining-upward and coarsening-upward sequences, representing depositional sub-environments ranging from upper continental slope channels incised by canyons to inner fan deep channel-levee complexes and outer fan distal lobes, primarily formed by turbidity currents and debris flows. The prevalence of dark grey to black mudstone or shale with interbedded thin sandy layers points to intervals of organic-rich sediments favorable for source rock potential, with total organic carbon (TOC) values from 0.63 to 3.3 wt %. Concurrently, the sand-rich turbidite facies, characterized by moderate net-to-gross sand ratios (60%), high porosity ranging from 15% to 39% and well-compacted sandstones with low porosity and high mechanical strength, indicate good reservoir quality. The lateral and vertical facies variability, along with the presence of submarine mass-transport deposits and slump features, further highlights the complex reservoir heterogeneity typical of deep-marine settings. Together, these sedimentological and geochemical characteristics underscore the Semantan Formation's dual role as a viable petroleum reservoir and source rock, making it a promising target for hydrocarbon exploration in the Central Belt of Peninsular Malaysia.

Keywords: Semantan Formation, turbidite deposit, reservoir, source rock

PETROPHYSICAL EVALUATION AND RESERVOIR QUALITY ASSESSMENT OF WEST CROCKER FORMATION, NORTHWEST SABAH

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Abstract

Northwest Sabah is recognized for its prolific untapped petroleum potential, primarily within the West Crocker Formation of Mid Eocene to Early Miocene age. This formation is characterized by the deepwater sandstone, specifically turbidites, which are well-known as a effective hydrocarbon reservoirs. Petrophysical study, including blue-dye petrography and porosity-permeability (poro-perm) study, were done to evaluate reservoir quality. Microscopic analysis indicates the presence of compaction and cementation, processes that substantially reduce porosity and permeability. The poro-perm data exhibit a robust correlation coefficient of 0.87, possibly indicating the uniformity of the sandstone samples. Based on reservoir quality parameters, three reservoir rock types (RT1, RT2, and RT3) were identified in descending order of quality. Despite these variations, diagenetic alterations have rendered the sandstone a tight reservoir, limiting its hydrocarbon potential primarily to gas. This study highlights the complex diagenetic history influencing reservoir characteristics and underscores the importance of integrated petrophysical analysis in evaluating deepwater turbidite reservoirs in Northwest Sabah.

Keywords: Crocker Formation, petrophysics, reservoir quality, northwest Sabah, turbidites

FEASIBILITY STUDY OF GRANITE RESOURCES USING GEOPHYSICAL AND GEOTECHNICAL APPROACHES IN MUKIM JORAK, JOHOR

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Abstract

A comprehensive geological and geotechnical investigation was conducted at proposed site area near Mukim Jorak, Muar, Johor, to evaluate the feasibility of developing a granite quarry. The study involved topographic and boundary surveys, seven lines of 2D electrical resistivity imaging (ERI), rotary core drilling, and laboratory testing including petrographic analysis, X-ray fluorescence (XRF), and unconfined compressive strength (UCS) assessments. The site is underlain by Bukit Mor Granite, consisting of medium- to coarse-grained biotite granite with high silica content (>70 wt% SiO_2), minimal reactive minerals, and favorable petrographic and mechanical characteristics for use as construction aggregate. The resistivity data revealed granite bedrock overlain by overburden material with variable thickness ranging from 7 to 45 meters. Drill hole data and geophysical modeling supported the development of a three-dimensional block model and preliminary quarry pit design. The total estimated recoverable granite reserve is approximately 89.7 million tonnes, with overburden volume estimated at 10.5 million tonnes, resulting in an average stripping ratio of 1:5. The findings confirm that the site is geologically viable for quarry operations and suitable for long-term aggregate production. Recommendations were made to address environmental considerations, especially regarding nearby water catchment areas and land-use constraints.

Keywords: granite reserve, electrical resistivity imaging (ERI), Bukit Mor Granite, quarry feasibility, overburden thickness

PRELIMINARY STUDY OF THORIUM RECOVERY FROM CATION EXCHANGE RESIN: EFFECT OF SULFURIC ACID CONCENTRATION

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Abstract

The increasing global demand for Rare Earth Elements (REEs) has highlighted the need for efficient thorium removal methods, as thorium is often present in REE ores. This study focuses on optimizing the desorption of thorium from cation exchange resins using varying concentrations of sulfuric acid (H_2SO_4). Different concentrations of H_2SO_4 ranging from 0.5 M to 4.0 M were tested and desorption efficiency was assessed for thorium, neodymium and cerium. The results show that thorium exhibited the highest desorption efficiency at 2.0 M H_2SO_4, achieving a maximum of 44.28%, while desorption efficiency for all elements remained below 50%, indicating incomplete recovery. Kinetic modelling using Pseudo-First Order (PFO) and Pseudo-Second Order (PSO) models revealed that the desorption process is governed by both surface adsorption and intra-particle diffusion where the PSO model providing a better fit for the data. These findings suggest that while sulfuric acid at 2.0 M enhances thorium recovery, the process remains suboptimal. Future work should explore optimizing additional factors such as temperature, pH and contact time to improve desorption efficiency and maximize thorium recovery from cation exchange resins.

Keywords: cation exchange resin, desorption efficiency, rare Earth element extraction, sulphuric acid concentration, Thorium removal

GEOPHYSICAL INVESTIGATION AND KARST HAZARD ASSESSMENT FOR DEVELOPMENT IN LIMESTONE TERRAINS

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Abstract

This study proposed a geological-centered approach for future development in limestone terrains, emphasizing detailed surveys to identify subsurface risks early, thereby minimizing delays and costs while enhancing project quality. The study utilized Electrical Resistivity Imaging (ERI) and Multichannel Analysis of Surface Waves (MASW) method to acquire comprehensive karst subsurface information, specifically targeting cavities and fractured limestone bedrock. The methodology included literature reviews, ERI and MASW surveys using specialized equipment and data processing for 2D subsurface profiles of resistivity and shear wave velocity (Vs). ERI results identified a heterogeneous subsurface with two (2) distinct layers: shallow layer indicative of saturated/clay-rich material (<80 Ωm), mixture soil (50-400 Ωm), dry material (300-800 Ωm) and a deeper layer as limestone bedrock (20-1200 Ωm), with 20-200 Ωm indicating fractured karst-prone zones. Bedrock depths ranged from 2-20 m in Zone 3 and 8-40 m in Zone 1. MASW delineated four (4) zones based on Vs and SPT-N values, from soft soil (0-200 m/s) to weathered rock (>400 m/s). Undulating rock profiles were found between 2 m and >12 m depth. Geophysical results guided 24 boreholes, confirming shallow bedrock (2.5-11.0 m), with 45% encountering fractured rock and 7 showing cavities, indicating complex karstic terrain. A karst hazard risk assessment employed a scoring system based on 11 criteria; each assigned a risk level reflecting its contribution to potential failure. This comprehensive framework considers factors like depth to bedrock, the potential for near-surface disintegrated rock and boulders and the quality and fracturing of rock within the top 5m of bedrock. It also evaluates the presence and size of voids within both soil and rock, along with their proximity to structures. Historical sinkhole data, bedrock orientation and the presence of soft zones in underlying soil (identified by Vs value) are also assessed. Finally, depth to groundwater and stormwater ponding and runoff are analysed for their impact on soil stability and sinkhole formation. This framework allows for identifying and quantifying risks, enabling effective mitigation strategies. As a result, 96% of surveyed lines were categorized as very high-risk and 4% as high-risk. These findings highlight the project area's geotechnical challenges, necessitating robust mitigation strategies.

