2nd International Conference on
Oceanography and Sustainable Marine Production (ICOSMaP 2016)
International Islamic University Malaysia. Kuantan, Pahang

JOINTLY ORGANIZED BY
Department of Marine Science, Kulliyyah of Science, International Islamic University Malaysia (IIUM), Malaysia
&
Kagoshima University, Kagoshima, Japan
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Conference Objectives

- Identifying adaptation and minimization strategies for managing marine resources, aquaculture and capture fisheries for their sustainable production in the changing climate.

- Influencing building of national and international capacity to implement adaptation and minimization strategies by informing policy processes.

- Informing participants and creating awareness of the Working Committee on minimization and adaptation.
Conference Themes

Oceanography, Coastal Processes and Geomorphology
- Effects of climate change on Oceanography
- Coastal hydrodynamics
- Coastal erosion and sediment transport
- GIS and Remote sensing for marine application
- Ocean acidification and CO₂ sequestration
- Integrated Coastal Zone Management (ICZM)

Marine Ecology and Biodiversity
- Marine environment and pollution
- Marine plankton including Harmful algal bloom
- Threatened and Invasive species
- Conservation of marine resources
- Impacts of climate change on marine ecosystem and resources
- Adaptation and minimization strategies of climate change effects
- Artificial reef and marine ecosystem management

Biotechnology and Marine Natural Products
- Issues and challenges in breeding and hybridization in aquaculture
- Use of biotechnology for adaptation and minimization of climate change effects on marine resources
- Genetic effects of aquaculture escapees
- Marine Renewable Energy
- Marine Pharmaceuticals

Aquaculture and Fisheries
- Sustainable marine production
- Effects of climate change on aquaculture and fisheries: assessment and minimization
- Seafood security in the changing climate
- Environment-friendly aquaculture
- Disease and biosecurity in aquaculture
- Aquaculture feed and nutrition
- Stock assessment and marine ranching
Forward from the Dean, Kulliyyah of Science

Welcome and Selamat Datang

The Kulliyyah of Science, International Islamic University Malaysia (IIUM) is proud and honored in organizing the 2nd International Conference on Oceanography and Sustainable Marine Production (COSMaP) 2016. Under the Department of Marine Science, Marine Science programme is offered in Kulliyyah of Science in three different disciplinary; Integrated coastal zone management, Aquaculture and sea farming and Fisheries and postharvest technology. The Department of Marine Science aims are to provide foundation to scientist to expose them to technology and advancement made in the field and introduce critical thinking to discuss current issues and manage the marine environment with minor in Islamic Revealed Knowledge in addition to the core Marine subjects. This will generate competent and skill marine scientist who will contribute to nation-building and be the pride of Muslim Ummah.

On the other hand, research and innovation are given priority to complement the teaching and learning process. Department of Marine Science main research focus are varies due to unique combination of experts from different fields such as aquatic biology, marine ecology, fish reproduction, fish behavior, fish population dynamics, marine biology, marine toxicology, fish health and molecular biology. By using cutting-edge multi-disciplinary own by the researcher, many findings were successfully published, pattern and commercialized to serve the industry, nation and ummah.

The organization of this seminar is specifically to highlight the sustainable marine production and adaptations to climate change as a theme. I foresee the ideas that will prosper from this meeting of intellectuals that will be beneficial to improve the marine production and sustainability. I am also sure that this conference will enhance the networking of academicians, researcher and the industry.

Lastly, thank you to the organizers, presenters and contributors to this International Conference on Oceanography and Sustainable Marine Production (ICOSMaP) and I wish all the best to the participants.

Prof. Dr. Kamaruzzaman Yunus
Dean, Kulliyyah of Science
International Islamic University Malaysia
Message from the Chairman of ICOSMaP 2016

It is with great sense of duty that I have undertaken the Chairmanship of the ICOSMaP 2016 conference. I am deeply honored by the privilege of this position which, at the same time, entails a persistent and hard effort to ensure that the Conference is useful, interactive, challenging and mutually instructive. The Organizing Committee Members are doing their best to guarantee a flawless organization as well as a top-quality scientific programme which is being thoroughly planned.

The theme that we have chosen for this 2nd ICOSMaP Conference is “Sustainable Marine Production and Adaptation to Climate Change”, which is designed to explore research and gives us an opportunity to discuss the future directions of the field of marine science. We are thankful to key note, plenary and many local and international speakers who will shed light on the various marine science research areas that shape our field today.

Oceans, seas and coastal areas cover more than two-third of the earth’s surface and contain 97% of the planet’s water. They are essential component of the Earth’s ecosystem which host huge reservoirs of biodiversity and provides various resources for the livelihoods of over three billion people. They are also the primary regulator of the global climate, an important sink for greenhouse gases and they provide us with water and the oxygen we breathe. Although they provide numerous economic, social and environmental benefits, oceans, seas and coastal areas are facing a multitude of local and global challenges caused by human activity and climate change. As a consequence, the state of the oceans, seas and coastal areas are deteriorating and will be negatively affecting human well-being worldwide. Climate change is placing expanding pressure on marine areas particularly the coastal regions which are already seriously affected by intensive human activity. Increasing sea level changes the shape of coastlines, contributes to coastal erosion and leads to flooding and more underground salt-water intrusion. Thus, study of the impacts of climate change on marine ecosystems and its adaptation should be conducted comprehensively.

I hope this conference will provide a good platform to all participants to discuss and update the current issue and new strategy to minimize this serious phenomenon.

Thank you…

Assoc. Prof. Dr. Shahbudin Saad
Chairman, ICOSMaP 2016
Programme Details
**Venue: Main Auditorium**  
**Day 1: 23/08/2016 (Tuesday)**

### Theme: Oceanography, Coastal Processes and Geomorphology (OPG)

**Chairperson: Assoc. Prof. Dr. Shahbudin Saad**

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<td>11:20 am - 11:40 am</td>
<td>Wei-Koon Lee</td>
<td>Advection and Dispersion of Water Quality Constituents in Batu Ferringhi Penang</td>
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<td>11:40 am—12:00 pm</td>
<td>Muhammad Shaheed Shammodin</td>
<td>3-Dimensional Flood Inundation Model Of Pekan Sub-District, Pahang using Geographic Information System (GIS)</td>
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<td>12:00 pm - 12:20 pm</td>
<td>Dickson Lukose</td>
<td>Ontology Model for Oceanography Data, Information and Knowledge Management</td>
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<td>12:20 pm—12:40 pm</td>
<td>Juliana Mohamed</td>
<td>Sustainable Coastal Development In Malacca: Experiences on Reclamation Projects</td>
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### Theme: Oceanography, Coastal Processes and Geomorphology (OPG)

**Chairperson: Asst. Prof. Dr. Zuhairi Bin Abmad**

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<td>Shahbudin Saad</td>
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<td>Areezo Fereido-nian Dashit</td>
<td>Removing Colour and Chemical Oxygen Demand, From Palm Oil Mill Effluent (Pome) using Horizontal Roughing Filter</td>
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### Theme: Biotechnology and Marine Natural Products (BNP)  
**Aquaculture and Fisheries (AFI)**

**Chairperson: Asst. Prof. Dr. Nur Shuhada Tajudin**

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<td>Rashidah Abdul Razak</td>
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<td>Mohammad Mustafizur Rahman</td>
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### Theme: Aquaculture and Fisheries (AFI)

**Chairperson: Asst. Prof. Dr. Mohd Zani Mustapa**

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### Theme: Aquaculture and Fisheries (AFI)

**Chairperson: Asst. Prof. Dr. Nur Nazifah Mansor**

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<td>Nai Han Tan</td>
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<td>Leong-Seng Lim</td>
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<td>Shaidatul Nadia Waludin</td>
<td>Genetic Diversity of the Orange-spotted Grouper (<em>Epinephelus coioides</em>) in Terengganu Malaysia Based on Mitochondrial Cytochrome b Sequence Data</td>
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### Theme: Aquaculture and Fisheries (AFI)

**Chairperson: Assoc. Prof. Dr. Mohammad Mustafizur Rahman**

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<td>Mohd Razali Md Razak</td>
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**Venue:** Main Auditorium  
**Day 2: 24/08/2016 (Wednesday)**

**Theme:** Aquaculture and Fisheries (AFI)

**Chairperson:** Asst. Prof. Dr. Nur Nazifah Mansor

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<td>Hassan Syeikh</td>
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<td>Suphia Amiera Sulaiman</td>
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<td>Ma’ruf Kassim</td>
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### Theme: Marine Ecology and Biodiversity (MEB)

#### Chairperson: Asst. Prof. Dr. Mohd Fuad Miskon

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<td>Akbar John</td>
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#### Theme: Marine Ecology and Biodiversity (MEB)

#### Chairperson: Assoc. Prof. Dr. Yukinori Mukai

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<td>02:00 pm - 02:20 pm</td>
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<td>The Process of Semporna Marine Spatial Planning: A Study Case From Coral Triangle Initiative</td>
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<td>Rohini Shanmugapriya Murugesan</td>
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<td>Normawaty Mohammad Noor</td>
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#### Theme: Marine Ecology and Biodiversity (MEB)

#### Chairperson: Asst. Prof. Dr. Siti Waznah Abdurahman

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<td>Nurul Ashima Hamdan</td>
<td>Toxicity Profiles Between Strains of <em>Alexandrium tamiiyanichii</em></td>
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<td>Raveena Kim Lai</td>
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**Theme: Marine Ecology and Biodiversity (MEB)**

**Chairperson:** Assoc. Prof. Dr. Normawaty Mohammad Noor

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<td>10:00 am - 10:20 am</td>
<td>Zarinah Waheed</td>
<td>Reef Coral Species Richness Gradient Across Malaysia</td>
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<td>10:20 am - 10:40 am</td>
<td>Hiroto Maeda</td>
<td>Advancing red Tide Monitoring Technique and Countermeasure for a Sustainable Aquaculture Condition</td>
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10:40 am - 11:00 am **REFRESHMENT AND POSTER VIEWING SESSION**

**Theme: Marine Ecology and Biodiversity (MEB)**

**Chairperson:** Asst. Prof. Dr. Aimimuliani Adam

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<td>Zainudin Bachok</td>
<td>Hard Coral – Coral Reef Fish Trophic Level as Revealed by Fatty Acid Composition in Coral Reef Habitats of The Malaysian South China Sea</td>
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12:20 pm - 02:00 pm **LUNCH BREAK**

**Theme: Aquaculture and Fisheries (AFI)**

**Chairperson:** Asst. Prof. Dr. Asnor Azrin Sabuti

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**REFRESHMENT AND POSTER VIEWING SESSION**
## Poster Presentation

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ABSTRACTS

OCEANOGRAPHY, COASTAL PROCESSES AND GEOMORPHOLOGY
ADVECTION AND DISPERSION OF WATER QUALITY CONSTITUENTS IN BATU FERRINGHI PENANG

Muhammad Ilyas bin Ahmad\textsuperscript{a} Jamalluddin, Wei-Koon Lee\textsuperscript{b}\textsuperscript{*}

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The incident of beach pollution in Batu Ferringhi in year 2014 has created a major concern of the water quality in the tourists’ haven. In order to understand the advection and dispersion of pollutants in the area, the present study develops a coastal hydrodynamic model of Batu Ferringhi beach, taking into consideration wind, tide, coastal current and riverine runoff. The model is calibrated and validated with observations from adjacent coastal monitoring stations. Simulation is then carried out to investigate the fate of water quality constituents which originates from the three rivers in the vicinity. Results show high concentrations of the water quality parameters can be observed near the headland towards the northeast of the study area, with intermittent patchy escape which may retain more than one-third the initial concentrations, weighted by the river discharge. More worrying is that localised trapping of up to three-quarter the initial weighted concentrations also occurs at the beach owing to the interactions between river flow and longshore current.

\textit{Keywords:} Advection/dispersion; Batu Ferringhi; MIKE21; Water quality
3-DIMENSIONAL FLOOD INUNDATION MODEL OF PEKAN SUB-DISTRICT, PAHANG USING GEOGRAPHIC INFORMATION SYSTEM (GIS)

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Pekan sub-district which covers Pahang River basin is one of the most flood prone area in Pahang. Annual monsoon season during November to March is the main cause of flood which causes economic losses to the locals. The objective of this study is to produce a 3-Dimensional flood inundation model of the area. In the first stage, raw data especially elevation/terrain, bathymetry, and satellite images will be collected from USGS website, Malaysia Remote Sensing Agency (MRSA), and Department of Survey and Mapping Malaysia (JUPEM). Satellite images of Landsat 8 and SPOT 7 were combined together to produce an image that covers whole part of Pekan sub-district. Total of 35 ground control points (GCPs) including JUPEM and Royal Malaysian Navy (TLDM) benchmarks was collected for geometric correction in ENVI software using Differential Global Positioning system (DGPS). Collected digital elevation (DEM) and river depth data (bathymetry) was used to project a terrain model in 3-Dimensional view using ArcGIS software. Final product of analyzed images were applied to the terrain model to produce a 3D map of Pekan sub-district. The produced 3D map can be used to correlate between river water level and inundated area and thus, flood spreads can be observed and controlled later on. This study is expected to help local authorities in planning ahead to mitigate flood issues in the future.

