SPICE final conference

January 20 & 21, 2016

Proposal	
Affiliated to topic (Session 1- 8)	**Pollution**
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Impacts of megacities on tropical coastal ecosystems – The case of Jakarta, Indonesia

Special Issue in Marine Pollution Bulletin with SPICEIII results

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Abstract

The rapid economic growth in Indonesia induced a migration towards the cities. This trend is visible also in other emerging economies and is accompanied by the formation of coastal megacities in tropical Asia with more than 10 million inhabitants, like Jakarta, Bangkok and Manila metropolitan areas. Tropical coastal zones that are influenced by this urbanization process provide important ecosystem functions and services. They host unique and vulnerable habitats like mangroves and coral reefs which are characterized by a high biodiversity. Jakarta, the capital of Indonesia, is located on the northern coast of Java Island. The growth of the city is involving an overexploitation of freshwater resources, accelerated subsidence, pollution of coastal waters and habitat degradation, having adverse effects on the coastal ecosystem, the Jakarta Bay. The upcoming interdisciplinary special issue about the Jakarta Bay ecosystem will be published in *Marine Pollution Bulletin*. It will contain studies that investigated the origin of land-derived contaminants and the riverine transport of such contaminants into the Jakarta Bay. The environmental conditions and the oceanographic setting of the bay were investigated. The pollution of the bay and its effects on food safety of fishery resources and on marine resource use of local communities was assessed. Laboratory experiments were conducted to test the effects of relevant anthropogenic stressors on economically or functionally important bivalve and fish species. Changes of the biotic community composition in relation to different environmental conditions and along environmental gradients were determined. This included an investigation of biodiversity changes in the coral reefs of the Thousand Islands. Finally, possible future impacts of the planned great sea wall were studied. With this special issue we will provide valuable information for Jakarta and other densely populated tropical coasts, since knowledge gaps have been identified as one of the major problems in introducing effective management strategies.

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Impact of pollution on the ecosystem Jakarta Bay

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Abstract

Seafood is the main protein source and an important income basis for local communities in coastal areas of Indonesia. But seafood consumption is also a route of human exposure to contaminants. Commercially important fish and invertebrate species from densely populated and industrialized coastal areas with inputs of untreated sewage such as Jakarta Bay may contain potentially harmful organic contaminants. This probably poses a risk to human health, in particular with respect to bioaccumulating contaminants. It is therefore necessary to evaluate the quality of Indonesian coastal systems in terms of contaminant burden. The aim of our study was a *source-to-cell* approach to characterize the state of pollution in Jakarta Bay and its implication for human food resources. It traces the implications of harmful substance loads from their primary emission sources via surface water bodies to the consumed seafood.

Non-target screening analyses revealed a broad spectrum of organic contaminants present in particular in the river water samples. A total number of 71 organic contaminants was identified in river water samples from Jakarta City. Especially contaminants originating from municipal wastewaters were detected in high concentrations, including flame retardants, personal care products and pharmaceutical drugs. In river water samples from the industrial area southeast of Jakarta City, several specific agents used for paper production were identified. The contamination of sediments also reflected the various emissions sources, but the particulate matter contained more lipophilic compounds. Representative contaminants were e.g. linear alkylbenzenes (LABs), di-*iso*-propylnaphthalenes (DIPNs) and polycyclic aromatic hydrocarbons (PAHs). Analyses of mussel and fish species from Jakarta Bay revealed a higher similarity of the contaminant spectrum with sediment pollutants as compared to water pollutants. This applies e.g. to LABs and DIPNs. The LABs concentrations we detected in the green mussel (*Perna viridis)* from Jakarta Bay were the highest so far reported from Asian coastal waters.

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Numerical Simulation of River Discharges, Nutrient Flux and Nutrient Dispersal in Jakarta Bay: Current Status and Future Scenarios