Keywords: karst morphology, karst hazard assessment, geophysical survey, multichannel surface wave analysis, electrical resistivity imaging

DISTRIBUTION OF DISSOLVED Zn^{2+}, Cd^{2+}, Pb^{2+} and Cu^{2+} IONS AT MERSING COASTAL WATER

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Abstract

This study was conducted to identify the distribution of dissolved Zn^{2+}, Cd^{2+}, Pb^{2+}, and Cu^{2+} ions in the coastal waters of Mersing during August 2020 and April 2021. The total concentrations of dissolved metals were determined using the Cathodic Stripping Voltammetry (CSV) method, both in natural samples and in samples digested by UV irradiation to break down organic ligands bound to the metal ions. Various UV irradiation durations (ranging from 5 to 90 minutes) were applied to optimize the release of metal ions and obtain the maximum dissolved metal concentrations. A longer UV irradiation period was required to destroy all the organic ligands in the seawater samples collected in August 2020 (30–60 minutes), compared to the samples collected in April 2021 (5 minutes). This suggests that the metal-organic complexes present in August 2020 were more stable than those in April 2021. However, the total concentrations of dissolved Zn^{2+}, Cd^{2+}, Pb^{2+}, and Cu^{2+} ions remained consistent throughout the water column across both sampling periods. In August 2020, the concentrations ranged from 0.014–0.067 µM (Zn^{2+}), 0.003–0.018 µM (Cd^{2+}), 0.014–0.085 µM (Pb^{2+}), and 0.012–0.140 µM (Cu^{2+}). Meanwhile, in April 2021, the concentrations ranged from 0.016–0.075 µM (Zn^{2+}), 0.002–0.014 µM (Cd^{2+}), 0.012–0.061 µM (Pb^{2+}), and 0.009–0.071 µM (Cu^{2+}). The presence of organic ligands that bind to dissolved metal ions enhances their solubility in the dissolved phase and prevents them from precipitating into surface sediments during both sampling periods.

Keywords: seawater, dissolved trace metals, voltammetry, UV irradiation, organic ligands

DEPTH-DEPENDENT VARIATIONS IN MICROPLASTIC ABUNDANCE AND COMPOSITION IN THE MELAKA RIVER, MALAYSIA

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Abstract

Microplastics may lose buoyancy and occur in deeper waters and ultimately sink to the sediment, and this may threaten plankton inhabiting various water layers and benthic organisms. This study investigated the depth-dependent abundance and distribution (size, shape, and colour) of microplastics in the Melaka River. A total of 9 stations covering diverse land uses. Water samples were collected from surface and bottom layers using a Niskin water sampler. Microplastics were extracted via modified NOAA protocols involving filtration, wet peroxide oxidation, and density separation with zinc chloride. A stereomicroscope was used to identify and classify microplastics based on their morphology, which included shape, size, and colour. The study found substantial changes in the amount of microplastic across the surface and bottom layers ($p < 0.05$). Surface abundance (average: 185.1 ± 87.8 particles/L, with a range of 100–367 particles/L) consistently exceeded bottom abundance (average: 70.0 ± 28.3 particles/L, with a range of 32–120 particles/L) due to buoyancy and surface currents. Fibres dominated both layers, with peak surface concentrations reaching 968 particles/L, while films and foams were nearly absent at the bottom. Smaller microplastics (< 0.5 mm) were more prevalent in both layers, indicating higher mobility and fragmentation potential. Colour distribution varied vertically, with transparent and black particles more abundant at the surface, while blue and yellow particles accumulated at the bottom. These findings highlight the complex interplay of physical factors in shaping microplastic distribution. Understanding these dynamics is critical for assessing ecological risks and guiding effective monitoring strategies in freshwater systems.

Keywords: microplastic, river, depth-dependent, abundance

MICROPLASTIC-INDUCED GROWTH RESPONSES IN YELLOWTAIL DAMSELFISH (*Chrysiptera parasema*) IN A SIMULATED MARINE ENVIRONMENT

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Abstract

Microplastic pollution is an emerging threat to marine ecosystems, with growing concerns about its physiological impact on reef-associated fish. This study evaluated the effects of dietary microplastic exposure on the growth performance of *Chrysiptera parasema* (yellowtail damselfish) under controlled laboratory conditions. Fish were subjected to five treatment levels: control (0 mg/L), low (0.025 mg/L), medium (0.055 mg/L), high (0.083 mg/L), and very high (0.100 mg/L) microplastic concentrations. Over five weeks, changes in body weight and length were monitored. The control group showed a steady increase in length from 3.70 ± 0.09 cm to 5.20 ± 0.06 cm and in weight from 1.07 ± 0.02 g to 1.26 ± 0.03 g. Fish exposed to low concentrations exhibited the highest final length (5.18 ± 0.07 cm) and weight (1.30 ± 0.02 g), suggesting that minimal microplastic presence may not inhibit growth and may even stimulate it in the short term. Conversely, fish in medium, high, and very high treatment groups showed diminished growth trends. The medium group reached 4.92 ± 0.08 cm and 1.03 ± 0.05 g, the high group reached 5.15 ± 0.05 cm but with lower weight gain (1.13 ± 0.04 g), while the very high group showed final length and weight of 5.10 ± 0.06 cm and 1.08 ± 0.03 g, respectively. These findings suggest that chronic exposure to higher microplastic concentrations may impair nutrient assimilation or induce physiological stress, thereby reducing growth efficiency. The study highlights the ecological risks of continued plastic pollution in marine environments.

Keywords: *Chrysiptera parasema,* coral reef fish, fish growth, marine pollution, microplastic contamination

MIL-53(Fe) DERIVED rGO/Fe_2O_3/TiO_2 THIN FILM FOR PHOTOCATALYTIC DEGRADATION OF ORGANIC POLLUTANT IN WATER

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Abstract

Photocatalysis faces key challenges such as poor catalyst recovery, limited light absorption, and rapid electron-hole recombination. In this study, a TiO_2-based thin film photocatalyst was developed and modified with MIL-53(Fe) derived Fe_2O_3 and reduced graphene oxide (rGO), fabricated via a sol-gel dip-coating technique. The resulting rGO/Fe_2O_3/TiO_2 composite thin film was designed to address the key drawbacks of pristine TiO_2, including rapid charge carrier recombination and limited photoresponse under visible light. Photocatalytic activity was evaluated through the degradation of methylene blue (MB) under UV-A and visible light irradiation. The optimized rGO/Fe_2O_3/TiO_2 thin film comprising of 0.005 wt% of MIL-53(Fe) derived Fe_2O_3 and 0.4 mg/mL of rGO with five layers coating exhibited improved photocatalytic efficiency, achieving up to 84% MB degradation under UV-A and 47% under visible light, respectively. Its adsorption ability towards MB was enhanced attributed by the high surface area and π–π interactions provided by rGO. Kinetic analysis revealed a pseudo-first-order reaction, with rate constant of 0.007 min^{-1}, nearly double of pristine TiO_2 thin film. The composite film also demonstrated good stability, maintaining over 70% efficiency across five reuse cycles. The enhanced photocatalytic behavior is attributed to the synergistic effect of Fe^{3+} ions acting as charge trapping sites to suppress electron-hole recombination, while rGO offers a conductive platform for electron mobility and extended light absorption. These results suggest the rGO/Fe_2O_3/TiO_2 thin film is a promising, reusable, and scalable photocatalyst for applications in wastewater treatment and self-cleaning surfaces.

Keywords: TiO_2 thin film, MIL-53(Fe), Fe_2O_3, reduced graphene oxide (rGO), photocatalysis

INTEGRATING SUSTAINABLE DEVELOPMENT GOALS INTO SOLID WASTE MANAGEMENT AT UNIVERSITY CAMPUSES

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Abstract

This paper reviews the published articles on universities' municipal solid waste management and their applications of the United Nations Sustainable Development Goals, particularly SDG 12, Responsible Consumption and Production, in managing municipal waste. This article scrutinised the methodologies adopted by the universities qualified for Times Higher Education Impact Ranking, QS Sustainability, and UI GreenMetric, and the criteria qualifying their sustainability practices and identified the areas for improvement in municipal solid waste management practices, strategies to achieve a sustainable campus. It conducted a literature review of the published articles on municipal solid waste and Sustainable Development Goals. It searched the Scopus and Web of Science databases and limited the keyword search to the title and topic of the articles. The reviewed articles were selected using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The keywords used in the search were 'Waste', 'SDG12', 'SDG11', 'SDG2', AND 'University' from 2020 to 2024. The paper examined the waste management practices at the top five universities in 2024 for each ranking system. The review result showed that the primary areas requiring improvement are modifying the policies and strategies for reducing and reusing waste, procuring practices, green spending, and waste audits. This paper is unique because it determines the impacts of commitment to SDG 12 for municipal solid waste management on university campuses and how it affects their rank in the international sustainability ranking system. Furthermore, this paper proposes a methodology that universities can adopt to achieve a sustainable campus and a better ranking.