Keywords: Flood modelling, Digital Elevation Model, Bathymetry, Landsat 8, SPOT 7
The Malaysian National Oceanography Data Center (MyNODC) is the central repository for all oceanography data, information and knowledge. MyNODC provides its stakeholders with the ability to perform semantic search on the contents, upload oceanography data (i.e. physical, biological, geological, chemical and satellite data), and perform data curation, data management and reporting. It manages a directory of experts in oceanography in the country, and all the knowledge artifacts (e.g., papers, reports, equipment, research centers, organization and intellectual properties) associated to oceanography. Central to this system is the Oceanography Ontology that enables the formal naming and definition of the types, properties, and interrelationships of the entities that exist to compartmentalize the variables needed for computations and establishes the relationships between them. In this paper, we will outline the ontology modeling and engineering efforts: ontology development process, the ontology life cycle, the methods and methodologies for building ontologies, and the tool suites and languages that support them. This paper will further outline how we integrated MyNODC to Linked Open Data (LOD) and its ability to harvest oceanography related knowledge from LOD. This paper will conclude with illustration of the visualization features of MyNODC for ocean observation, simulation and analysis.
SUSTAINABLE COASTAL DEVELOPMENT IN MALACCA: EXPERIENCES ON RECLAMATION PROJECTS

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The coastal development in recent years in the world has created the need of more land especially land closed to developed areas. Like other developed country, reclamation had become the best option in Malaysia to extend shoreline area for economic growth, but poorly managed development can have diverse impact to the nearest marine environment and also to the local community. Sabah and Malacca were reported started a landfill reclamation type to extend their foreshore for the commercial purpose in 1957. Rapid development in Malacca and demand for accommodation and infrastructure at the coastal area had made the state government to approve reclamation project at the coastal area for tourism infrastructure, hotel, residential house, marina bay and marine museum. More than 2,300 hectares of reclamation area have been proposed in Malacca until 2006. Land reclamation projects bring adverse impacts to the coastal environment and social-cultural environment, for example, hawksbill turtle received impact from the reclamation activities where numbers of turtle laid lay eggs at Malacca coastline were decreased due to changes of coastline. The initiative to form policies to conserve and protect the coastal zone management started since the early 20th Century. The evolution of the coastal management initiative in Malaysia was based on problem-based and reactive approach to resource degradation and international commitments. Since Sixth Malaysia Plan until Eighth Malaysia Plan, coastal resources have been given attention due to the need to protect and conserve the coastal resources and marine environment. Thus, this paper is responding to the need for more information on the status of coastal reclamation in Malaysia especially in Malacca and the adverse impact. This paper is also look for information on the initiatives taken by government for coastal management and conservation in order to achieve sustainable coastal development as mentioned in Agenda 21.
CURRENT STATUS OF EUPHYLLIIDAE CORALS IN MARINE PROTECTED AREAS OF TIOMAN, REDANG AND PAYAR ISLANDS, MALAYSIA

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Recently, various conservation efforts of the Euphylliidae corals have been taken placed since these species are heavily targeted for the marine aquarium trade. In Malaysia, the information on average, distribution and abundance patterns of these vulnerable and near threatened species are not fully documented. Hence, the current status of the Euphylliidae corals were investigated by applying a method of coral video transect at 144 transect lines in 36 reef sites of Tioman, Redang and Payar Islands. This study recorded a total of six species of the Euphylliidae corals with *Euphyllia ancora* had the highest average percentage coverage (29.5% ± 1.5) and dominant in Tioman, *Plerogyra sinuosa* (92.3% ± 4.2) in Redang and *Physogyra lichtensteini* (98.0% ± 6.7) in Payar Islands. The diversity and distribution of the Euphylliidae corals were highly influenced by the difference in reef morphology, substrate condition, coastal development and human intervention at the particular reef area.

*Keywords*: Euphylliidae corals, Vulnerable species, Near threatened species, Coral Video Transect, Peninsular Malaysia
ESTIMATING DISPERsal OF CORAL Larvae FOR ECOSYSTEM MANAGEMENT IN TIOman ISLAND

Muhammad Faiz Mohd Hanapiah¹,*, Zuhairi Ahmad², Shahbudin Saad²

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Dispersal of coral larvae and successive recruitment are important for ecosystem management especially in marine protected areas to estimate how far larvae travel in the water and settle on substrates. Information on dispersal distance is crucial to determine the magnitude of self-recruitment and inter reefs connectivity. In this study, dispersal of larvae particles was investigated by applying Langragian particle tracking module integrated with 2-dimensional, hydrodynamic, flexible mesh model (MIKE 21 FM). Simulation were carried out for two distinct pelagic larvae durations (PLD); optimal PLD and extensive PLD during major spawning activities in April 2014 at four source reefs namely Genting Village, Renggis Island, Teduh Bay and Juara Bay. Results indicated that most of coral larvae particles from each source reef dispersed closer to natal reef during optimal PLD (5-7 days after spawning) suggesting self-recruitment from local larvae pool play major role in shaping coral reef assemblages. Extended PLD (14 days after spawning) may increase connectivity between reefs as coral larvae travel farther. However, successful recruitment rates may decrease due to larval mortality and predation. Therefore strategic ecosystem management and habitat restoration in Tioman Island is needed since reef resilience may depends on local larvae pool.

Key words: Coral Reef, Dispersal, Coral Spawning, MIKE 21 FM, Tioman Island
Abstract ID: OPGO07

REMOVING COLOUR AND CHEMICAL OXYGEN DEMAND, FROM PALM OIL MILL EFFLUENT (POME) USING HORIZONTAL ROUGHING FILTER

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Roughing filter can be considered as a major post-treatment process in waste water management. It reduces influent colour and suspended solids to a level that is effective for operation; meanwhile, roughing filter presents a promoting method for improving raw water quality without using any chemicals. This research aims at improving Palm Oil Mill Effluents (POME) using limestone roughing filter to remove colour and chemical oxygen demand. To obtain this goal, four different series of experiment that involved different sizes of limestone filter media and various filtration rates were carried out; the four categories of limestone filter media included small size (3mm), medium size (12-mm), large size (20mm) and a combination of the three filter media and were utilized in the experiment with three different filtration rates of 0.3 ml/min, 0.8 ml/min and 1.5 ml/min. The results indicated that achieving efficient COD and colour removals depend on the size of filter media and the applied flow rate. COD and Colour, removals were found 59.64%, 63.43%, Removal efficiency was found increased with slower flow rate and the smallest size of media.

Keywords: Roughing filters, Pretreatment, Palm oil mill effluent (POME),Limestone
The neural network model has been performed on the Principal Component Analysis (PCA) to obtain nonlinear principal component analysis (NLPCA), which allows the extraction of nonlinear features in the dataset missed by the PCA. This nonlinear method is applied on detrended monthly Sea Surface Temperature Anomaly (SSTA) data from the tropical Atlantic Ocean (30°W-20°E, 26°S-22°N) for the period 1950 to 2005. The objective is to compare the modes extracted through this statistical analysis to those previously extracted through the more simple PCA. The focus is on the differences between SST inter-annual variability patterns; either extracted through traditional PCA or NLPCA methods. CMIP5 (Coupled Model Intercomparison Project Phase 5) pre-industrial simulations are examined to assess the ability in reproducing the El Niño, Atlantic dipole and Atlantic cold tongue (ACT) variability in the Tropical Atlantic Ocean. We present results of PCA and NLPCA on the ERSST data set from the NOAA and few models of CMIP5 model ensemble. Our results show that a modest number of models were able to correctly capture the meridional mode (Atlantic dipole). NLPCA shows that the spatial distribution of the El Niño pattern signature in model HadGEM2-AO compares reasonably well with the observed features but with sign reversal. The correlation coefficient between the standardized time series of nonlinear principal component (NLPC) and the ACT time series is very strong.

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**Keywords:** PCA, NLPCA, SST, Tropical Ocean, CMIP5
Temporal variation of scleractinian coral recruitment density was examined at 3 sampling stations around Bidong Island, Malaysia in relation to currents speed in 2014. Although almost all corals were brooder spawners (Pocillopora, Stylopora and Seriatopora), the relationship between recruitment density and currents were differed among sampling stations, likely due to differences in coastal topography. Recruitment of brooder spawner corals varied between sampling stations, and recruitment was greater at leeward compared to windward reefs. This result suggests that embryonic development time and currents affect larval dispersal and subsequent recruitment patterns at a local scale. Based on embryonic development time, brooder spawner corals whose larvae develop more rapidly (internal fertilization) are likely to have higher rates of self-seeding than others. Our results predict that among spawning corals, local populations of brooder corals, whose larvae disperse short distances and recruit near to natal reef are not resilient to local disturbances, whose recruitment relies upon local stock compared to broadcast corals.

Keywords: Current, temporal variation, recruitment density, brooder spawned coral, Bidong Island
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Atmospheric particles in the surface air including aerosol and dust were collected using high volume air sampler (HVAS) for obtaining the activity levels of $^{210}\text{Pb}$ and $^{210}\text{Po}$ over Malaysian waters during the EPSP’09 Scientific Expedition. The average mass concentration of total suspended particles (TSP) in maritime air was 33 ± 2 µg/m$^3$ (ranged from 13 ± 1 to 74 ± 4 µg/m$^3$). Based on previous literatures, it has been suspected that the haze episodes were mainly due to forest and peat bog fires as well as vehicle and industrial emissions during dry period, especially during southwest monsoon. Consequently, the activity levels of $^{210}\text{Pb}$ and $^{210}\text{Po}$ in maritime particles were relatively in proportion with the TSP concentrations. Meanwhile, the temporal variation of $^{210}\text{Po}/^{210}\text{Pb}$ activity ratios in the aerosol samples perhaps related to the difference of residence time airborne particles and contribution from different sources of radionuclides in which $^{210}\text{Pb}$ and $^{210}\text{Po}$ are not in secular equilibrium. The highest TSP concentrations and $^{210}\text{Pb}$ and $^{210}\text{Po}$ activities were closely related to warm and dry period during southwest monsoon.

Keywords: $^{210}\text{Pb}$, $^{210}\text{Po}$, aerosol, Strait of Malacca, South China Sea, Sulu-Sulawesi
FRACTIONATION OF RARE EARTH ELEMENTS IN SURFACE SEDIMENT OF PENINSULAR MALAYSIA COASTAL WATERS, WITH EMPHASIS ON THE INTERSPATIAL VARIABILITY

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Knowledge of the environmental fate of rare earth elements (REEs) in Malaysian environment is limited, but the industrial emission is growing. This study emphasis on the assessment of REEs in surface sediment collected from rocky shore ecosystem along Peninsular Malaysia coastal waters, describing their partitioning and deliberating interspatial variability. Samples were treated using Teflon Bomb technique and concentrations of 14 naturally occurring REEs were measured using ICP-MS technique, along with selected trace metals for additional data. The results were confirmed using standard reference material BCR 667 through quality control practices. The distribution tendency of REEs seemed to be the most mutual feature of particular places in Malaysia and worldwide. Strong correlations among REEs in sediment were found, signifying that they behave coherently to each other in various geochemical fractionation processes. The contaminant metals As, Mn, Cu and Cd were significantly correlated with REEs (p<0.05 and p<0.01), thus proposes that these metals are perhaps non-anthropogenic in origin as the REEs are geogenic in origin. EF values of comparative results divided by regions specified deficiency to minimal enrichment in all regions, except the East Coast region that presented significant enrichment, which suggests the probability of anthropogenic effluent discharge. The results of the analysis normalized to chondrite presented patterns of LREEs enrichment, gradual downward pattern and depletion through HREEs concentrations. Quantification of anomalies calculated using values normalized to chondrite, PAAS and NASC data presented ratios higher than unity for Ce and ratios lower than unity for Eu in all sites.

Keywords: rare earth elements; surface sediment; enrichment factor; chondrite
HYDRODYNAMIC AND WAVE REFRACTION MODELLING FROM SELECTED BEACHES OF PAHANG

Mohd Zaini Mustapa\textsuperscript{1,*}, Shahbudin Saad\textsuperscript{1}, Muhammad Salih\textsuperscript{1},
Kamaruzzaman Yunus\textsuperscript{1}, Noraisyah Sapon\textsuperscript{2}

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Among the most energetic force that control the beach morphology are the waves. The beach alteration profile mainly depends on the way that the incident wave force distribute along the profile, as the dissipation and refraction being the major mechanisms. While the dissipation effect have been widely studied, the phenomena of wave refraction on the beach environment has drawn less attention and is still poorly known, especially in the east coast region of Peninsular Malaysia particularly in Pahang. In order to acknowledge it’s important, the present study demonstrated the physical model Pahang coastal area. The model is based on two-section profile scheme; particularly the hydrodynamic and wave refraction models. The computer simulations of 2D (two-dimensional) numerical modelling systems was conducted using the MIKE-21 software package as the model coupling setup was integrated using the hydrodynamic model (MIKE-21 HD) and the spectral wave transformation model (MIKE-21 SW). The selective domain for this study are Teluk Chempedak, Pantai Sepat and Kuala Pahang as representative for different coastal morphological settings and environmental system in order to comprehend the processes involved in transforming the beach morphology.

Keywords: Beach morphology, hydrodynamic model, wave-refraction model
MARINE ECOLOGY AND BIODIVERSITY
This ecological modeling using system dynamics simulation in order to determine the relationship between the structure of community of mangrove with sedimentation in the Bay of Jakarta. Selected system dynamics for a system that wants to be observed are complex systems, dynamic, un-linear, and has a feedback relationship. The relations wants to know is the specific understanding between the structure of community of mangrove by sedimentation, the optimization of the relationship in order to have optimal conditions, and trends that relationship for the future related to all aspects of the underlying relationship between the two parameters, given the acceleration of development activities in Jakarta Bay high lead to increased accumulation of sediment along the coast and the mouth of the 13 rivers in Jakarta bay. This modeling focus is on the structure and behavior of both parameters. Modelling is beneficial to provide feedback to stakeholders so that optimal management of mangrove be associated with the increasing pace of development in the Bay of Jakarta which can damage the mangrove ecosystem that is in them, even though they are in a protected forest area Angke Kapuk. Vegetation analysis carried out at 5 stations with 3 repetitions with the transect method. Meanwhile, sediment sampling conducted around the shoreline and then do the treatment in the laboratory to determine the type of sediment. Primary data, secondary, and data mental obtained incorporated into the simulation software powersim studio 10.0. The results obtained are at the level of the community structure of mangrove trees are *Avicennia marina*, *Avicenia alba*, *Delonix rega*, *Avicennia officinalis*, *Sonneratia caseolaris*. At the level of the pole is dominated by *Avicennia sp* and *Rhizophora sp*. While at the sapling is dominated by *Avicennia sp*, *Rhizophora sp*, *Acacia sp*, and *Delonix sp*. The behavior shown is the behavior of the growth of decay with the carrying capacity began to decline. Dominance *Avicenia sp* also affect the condition of the sediments in these waters. Water pollution and calm currents due to reclamation right in the mangrove areas make the energy cycle becomes disrupted. This resulted in nutrient cycling, too distracted and feared damage to the mangrove vegetation will occur continuously and can cause loss of mangrove vegetation in Jakarta Bay. Some suggestions submitted to the stake holders associated with the management of mangroves in the Bay of Jakarta.