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Abstract

The understanding of circulation processes and associated flux of pollutants in and to Jakarta Bay are crucial for the development of effective mitigation strategies in the region. Otherwise difficult to capture by field measurements, spatiotemporal information of river discharges, nutrient and pollutant flux and dispersion in Jakarta Bay was simulated using a sequence of numerical modelling techniques.
The applied hydrological model indicated a total river discharge in the range of 90 to 377 $m^3 s^{-1}$ entering Jakarta Bay through its 13 adjacent rivers. Daily total nitrogen and total phosphorus loads ranged from 40 to 174 tons and 14 to 60 tons, respectively. A relatively small share of these nutrients originates from Jakarta City, whereas the bulk enters via the Citarum and Cisadane Rivers, from the edges of Jakarta Bay. High nutrient levels prevail at the near shore of the Jakarta City shoreline due to limited water exchange between the inner Jakarta Bay and the Java Sea. Flow model results indicate that a combination of tides, wind and sea surface height dynamics affect the circulation pattern and nutrient dispersal in Jakarta Bay. Jakarta is subject to issues that threaten the livelihood of many Jakartans. Urgent actions are needed to deal with land subsidence, flooding and pollution through insufficient management of industrial and domestic wastes. Mitigation scenarios were simulated assuming that domestic waste water was subjected to state of the treatment. An offshore solution to deal with flooding is under discussion due to the uncertainties of, amongst others, environmental impacts. One of the scenarios simulated by the model described above, are the implications of the construction of the Giant Seawall on nutrient patterns in Jakarta Bay.

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Parasites as environmental indicators

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Parasites as environmental indicators

Abstract

The objective of this presentation is to demonstrate the opportunity to assess the environmental conditions of different anthropogenic impacted marine habitats by using the parasite fauna of groupers. 70 Epinephelus coioides (Hamilton, 1822) from Jakarta Bay as well as off Jakarta Bay were investigated for metazoan parasites during the recent SPICE III phase. Considering the findings of previous studies (SPICE I & II) based on 230 fish from Segara Anakan lagoon, off Segara Anakan lagoon and Ringgung Bay, an environmental indicator system was designed. A total of 51 parasite species have been recorded for E. coioides from Indonesian waters. Seven of them combined with five parasitological indices are useful descriptors for the status of the marine ecosystem. A star graph is used to illustrate these results. High parameter values indicate natural environmental conditions and are oriented towards the outer circle of the star graph. Low parameter values indicate affected environmental conditions and are oriented towards the inner circle of star graph. Normalization onto a range of zero to 100 ($X' = 100 \cdot (X - Xmin) / (Xmax - Xmin)$) allows for the first time the calculation of the star graph area, which makes it possible to assess the environmental conditions in a range from poor, medium and good. The results are presented in a figure called the pollution light. Significant differences in the star graph as well as in the pollution light demonstrate the highly negative influence of the megacity Jakarta onto the coastal environment. We herewith complete the parasite based indicator system developed during the first two SPICE phases. Furthermore, a new method by using acanthocephalans as biological indicators to detect organic pollutants was developed. This study is the first molecular-chemical screening by pyrolysis-field ionization mass spectrometry carried out with fish parasites worldwide.

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Effect of environmental stressors on the ecophysiology of marine organisms: local and regional impacts of pollution

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Abstract

Worldwide, coral reefs are challenged by multiple stressors due to growing urbanization, industrialization and coastal development, especially in densely populated tropical coastal areas. Coral reefs off Jakarta, one of the largest megacities worldwide, have degraded dramatically over recent decades. Here, the spatial impact of anthropogenic stressors at local and regional scales on coral reefs north of Jakarta was investigated. The direct impact of Jakarta is mainly restricted to inshore reefs, separating reefs in Jakarta Bay from reefs along the Thousand Islands further north. A spatial patchwork of differentially degraded reefs is present along the islands as a result of localized anthropogenic effects rather than regional gradients. Eutrophication is the main anthropogenic stressor, with over 80 % of variation in benthic community composition driven by sedimentation rate, NO2, PO4 and Chlorophyll a. Thus, the spatial structure of reefs is directly related to intense anthropogenic pressure from local and regional sources. Therefore, spatial management that accounts for both local and regional stressors is needed for effective marine conservation.

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Microbial biodiversity in fish and shellfish under pollutant conditions in Jakarta Bay

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Abstract

Within the framwork of this project we are elucidating the microbial biodiversity in fish and shellfish under pollutant conditions in Jakarta Bay. The microbial biodiversity includes bacterial, fungal and other parasitic microorganisms. Thereby we are investigating core microbiomes as well as pathogenic microbes in a selected small number of marine species from different regions of the bay and which are of nutritional and commercial importance, i.e. *Seranidae*/*Scambridae*, (*Mytilus*) and Black Tiger Shrimp (*P. monodon*).
Our investgations are linked to the efforts of other scientists working in topic 1, i.e. from Germany, especially Larissa Dsikowitzky (ZMT, Bremen) and Harry Palm (Uni Rostock)
Our microbiome research contributes with new means to secure stability, sustainability and profitability of the corresponding fishery. In addition, it contributes to successfully cope with infectious seafood diseases, which are spreading more and more in the surroundings of megacities and in the environment of wild populations.