Keywords: waste, SDG 12, SDG 11, SDG 2, university

NETWORK INTERACTIONS AMONG STAKEHOLDERS IN BLUE CARBON TRADING IN MALAYSIA

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Abstract

Blue carbon ecosystems (BCE) such as mangroves, seagrass meadows and salt marshes are well known as large reservoirs of blue carbon (BC). Successfully registered carbon projects under a carbon standard potentially monetizes each ton of carbon dioxide equivalent (CO2e) as BC credits. BC credits are sold at higher premiums compared to their terrestrial counterparts, garnering interests from various stakeholders. Due to the nascency of BC projects in Malaysia, lack of transparency and regulation gaps hinder the effective governance of BC projects and carbon trading in general. Risks of malpractice and corrupt dealings may arise among stakeholders participating in the BC credit ecosystem. Hence, we endeavour to study the network structures of stakeholders in BC trading. We identified 11 stakeholder categories through a systematic literature review and conducted semi-structured interviews with stakeholders from each category. Our interview dataset complements and validates the limited studies on carbon credit stakeholders. Social Network Analysis (SNA) was employed to map and quantify communication patterns among stakeholders involved in blue carbon trading. SNA revealed that project developers exhibited the highest scores for centrality measures namely degree, betweenness and closeness. This indicates that project developers are the most influential and dominant stakeholder, potentially shaping how integrity and transparency are upheld throughout the carbon project and among participating stakeholders. Our findings may inform the decisions of regulators and policy makers to ensure best practices in the governance of blue carbon in Malaysia.

Keywords: blue carbon credit, carbon markets, social network analysis, stakeholders

SIZE AND ELEVATIONAL REPRESENTATIVENESS AS INDICATORS FOR ASSESSING THE DESIGN EFFECTIVENESS OF THREE PROTECTED AREAS IN SELANGOR, PENINSULAR MALAYSIA

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Abstract

In Peninsular Malaysia, the design of established protected areas has been conducted on an ad hoc basis. As a result, modified ecosystems have emerged within these protected areas. Evaluating design effectiveness is therefore critical for developing strategies to maintain and enhance the capacity of the protected area system. Thus, this study evaluated the design effectiveness of three protected areas: the Sungai Dusun, Bukit Kutu, and Klang Gate wildlife reserves. To measure design effectiveness, a comparison index was employed, consisting of two dimensions of representativeness: size and elevation. Forest and elevational maps of the study areas were used as the basis for analysis. The size indicator considered the current forest area (i.e., "present state") and the entire protected area (i.e., "original state"). The "original state" was also calculated for comparison with the "present state." The results of size representativeness showed that, in the "present state," Sungai Dusun has good size representativeness, while Bukit Kutu and Klang Gate do not. This trend was also found for the "original state" across all protected areas. Bukit Kutu has good elevational representativeness, whereas Klang Gate and Sungai Dusun do not. Overall, in both the "present state" and "original state," Sungai Dusun and Bukit Kutu are partially effective in design, whereas Klang Gate is not. In conclusion, ineffectiveness in size and elevational representativeness is present, affecting the design effectiveness of the protected areas studied. Therefore, future guidelines for establishing protected areas should ensure that they are adequately sized and appropriately located.

Keywords: biodiversity conservation, comparison index, conservation area, protected area efficiency, sustainable development

CHECKLIST OF AVIFAUNA IN TASIK KENYIR, TERENGGANU

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Abstract

Tasik Kenyir, located in Terengganu, Malaysia is the largest man-made lake in Southeast Asia and is widely recognized for its scenic landscapes and exceptional biodiversity. This unique ecosystem serves as an important habitat for a diverse range of avifauna, playing a vital role in sustaining ecological functions such as seed dispersal, pollination and insect population control. With over 500 recorded bird species, Tasik Kenyir stands out as a premier site for birdwatching. Its varied habitats including forests, wetlands and riverine zones support a wide range of avian life. To better understand this biodiversity, avian surveys were conducted from 2017 to 2023 using observational methods along 1 km transects, targeting understorey, canopy and above-canopy bird communities. A total of 157 bird species from 42 families were recorded during these surveys Most of the bird species recorded in this study were observed occupying the understorey and canopy layer of the forest. Two species (Wrinkled Hornbill and White Crowned Hornbill) are classified as endangered according to the IUCN Red List. Additionally, two flycatcher (Ferruginous Flycatcher and Blue and White Flycatcher) were identified as migratory birds. These findings highlight the ecological importance of Tasik Kenyir and underscore the need for continued conservation efforts and sustainable ecotourism practices to preserve this vital habitat and the biodiversity it supports for the long-term health of this natural environment.

Keywords: birds, conservation, diversity, ecological, lake

MULTI-DIMENSIONAL VULNERABILITY FACTORS AFFECTING INLAND FISHERMEN'S LIVELIHOOD AT SUNGAI PAHANG

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Abstract

Inland fisheries constitute one of the sub-sectors of the fisheries sector, other than marine fisheries and aquaculture. Despite their long-standing role in livelihoods of fishing community, inland fisheries receive relatively less attention compared to marine fisheries, particularly in terms of catches, income, employment, technology and innovation, and investment. This study focuses on the inland fishing community living along the Sungai Pahang River, where fishing as a main livelihood particularly among the Malay group. Sungai Pahang rich with diverse of fish species, including *Patin Buah, Jelawat, Baung*, *Tapah* and *Temelian* and gained high demand among freshwater fish lovers, making it a primary source of income for fishermen. However, rapid development along the Sungai Pahang threatening the livelihood of the fishing community. These threats are multi-dimensional, including economic, socio-physical, and environmental dimensions. The objective of this study is to examine the vulnerability factors that affecting the inland fishing community of Sungai Pahang. A qualitative research approach is employed, using semi-structured interviews which targeted a full-time fisherman. The Sustainable Livelihoods Framework (SLF) is adopted as the conceptual framework of the study. Findings indicate that the fishermen face multidimensional vulnerabilities including income instability, declining in fish catches, the increase of fishing costs, natural disasters (such as floods and droughts), river pollution, the depletion of certain fish species, competition of fishing territorial, and illegal fishing practices. These factors threatening the sustainability of fishing community as well as the fish resources of the Sungai Pahang.

Keywords: inland fisheries, Pahang River, fishing community, vulnerability, sustainable livelihoods

PREDICTING RHIZOPHORACEAE DISTRIBUTION ALONG THE EAST COAST OF PENINSULAR MALAYSIA USING HERBARIUM RECORDS AND ECOLOGICAL NICHE MODELLING

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Abstract

Mangrove forests dominated by Rhizophoraceae species help maintain coastal stability, conserve biodiversity and enhance climate resilience. In Peninsular Malaysia, especially along the east coast (Pahang, Kelantan and Terengganu), these ecosystems face escalating pressures from land-use change, aquaculture, coastal development and climate variability. However, knowledge of the environmental drivers that govern the distribution of Rhizophoraceae remains limited. We compiled 895 herbarium specimens of Rhizophoraceae from four national collections including FRIM (Forest Research Institute Malaysia), KLU (Universiti Malaya), UMT (Universiti Malaysia Terengganu), and UKMB (Universiti Kebangsaan Malaysia) to document species occurrences and inform species distribution modelling. True mangrove genera (*Bruguiera, Ceriops, Kandelia* and *Rhizophora*) were present but under-represented relative to non-mangrove genera, suggesting either natural scarcity or collection bias. To project potential distributions, we propose using Ecological Niche Modelling (ENM) with herbarium coordinates, bioclimatic and topographic variables. This approach will produce predictive maps for present and future climate scenarios, delineating core habitats and identifying areas susceptible to sea-level rise or land-use conversion. By combining historical herbarium data with modern modelling techniques, this study enhances our understanding of Rhizophoraceae biogeography and informs strategies to conserve Malaysia's mangrove biodiversity.