*Keywords*: ecological model, system dynamics, sedimentation
HEAVY METAL RESISTANCE BACTERIA IN MARINE SEDIMENT OF PAHANG COASTAL WATER

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This study investigated the heavy metal resistance capabilities towards chromium (Cr), cadmium (Cd), nickel (Ni), copper (Cu) and cobalt (Co) of bacteria isolated from marine sediments of three locations, namely, Teluk Chempedak, Pantai Batu Hitam and Pantai Balok. Majority of the isolates from Pantai Balok area exhibited high resistance to Cr, Ni, Cu and Co with MIC >450 µg/ml and most isolates were found to be susceptible to Cd with highest MIC recorded 150 µg/ml. Meanwhile, isolates from Pantai Batu Hitam displayed high resistance to Cr and Ni (MIC >450 µg/ml) and a few isolates were found to show high resistance towards Co and Ni (MIC >450 µg/ml). However, almost all isolates from Teluk Chempedak were susceptible to all the heavy metals tested. Interestingly, there were a few isolates that displayed high resistance to Cd with MIC >450 µg/ml and this was not the case for isolates from Pantai Batu Hitam and Pantai Balok. Previously, these isolates were also found to have antibiotic resistance towards several antibiotics tested (vancomycin, tetracycline, streptomycin, penicillin G, ampicillin, rifampicin, polymyxin, chloramphenicol, erythromycin and gentamicin). Thus, this study illustrated that antibiotic resistance bacteria also possess heavy metal resistance capabilities. The presence of bacteria with both capabilities may indicate possible contamination of antibiotics and heavy metals residues in these areas which may pose a threat to the environment and human population if necessary actions are not taken immediately.

Keywords: heavy metal resistance bacteria, marine sediment, Pahang coastal water, antibiotic resistance
DIVERSITY AND COMMUNITY COMPOSITION OF MACROBENTHOS IN HORSESHOE CRAB NESTING GROUNDS

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Present study was aimed to explore the diversity of major macrobenthic community (Bivalve, gastropod, crustaceans and polychaete and others including insects, amphipods, isopods, larval and juvenile fishes, foraminifera and annelids) in the observed nesting grounds of horseshoe crabs along the Pahang coast, East coast of Peninsular Malaysia. Two sampling stations (Balok and Pekan) were noted as nesting sites of horseshoe crabs (Tachypleus gigas and Carcinoscorpius rotundicauda). Macrobenthic diversity was comparatively lower during full moon (FM) days compared to new moon (NM) days in both the sampling stations. However, the diversity and richness of macrobenthos was higher during peak mating seasons of horseshoe crab (June, 2010) in both the stations. Seasonal variation in the macrobenthic diversity showed significant variation in Balok station (P < 0.05) while it was not apparent in Pekan nesting ground. Overall, macrobenthic diversity was lower in both the sampling sites (H’ = < 1.1) indicating severe habitat degradation in these nesting grounds which in turn might reflect in declining number of shore reaching horseshoe crabs.

Key words: horseshoe crabs, nesting grounds, macrobenthos, habitat degradation, Pahang coast
COMMUNITY STRUCTURE OF REEF CORALS IN PAYAR ISLAND,
MALAYSIA

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The community structure of reef corals were investigated by applying a method of Coral Video Transect (CVT) at seven fringing reef sites around Payar Island, Peninsular Malaysia. Field survey recorded 37 genera from 12 families, from which massive Porites and massive-platy Physogyra were found dominant in the coral assemblages. These coral genera are believe to be able to tolerate with the natural bleaching phenomenon recorded in 1998 and wide changes in environmental conditions, such as currents, wave actions and high suspended sediment concentrations. The finding of this study also showed that the reefs around Payar Island were in “poor” condition with low average coverage of live corals (14.8% ± 6.1). Most of the reef sites were categorized as having “poor” (8.1% - 20.8%) condition, low generic complexity (H’: 1.46 – 2.17; J’: 0.58 – 0.84) and low reef conservation value (CC 1). The unsustainable tourism related activities result from the increase number of tourists and shortcoming in environmental conservation are the factors which influenced poor reef condition, few generic diversity, low generic complexity and low reef conservation value in Payar Island.

Keywords: Scleractinian corals; soft corals, reef condition, r-K-S ternary diagrams, Payar Island, Peninsular Malaysia
THE PROCESS OF SEMPORNA MARINE SPATIAL PLANNING: A STUDY CASE FROM CORAL TRIANGLE INITIATIVE

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With the increasing demands of our sea space such as land reclamation for local settlement, seaweed farming, fish cage culture, lobster farm, tourism and commercial fishing activities cause conflicts among sea space users. These activities are no longer compatible with traditional demands as traditional fishing ground, disposal area, ship channels etc. The crowded sea space not only brings negative impacts to the environment, it is also impact on the local community socially and economically. Marine Spatial Planning (MSP) as an emerging tool to create rational arrangement for the use of marine space and balance the demands for development and environment protections, to achieve ecological, economic and social objectives. Semporna, a district at the Southeast of the Sabah State in Malaysia is in the process of MSP to resolve the conflicts among the stakeholders to ensure the security of ecosystem, food, economic and community. Semporna’s water formed most of the Semporna Priority Conservation Area, harbours the highest concentration of coral reefs in Malaysia. Semporna Priority Conservation Area is within the Sulu Sulawesi Marine Ecoregion (SSME), which is at the apex of Coral Triangle-which known as the center of marine biodiversity hotspot. The aim of this paper to showcase the process of Marine Spatial Planning in Semporna Priority Conservation Area, and how it will contribute to Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security’s Goal 1: “Priority seascapes designated and effectively managed”. As this is the first Marine Spatial Planning within Malaysia’s water; hence this paper will also compare the conventional ways of marine resource management versus MSP and the proposed legal framework for MSP and it’s way forward. This paper illustrate how the MSP, an ecosystem approach in natural resource management become reality in Malaysia and received recognition from the Royal Town Planning Institute, UK.
ASSESSMENT OF BALLAST WATER TREATMENT BY FLOCCULATION TECHNOLOGY

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The ballast water management (BWM) includes ballast exchange, and other measures aimed at preventing and minimizing update and discharge of the contaminated water. The current efforts on ballast water management in India are not up to the greater level. The methods which are created are not completely effective in preventing the invasive species. The systems which treat the ballast water to remove or kill the organisms are not potentially more reliable but are designed and installed to achieve the safety of vessels. When we go through other countries, the normal treatments of ballast water have been done. In India majorly in north side the traces of doing treatments are seen. But in southern part of India these traces too missing and all the treatment methods are swept out. The interest of doing treatments has gone lesser and the effects of these ballast water have not been noticed as higher level. So we aimed majorly working ports in south India (VOC PORT TRUST, CHENNAI PORT TRUST). The major areas covered by these ports are numerous and the peoples around these harbours are extensive. The areas surrounded by the Tuticorin port are Muttayapuram, Pillainagar and the areas surrounded by the Chennai port truss are Sowcarpet, Royapuram. Due to the release of ballast water into the sea these peoples are unknowingly affected by severe diseases. The samples of ballast water from these ports are collected and the characteristics of the ballast have been tested. According to the results obtained the content of total solids and chemical oxygen demand (COD) are very extensive. Thus for reducing the considerable effects due to these factors, we have planned to utilize different coagulant and dosage for flocculation treatment process which is acceptance of fully effective, practicable, safe, economically viable, and environmentally friendly. The process of treatment can be done during the voyages or the time of ballast water exchange. The ultimate aim of this treatment is to eliminate the transfer of organisms and pathogens via discharging ballast water and to ensure safe installation systems to ballast water management.

Keywords: Ballast water, Total solids, Chemical Oxygen Demand (COD), Flocculation
VERTICAL AND HORIZONTAL DISTRIBUTION OF SAND-DWELLING DINOFLAGELLATES FROM DINAWAN ISLAND, SABAH, MALAYSIA

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A study on the vertical and horizontal distribution of sand-dwelling dinoflagellates was conducted over a one year period in the coastal (open area) and lagoon (semi-enclosed area) areas of Dinawan Island. Fifty metre line transects were horizontally laid out perpendicular to the beach. The interval of each station was 10 m, and at each station, 12–14 cm of sediments was vertically collected. These sediments were divided every 2 cm over a 10 cm distance. At each slice of the sediments, sand-dwelling dinoflagellates were identified and counted. Furthermore, the sediments were sieved for sand size characteristics. Sand total phosphorus and sand total nitrogen were horizontally determined. Sixteen species of dinoflagellates were identified including five dominant dinoflagellates species viz. Prorocentrum lima, P. rhathymum, Amphidinium carterae, Bsymatrum caponii and Peridinium quinquerorne. The number of dinoflagellate cells was concentrated at the top 2 cm of the sediment and tended to decrease towards the deeper depth of sand at the coastal and lagoon areas. The horizontal distribution of sand-dwelling dinoflagellates depended on the geomorphology of the area. In the coastal areas, the distribution of sand-dwelling organisms increased towards the sea but not towards the lagoon areas. However, a positive correlation was found between fine sediment size and sand-dwelling abundance and not for other parameters studied. This indicates that the sediment characteristics played an important role in determining the abundance of sand-dwelling dinoflagellates.
COMMUNITY BASED RESTORATION OF CORAL REEFS USING RECYCLED MATERIALS

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Coral reefs throughout SE Asia have been seriously damaged by human activities, especially blast fishing which has reduced many reefs to rubble. With no protection from damaging activities, surveys in 1997 and repeated in 2011 show there is very little recovery over many years. With protection and control of fishing but no restoration, there is a slow increase in fish diversity over a 3 year period with small herbivores showing the biggest increase in numbers. With the addition of community reefs restoration using a variety of techniques, fish diversity at all trophic levels improves dramatically as a result of the increasing rugosity of the previously barren rubble. While environmental education is important, proactive reef conservation is more inspiring for local villagers. Kalapuan village community in Semporna Sabah, has shown a surprising willingness to work at creating their own reefs. A variety of reef types have been created using readily available recycled materials. The community has made coral biscuits, bottle reefs, igloos, turtle and lobster reefs. All the new reefs are growing coral and have attracted shoals of fishes, both from the plankton as post-settlement juveniles and from fish living on the nearby rubble field. This paper describes the process of involving the community in building community reefs, and presents preliminary information on biodiversity changes.

Keywords: coral reef conservation, Community reef restoration, Artificial reef, coral reef, recycled materials
IMMEDIATE IMPACTS OF ARTIFICIAL BOTTLE REEF CONSTRUCTION ON FISH COMMUNITIES OF RUBBLE REEFS

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Surveys of fish communities on shallow rubble reef areas destroyed by historical blast fishing show low biodiversity with low abundance of fish species. Small & medium planktivore fish species were resident on occasional coral heads in the field of rubble and fish abundance was found to be directly inversely related to distance from shelter. The shelter requirement means that large expanses of rubble are devoid of resident fish. A limited number of Large fish species (goatfish, wrasse) used the rubble areas to search for benthic crustaceans. Algal grazers were also present in restricted numbers. Two bottle reefs were positioned at each of 6 locations on large rubble patches at a depth of 5 m on Pom Pom Island, Malaysia. Each artificial reef was planted with an assortment of living coral. From Jan – Aug 2016, replicate surveys of species diversity and abundance were conducted at each experimental and control sites. Small fish which were already present within the rubble were abundant and numbers did not change significantly after artificial reef introduction. The most significant results were seen with Medium fish abundance which increased after artificial reef introduction within hours and remained consistent over time, suggesting the fish had taken up residency. The data suggests that the introduction of artificial bottle reefs has a significant impact on increasing the local population of Medium to Large fish. This is possibly due to the provision of shelter with a complex 3D topography in an otherwise flat, mainly 2D landscape. The reefs also provide a substrate for coral planting and growth, providing food source. The cheap materials and basic knowledge required for bottle reef construction allows this technique to be accessible to all and can have a widespread application in poorer areas where bomb fishing is a commonly used fishing technique.

Keywords: Artificial reef, bottle reef, Reef restoration, reef recruitment, Reef rugosity
THE TRIALS AND TRIBULATIONS OF CORAL REEF RESTORATION ON STEEP SLOPING RUBBLE AREAS.

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The reefs of Pom Pom Island are representative of many coral reefs in Sabah. The reef crest to the reef slope at 12-25m has been blasted by historical fish bombing. The reef crest typically has low coral cover, is dominated by massive coral species and there are few places with healthy stands of branching corals. In a few cases, healthy reef has clearly defined blast craters but in most places the reef has been blasted so many times that the craters have merged, and the seabed is a continuous rubble field with >5% living coral cover. Reef restoration on the steepest rubble slopes at 25-35deg is fraught with difficulties. The rubble has created a thick and unstable layer of old acropora fragments. Heavy objects slide and the rubble slowly flows down at a rate of 12cm per week. Several engineering and biological solutions were tested to determine optimum use of resources. Large areas of rubble stabilised by cement and growing small corals were simply engulfed by landslides of rubble from above. Small coral biscuits planted on the slope tumble and slide. Large crate reefs filled with rubble simply slide slowly down the slope. Any object not anchored moves slowly or rapidly when turtles scratch on the reefs. Step reefs made with legs dug into the substrate and interlocked by fibreglass rebar hammered into the rubble survive well but they are also gradually inundated by flowing rubble from the top. The best reef restoration technique is a two part approach, netting spread across the rubble and planted with soft coral stabilises the rubble. The biodiversity can then be increased by a series of splay leg reefs anchored at the top of the slope and linked by a rope joining several reefs into a long chain which gradually gets deeper.