Keywords: Rhizophoraceae, ecological niche modelling, mangrove conservation, Malaysia, habitat suitability

INFLUENCE OF PARENT ROCK TYPE ON THE DISPERSIVE PROPERTIES OF MALAYSIAN RESIDUAL SOILS

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Abstract

Dispersive soils pose significant challenges because of their tendency to deflocculate in water, resulting in internal erosion and instability in geotechnical structures, particularly in the distinct geological settings of Malaysia. Nonetheless, the impact of parent rock mineralogy on the dispersive characteristics of Malaysian residual soils has yet to be thoroughly investigated. This study thoroughly investigates the dispersive potential of residual soils obtained from different locations in Malaysia, which originate from igneous, metamorphic, and sedimentary rocks. The investigation employs both physical tests (crumb, double hydrometer, and pinhole tests) and chemical analyses (sodium adsorption ratio [SAR] and exchangeable sodium percentage [ESP]). The findings indicate that soils derived from sedimentary rocks demonstrate significantly elevated dispersivity (SAR > 9; ESP > 10), largely attributed to the prevalence of 2:1 clay mineral like montmorillonite and illite which facilitate sodium ion interactions and promote soil deflocculation. In contrast, soils derived from igneous and metamorphic rocks, characterized by 1:1 clay mineral such as kaolinite and halloysite, exhibit notably reduced dispersive tendencies (SAR < 5; ESP < 6), probably due to the preferential adsorption of divalent cations. Principal Component Analysis (PCA) indicates that clay mineralogy, consistency, and clay content are key factors influencing soil dispersion. Understanding the dispersive characteristics of Malaysian residual soils is needed for evaluating internal erosion risks and maintaining the stability of engineering projects. The results establish a solid foundation for enhancing geotechnical risk evaluation and management in Malaysia.

Keywords: clay minerals, dispersive properties, parent rocks, residual soils

CHARACTERIZATION OF DISPERSIVE BEHAVIOR FOR RESIDUAL GRANITIC SOILS IN PERAK, MALAYSIA

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Abstract

Dispersive soils are inherently vulnerable to erosion due to particle disintegration upon interaction with water, primarily driven by high concentrations of exchangeable sodium ions that induce deflocculation of clay particles. This study investigates the dispersivity characteristics of residual granitic soils in Perak, Malaysia, through three standard methods: the crumb test, the double hydrometer test, and the pinhole dispersive test. The results revealed non-dispersive behavior in the crumb test, while both the double hydrometer and pinhole dispersive tests indicated moderate dispersivity. This behavior is attributed to the high content of clay colloids in granitic residual soils, which impedes water infiltration and alters the rate of particle dispersion. These findings are critical for understanding the geotechnical behavior of such soils, particularly in assessing the risks associated with slope instability, dam failure, and foundation integrity in construction and infrastructure development.

Keywords: dispersive soils, residual granitic soils

AN ESTIMATION OF SOIL EROSIVITY FACTOR, (*k*) IN JANDA BAIK AREA, PAHANG, MALAYSIA: A CASE STUDY

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Abstract

Soil erosion poses a significant threat in tropical regions such as Janda Baik district area in Pahang state, Malaysia due to intense rainfall, steep terrain, and land development activities.

This study aims to assess the severity of soil erosion using the Universal Soil Loss Equation (USLE) and its modified form (MUSLE). Soil samples were collected at multiple depths and tested for particle size distribution, organic content, and specific gravity. The USLE and MUSLE were used to calculate annual soil loss and storm-based sediment yield, respectively. The results showed that erosivity factor, k in the study area ranging from 0.035 to 0.052. While soil loss and sediment yield recorded as 3,852 tonnes/ha/year and 1,266 tonnes/storm each averagely. The analysis demonstrates the significant influence of slope, vegetation, and soil type. Best Management Practices (BMPs) such as temporary drainage and seeding, are recommended. This research illustrates the importance of integrated erosion control strategies in rapidly developing regions.

Keywords: soil erosion, USLE, MUSLE, BMPs

SOLVENT-SPECIFIC DISSOLUTION KINETICS OF SEDIMENTARY ORGANIC MATTER: COMPARATIVE INSIGHTS FROM WATER AND ALKALINE EXTRACTIONS

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Abstract

Sediment organic matter is a heterogeneous mixture of soluble organic compounds derived from both terrestrial and aquatic sources, which plays an important role in the biogeochemical cycles, affects speciation and bioavailability of trace metals, the solubility of organic pollutants, and natural acidity. The bulk of the organic matter is retaining in the solid phase in different states and when in contact with solvents this organic matter can dissolve. This present study was performed to determine the influence of dissolution solvent in extracting organic matter from the coastal sediment matrices by comparing the dissolution kinetics and its spectroscopic characteristics. Two extraction methods were applied: water-extractable organic matter (WEOC) and alkaline-extractable organic matter (AEOM). Dissolution behaviour was assessed across a pH range of 3–10 and at varying contact times to evaluate the relationship with dissolution rates. Extracts were characterized using ultraviolet–visible spectroscopy, and normalized absorption spectra showed comparable patterns for both WEOC and AEOM. Four indices; $SUVA_{254}$, E_2/E_4 ratio, E_4/E_6 ratio, and spectral slope were calculated and used to characterized form each solvent. Results demonstrated that WEOC contained lower aromaticity than AEOM, while alkaline extraction yielded a higher proportion of aromatic compounds. Spectral slope analysis further indicated that AEOM fractions comprised higher molecular weight compounds, whereas WEOC was enriched with lower molecular weight components.

Keywords: dissolved organic water, heterogenous substances, dissolution kinetic, marine sediment

EFFECTS OF CARBON DIOXIDE ON THE ACCUMULATION OF ZINC AND IRON IN PADDY GROWN IN CONTAMINATED SOIL

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Abstract

Climate change induced by increased carbon dioxide levels in the atmosphere may affect the heavy metal content in rice grown in heavy metal contaminated paddy soil. This study aims to assess the influence of carbon dioxide to the distribution of zinc (Zn) and iron (Fe) in paddy grown in soil treated with these heavy metals. The experiment was conducted in a standard glasshouse (RK) and a carbon dioxide-enriched (700-800 ppm) glasshouse ($RKCO_2$). Five replications of paddy (*Oryza sativa*) variety MR219 were used in this study. The plants were treated with individual applications of zinc (150 ppm, 200 ppm, 250 ppm, 300 ppm, and 350 ppm) and iron (200 ppm, 250 ppm, 300 ppm, 350 ppm, and 400 ppm), as well as combinations of both metals. Paddy plant tissues (root, stem, leaf, and rice) were digested using wet digestion, whereas zinc and iron in soil fractions (TIML, PA, OO, and RR) were extracted using sequential extraction. Both extracts were then analysed using inductively coupled plasma mass spectrometry (ICP-MS). Elevated carbon dioxide exposure increased the uptake of zinc and iron in paddy plant tissues, following the order: roots >> stems > leaves > rice. Uptake under single-metal treatments (Fe or Zn) was higher compared to the combined Fe+Zn treatment. Despite the increased metal uptake, the concentrations of both metals in rice grains remained within safe consumption standards. In soil, both metals were predominantly concentrated in the weakly bound form, following the order: PA >> TIML > OO > RR fractions.

Keywords: zinc, iron, *Oryza sativa*, paddy soil

DISTRIBUTION OF SOIL CADAVERIC DERIVED LIPIDS ASSOCIATED WITH THE DECOMPOSITION OF DIFFERENT ANIMALS

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Abstract

Lipid changes during the decomposition of animal remains can offer useful information for forensic science, especially in estimating the postmortem interval (PMI) and locating a clandestine grave. Therefore, this study focused on observing the differences in decomposition rate (ROD) and lipid profiles found in soil surrounding pig and chicken fatty tissues buried in sandy beach environment under tropical climate. The aim was to compare how these animals break down and to analyse how total lipid extracts (TLE), palmitic (C16:0), and stearic acid (C18:0) acids vary at each of the decomposition stages. A simulated burial experiment was performed where the fatty tissues of pig and chicken were buried in sandy soil for a period of 20 days and allowed to decompose at several designated sampling points. The associated soils were collected during each sampling point and the remaining fatty flesh was weighed. Cadaveric derived lipid extraction was carried out using a modified Bligh-Dyer extraction method, followed by derivatization and analysis using Gas-Chromatography - Flame Ion Detector (GC-FID). Measurements of post-experimental soil pH and decomposition rate were also performed. The relationship between ROD, lipid concentrations, and fatty acids was analysed using Principal Component Analysis (PCA). The findings showed that pig had a strong positive relationship between ROD and lipid concentrations, with higher levels of fatty acids detected during the active breakdown phase. On the other hand, chicken showed a different trend, where lipid concentrations increased at later stages, even when the decomposition rate had slowed. Moreover, the post-experimental soil pH became more acidic during the early decomposition stages and gradually returned to near-neutral levels towards the completion of burial interval. This study, hence, suggested that soil cadaveric derived lipid profile was dependent on the animal species and different among the decomposition stages and can be used as potential biomarkers in forensic work.

Keywords: Cadaveric derived lipids, postmortem interval, Clandestine graves, rate of decomposition, free fatty acids

MULTIDISCIPLINARY RESOLUTION OF AGE AND PALEOENVIRONMENTAL DISPARITIES: A CASE STUDY OF SUB-SAHARAN SEDIMENTARY DEPOSIT, ETSAKO-EAST, EDO STATE, NIGERIA

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Abstract

A multidisciplinary assessment of the sedimentary deposit along Imiegba, Etsako-East, in Edo State, Nigeria, was conducted to resolve the controversy regarding the palaeoenvironmental history and age disparity of the deposit observed in the literature. Previous researchers adopted a field study and palynological approach. Some assigned the sediments to the Campanian. In contrast, others dated the same sediments to the Maastrichtian with contrasting palaeoenvironmental conditions. This prompted the question of why a sedimentary deposit has dual ages and a contrasting palaeoenvironment despite the similarity in the study approach. For the age-resolution of the dual age controversy, 34 (Thirty-four) sedimentary samples were carefully selected from the field. These were subjected to palynological, petrography, radiometric isotope, X-ray diffraction (XRD), X-ray Fluorescence (XRF) and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) analyses. Results from the palynological study indicate the presence of *Monocolpollenites spheroidites, Tubistephanocolpites cylindricus, Cingulatisporites ornatus, Mifordia jadinei,* and *Monoporites annulatus* and *Cyathidites australis,* suggesting late Campanian to early Maastrichtian age. Similarly, evidence from radiometric isotope analysis indicates an age range of 68.5 to 83.2 Ma, which aligns with the indications from palynology. The plot of modal composition of Quartz, Feldspar and Lithic fragments from petrography on a ternary diagram, high enrichment in the concentration of the rare earth elements, high concentration index of alteration and low concentration of MgO, CaO, K_2O, MnO and Na_2O, coupled with an indications from the bivariate plots of major oxides suggest an estuary environment with tropical humid and arid climate.

Keywords: palynology, petrography, geochemistry, paleoenvironment, deposit

ASSESSING GENETIC VARIATION AND TAXONOMIC IDENTITY OF POLYGONUM MINUS HUDS. IN PENINSULAR MALAYSIA: STRATEGIES FOR CONSERVATION AND SUSTAINABLE EXPLOITATION

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Abstract

The taxonomic status of *Polygonum minus* Huds., a medicinal plant native to Peninsular Malaysia, remains a subject of debate. This study investigated the genetic diversity of 33 wild-type accessions of P. minus from Peninsular Malaysia using nuclear ribosomal internal transcribed spacer (ITS) sequences to clarify its taxonomic position and explore implications for conservation and sustainable use. Phylogenetic analysis, employing neighbor-joining, maximum parsimony, and maximum likelihood methods, revealed that geographic distribution does not significantly influence the genetics of P. minus due to the high conservation of the ITS region. Consistent with previous studies, tree topologies indicated that P. minus accessions from Peninsular Malaysia are distinct from the synonymous *Persicaria minor* (Huds.) Opiz and *Polygonum kawagoeanum* Makino. Interestingly, *P. minus* accessions clustered with *P. pubescens* and *P. hydropiper*, suggesting close relationships. These findings have implications for conservation strategies, sustainable harvesting practices, and potential breeding programs for *P. minus* in Peninsular Malaysia, and highlight the importance of accurate taxonomic identification for effective resource management.

Keywords: internal transcribed spacer, Peninsular Malaysia, *Polygonum minus* Huds**.**

CLIMATE-RELATED RISK DISCLOSURE AND EXPORT MARKETS: ARE THEY CONNECTED?

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Abstract

Global buyers increasingly treat climate transparency as a prerequisite for trade. Using accountability theory, this study examines whether detailed climate-related risk disclosure enhances the export performance of Malaysian publicly listed palm-oil producers. We manually compiled disclosure scores from 105 annual, integrated, and sustainability reports issued by 21 firms during the period from 2018 to 2022. Each report was evaluated against the four thematic areas recommended by the Task Force on Climate related Financial Disclosures. Panel regressions linked disclosure quality to firm-level export value while controlling for size, age, capital intensity, and profitability. The analysis reveals a positive and statistically significant association between comprehensive climate-related risk disclosure and higher export value. Larger companies benefit most from transparent reporting, whereas older firms exhibit weaker export outcomes, suggesting that organisational adaptability reinforces the competitiveness gained through enhanced disclosure. Capital intensity and profit margin do not display significant effects in this model. By demonstrating that rigorous climate communication influences downstream customers as well as investors, the research extends the disclosure–performance literature into the sphere of international trade. The findings encourage policymakers to integrate mandatory climate reporting into certification schemes, thereby reinforcing trust within palm-oil supply chains. For corporate managers, the evidence indicates that clear climate disclosure is not solely a compliance obligation; it can generate substantive market access and revenue advantages. Future investigations should consider how specific narrative elements such as transition financing and scope three emissions influence export success in other carbon-intensive industries.

Keywords: climate-related disclosure, palm oil, export market

ASSESSMENT OF HEAVY METAL LEVELS AND ASSOCIATED ECOLOGICAL RISKS IN THE SEDIMENTS OF PULAU BESAR, JOHOR

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Abstract

Human activities such as tourism, shipping, and coastal development contribute to heavy metal pollution in marine areas, including ecologically and economically important marine parks. This study aimed to evaluate the concentrations of eight heavy metals (Pb, Mn, Cd, Cu, Ni, As, Cr, Zn) in surface sediments of Pulau Besar, Mersing, and assess the ecological risks. In March 2024, seven surface sediment samples (0–5 cm) were collected using a Ponar grab sampler. Heavy metal concentrations were analyzed via Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), and ANOVA was used to assess spatial variations. Ecological risks were evaluated using Sediment Quality Guidelines (SQGs), Pollution Load Index (PLI), Geoaccumulation Index (I_{geo}), and Potential Ecological Risk Index (RI). The concentration order was Mn > Cr > Ni > Pb > Zn > As > Cd > Cu. Station S3 showed the highest concentrations, likely due to intense tourism-related activities such as boating and waste disposal. Statistical analysis confirmed significant differences ($p < 0.05$) between S3 and other stations. According to the I_{geo}, sediments were categorized as Class 1 (unpolluted), and RI values indicated low ecological risk (<150). Overall, the Pulau Besar Marine Park remains at a low ecological risk level. However, ongoing monitoring and improved waste management and tourism control are crucial to maintain ecosystem health. These findings provide valuable baseline data to support sustainable marine park management strategies.