Keywords: reef slope, stabilisation, soft coral, reef restoration techniques
Phycotoxins are byproducts of toxic microalga that capable of causing severity on humans upon consuming contaminated seafood. The threshold level for bivalve toxicity accumulation has been universally compromised by the scientist worldwide to be 80µg/STX equivalent. The amount of toxins released by microalgae however varies according to species as some of the microalgae synthesize toxins within small number of cells while others required a blooming event for the toxins to be detected. It is also possible for the toxicity of one species being gradually decreases throughout years in culture. *Alexandrium tamiyavanichii* has been reported to cause toxicity in seafood products that subject to hospitalized cases in Malaysia. Genus *Alexandrium* has been known for the stability of the saxitoxin production yet no total loss of toxicity has been recorded. Two cultures of *A. tamiyavanichii* have been tested for its toxicity using high-performance liquid chromatography (HPLC) with GTX standards as the reference. Strains isolated from Kuantan Port during recent cases of paralytic shellfish poisoning (PSP) outbreaks showed extremely high in toxin content (32 937 fmol.cell\(^{-1}\)) while the old culture of *A. tamiyavanichii* taken from Sebatu Malacca exhibited very low level of toxicity (0.4405 fmol.cell\(^{-1}\)). There are many factors influencing toxicity properties of *A. tamiyavanichii* with highlights in nutrients deprivation and adaptation as well as bacterial influences for the old culture. Further justification is needed for both strains with consistency in culture medium in order to reason out the possibility of reduction in toxicity.
CORAL REEF HEALTH INDEX OF TERENGGANU ARCHIPELAGO, MALAYSIA

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A coral reef health assessment is conducted at Terengganu Archipelago to determine the current health condition of the coral reefs. The assessments is based from the Coral Health Index (CHI) formula developed by Kaufman et al. (2011). Parameter measured are benthic cover, fish biomass and Vibrio density of each sites and the calculation is then used to develop an index value representing the health of the coral reef. The status of the coral health can be determine by referring the calculated index value to the develop index beoolow. The assessment involved 24 sites covering Perhentian Besar, Perhentian Kecil, Susu Dara, Redang, Lang Tengah and Bidong islands respectively. A 100 meter transect was laid at 3 m and 10 m depth parallel to coastline. Survey was done via SCUBA, where Coral Video Transect, CVT (Safuan et al., 2015) is used for reef benthic survey while visual survey is used for reef fish estimation. Water sample were also collected at each station. Reef benthic cover video were processed and analyzed using Coral Point Count with Excel extension (CPCe) software. Weight length relationship calculation is used for fish biomass estimation. As for Vibrio density calculation, filtered water sample is used where colonies formed on agar were counted and averaged. The Benthic Index showed that most of the station result in fair (0.40 – 0.59) condition. Redang had higher benthic index (0.377) followed by Bidong (0.33), Perhentian Besar (0.307), Susu Dara (0.259) and lastly Perhentian Kecil (0.181) *Lang Tengah which had only 1 station with benthic index of (0.415). As for Fish Index, results showed that most of the islands are ‘very degraded’ (0.00 – 0.19) except for Redang at 0.309. Alternatively, the Vibrio Index showed a perfect scored of 1.00 (very healthy) condition in all stations. Conclusively, the average Coral Health Index (CHI) showed a FAIR condition result for all sites (0.40 – 0.60) except for Pasir Mas and Batu Mogong (Perhentian Kecil) with 0.38 and 0.36 respectively.

<table>
<thead>
<tr>
<th>Very Healthy</th>
<th>Healthy</th>
<th>Fair</th>
<th>Degraded</th>
<th>Very Degraded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 - 0.80</td>
<td>0.79 – 0.60</td>
<td>0.59 – 0.40</td>
<td>0.39 – 0.20</td>
<td>0.19 – 0.00</td>
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Keywords: Terengganu archipelago, Coral Health Index, coral reef, fishes, vibrio
COMMUNITY STRUCTURE OF MEIOBENTHOS WITHIN THE PORT AREA OF JOHOR, TERENGGANU AND KELANTAN, PENINSULAR MALAYSIA

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Ballast water is necessary for the ship as it provides stability during a voyage, however, its could caused different aspect of the problem such as a threat to marine biodiversity and alteration of ecosystems. Malaysia has ratified the International Convention for The Control and Management of Ships Ballast Water and Sediments, 2004 (BWM 2004) on the 27th September 2010. To meet this commitment there are necessity for development of baseline data on marine diversity. The possibility of those sedentary benthic organisms to enter the local environment through ballast water discharged are very high. This study aims to determine and compare the spatial and temporal abundance of meiobenthos before and during the northeast monsoon. The meiobenthos was classified to the lowest major taxonomic level and relationship between meiobenthos with environmental parameters were also investigate. This study were conducted in the port area of Johor (Pasir Gudang and Tanjung Pelepas), Kelantan (Tok Bali) and Terengganu (Kemaman). Three types of component were collected, meiobenthos, sediment sample and in situ water parameters. Smith-McIntyre grab was used to collect sediment samples for meiobenthos and sediment analysis (grain size and total organic carbon). For water parameters, Hydrolab Water Quality Data Logger Readings was used to measure and record in situ water parameters. In the laboratory, sediment sample was analyzed for the meiobenthos numeration and classification, grain size distribution and amount of total organic carbon (TOC) content. Data of the meiobenthic sample was analyzed for density, abundance, univariate and multivariate analysis. Results of this study shows that every port were dominated by nematode and copepod species in term of their abundance. This study provide an additional information on biodiversity, community structure and some aspect of ecology of meiobenthos within the port area of Malaysia which can compliment the baseline database for ballast water management in Malaysia.

Keyword: Community structure, meiobenthos, port, Peninsular Malaysia
REEF CORAL SPECIES RICHNESS GRADIENT ACROSS MALAYSIA

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Biodiversity components such as species richness are commonly used for conservation prioritisations. In this study, the reef coral species richness patterns were examined across Malaysia from east to west spanning the Sulu Sea, South China Sea and Strait of Malacca: Semporna, Kudat, Kota Kinabalu, Layang-Layang in the Spratly Islands, Tiongan, Redang and Payar. Three reef coral families i.e. Fungiidae, Agariciidae and Euphylliidae, with a total of ~95 species were used as model taxa to represent all scleractinian reef corals (>500 species). There was a decrease in species richness from east to west Malaysia with longitude being a major factor in structuring species richness composition. A similarity profile analysis revealed clusters that were concordant with earlier recognised marine ecoregion delineations. Most species were widespread. Several species with a central Indo-Pacific distribution showed limited geographical range, not extending westward beyond Sabah, East Malaysia, while others were restricted to a single locality. Patterns of species richness and geographical distribution are most likely influenced by environmental heterogeneity, seasonal current circulation patterns and the geological history of the Sunda Shelf. The present results may be relevant for the conservation and management of coral reef areas in Malaysia.

Keywords: Scleractinia, Fungiidae, Agariciidae, Euphylliidae, South China Sea, Sulu Sea, Strait of Malacca, Coral Triangle, Sabah, Borneo, environmental heterogeneity
ADVANCING RED TIDE MONITORING TECHNIQUE AND COUNTERMEASURE FOR A SUSTAINABLE AQUACULTURE CONDITION

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In 2008 and 2009, fish of aquaculture died of red tide of *Chattonella marina* in southern Kyushu, its economical damage was 8.8 billion yen. We are proceeding the project of advancing red tide monitoring technique and countermeasure for a sustainable aquaculture condition. We began to monitor of red tide in Nagashima, Kagoshima Bay and Koshiki Island in 2013. Cell discrimination and counting by flow cytometry are established for rapid detection of red tide organisms. Dynamics of nutrients are analyzed through detection by autoanalyzer. An information of nutrients is important for prediction of red tide. By DNA analysis like as PCR and DGGE method, cyst of red tide organism is detected on sediment step by step. Making map of the cyst, a treatment of sediment for repress of cyst germination will be possible for prevention of red tide. Although we monitored periodically, we have big damage of new type red tide, *Dictyoca* sp. in 2014 and *Cochlodinium* sp. in 2015 in Koshiki Island where tuna aquaculture is farmed. In particular *Dictyoca* sp. is uncommon species in southern Kyushu. It is obscure why the organisms make a big bloom in clean island. For risk reduction of red tide, we applied to absorption of nutrients by red algae, *Solieria robusta*. The algae have an effective ingredient and will be important for commerce. Polyculture combined between fish and algae will be an advanced pathway for a sustainable future of aquatic environment.

*Keywords:* eutrophication, red tide, monitoring, countermeasure
Abstract ID: MEB

HARD CORAL-CORAL REEF FISH TROPHIC LEVEL AS REVEALED BY FATTY ACID COMPOSITION IN CORAL REEF HABITATS OF THE MALAYSIAN SOUTH CHINA SEA

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In order to understand trophic level of coral and reef fish, fatty acid composition was examined in two hard coral species, *Galaxea fascicularis* and *Fungia fungites* and five coral reef fishes, *Thalassoma lunare, Lutjanus lutjanus, Abudedefduf bengalensis, Scarus rivulatus* and *Scolopsis affinis* collected in the Bidong Island of Malaysian South China Sea. Profile of saturated fatty acids (SAFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA) and others individual FA indicate significant variation in proportions among corals and fishes. The results showed that, *G. fascicularis* were dominated by PUFA (57.3%) followed by SAFA (37.7%) and then MUFA (5.03%), while *F. fungites* oppose the trend with SAFA (54.3%) dominated more followed by PUFA (40.6%) and MUFA (5.06%). In fishes, the proportions of SAFA ranged from 55.0% to 66.5%, with the highest proportions in fatty acids, the second highest was MUFA ranged from 30.7% to 40.2% while the proportion of PUFA was the lowest ranged from 2.8% to 4.8%. Fatty acid concentrations, especially in SAFA and MUFA, increased with fish growth, suggesting diet shifts during the fish life history. Hard corals area animal but there are symbiotic algae namely zooxanthellae live within the host coral. The high amount of PUFA and the occurrence of FA 20:5ω5 (EPA) with the absent of FA 22:6ω3 (DHA) indicate the lower tropic level for the hard corals. In fishes, the lower amount of PUFA and most of the fish had more than 1 of EPA: DHA ratio, thus suggested that diets of fishes such as *L. lutjanus* tended to be higher trophic organisms such as zooplankton and crustacean in coral ecosystem.

Keywords: Hard coral, coral reef fish, trophic level, fatty acid, Bidong Island, South China Sea
THE MIGRATION AND CONGREGATION OF BILLFISH IN KUALA ROMPIN WATERS

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Although billfish are primarily oceanic, they migrate seasonally towards coastal waters. As noted by Nakamura (1985), the migration pattern of the billfish towards coastal waters involves seasonal movement into temperate waters for feeding purposes, after which they go back to subtropical and tropical waters for over wintering and spawning. The best fishing grounds of billfish in Malaysia are in Kuala Rompin off Pahang, Aur Island off Johor, Jarak Island off Perak, and Spratlys Island north of Sabah. Based on locals’ observations, it was believed that this fish congregate in Kuala Rompin between July and September every year. Other months like October, November and December are not mentioned by the locals because these are the months when the waters are too choppy due to monsoon season and no fishing activity is carried out during this time. During monsoon season both trawlers and purse seiners are not in operational situations. From the histology and stomach contents studies, it was found that migration and congregation of billfish in Kuala Rompin waters is for feeding purposes.
HOW LONG CAN MANGROVE PROPAGULES OF *Rhizophora mucronata* FLOAT WHILE REMAINING VIABLE? A FIELD-BASED ASSESSMENT AT SETIU WETLAND, TERENGGANU

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Besides physical factors like tides and water current, the period of propagule floating is considered as important in explaining the dispersal behavior of the viviparous mangrove species. But for a successful dispersal, propagules must also be viable when reached their suitable location after floating which is also translated as longevity. Hence, the purpose of the present study on the floatation and viability of the *Rhizophora mucronata* propagules is to determine its maximum floating period, viability and also the trend of the buoyancy variation from floating to sunken position. Propagules of *Rhizophora mucronata* were tested under laboratory conditions where the propagule floating behavior is monitored using the classification of various floating and sunken positions in the tank (salinity: ~30‰). As for viability, propagules were planted monthly throughout the experiment with sample chosen from each different floating and sunken position. Propagules are considered viable when it sprouts where its first pairs of leaves appears. Initially, propagules float at the surface vertical position and proceed to surface slanted, surface horizontal and ended at the bottom horizontal position with no sign of resurface. On average, the *Rhizophora mucronata* propagules spent 8 weeks floating at surface and 7 weeks at the bottom and eventually rot. Propagules left outside during the early stage of the experiment to simulate stranded propagules influence its viability as only freshly planted propagules during the early months sprouted. The acquired knowledge of the propagule floating period and characteristic will soon be applied in the field at Setiu wetland not only to identify their dispersal distances, but also as a reference and input parameter for hydrodynamic simulation of propagule dispersal models.

*Keywords*: propagule buoyancy, *hydrochorus dispersal*, Rhizophoraceae family
BIOMONITORING HEAVY METAL CONCENTRATION IN *Nerita* sp. FROM MANGROVE FOREST TANJUNG LUMPUR, KUANTAN, MALAYSIA

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Environmental pollution of aquatic environments with trace metals from mining, industrial activities and domestic wastes is a serious threat and pose immense health hazards to human and biota. Accumulation of heavy metals in the biota may pose hazardous impact on public health through bio-magnification process in food web. Based on above contexts, a study was conducted to determine the levels of selected heavy metals (Cd, Cu, Cr, Fe) in *Nerita* sp. collected from Tanjung Lumpur mangrove forest, Kuantan, Malaysia. Samples were collected from three (3) stations representing undisturbed habitats and disturbed sites. Samples were segregated based on the size. Heavy metal analysis was carried out using Graphite Furnace Atomic Absorption Spectrometer. Results showed that the concentration of selected metals were in the order of Cu>Fe>Cr>Cd in both smaller and larger *Nerita* sp. The concentrations of Cu ranged from 189.8 µg/ L to 247.95 µg/ L with the highest concentration observed at station 3. Fe concentration was ranged from 121.25 µg/ L to 174.55 µg/ L, followed by chromium concentration (23.49 µg/ L – 46.15 µg/ L) and cadmium (8.69 µg/ L – 18.46 µg/ L). The concentration of metals was below the maximum permissible limit set by National and International consortiums. This study can be used to identify contamination of heavy metals in marine habitat by using bio-indicators to avoid environmental perturbation. However, a continuous long term monitoring is an essential for effective bioaccumulation of toxic metals among the living organisms of the mangrove forest Kuantan, Malaysia.