Keywords: heavy metals, marine sediment, ecological risk index, Pulau Besar, marine park

PREDOMINANT OF POLYETHYLENE-MICROPLASTICS (PE-MPs) CONTAMINATIONS AT SUNGAI BULOH ESTUARY, MALAYSIA

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Abstract

Sungai Buloh estuary is known for its economic and ecosystem value. This region is crucial for waterbirds' foraging, while cockles are being actively cultivated and harvested in the area. Unfortunately, this region has been noted to be tainted by the disposal of plastic waste and other pollutants, which are thought to originate from the industrial and residential zones near the river. Primarily, this research is purposely to determine the type and abundance of Microplastics (MPs) collected from the water surface of the Sungai Buloh estuary region. Samples were collected from nine different sites, ranging from the river region to the open sea, using a filtration process with a 1.25 mm sieve size. Results indicated that the region of the river had a higher concentration of microplastics than the other sampling locations. In the meantime, FTIR analysis was performed, revealing that polyethylene (PE) is the predominant polymer type identified at the highest sampled location. This study indicates that microplastics have polluted the Sungai Buloh estuary. Spatial and temporal studies are being suggested to comprehend the distribution pattern of MPs in this estuary.

Keywords: Microplastics, estuary, FTIR-ATR, polyethylene (PE), fragment

EVALUATING COASTAL CHANGES IN KEDAH THROUGH MNDWI AND NDVI SPECTRAL INDICES

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Abstract

The coastal zone is vital for protecting ecosystems and communities from natural disasters, yet it is highly dynamic and subject to constant physical changes. Remote sensing and GIS technologies are crucial for monitoring these shifts. A study was conducted along the coast of Kedah, Malaysia, using satellite imagery (Landsat 7 in 2002 and Landsat 8 in 2024) and software (ERDAS Imagine and ArcGIS) to analyze coastline dynamics over 22 years. The study aimed to evaluate the effectiveness of the Modified Normalized Difference Water Index (MNDWI) and the Normalized Difference Vegetation Index (NDVI) in determining the shoreline and detecting changes in the coastal zone. Spectral index images were generated using OTSU classification, and image overlays helped assess shoreline changes. Results showed that both indices effectively distinguish land and water, with MNDWI demonstrating high accuracy: 100% (Kappa 1.00) for Landsat 7 (2002) and 98.5% (Kappa 0.97) for Landsat 8 (2024). The analysis revealed significant coastal changes, including an accretion of 348.80 hectares and a reduction of 171.34 hectares over the study period. These findings highlight the potential of MNDWI and NDVI for coastal change detection, offering valuable insights for effective coastal management and conservation.

Keywords: coastline changes, MNDWI, NDVI, Landsat, Kedah

ABUNDANCE OF MICROPLASTICS IN WATER AT PULAU BESAR, JOHOR

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Abstract

The presence of microplastics in marine environments poses significant threats not only to marine life but also to human health. In Southeast Asia, including Malaysian coastal waters, rapid urbanization, tourism, and mismanaged plastic waste contribute significantly to marine microplastic pollution. However, limited studies have comprehensively assessed microplastic characteristics in specific island environments such as Pulau Besar, Johor. Microplastic pollution is closely linked to human activities such as improper waste disposal and tourism, which are prevalent in island environments. Tourist destinations like Pulau Besar are particularly vulnerable due to increased human activity and poor waste management, leading to high microplastic accumulation in surrounding waters. This study aims to determine the abundance, morphology, color, size, and polymer composition of microplastics from seawater samples collected at seven stations around Pulau Besar, Johor. Triplicate samples from each station were processed using the Wet Peroxide Oxidation (WPO) method and analyzed under a stereo microscope. The study revealed that microplastic concentrations ranged from 49.33 ± 3.84 to 73.67 ± 8.21 particles/L, with fibers being the most prevalent form. These fibers are likely derived from synthetic textiles, fishing gear, and household wastewater, highlighting the influence of both domestic and marine-based human activities in contributing to microplastic pollution.Transparent microplastics accounted for 48.43%, while particles measuring between 1 mm and 5 mm comprised 56.30% of the total. Five dominant polymer types were identified through μ-Raman spectroscopy, namely polyamide (PA), polyethylene terephthalate (PET), polypropylene (PP), polystyrene (PS) and polytetrafluoroethylene (PTFE). These findings offer valuable insights into the abundance and characteristics of microplastics in the marine environment of Pulau Besar and support ongoing efforts in pollution management and mitigation.

Keywords: microplastics, human activities, waste disposal, abundance, polymers

A PILOT INITIATIVE FOR STANDARDIZED MONITORING OF AIRBORNE MICROPLASTICS IN SOUTHEAST ASIA

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Abstract

Microplastic pollution poses a significant threat to coastal ecosystems worldwide, with Southeast Asia emerging as a hotspot for plastic contamination. In response to this pressing environmental issue, initiatives are underway to establish a regional network for microplastic monitoring. This pilot project primarily aimed to develop a uniform methodology for sampling and analysis of airborne microplastics across Southeast Asia. To achieve this, a survey was circulated among project partners in Malaysia, Thailand, and Vietnam to assess each laboratory's current research setup and capacity, and identify key challenges in airborne microplastic monitoring. Furthermore, benchmarking and analysis of best practices were conducted through a review of existing literature, including consultation with experts from a leading research institute in developed countries. These exercises are crucial for formulating robust and harmonize strategies for monitoring airborne microplastics. Our preliminary findings provide insights into the current state of airborne microplastic research in Southeast Asia, highlighting varied analytical capabilities and methodological approaches across the region. Based on this assessment, a framework for developing standardized monitoring protocols is proposed. The project also identifies key initiatives and strategies calling for collective action to tackle the pervasive threat of microplastic pollution in Southeast Asia's coastal regions. These include standardizing monitoring protocols, enhancing analytical capabilities, and fostering knowledge exchange and capacity building. The pilot network established through this study is anticipated to significantly increase scientists' capacities and facilitate impactful results at both community and policy levels, contributing to more effective regional management of microplastic pollution in Southeast Asia.

Keywords: ambient microplastic, uniform methodology, Southeast Asia

LANDFILL-IMPACTED ENVIRONMENTS: EVALUATING SOIL HEALTH AND WATER CONTAMINATION THROUGH PHYSICOCHEMICAL AND HEAVY METAL ANALYSIS

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Abstract

Landfill sites pose significant risks to the surrounding environment, particularly through the leaching of contaminants into soil and water systems. This study aims to evaluate the impact of landfill activities on soil health and water quality by examining the physicochemical properties and heavy metal concentrations in soil and water samples. Soil and water samples were systematically collected from various distances around municipal landfill site. Parameters such as pH, electrical conductivity (EC), organic matter content, and nutrient levels were assessed alongside concentrations of selected heavy metals, including lead (Pb), cadmium (Cd), zinc (Zn), mangan (Mn), aluminium (Al), cobalt (Co), nickel (Ni) and copper (Cu). Results revealed a marked increase in heavy metal concentrations in soil, confirming that leachate contributes significantly to metal contamination. In addition, water quality near the landfill was found to be more deteriorated compared to control sites, with several parameters exceeding permissible limits. This study highlights the importance of regular monitoring and effective landfill management to protect soil health and water resources, while providing baseline data for future risk assessment and remediation strategies.

Keywords: landfill leachate, soil contamination, water quality, heavy metals

WASTE NOT, THRIVE MORE: MICROBES TRANSFORMING PALM OIL MILL EFFLUENT (POME) INTO ENERGY

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Abstract

Palm oil mill effluent (POME) represents one of the most significant organic waste streams in Southeast Asia, presenting both environmental challenges and biotechnological opportunities. Understanding the microbial communities within POME treatment systems is crucial for optimizing biogas production and exploring novel biotechnological applications. This study characterized the prokaryotic and archaeal communities in activated sludge and raw POME samples from multiple palm oil processing facilities to identify their biotechnological potential for sustainable waste management and resource recovery. Microbial community analysis was conducted on five samples: fresh raw POME from a private palm oil mill in Kedah (1); raw POME (2) and activated sludge (2) from both Cenergi biogas plants in Pulau Carey and Teluk Intan, respectively. 16S rRNA gene sequencing was performed to characterize bacterial and archaeal communities, with particular focus on methane-producing consortia and their functional diversity. Distinct microbial community structures were observed across sample types and locations. Activated sludge samples were dominated by Bacteroidota and Chloroflexota, essential for hydrolytic and acidogenic processes. Raw POME samples exhibited high Proteobacteria diversity, and might contained substantial Firmicutes populations. Notable differences between facilities suggest location-specific adaptations that may influence biogas production efficiency. The characterized microbial consortia offer pathways for creating sustainable solutions that bridge environmental management, renewable energy production and circular economy principles.

Keywords: palm oil mill effluent, microbial communities, anaerobic digestion, biogas production, waste-to-energy

DETERMINATION OF HABITAT AND CORRIDOR LINKAGE OF MALAYAN TIGER (*Panthera tigris*) AT GUA MUSANG USING GEOSPATIAL METHODS

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Abstract

Malayan tiger (*Panthera tigris*) has been listed as an endangered species on the International Union for Conservation of Nature (IUCN) Red List since 2008. Habitat loss and human-wildlife conflict caused by fragmentation have led to a declining Malayan tiger population over the years. The objectives of this study were to determine habitat suitability and predict wildlife corridors linkage affected by forest fragmentation. Habitat suitability analysis in this study uses environmental parameters of land use, elevation, slope, distance from water sources, distance from roads and urban and lithology. Presence data of Malayan tiger at Gua Musang in 2018 were integrated with these environmental parameters using the Maximum Entropy Model (MaxEnt) to identify suitable habitats in the area. Meanwhile, the location of the corridor linkage was determined using the least-cost analysis within a GIS environment. The results showed that suitable habitats for the Malayan tiger cover 90% of the study area. Distance from water sources contributed the highest percentage to the habitat suitability model at 55.7%, followed by slope (19.2%), elevation (13.5%), land use (3.8%), distance from roads and urban (6.5%) and lithology (1.4%). Three predicted wildlife corridors linkage were identified; along the railway line connecting the fragmented Gunung Stong and Ulu Temiang Forest Reserves, road separating the Sungai Brok and Sungai Betis Forest Reserves and along the highway connecting the Chiku and Gunung Rabong Forest Reserves. These findings can serve as a reference for future conservation efforts in the study area and similar regions.

Keywords: Malayan tiger, MaxEnt, least-cost analysis, habitat suitability, corridor linkage

MINERALOGY AND REE RESOURCE POTENTIAL IN PLACER DEPOSITS IN LENGGENG, NEGERI SEMBILAN

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Abstract

Despite their potential as rare earth element (REE) resources, placer deposits in Negeri Sembilan remain largely unexplored. This study aims to evaluate the REE resource potential of placer deposits in the Lenggeng area, Negeri Sembilan. A total of six heavy mineral samples from stream sediments and five granite samples were collected from the study area. The mineralogy of heavy minerals was identified using QME analysis, while petrographic analysis was conducted on the granite samples. REE concentrations in both heavy minerals and granites were determined using an ICP-MS (NexION 2000 model). The study found that heavy minerals in the study area consist of ilmenite (25.00–35.00%), cassiterite (13.33–23.33%), monazite (10.00–20.00%), zircon (6.00–17.33%), tourmaline (8.33–10.00%), rutile (6.67%), as well as topaz and garnet (4.33–8.33%). REE concentrations in the heavy minerals are notably high (2,934.97–10,896.81 ppm), with light rare earth elements (LREEs) (2,313.98–10,256.52 ppm) being more dominant than heavy rare earth elements (HREEs) (125.21–640.29 ppm). The higher LREE content compared to HREEs suggests that these elements are derived from felsic igneous rocks. The granite rocks in the study area are medium-grained and composed of alkali feldspar (45%), quartz (35%), and plagioclase (20%), along with minor biotite and zircon (<1%). However, REE concentrations in the granitic rocks are relatively low (2.43–37.52 ppm). Despite this, processes such as erosion, transport, mechanical breakdown, and deposition have concentrated heavy minerals and led to REE enrichment in the placer deposits.

Keywords: placer, rare earth elements (REE), granite, Lenggeng

VERTICAL DISTRIBUTION PATTERNS OF *Aedes* MOSQUITOES IN LOW-RISE BUILDINGS UNDER DISTINCT ENVIRONMENTAL SETTINGS

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Abstract

Dengue continues to pose a significant global public health burden, primarily due to the proliferation of *Aedes* mosquitoes, which serve as key vectors of the virus. Understanding species-specific distribution in relation to environmental and structural factors is critical for optimizing vector surveillance and control strategies. Despite extensive research on *Aedes* ecology, limited attention has been given to vertical distribution patterns in low-rise buildings across contrasting environmental contexts. This study aimed to compare the vertical stratification of *Aedes* mosquitoes in two distinct settings: a rapidly developing urban area and a vegetated residential campus. Ovitrap surveillance was implemented at multiple floor levels, and Ovitrap Index (OI) values were calculated alongside species identification. Results demonstrated an inverse correlation between elevation and OI, indicating a consistent decline in mosquito abundance with increasing floor height in both environments. Species composition exhibited clear environmental preferences: *Aedes albopictus* predominated in the vegetated campus, whereas *Aedes aegypti* was more prevalent within the urban development zone. These findings underscore the influence of environmental heterogeneity on species distribution and vertical stratification, with implications for targeted dengue vector control. Incorporating building height and environmental characteristics into surveillance protocols may enhance intervention efficiency, particularly in mixed urban landscapes where both species coexist. This study contributes novel insights into the ecological determinants of *Aedes* distribution in low-rise structures, supporting evidence-based strategies for vector management in diverse urban environments.

Keywords: *Aedes aegypti*, *Aedes albopictus*, vertical stratification, ovitrap index, urban ecology

MICROPLASTIC CONTAMINATION IN COMMERCIAL EDIBLE SALTS IN MALAYSIA

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Abstract

Commercial edible salts and other food products are increasingly found to include microplastics (MPs), which are plastic particles smaller than 5 mm. Because of their pervasiveness in aquatic systems, humans have been exposed to them over time through their diet. This study examines the physical properties, concentration, and presence of MPs in twelve commercial salt items, including rock and sea salts, purchased from Malaysian supermarkets. A 10 µm polycarbonate membrane was used to filter each 350 g salt sample after it had been dissolved in filtered distilled water. Fluorescence microscopy was used to visualize MPs after they were stained with Nile Red. All samples had MP values between 33.8 ± 29 and 2364.3 ± 1760 particles/kg. Sea salts had considerably greater MP levels (mean: 3155.4 particles/kg) than rock salts (654.2 particles/kg), according to a one-way ANOVA ($p < 0.05$). Most of the MP particles found were less than 20 µm, predominantly fibres and fragments. Malaysian adults may consume between 1825 and 3650 MP particles a year from salt alone, based on the recommended daily intake of 5–10 g. According to these findings, commercial salt may provide long-term health hazards and is a significant source of MP exposure. This study emphasizes the critical necessity for food safety monitoring and regulatory guidelines for MP contamination in edible items, given the significance that salt plays as a food preservative and dietary staple. To evaluate the toxicological effects of prolonged exposure to microplastics, more research is advised.

Keywords: microplastic, sea salt, rock salt, food safety

RELATIONSHIP BETWEEN MICROPLASTIC ABUNDANCE AND SEDIMENT PARTICLE SIZE IN SUNGAI MELAKA, MELAKA, MALAYSIA

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Abstract

Microplastic pollution in river ecosystems poses significant environmental risks due to the persistence and widespread distribution of particles smaller than 5 mm. The abundance of microplastics in the Sungai Melaka, and their relationship to the range of sediment particle sizes were examined in this study. Surface sediment samples (0–15 cm) were collected from 30 random points and analyzed using density separation, wet peroxide oxidation, and filtration methods. Microplastics were quantified through imaging and ImageJ analysis, while sediment particle sizes were determined via sieving. Results revealed a total of 86598 microplastic particles, with an average of 2886.61 particles per sampling point. The highest concentration was observed at sampling point 7, with 2.11×10^5 particles/kg. The dominant microplastic size was <0.1 mm, comprising 97.53% of particles. Coarse and medium sand were the most prevalent sediment types. However, Pearson correlation analysis indicated no significant relationship between microplastic abundance and sediment grain size. This suggests that factors such as hydrodynamics, pollution sources, and anthropogenic activities may play a more influential role in microplastic distribution. The findings contribute to the understanding of microplastic dynamics in tropical rivers and highlight the need for further studies involving polymer identification and seasonal or biological correlations.