**Keywords:** Heavy metal, Bio-monitoring, *Nerita* sp., Bio-indicator, Mangrove forest, Tanjung Lumpur
Coral taxonomy at genus and higher taxonomic level has been dramatically changed in the last 10 years. Originally, the coral taxonomy had been done based on the skeletal macro-morphologies such as colony shape and corallite structures. This classical morphology-based taxonomy, however, was problematic because of the morphological plasticity, and the intra- and inter-specific morphological variation, leading to the ambiguous definition at higher taxonomic level. Recently molecular phylogenetic analysis using mitochondrial and nuclear genetic markers has been applied into the coral taxonomy, together with the morphological analysis using micro-structures of the skeletons. As the results, a large number of families and genera of corals have been revised taxonomically until present. Especially, in the families Merulinidae and Lobophylliidae, the taxonomic revisions are remarkable and coral scientists should know the present taxonomic status of these two families. On the other hand, coral taxonomy at species level is still challenging although the taxonomic studies are limited to the genus Acropora and a few other genera. Recent molecular studies using Acropora revealed that one species contains several cryptic species without clear morphological differences. Thus, at present, it is quite difficult to identify “species” of corals in some cases. This is a serious problem for coral scientists who survey corals in the fields. Thus, coral scientists should know which species are taxonomically problematic or not. Therefore, I introduce the present taxonomic revisions of coral families and genera mainly in the families Merulinidae and Lobophylliidae, and also taxonomic problems of “species” of the genus Acropora.
NICHE OVERLAPS BETWEEN SPECIES OF OTTER AT THE NORTHERN TIP OF BORNEO, SABAH, MALAYSIA

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Otters are regularly reported from the mangroves, rocky shores and other coastal zones of Sabah, Brunei and Sarawak. One of these coastal populations was studied for four years ending in May 2015 around the North Tip of Borneo in Sabah. Two species of otter were identified, the Asian short-clawed (*Aonyx cinerea*) and the Smooth (*Lutra perspicillata*). Their ecology was monitored by observing spraint sites, foot prints, calls and sightings. It was challenging to differentiate the species by calls and foot prints but the spraints were quite distinctively different and a valuable identification methodology for such an elusive species. There was remarkable ecological overlap between the species with strong similarities in feeding regimens and diet. *Grapsus* crabs were the primary food source for both species, almost exclusively so, although fish and other crustacea were also occasionally identified. The requirements of holt and spraint sites were so similar that both species frequently used the same locations at different times. In these instances being able to speciate from spraint shape was very valuable. The family groups studied conform to established data for both species. A Smooth family consisted of a breeding pair and between one and three juveniles who remained with their parents for a year. The Short-clawed families had between two and six adults although apparently only a single female was reproductive. Short-clawed litters of between three and five pups were recorded.

*Keywords:* Aonyx, lutra, otter, spraint
EXTERMINATION OF HARMFUL MICROALGAE BY Ulva sp.

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Harmful algal blooms (HABs) are globally a growing concern which have significant impacts on fisheries, public health, ecosystem and economies. They have brought serious economic damages for the cultivation of aquatic product particularly in Japan. However, limited strategies have been applied to decrease the damages caused by HABs. A macroalga is important not only as a competitor of the nutrients and light for a microalge, but also showing allelopathic effect to other microalga in the ocean environment. Ulva sp. in particular is known to give damage to microalga. In this study, experiments were conducted to reveal the effect of Ulva species as a control agent for HABs. The thalli of Ulva sp. was collected from Yatsushiro Sea, Kagoshima prefecture, Japan in August, 2015. Ten gram of the thalli of Ulva sp. were shredded in 3 seconds using a blender with 300 mL of filtered sea water. The shredded thalli (0.1 wet-g) was incubated with cultured phytoplankton (10 mL of ca. 5.0 x 10⁴ cells/mL), Heterosigma akashiwo (NIES-6), Chattnella marina (NIES-559) and Karenia mikimotoi (NIES-2411), at 25 °C in 6-wll microplate with a 12: 12 light: dark cycle. The number of moving cells were counted in a counting plate (RIGO Co., Ltd.) with a microscope. All phytoplankton were cultured using Daigo’s IMK Medium (Nihon Pharmaceutical Co., Ltd). The moving cell number of K. mikimotoi, H. akashiwo, and C. marina decreased after 24, 48 and 96 hours respectively. When the amount of additional thalli of Ulva decreased, the number of dead cell of the microalga was decreased. Our study indicates that there is a possibility to utilize the Ulva as a control agent for HABs. Further study should be conducted to reveal the optimum concentration and a material indicating the algicidal activity.

Keyword: red tide, microalgae, Ulva sp.
ARTIFICIAL LIVE ROCK AS POTENTIAL BIOLOGICAL FILTER FOR MARINE AQUARIUM SYSTEM

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Natural live rock has widely exploited as biological filter for marine aquarium for decades. This activity could destruct the marine life since live rock play vital role for coral reef ecosystem. This study aimed to develop artificial live rocks (ALR) that potentially to be used as one of the alternatives as biological filter for marine aquarium. Prior to the study, the ALRs were constructed and deployed at Bidong Island for 10 months. The retrieved ALRs were used to examine the ability of ALR to act as a biological filter for a marine aquarium. The study successfully proved that the ALR was capable of reducing 12 – 51% of nutrient concentration (ammonia, nitrate, nitrite and phosphate) in the marine aquarium. Based on statistical analysis (Two-way ANOVA), there was no significant difference between ALR and natural live rock (p > 0.05) in term of nutrient reduction. PCR- assay was done in order to detect the present of target genes in the ALR. The nitrifying bacteria species identified using the amoA gene, and the BLAST result showed the samples were closely related to Nitrosomonas sp. and Nitrosospira sp.. The target gene of denitrifying bacteria species was amplified using the nirS gene and BLAST result showed it was closely related to Paracoccus denitrificans and Pseudomonas sp. The presence of these bacteria contributed in reducing the excess nutrient in the marine aquarium. This finding showed that ALR has the potential to be used as biological filter for marine aquarium which indirectly gives an alternative for natural live rock exploitation.

Keyword: Artificial live rock, nitrifying bacteria, denitrifying bacteria, biological filter, marine aquarium, amoA genes, nirS genes, biofilter
MANGROVE PROPAGULES ON THE EVALUATION OF ITS BUOYANCY AND VIABILITY: A CASE FOR Ceriops AND Bruguiera spp.

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Mangroves possessing a unique reproductive mechanism called “viviparous” germination deliver their propagules seasonally. Though it is known that these propagules are dispersed by tidal water and reach to different locations for establishment/growth, there is still uncertainty over the maximum buoyancy and best viability periods that vary from species to species. In present study, the propagules of *Ceriops tagal* (Perr) CB. Rob. and *Bruguiera gymnorrhiza* (L.) Lam. were released into seawater (PVC tanks) (salinity: ~30‰) and monitored long-term under the laboratory conditions (October 2014 - February 2015). While the propagule buoyancy patterns i.e., surface horizontal or vertical or slanted, sunken to bottom, etc., were recorded for every week, select propagules (max. 5 nos.) from each orientation were picked and planted in soil bags once a month. The results have helped us to understand not only the maximum period of floatation, but also the right time for propagules to reach destination and become viable.

**Keywords:** Rhizophoraceae family, viviparous germination, controlled experiment, plantation
Biotechnology and Marine Natural Products
Caulerpin, a unique alkaloid with two indole structures, was isolated from green Malaysian seaweed, *Caulerpa racemosa*, was collected from Port Dickson, Malaysia. Caulerpin was isolated using chromatographic techniques and its structure was elucidated using spectroscopic techniques UV-Vis, IR, NMR and HR-MS. The *C. racemosa* extracts and caulerpin showed no inhibition against *Staphylococcus cereus*, *Bacillus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*, and low activity was observed in inhibition of cell proliferation against MCF-7 and H-1299 cell lines. However, significant value of percentage with 35.5% of cell viability for A-549 was expressed by caulerpin. The compound slightly reduced nitric oxide concentration on RAW 264.7 from 32.17 to 29.08 μM.

*Keywords: Caulerpa racemosa, caulerpin, antimicrobial activity, cytotoxic activity, anti-inflammatory activity*
COMPARISON OF FATTY ACID COMPOSITION OF TWO NUDIBRANCHS SPECIES AT SELECTED AREAS OF COASTAL WATER OF BALOK, PAHANG AND BIDONG ISLAND, TERENGGANU, MALAYSIA

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The fatty acids composition of two nudibranch molluscs Phyllidia varicosa and Phyllidiella pustulosa were studied. The phyllidiid nudibranchs species were collected from coastal water of Balok - Pahang "3°56.233' N 103°22.627° E" and Bidong Island - Terengganu "5.6167°N, 103.0667°E", Malaysia. Fatty acid content of selected species was analyzed by gas chromatography-mass spectrometry (GC-MS) and found that C15:0, C16:0, C17:0, C18: 0, C18:1 (n-9), C20:1 (n-9) and C20:4 (n-6) were predominant. Significant levels of the bacterial fatty acids were also detected in the nudibranch. Total saturated fatty acids (SFA) levels in P. varicosa and P. pustulosa from coastal water of Balok were higher than SFA acids from Bidong Island with 20.05 and 21.12 % respectively in Balok while in Bidong 19.3 in P. varicosa and 19.34% in P. pustulosa. The percentage of C20:4 (n-6) and C18:1 (n-9) acids were higher in nudibranch from coastal water of Balok. Besides that, total levels of odd-branched chain fatty acids (OBFA) in Balok samples were noted to be higher than ΣOBFA and total polyunsaturated fatty acids (PUFA) in Bidong Island samples. However, ΣPUFA Bidong Island was found to be higher than ΣPUFA in Balok with 25.51% in P. varicosa and 25.09% in P. pustulosa respectively. The overall fatty acid composition was significantly different and the fatty acid composition between the same species but different sites was also significantly different p< 0.00150 in p. varicosa species and p< 0.0065 in p. pustulosa.

Keywords: Nudibranchia, Phyllidia varicosa, Phyllidiella pustulosa, Fatty acids, Balok, Bidong Island
BIOLOGICAL SCREENING OF SELECTED MEDICINAL PLANTS FROM UPM’S AGRICULTURE PARK USING BRINE SHRIMP (Artemia salina) TOXICITY BIOASSAY

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The brine shrimp (Artemia salina) bioassay was used to investigate the general cytotoxicity activity of methanolic and aqueous extracts of four selected medicinal plants. These medical plants consisting of Syzygium polyanthus, Premna cordifolia, Polygonum chinense and Pimenta dioica were collected from Universiti Putra Malaysia’s Agriculture Park in Serdang, Selangor. The brine shrimp were exposed at four concentrations; 10, 100, 500 and 1000 µg/mL for each plant extract. The strongest toxicity was found in the methanolic extracts of \textit{P. dioica} with an LC\textsubscript{50} of 109.04 µg/mL. The methanolic extract of \textit{P. cordifolia} showed the highest LC\textsubscript{50} (lowest toxicity) of 743.57 µg/mL, followed by methanolic extract of \textit{P. chinense} at 712.60 µg/mL. Other extracts have showed moderate toxicity (LC\textsubscript{50} < 500 µg/mL). There was a significant correlation (p<0.05) between the extracts and the mortality of brine shrimp. Therefore, these results supported that toxicity bioassay is a convenient and useful method for predicting oral acute toxicity of plant extracts.

\textit{Keywords}: medicinal plants, toxicity, brine shrimp
COMPARISON BETWEEN DISTILLED WATER FRESH AND DRIED PLANT EXTRACTS OF Sanseviera trifasciata TO INHIBIT THE GROWTH OF Alexandrium tamiyavanichii, A TOXIC DINOFLAGELLATE SPECIES

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Dinoflagellate is the second largest group of phytoplankton in the marine environment and many of the species have been recognized as toxic species. The high abundance of this species caused a lot of problems to human health, marine organisms especially caged fish and the environment. In Malaysia, several species of Alexandrium have been reported to cause human intoxication after consumption of contaminated shellfish. During the event, shellfish was banned and lead to economic lost especially to the local fishermen. Therefore, this study was conducted to find alternative way to mitigate the blooms. Ornamental plant, Sanseviera trifasciata or known as mother-in-law tongue was used. The extraction of this plant was extracted in distilled water using dried and fresh plants. Different concentrations of crude extracts were tested on Alexandrium tamiyavanichii within 24 hours. The removal efficiencies (RE) were determined for each concentration tested. The extracts were also tested on brine shrimp to see the possible harmful effect. Results indicated that both extraction methods yielded positive results on Alexandrium tamiyavanichii whereby the crude extracts managed to mitigate the species. The LC50 of brine shrimp was found at high concentration i.e. 30 mg/ml of crude extracts for both extraction methods. This indicates the possibility of the extractions to be used to mitigate harmful algal bloom (HAB) particularly Alexandrium and provide an alternative way to the relevant agencies to minimize the impact of HAB.
THE GROWTH OF ANTIBIOTIC-PRODUCING STREPTOMYCETES AND THE EFFECT ON UNDECYLPRODIGIOSIN (RED) AND ACTINORHODIN (ACT) PRODUCTIONS UNDER CONDITION OF NITROGEN LIMITATION

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Actinomycetes are gram-positive, filamentous, subgroup of bacteria mostly known for antibiotic production. For the past few decades, novel bacteria with antimicrobial activities have been discovered and there are still more yet to be explored. Actinomycetes are well recognized for their metabolic flexibility, commonly accompanied by the production of primary and secondary metabolites of economic significance. Streptomycetes, a genus of actinomycetes, produce a wide variety of secondary metabolites that have important applications as antibiotics or other useful compounds in human medicine. Undecylprodigiosin (Red) and actinorhodin (Act) are some of the antibiotics produced by streptomycetes under condition of nitrogen limitation. Streptomycetes were assayed with nitrogen limited SMMS and modified Evan’s medium with nitrogen limited medium. Several studies revealed that both antibiotic productions have a positive correlation with the presence of ppGpp gene. It is also suggested that highly phosphorylated guanine nucleotide ppGpp have been implicated in growth rate control of gene expression and in the regulation of stationary phase gene expression. The depletion of ppGpp gene, which showed continued rRNA synthesis upon amino acid depletion (the relaxed response), failed to produce undecylprodigiosin (Red) and actinorhodin (Act) under conditions of nitrogen limitation. Keywords: Actinorhodin, Actinomycetes, Streptomycetes and Undecylprodigiosin.
THE POTENTIAL OF MANGROVE AS BIO-ADSORBENT FOR BAUXITE WASTEWATER TREATMENT

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Increasing bauxite mining in Kuantan has resulted in water quality degradation and fishkill due to highly exposure on metal ions from the wastewater. This study explored the potential of adsorption by composite bead which contains raw waste from charcoal factory, *Rhizophora apiculata* bark and alginate as an alternative to treat wastewater that is economically feasible and easy to handle. Based on FTIR, XRD and SEM analysis, carboxyl group is the main functional group for adsorption while the optimum batch parameters is more than 80% included 7 g/L of adsorbent concentration, 150 mins contact time, 5 as initial pH, 65% for adsorption temperature and 250 rpm agitation speed. The highest adsorption capacity of beads was 10.65 mg g⁻¹ under optimum conditions. The mechanism of metal ions on beads was chelation and Freundlich isotherm is found best-fitted on equilibrium data. The process is spontaneous, exothermic and possessed pseudo-second order. There is significant different on the present of *Rhizophora apiculata* bark in composite beads on the adsorption efficiency.
Aquaculture and Fisheries
A SIMPLE AND EFFECTIVE METHOD TO CULTURE CILIATED PROTOZOA AS A STARTER DIET FOR MARINE FINFISH LARVAE

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Infusoria play an important role in microbial food chains. Infusoria are the microscopic single celled animalcules belonging to Class, Ciliata and Phylum, Protozoa. They are smaller in size than SS rotifers, soft bodied and highly nutritious, making them an ideal starter diet for early stage fish larvae. In tropical regions, grouper and snapper species are cultured in fish farms. Infusoria will be suitable live feed for these fish larvae, however there are a limited number of studies about infusoria culture method. This study was conducted to determine optimum salinity to culture infusoria. In this study, infusoria were cultured following Kitani’s (1989) method. Fish meal was made by small dried anchovies (TL 40–60 mm) by a general food processor. Vegetables (Chinese cabbage) were cut into small pieces (1–2 cm). Fish meal (0.025%/water volume) and vegetables (0.5%/water volume) were put into 0, 10, 15, 20, 25 and 30 ppt fresh and saline water in 3 liter aquaria. Many types of infusoria were observed in fresh water group. Less number species of infusoria were observed in saline water groups. The density of infusoria in saline water showed no significant difference among different salinities. In the saline water groups, Euplotes sp. with the size of 60-80 µm was observed, and this species would be good candidate as live feed for marine finfish larvae.

Keywords: Infusoria, Protozoa, Ciliata, live feed, starter diet
SUSTAINABLE EXPLOITATION OF MARINE FISHES WITH AN EMPHASIS ON OVEREXPLOITED FISH STOCKS

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Although total marine capture production in Malaysia is still increasing by 10% since 2000, the production of some fishes such as yellowstripe scad and other carangids are decreasing very rapidly. An intensive research is needed for an urgent basis to find out the actual reason of reducing production of these species. However, the possible reason of dramatic reduction in catch might be due to over exploitation. Once any fish stock is overexploited, it produces lower yields than their biological and ecological potential. Therefore, proper management is urgently needed for sustainable production to ensure long-term sustainability of these fishes. To recover overexploited stock many suggestions has been proposed in the literature. After synthesizing literatures, two main approaches can be proposed for sustainable fisheries production: (i) establishing protected areas, or (ii) limiting capacity and number of fishing vessels, and the allocation of access rights. Continuous data collection and their analysis are prerequisite for the successful of both approaches. Collaboration between scientists, policymaker and fishers is extremely valuable in managing fisheries for sustainable production. Apart from these, managing competing uses such as fishing industry, aquaculture, energy companies, shipping companies, government interests and conservation groups, and reducing by-catch should also be considered for sustainable fisheries production.

Keywords: yellowstripe scad, carangids, marine fisheries, overexploitation
ISOLATION AND CHARACTERIZATION OF VITELLOGENIN IN IMPORTANT AQUACULTURE SPECIES IN MALAYSIA.

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Vitellogenin (Vtg) is an egg yolk precursor protein found in most oviparous vertebrates. It is a large glyco phospholipoprotein that is synthesized in the liver, released into the bloodstream and travel to the oocytes for incorporation. In addition, Vtg was reported to have various molecular weights ranging from 300 to 640 kDa in different fish species belonging to different families and differing in their biochemical properties. The problems associated with artificial propagation in fish brood stock are lack of spontaneous spawning in captivity, simultaneous maturation of both male and female, egg and sperm quality and survival of larvae. In order to evaluate the reproductive condition in fish, the Vtg protein should be isolated and characterized. The molecular weights of denatured purified Vtg were expressed by two major bands (170 kDa and 120 kDa in Hemibagrus nemurus, 232.86 and 118.80 KDa in Lates calcarifer and 133 kDa in Tor tambroides). Recently, we have developed a Vtg assay on three important aquaculture species in the country based on conserve region of Vtg. Measurement of Vtg levels is important to overcome these problems and can be used as a tool for successful brood stock management, direct indicator of female maturity stage, to differentiate males and immature females of wild and captive river species, and also to identify environmental pollution due to xenobiotics. The ELISA assay would provide a more relevant information on reproductive biology of a particular species. Thus, it is a great tool for spawning prediction with rapid innovations in Vtg-assay technologies and is able to detect maturing fish easily, quickly, with high accuracy and efficiency.
This study was carried out to investigate the effects of marine microalgae, *Chlorella vulgaris*, as a diet in spat production of an edible oyster, *Crassostrea iredalei*. The oysters were collected from the aquaculture area in Setiu Wetland, Terengganu. *C. iredalei* was induced to spawn in the hatchery by thermal stimulation, and the larvae were reared to spat. Feeding experiment was started once the larvae attained the trochophore stage at 20 hours after fertilization (h.a.f). Two feeding treatments were tested on the *C. iredalei* larvae which were fed with *C. vulgaris* and with unfiltered seawater. The larval length, density and growth were measured daily and its morphological changes were observed for 30 days. A total of 6 identified stages of larval development were observed. There were trochophore stage (20 h.a.f), early umbo (5th day), late umbo (10th day), late pedi-veliger (15th day), crawling veliger (21st day) and metamorphosis to spat (27th day). The survival rate of larvae up to spat stage at day-30 was 40% with *C. vulgaris* feeding while there was only 20% larval survived when supplied unfiltered seawater. The finding obtained were analysed using SPSS (version 16.0). There was a significant difference at (p<0.05) between dependent variables; larval length, larval density and growth rate with the fixed factors; treatments and stages. Pure microalgae *C. vulgaris* feeding gave higher spat production with 40% survival individuals compared to the supplied unfiltered seawater, indicating the important role of maintaining such diet supply in bivalve hatchery.
MORPHOLOGICAL AND 18S rRNA SEQUENCING OF *Euplotes* sp.: A POTENTIAL LIVE FEED FOR MARINE FINFISH LARVAE

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*Euplotes* is a ciliated protozoan that is highly diverse in size and species and has potential to be used as live feed for marine feed larvae. This study was conducted to identify the suitable *Euplotes* candidate through molecular and morphological methods. *Euplotes* sp. was characterized by its morphological and 18S rRNA gene sequence. The selected *Euplotes* sp. was identified morphologically based on its unique present of infraciliature, dorsal-ventrally flattened, dorsally ridged and oval in shaped. For molecular identification, samples of *Euplotes* sp. were collected and starved overnight before pelleted through centrifugation to provide closely packed *Euplotes* species. The extraction and amplification of genomic DNA of *Euplotes* sp. were done using REDExtract-N-Amp™ Tissue PCR Kit (Sigma). The phylogenetic analyses of the SSU RNA gene was analyzed with evolutionary distance calculated using Kimura-two-parameter and further analyzed by using Maximum Likelihood (ML) and Neighbor-joining (NJ) with *Coris julis* (accession number HM049942.1) as an out group. The result showed *Euplotes* sp. is 96% related to *Euplotes encysticus* (accession number LN864512.1) and *Euplotes novemcarinatus* (accession number HM140407.1).

Key words: 18S rRNA sequencing, live feed, *Euplotes* sp.
THE EFFECTS OF LIGHT WAVELENGTHS AND LIGHT INTENSITIES ON THE AGGRESSIVE BEHAVIOUR OF AFRICAN CATFISH *Clarias gariepinus* JUVENILES

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The survival and growth rates of African catfish *Clarias gariepinus* were reported to be affected by light conditions. One of the methods to understand the effects of light conditions on fish survival and growth rates is through analysing the aggressive behavior of the fish. The objective of the present study was to analyse the aggressive behaviours of African catfish juveniles under different light wavelengths and light intensities. For this purpose, the behaviour of African catfish juveniles (age: 34 days old) was observed under five light wavelengths (white, blue, green, yellow and red) and three light intensities (0.0014, 0.014, and 1.40 \(\mu\)moles/m\(^2\)/s). The results showed that the aggressive behaviour of the juveniles were significantly affected by light wavelengths and light intensities. Among five light wavelengths, the juveniles showed less aggressive behaviour under yellow light wavelength. Furthermore, the juveniles also showed less aggressive behaviour under 0.0014 \(\mu\)moles/m\(^2\)/s. Therefore, rearing of African catfish juveniles under yellow light wavelength with light intensity of 0.0014 \(\mu\)moles/m\(^2\)/s can be recommended.

*Keywords: African catfish, fish behaviour, light wavelengths, light intensities*
CORTISOL (STRESS) LEVEL OF SUTCHI CATFISH (*Pangasianodon hypophthalmus*) JUVENILE UNDER DIFFERENT LIGHT WAVELENGTHS AND INTENSITIES

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Light wavelengths and intensities affect the cortisol (stress hormone) levels in fish. Thus, this study aims to determine the optimum light wavelength and intensity to reduce stress of juvenile sutchi catfish, *Pangasianodon hypophthalmus*. The sutchi catfish juveniles (35 days post hatching) were reared for 28 days (20 individuals/30 L) under five light wavelengths (white, blue, green, yellow, and red) with three light intensities (1.40 × 10⁻³, 1.40 × 10⁻², and 1.40 × 10⁰ µmoles/m²/s) in triplicates. The sutchi catfish juveniles were anesthetized at the end of rearing experiment. Cortisol hormones were extracted by homogenization and the cortisol levels of sutchi catfish juveniles were determined using ELISA kit. The results from the present study showed that light wavelengths had significant difference on the cortisol levels of sutchi catfish. Light wavelengths of green, yellow and red had significantly higher cortisol levels than light wavelengths of blue and white. For light intensities, sutchi catfish juveniles showed tendency for high cortisol level in 1.4 x 10⁰ µmoles/m²/s compared to 1.4 x 10⁻² µmoles/m²/s and 1.4 x 10⁻³ µmoles/m²/s. This result will be useful knowledge for rearing of sutchi catfish juveniles in hatchery thus improves their production rate.

Keywords: Cortisol, stress, *Pangasianodon hypophthalmus*, light wavelengths, light intensity
Abstract ID: AFI008

A SPECTROPHOTOMETRIC STUDY ON THE VISUAL PIGMENTS FROM RETINAL PHOTORECEPTORS OF JUVENILE SUTCHI CATFISH

_Pangasianodon hypophthalmus_

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Visual pigments are photopigments in the retinal photoreceptors that absorb light and mediate vision. The absorbance spectra of visual pigments that fish has are closely related to the environmental light in its natural habitats. In order to understand the visual spectral sensitivity of juvenile sutchi catfish (_Pangasianodon hypophthalmus_), the absorbance spectra of visual pigments were measured in this study. Sutchi catfish juveniles were dark-adapted overnight and then anaesthetized. In the dark room, both eyes of the juveniles were enucleated and retinae were isolated under a dissecting microscope with the aid of a night vision goggles. The retinae were cut into small pieces (~ 9 mm²) in a petri dish filled with buffered saline. Each retina sample was placed on a coverslip with a drop of saline. Second smaller coverslip was then placed on the sample and sealed with Vaseline to prevent dryness. Absorbance measurement was conducted by means of spectrophotometrically using a portable spectrophotometer. The sample and baseline absorbance spectra were analysed using a custom-made software to obtain spectral absorbance curves of the measured visual pigments. The spectral absorbance curves obtained from measurements indicated parabolic shape. Higher absorbance was observed at the wavelength ranged from 530 nm to 580 nm. It is clearly suggested that the visual spectral sensitivity of juvenile sutchi catfish is adapted to longer wavelength of light which dominates in turbid water. The results will be useful in determining optimum light conditions to improve seed production of sutchi catfish as well as conserving its natural population.