Keywords: anthropogenic impact, environmental contamination, river ecosystem, sediment particle size

AN INVERSE RELATIONSHIP BETWEEN LIPID CONTENT AND MICROFIBER CONTAMINATION IN COMMERCIAL BIVALVES: DOMINATION OF TEXTILE POLLUTION

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Abstract

Microplastic contamination of seafood is a growing concern for food safety and marine ecosystem health. Bivalves, as filter-feeders, are particularly prone to accumulating microplastic, yet the relationship between their contamination burden and nutritional value remains poorly understood. This study undertakes a comparative analysis of microplastic contamination and proximate composition in two commercially important bivalve species, oysters (*Crassostrea* sp.) and clams (*Meretrix* sp.), sourced from commercial farmers. We quantified and characterized microplastic and analysed protein, fat, moisture, and ash content to investigate species-specific contamination-nutrition patterns. Our results reveal a stark contrast between the species as clams exhibited a 6.3-fold higher microplastic contamination load per gram of tissue compared to oysters (0.50 ± 0.15 vs. 0.08 ± 0.03 particles/g, respectively; $p < 0.001$). This was paralleled by a significant difference in nutritional profiles, with clams containing 34% higher protein content, while oysters had 72% higher fat content. This presents a risk-benefit paradox for consumers, where the more protein-rich option carries a significantly higher contamination risk. Polymer analysis via Fourier-transform infrared (FTIR) spectroscopy identified fibers as the dominant microplastics morphology, with rayon, a semi-synthetic cellulosic fiber, comprising 74.67% of all identified particles, strongly implicating textile industry effluent as a primary pollution source. The data reveal a novel inverse pattern between bivalve lipid content and microfiber contamination at the species level, leading to the hypothesis that lipid-rich tissues may offer a protective effect against the accumulation of certain hydrophilic fibers. This study highlights a new perspective on polymer-tissue interactions, demonstrates a critical food safety dilemma, and provides clear, actionable evidence for targeting textile-related pollution at its source.

Keywords: microplastic, fiber, lipid content, nutrient profile, textile

AEROSOLIZED MARINE MICROALGAE DIVERSITY IN COASTAL MALAYSIA: CASE STUDIES FROM MELAKA AND JOHOR

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Abstract

The studies on aerosol microalgae have existed for a long time, but studies on aerosol microalgae are still scarce compared to studies on bacteria and viruses. There were not many studies about microalgae aerosol in Malaysia, especially in marine areas. Therefore, this study was conducted to provide new information on the abundance and diversity of aerosol microalgae on the beaches of Pengkalan Balak, Melaka and Tanjung Resang, Johor. Aerosol samples were taken by exposing a petri dish containing 15 ml of SWII media for 30 minutes at a height of 0.5 m, 1.0 m and 1.5 m from the sea surface at the tidal zone. Based on the results, there were 4 microalgae taxa found in Pengkalan Balak and there were 5 taxa in Tanjung Resang. All the phytoplankton taxa were diatoms which were *Navicula* spp., *Pleurosigma* spp., *Skeletonema* spp., *Thalassionema* spp. dan *Coscinodiscus* spp. except for one from Tanjung Resang which is *Gymnodinium* spp., that belongs to the dinoflagellate group. The density of aerosolized microalgae in Pengkalan Balak was lower than in Tanjung Resang which was 266.7 cells/L in Pengkalan Balak and 59400.0 cells/L in Tanjung Resang. The results of 1.39 for the Shannon Wiener's diversity index and 0.00 for Simpson's dominant index shows that Pengkalan Balak has a higher diversity compared to Tanjung Resang that has the value of 1.58 for Shannon Wiener's diversity index and 0.97 for Simpson's dominant index. This shows that there was one dominant species in tanjong Resang which was *Gymnodinium* spp. There are various factors that needs to be taken into account, to explain the results that have been presented such as wind speed, temperature, relative humidity, cell size and weight. The main factor that causes the spread of phytoplankton cells into the air is mostly caused by wind speed and sea spray. Wind speed can promote the production of wave breaking on the sea surface which also contribute the production of sea spray. The microalgae would be released into the air through the eruption of bubble droplets. As the wind speed increases, the dispersal rate of microalgae into the air will also increase. However, the most efficient dispersion factor is a combination of wind speed and various other factors specifically meteorological factors. The spread of aerosol microalgae can also bring various effects to health, life and the environment. Therefore, further studies are needed to identify other meteorological factors that influence the spread of aerosol microalgae and their impact on life and the environment.

Keywords: diatoms, dinoflagellates, dispersal, sea spray

THE BEHAVIOUR OF BENTONITE SUPPORTED NANOPARTICLES (B-NZVI) IN REMOVING A MIXTURE OF METHYLENE BLUE AND HEAVY METALS

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Abstract

This paper focuses on the behaviour of Bentonite Supported Nanoparticles (B-nZVI) to remediate the mixture of Methylene Blue (MB) and Heavy Metals (HM). The supported nanoparticles (B-nZVI) were synthesized by using the chemical reduction method of Ferric Chloride Tetrahydrate and Sodium Borohydride, NaBH4 solutions. Batch Test studies were also conducted to delineate the effectiveness of absorbent materials removing methylene blue and heavy metals in single and mixture solutions. Batch tests involved five effects including concentration, dose, pH, kinetic and temperature. Based on the Freundlich equation in the initial concentration effect, the KF values of M B in a single solution (KF=256.7438 L/g; R2=0.8111) is higher compared to KF in a mixture solution (KF=39.2464 L/g; R2=0.7813). The sequence of adsorption capacity by B-nZVI is as follows; MB= Cu> Pb> Cd = Zn> Ni> Co (single solution); MB> Pb > Cu> Ni = Co> Zn> Cd mixture solution). This study highlights the complex interactions between different contaminants as B-nZVI in dye mixture solutions and single solutions. The results also revealed that the B-nZVI can be an effective absorbent to remove the mixture of cationic and heavy metals.

Keywords: Bentonite supported nanoparticles, dyes. heavy metals, treatment, Bentonite

HEAVY METAL CONCENTRATIONS AND MICRONUCLEUS FREQUENCY IN *Tegillarca granosa*

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Abstract

Industrialization has raised concerns about heavy metal contamination in aquatic systems, making continuous monitoring vital for food safety and ecosystem health. *Tegillarca granosa* (blood cockle), a widely consumed filter-feeding bivalve, is an important bioindicator due to its ecological role and dietary relevance. This study assessed heavy metal concentrations and genotoxic effects in *T. granosa* collected from markets in Malacca, Negeri Sembilan, and Penang. Blood samples were analyzed for lead (Pb) and cadmium (Cd) using inductively coupled plasma mass spectrometry (ICP-MS), while micronucleus (MN) frequency in hemolymph was evaluated as a biomarker of genotoxic stress. Results showed Pb and Cd concentrations well below the Maximum Acceptable Limits set by the FAO and Malaysian Food Act (1985). MN frequencies were 2.6% ± 0.15, 2.2% ± 0.23, and 2.5% ± 0.20 across the three sites. Although MN formation indicates potential DNA damage, the low metal levels suggest these values likely represent natural background variation rather than pollution. Findings confirm the current safety of *T. granosa* for human consumption and highlight MN assays as a sensitive early-warning tool for long-term environmental monitoring. Ongoing surveillance is recommended to detect emerging risks.

Keywords: genotoxicity, biomarker, bioaccumulation, food safety



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