Keywords: Sutchi catfish, _Pangasianodon hypophthalmus_, visual pigment, spectral sensitivity, spectrophotometry
FEEDING RESPONSE OF JUVENILE MARBLE GOBY *Oxyeleotris marmoratus* TO FREE AMINO ACIDS

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Marble goby *Oxyeleotris marmoratus* is a popular aquaculture species in the Southeast Asian region. In captivity, this fish generally rejected pelleted feed and mass mortality occurred during the pellet-weaning process as a result of starvation. Supplementation of dietary feeding stimulant can be practiced to solve this problem but there is still not suitable feeding stimulant for this species as the taste preference in fish is mostly species-specific. Amino acid is the most common taste-elicited substance. Therefore, the present study was conducted to evaluate the feeding response of *O. marmoratus* to 19 free amino acids. Agar gel pellet was used as the medium to deliver each amino acid (0.1 M) to the fish, and each of them was tested on 50 fish (replicates). Subsequently, the fish acceptance on these agar gel pellets was evaluated by calculating the acceptance index (total pellet ingested/total pellet given; maximum and minimum index’s values are 1 and 0, respectively). Binomial test was conducted to detect the significant difference among the acceptance for the amino acids at 0.05. Among all the amino acids tested, only L-aspartic was highly accepted by the fish and the acceptance index (0.94) was significantly higher than those of the others (alanine, arginine, histidine, glutamine, serine, glycine, lysine, asparagine, cysteine, proline, valine, tyrosine, threonine, methionine, leucine, phenylalanine, isoleucine, glutamic acid; all L-isomer; index’s values ranged from 0.02 – 0.36). Such results showed that the *O. marmoratus* preference for amino acids was narrow and specific with L-aspartic acid identified as the potential feeding stimulant.
GENETIC DIVERSITY OF THE ORANGE-SPOTTED GROUPER (Epinephelus coioides) IN TERENGGANU MALAYSIA BASED ON MITOCHONDRIAL CYTOCHROME B SEQUENCE DATA

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Orange-spotted grouper (Epinephelus coioides) is known to be one of the economically high values marine. However, its spawning condition is still not well understood by the aqua culturist in Terengganu, Malaysia. Fish farmers depend on natural supply by collecting eggs of orange-spotted grouper from the wild. A study was conducted to determine the genetic diversity of farmed orange-spotted grouper population using partial Cytochrome b (Cyt-b) gene. A total of 20 farmed orange-spotted grouper were collected from a fish farm in Besut, Terengganu. A piece of dorsal fin area- (1 cm²) was individually clipped from the orange-spotted grouper and immediately preserved in 95% ethanol at ambient temperature upon sampling and kept on -80 ºC until DNA extraction was performed. DNA extraction was carried out using Qiagen Blood and Tissue kit. PCR amplification of partial Cyt-b was conducted using a universal Cyt-b primer and amplicons of 491 bp was obtained. The amplicons were then purified, sequenced and the genetic relationship among individuals was analyzed using MEGA6 software for their pairwise distance and phylogenetic tree. Phylogenetic analysis showed orange-spotted grouper is divided into two major groups. Genetic distance among individuals ranged between 0.000 – 0.014. These findings indicate that orange-spotted grouper has low genetic diversity and most of the individuals might be originating from a small population.

Keywords: Epinephelus coioides, orange-spotted grouper, partial Cyt-b, genetic variation, phylogenetic analysis
FISHERY ASPECT OF HORSESHOE CRAB, *Tachypleus gigas* IN THE PENINSULAR MALAYSIA: EXPLOITATION STATUS

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Horseshoe crab is a unique Arthropoda which is also known as a living fossil because of the ancient morphological appearance. The animal established its existence for more than 300 million years ago and maintained its features to present day. The greatest proportion of adult horseshoe crab mortality is probably due to human activity. Horseshoe crabs in Malaysia are known to be mainly as food for local consumption or marketed to the neighbour country. Series of survey were carried out to understand the harvesting status and collection purpose of horseshoe crab in selected coast, Pahang and Melaka coastal area. Interviews were carried out with the locals involved in the harvesting activities. Data collected from around 100 respondents were analysed to compare the harvesting activity in both coastal area. The collectors were mostly fisherman which used both techniques; collecting on shoreline and net fishing to catch horseshoe crab. More people significantly (p<0.05) used traditional collection method (collecting in shoreline) in Pahang (56.1%) if compared to those in Melaka (34.15%). Only 43.9% collectors in Pahang adopted the fishing net technique while 65.85% collectors in Melaka preferred the same method to collect adult horseshoe crabs coming to the shore during spawning season. The frequency of net fishing usage to on shoreline collection by individual per month was significantly high (p<0.05) in Melaka if compared to Pahang. This resulted to the higher horseshoe crab catch found in Melaka (400 individuals per month) than Pahang (102 individuals per month). The initial results from this survey indicate an alarming condition faced by the horseshoe crab coming to the beach for nesting. Monitoring program should be planned for a sustainable fishery activity on horseshoe crab in Malaysia water.
DYNAMICS OF DISSOLVED INORGANIC NITROGEN IN A TROPICAL TIDAL RIVER

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Dissolved inorganic nitrogen plays a critical role in controlling primary production in the river ecosystem. A 12-month study (September 2014-August 2015) was conducted to know the spatio-temporal dynamics of inorganic nitrogen in the Kuantan river which is influenced by daily tidal activity. Various forms of inorganic nitrogen (NO₂⁻, NO₃⁻ and NH₃⁻) were measured at two sampling sites: 5 (near Kuantan city) and 10 (upstream, freshwater zone) km upstream from the Kuantan river estuary. Each zone had a total of three sampling stations which were considered as replication. Besides inorganic nitrogen, physical parameters such as water temperature, dissolved oxygen (DO), pH, conductivity, salinity were measured. All parameters were measured in the three layers (surface, middle and bottom) of the water column in each sampling station. Results indicated that mean inorganic nitrogen concentration near the Kuantan city (2.25±0.09 mg L⁻¹) was significantly higher than the mean inorganic nitrogen concentration in the upstream zone (1.46±0.11 mg L⁻¹). This might be due to organic discharge into the river from the Kuantan city compare to upstream zone. Similar pattern of inorganic nitrogen concentration was also observed in the case salinity, conductivity and DO concentrations. Overall inorganic nitrogen content was higher near the bottom water (2.15±0.16) compare to surface (1.65±0.10) and middle (1.75±0.12) layers of water. Both temperature and dissolved oxygen concentration were higher in the surface water compare to middle and bottom layers of water. The mean highest and lowest inorganic nitrogen concentrations were observed in January (0.70±0.15) and May (3.46±0.25), respectively. The overall mean inorganic nitrogen concentrations were lower in the monsoon months compare to non-monsoon months.

Keywords: estuary, tropical river, Kuantan, Malaysia, dissolved oxygen, conductivity
UTILIZATION OF TUNA WASTE PRODUCT FOR THE PRODUCTION OF TRADITIONAL FERMENTED PRODUCT “BAKASANG”

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Indonesia is surrounded with waters that provide a high production of marine fish. Traditional preservation and processing methods, such as salting, boiling, smoking and fermentation, are responsible for 54.67% of the total preserved and processed fish products. Bakasang is one of the traditional fermented fish product that is produced in the area of North Sulawesi province and the Moluccas Island. Physically, bakasang is a dark brown liquid product with a strong fishy flavor. It is usually used as a flavoring agent for many dishes or mixed with red chilies, tomato, red onion, and garlic, which are then sautéed with coconut oil and eaten with hot porridge mixtures of rice and vegetables called tinutuan. The main raw materials for bakasang processing are the internal organs (viscera and roe) of tuna and tuna-like fish obtained as a waste product from the processing of smoked tuna. This article will elaborate on the general processing methods of bakasang and some data related with their chemical composition and microbial characteristics.
POPULATION DYNAMICS OF *Gerres oyena* (FORSSKÄL, 1775) IN THE ESTUARY OF MARUDU BAY, SABAH, MALAYSIA

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An investigation of the population parameters of Gerreid fish, *Gerres oyena* (Forsskål, 1775) in the Marudu Bay, Sabah, Malaysia was carried out from November 2012 to September 2013. The relationship between total length and body weight was estimated as \(W = 0.048TL^{2.493}\) or \(\log W = 2.493 \log TL - 1.315\) (\(R^2 = 0.765\)). Monthly length frequency data of *G. oyena* were analyzed by FiSAT software to evaluate the mortality rates and its exploitation level. Asymptotic length (\(L_\mu\)) and growth co-efficient (\(K\)) were estimated at 13.65 cm and 1.10 yr\(^{-1}\), respectively. The growth performance index (\(\varphi'\)) was calculated as 1.85. Total mortality (\(Z\)), natural mortality (\(M\)) and fishing mortality (\(F\)) was calculated at 4.03 yr\(^{-1}\), 2.45 yr\(^{-1}\) and 1.58 yr\(^{-1}\), respectively. Exploitation level (\(E\)) of *G. oyena* was found to be 0.39. The exploitation level was below the optimum level of exploitation (\(E = 0.50\)). It is revealed that the stock of *G. oyena* was found to be still under exploited in Marudu Bay.
Aquaculture is the farming of fish especially freshwater fish is one of the fastest growing sectors of the global food production industry. However, high mortality due to bacterial and virus infection is the main problem that needs to be solved. Pangasius spp. is the most widely cultured freshwater fish in Pahang especially in Pekan and Temerloh, Pahang. The Fishery Department in Malaysia is encouraging the expansion of freshwater industry to alleviate income among the agriculturist and fishermen. Unfortunately, effect of the disease in Pangasius aquaculture had caused loses approximately RM 2.4 millions per year and this scenario may not reflect the rapid pace in Malaysia Fisheries Sector. Therefore, this research is conducted to determine the risk factors associated with the prevalence of bacterial and virus infections in Pangasius spp. in Temerloh, Pahang, Malaysia. The observation was carried out for four months which in February 2016 until May 2016 at two separate farms in Temerloh. Bacterial identification is conducted using biochemical test, 20 NE and 20 E system followed by confirmation of the bacteria by using Polymerase Chain Reaction (PCR). Meanwhile, molecular approaches using conventional PCR is used for virus identification. Physical and chemical water quality parameters observed are water temperature, pH and dissolved oxygen (DO), nitrite, sulfide, iron and ammonia. The results showed that fish sampled were highly infected by bacterial disease caused by Aeromonas hydrophila which constitute 52% from all bacteria found. The temperature of water is increasing from February to May which is from 28 °C to 32 °C meanwhile pH and DO value are constant. There is no virus detected throughout these four months observation. Temperature significantly affects the bacterial infection in Pangasius hypophthalmus farming in Temerloh, Pahang. In conclusion, most common disease in Pangasius hypophthalmus farming in Temerloh, Pahang is Motile Aeromonas Septicemia (MAS).

Keywords: Motile Aeromonas Septicemia (MAS), Pangasius hypophthalmus, Fish Diseases
AMOEBOCYTE PROFILING OF CAPTIVE AND WILD MALAYSIAN HORSE-SHOE CRAB (*Tachypleus gigas*)

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Amoebocyte cells degranulates to form gel clot when they come in contact with endotoxins or Lipopolysaccharide (LPS) that are present in cell walls of gram negative bacteria. This phenomenon is the basis of both horseshoe crab immune and detection of endotoxin in biologicals. This study aimed to investigate the quality of amoebocyte cells in captive and wild *Tachypleus gigas*. Captive breeding is presumed to have detrimental effect on horseshoe crab's health generally and in particular on amoebocyte quality. Wild and captive horseshoe crabs (5 month captivity) were bled. A total of 6 anticoagulant formulations (A, B, C, D, E and F) were used to obtain the amoebocyte cells. All experiment were carried out in triplicate using a total of 6 crabs (3 wild, 3 captive) to determine cell viability and density. Results showed that there was no significant difference in cell density between captive group and wild group with the mean value of $11 \times 10^6$ cells/ml and $11.67 \times 10^6$ cells/ml, respectively. On the other hand, cell viability of captive crabs was significantly lower than wild crabs ($P<0.001$). Cell viability of captive crabs in formula A, B, C, D, E, F were 40%, 52%, 58%, 11%, 18%, 39%, respectively. Whilst, cell viability of wild crabs was 80%, 84%, 86%, 36%, 45%, 54%, respectively. The anticoagulant formulations had also varying capabilities in maintaining cell viability with formula C and B being significantly better than the rest ($P<0.001$), however, there was no significant difference between Formula B and C. This was regarded to the various components in the anticoagulant formulations such as the buffering agent and chelating agent used. Formula B and C contained various types and high amounts of chelators and buffers. We conclude that the captivity was found to have negative effect on the amoebocyte viability. The anticoagulant formulations had also significantly affected the amoebocyte cell viability.

**Keywords:** *Tachypleus gigas*; anticoagulant; living fossil; amebocyte cells; captive breeding
Streptococcosis is a wide-spread disease infecting cultured red tilapia (*Oreochromis sp.*) in Malaysia and globally. Infection triggered by *S. agalactiae* in tilapia caused high mortality rate. Treatment using antibiotics has been practiced by both farmers, locally and internationally. However, antibiotics usage even though might be effective could lead to negative environmental impact unfavourable to the aquaculture industry. Molecular characterization of local *S. agalactiae* isolates confirm the true causal pathogen strain infecting tilapia culture, needed for development of recombinant vaccine. A number of 104 local isolates were obtained for this study, isolated from different water-body in Kedah and Terengganu, Malaysia. All of the isolates were identified using API 20STREP Kit (Biomerieux, France) and further re-confirmed through 16S rRNA PCR method. Biochemical studies were done to determine the serotype and the Lancefield Group. The Group B Streptococcus (GBS) can be sub-divided into ten serotypes (Ia, Ib and II to IX) (Imperi *et. al.*, 2010) based on the polysaccharide composition. From the test using Strep-B-Latex kits (Statens Serum Institute, SSI, Sweden), the results indicated that all local isolates belong to Group B Type III respectively. Group B Streptococcus (GBS) type III is found worldwide as it is associated with invasive disease in non-pregnant adult in France. GBS with molecular serotype III-4 is found in non-pregnant adult in Hong Kong with the same serotype affecting the fish in the Southeast Asian region. This serotype has been reported to be the major factor causing high mortality rate of Tilapia (*Oreochromis sp.*) farming. Thus a better understanding of the specificity of the strains serotype will results in the development of improved vaccine against the local *S. agalactiae* strains infecting tilapia.

*Key words:* Streptococcosis, serotypes, Red Tilapia (*Oreochromis sp.*)
DIFFERENT GROWTH RATES OF *Kappaphycus alvarezii* AND *Eucheuma denticulatum* CULTIVATED IN FLOATING CAGE

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Eucheumatoid cultivation continues to expand with a variety of methods that can increase production. This research was conducted during March–November 2015 in the area of Eucheumatoid cultivation in Southeast Sulawesi Province, Indonesia. Results showed that the growth rates of *Eucheuma denticulatum* in floating cage were faster and appeared to have better thallus morphology than *Kappaphycus alvarezii*. Total weight of *E. denticulatum* and *K. alvarezii* cultivated by floating cage for 50 days, from 5 kg in first weight were 31 kg and 25.6 kg, respectively. Thallus growth of *E. denticulatum* and *K. alvarezii* seem most different in September and October. The growth of *E. denticulatum* and *K. alvarezii* from 50 g in first day, after 45 days in September and October were 253 g and 168.5 g, respectively. Specific Growth Rate (SGR) of *E. denticulatum* cultivated in Floating cage seems high during all month range 3.1 – 3.6 % day\(^{-1}\) in average. It was different with *K. alvarezii* that reach 3.1 only in July and August.

*Keywords:* Floating cage; seaweeds; cultivation, propagules
DETERMINATION OF OPTIMAL DOSAGE OF FREUND’S INCOMPLETE ADJUVANT (FIA) AND PALM OIL ADJUVANT IN FISH VACCINE

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Adjuvant plays an important role in the effectiveness of vaccines. It causes slow release of the vaccine thus inducing long term protection in animals and man. The optimal dosage added to the vaccine is therefore needed to be determined in the newly developed feed-based Streptococcal vaccine against Streptococcosis in tilapia. In this study, two different adjuvants were used, Freund's Incomplete Adjuvant (FIA) and Palm Oil Adjuvant (POA) to determine the optimal dose. The dosage studied ranged from 0%, 3%, 5%, 7% & 10% incorporated in the vaccine to determine its efficacy in protecting Tilapia from streptococcosis. Each group of experiment consist of 600 red tilapias of almost 100g. Each replicate was vaccinated with double booster(3X) using the Adjuvanted Vaccine Incorporated Feed Pellets (AVIF) on the first, second and six weeks consecutively, while the rest only ordinary feed were given. On the tenth week the fish were challenged intraperitoneally with 2.6 x 10^9 cfu/ ml of live Streptococcus agalactiae. Blood serum samples collected at weekly interval in all the replicates for a period of sixteen weeks were subjected to ELISA to determine the systemic antibody responses. Immunization by AVIF resulted in significant (p<0.05) increase in the serum and mucus antibody levels (IgM) as early as week 2 in all vaccinated groups, while the level in the control group was insignificant (P>0.05). Group with high dosage of adjuvant from 5% to 10% showed the highest antibody levels compared to group with low dosage of adjuvant at 0% and 3%. The antibody response of 7% and 10% added adjuvant have no significance difference in both group. 10% added adjuvant of both palm oil and Incomplete Freund’s adjuvant in vaccine stimulated better systemic immune response giving good protection of 65-70% survival rate even after challenge and thus the optimal dose for use in vaccine is 10%. Palm oil however, is the adjuvant of choice as it is cheap and easily available. In conclusion, vaccination using AVIF stimulated systemic immunities and protection provided by group with Adjuvanted vaccine with each other. Thus, we can say that 5-7% adjuvant is the optimal dosage of adjuvant needed to improve the effectiveness of the vaccine hence gives better protection to Tilapia fish against streptococcosis. For Overall, comparing Freund's Incomplete adjuvant and Palm Oil adjuvant using 10% dosage of adjuvant, both gives good protection level to Tilapia up to 65-70% survival rate of fish. However, Palm oil adjuvant appeared to be the best option economically as it gives significance reduces of the cost of producing vaccine but still at the same time gives maximum protection to the fish against streptococcosis.

Key words: optimal dosage, adjuvants, vaccines, streptococcosis, Tilapia fish
Infection caused by *Aeromonas hydrophila* is a looming threat to both cultured and wild catfish, *Clarias gariepinus* especially in Malaysia and considered one of the most important pathogens of freshwater fish. African catfish (avg. Bwt: 1.3-1.5 kg) with clinical signs of fins rot, yellowish body discoloration and haemorrhages on skin were sampled from a breeding farm in Selangor, Malaysia. Then, its pathogenicity was determined by intraperitoneal (IP) injection using *C. gariepinus* fingerlings. The challenged catfish exhibited disease criteria such as fin and tail rot, excess mucus production, and reddish operculum. The LD$_{50}$ of *A. hydrophila* was found to be 10$^6$ cells fish$^{-1}$. Isolates of *Aeromonas hydrophila* were isolated from the kidney and were identified using commercial kit, API 20E® in combination with oxidase, catalase, amylase, caseinase, lipase, lecithinase and hemolytic activity. The isolates were further confirmed by 16SrRNA and aerolysin gene (*aer*) was detected using PCR. Later the fish tissues (muscle, kidney, gills, liver, intestine and spleen) were fixed in 10% buffered formalin, processed and embedded into paraffin wax blocks. The sections were stained with H & E. Interestingly, all isolates possessed aerolysin gene which play crucial role in establishment of infection. Histopathological observations on kidney of infected catfish revealed degeneration of glomerular and tubular cells. Melanomacrophages centres (MMCs) were found in spleen and liver of catfish. Presence of MMCs increased in the liver and spleen of infected catfish were possibly related with cellular immune response. Histopathological changes which included necrosis and hemorrhage observed in the kidney, liver and muscle were presumably suppuration and were postulated due to the toxin produced by the bacteria.

*Keywords: Aeromonas hydrophila, Clarias gariepinus, histopathology, aerolysin, 16SrRNA*
EFFECT OF DELAYED FIRST FEEDING ON INTESTINAL EPITHELIUM DEVELOPMENT OF MARBLE GOBY (*Oxyeleotris marmoratus*) LARVAE

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This study was carried out to examine the effects of delayed first feeding time on intestinal epithelium development of marble goby (*Oxyeleotris marmoratus*). Larval intestinal epithelium heights of fed and starved larvae were observed histological to indicate larval nutritional condition. In the present study, the onset of first feeding time was indicated as 0 hours delayed first feeding (h DFF). Six different onsets of first feeding time were tested at 12 hours intervals which were 0, 12, 24, 36, 48 and 60 h DFF, respectively. Larvae commenced first feeding at 36 hours after hatching (h AH) (29±0.5°C). Through this study, it was comparable when the result showed that there were no significant differences (*p* >0.05) of intestinal epithelium height of fed and starved larvae in treatments 0 (fed: 17.83±5.80 µm; starved: 18.04±3.46 µm), 12 (fed: 21.52±6.19 µm; starved: 21.08±6.31µm), and 24 (fed: 22.17±2.40 µm; starved: 21.08±3.46 µm) h interval times. However after 36 h intervals of delayed, intestinal epithelium height were observed developed significantly higher (*p*<0.05) for fed at interval of 36 (23.91±4.11 µm), 48 (24.35±6.05 µm) and 60 (27.39±7.21 µm) but decreased significantly different for 36 (20.00±3.57 µm), 48 (18.50±3.28 µm) and 60 (15.65±3.96 µm) h DFF. The intestinal epithelium was observed to become thinner due to the cell degeneration and reduction of the mucosal fold at these intervals. In conclusion, delayed first feeding times induces poor intestinal epithelium development that potentially decrease the efficiency of nutrient absorption.

*Keywords:* Intestinal epithelium, cell degeneration, delayed first feeding, Marble goby
FORECASTING THE MONTHLY MEAN CHLOROPHYLL (CHL-A) CONCENTRATION OF THE WATERS OFF PENINSULAR MALAYSIA’S WEST COAST

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Chlorophyll (chl-a) in the water is generally produced by planktons and the amount of planktons in the water is measured by chl-a concentration (biomass and abundance indicator). Fishing grounds are always dynamic and using chl-a concentration may help to narrow down the search area and in turn increases the probability of higher catches. Thus, waters with high levels of chl-a showing abundance of phytoplankton may indicate a more favourable fishing ground, since this forms the base of the food chain. The small pelagic fish which feed on phytoplankton is one of the dominant fish species caught in Malaysia owing to its large number of landings in each year. It is important to forecast the chl-a concentration for sustainable fishing as fisheries is one of the major contributors to the Malaysian economy. Since it is natural for chl-a levels to fluctuate over time due to climatic factors, it is appropriate to model and forecast chl-a concentration using statistical time series methods. In this paper, a time series model is fitted using the Holt-Winters multiplicative method to forecast the monthly mean chl-a concentration of the waters off Peninsular Malaysia’s west coast. Based on this model, a web portal is developed to enable end users (fishermen) to forecast the monthly mean chl-a concentration for a maximum period of 12 months ahead from the time of last updated data for various fisheries areas scattered along the Straits of Malacca within the Exclusive Economic Zone (EEZ) of Malaysia. The web portal consists of a forecast plot along with a forecast table which displays the point forecast and the 80% prediction interval for selected forecast periods and fisheries area.

Keywords: chlorophyll concentration, phytoplankton, small pelagic fish, time series forecasting
STOMACH CONTENT OF FISHES IN SETIU LAGOON, MALAYSIA

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Predator-prey relationship is an important aspect when measuring the fish contribution in coastal ecosystem. The number of fishes would influence the number of the prey. This study is carried out to investigate the diet preferences in small fishes by examining their stomach content and to understand the relationship between the fishes and their prey. A total of 6 locations in Setiu Lagoon, Terengganu were selected for the sampling starting from the innermost area of mangroves down to the opening to the South China Sea. Fish samples for the study were collected using a seine net. Upon collection all samples were directly immersed in 10% buffered formalin to stop any degradation process in the stomach. Zooplankton samples were obtained using a 110 microns zooplankton net and fixed with 5% buffered formalin. Laboratory analysis on the stomach content was carried out for the numeric and frequency of occurrence of the food item. A total of 34 small fishes were caught during the one-day sampling, representing 7 fish species; Leiognatus equulus, Leiognatus brevirostris, Gerres oyena, Gerres filamentosus, Arothron stellatus, Xenodonton canciloide and Scantophagus argus. Most fishes (15) were caught in the innermost station. Harpacticoid copepods become the highest contributor in the stomach content (85.06%), followed by calanoid copepods (12.84%) and the lowest was fish larvae (0.83%). This is contrasting the density of plankton group found in the study area where they composed mainly the cyclopoids, calanoids, nauplii, mites and cladocerans. The density of zooplankton ranged at 6.8 ind/L (innermost station) and 40.5 ind/L (near to the opening to the sea). The low density of zooplankton in the water column does not affect the number of fishes found in the sampling area. Furthermore, their preference towards benthic diet (harpacticoid copepods) could indicate their weak relationship with the planktonic diet which needs further investigation.
LANDMARK-BASED MORPHOMETRIC ANALYSIS OF Arius SPECIES (SILURIFORMES: ARIIDAE) IN PENINSULAR MALAYSIA

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Ariid catfishes, belongs to family Ariidae is considered as one of the taxonomically problematic group and still under review by fish taxonomist globally. A vigilant and detail observation is important during the species level identification of ariids. Therefore, this study was carried out to determine the morphological variations of one of the ariid genus, Arius, which have been giving misleading taxonomic information in the south-east Asian countries. A truss network technique was used throughout the study period. The study was conducted based on 20 truss distances using 22 to 25 specimens per species. Morphological variations were determined using a multivariate technique of discriminant function analysis (DFA). The results obtained showed a clear separations of all the species in Arius group. Several important morphological characters have been identified, which represent body depth and body length of the fish. The documentary evidences of these variables could be considered as the constructive functional features, which could enable us to assess more accurately distinguish the species within this complex Ariidae family.

Keywords: Ariidae, Arius, Taxonomy, Truss network
INTRASPECIFIC MORPHOLOGICAL VARIATION BETWEEN CULTURED AND WILD POPULATIONS OF CLIMBING PERCH,

*Anabas testudineus*

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Several body measurement methods used to identify stock have recently been criticized because of inherent biases and weaknesses. As an alternative, a new system of morphometric measurement called the truss network has been increasingly used for stock identification. Therefore, the morphometric differentiations between wild and captive populations of *Anabas testudineus* were carried out throughout this study using truss network. Truss measurements based on anchored at 10 homologous landmarks with 19 distances of 120 specimens were measured. Discriminant analysis was performed to investigate distinction and patterns of morphological variations between wild and captive populations of *Anabas testudineus*. The findings support the use of the truss network to study the morphological variation among populations as it provides interesting perspectives for the study of biodiversity patterns.

*Keyword: Morphology, Anabas testudineus, Truss network*
The present study conducted to breed and observe the embryonic development of hybrids, *Clarias gariepinus* (♀) and *Pangasionodon hypopthalmus* (♂) from fertilization until early hatched. The matured eggs and sperm were obtained by induced breeding using a commercial hormone, ovaprim. Dosages given for female and male were 0.5 ml and 0.25 ml ovaprim kg⁻¹, respectively. Fertilized eggs were adhesive, spherical, sticky and brownish green colour. Fecundity for female weighing 40 g and 60 g were 37,333 and 40,664 eggs/fish. Fertilization of eggs occurred 12 minutes after stripped the eggs and mixed with the sperm. Fertilization rates were 90% and 85% whereas hatching rates were 50% and 35%. The temperature during incubation was maintained to 27.7° C. The embryonic development ended when the eggs hatched after 16 hours and 15 minutes incubation.

*Keywords*: Hybrids, *Clarias gariepinus, Pangasionodon hypopthalmus*, induced breeding, embryonic development
VERTICAL DYNAMICS OF BACTERIA IN A TROPICAL TIDAL RIVER

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Bacteria play a very important in controlling mineralization of organic matter. Therefore, river ecosystem is greatly influenced by bacterial dynamics. A study was conducted to vertical dynamics of bacterial in the Kuantan River which is influenced by daily tidal activity. For this study water samples were collected from three layers: surface, middle and near bottom. Sediment samples also collected to observed bacterial load in this river sediment. Bacteria were cultured on both nutrient agar and marine agar. Results indicated that more bacteria preferred to grow on marine agar than to grow on nutrient agar. An opposite result was observed in the case of sediment bacteria. They preferred to grow on nutrient agar than to grow on marine agar. Overall gram negative bacteria were higher in number compared to gram positive bacteria. The mean total CFU were higher in middle later of water compare to water from surface and near bottom.

Keyword: River, sediment, bacteria, vertical dynamics
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