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17A Science to support the Coral Triangle Initiative

Linking research to Indonesia's CTI Action Plan: the SPICE Program

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Abstract. The Indonesian-German SPICE program (Science for the Protection of Indonesian Coastal Ecosystems) has been an umbrella for joint research since 2003. In 2012, SPICE enters its third phase. The 12th ICRS thus presents a unique opportunity to link activities within the program to other initiatives in the area.
One focus of SPICE has been to examine topics with policy relevance for Indonesia, such as environmental change and governance in the Segara Anakan Lagoon in Java, or reef fisheries and marine management in the Spermonde Archipelago near Makassar, Sulawesi. Research in Spermonde has examined the implementation of community-based MPAs within the frame of the Coral Reef Rehabilitation and Management Program (COREMAP). Results have been presented to policy makers at a regional workshop in Makassar and a national workshop in Bogor, and to international audiences during the World Ocean Conference 2009 in Manado. Yet, the link to parallel activities, in particular by NGOs, and to regional initiatives such as the CTI needs strengthening in order to increase the effectiveness and policy impact of SPICE activities. During the third phase, SPICE strives to better align with other research as well as policy initiatives, in particular by contributing to goals of the Indonesian CTI National Plan of Action – such as applying an ecosystem approach to fisheries management, and effectively implementing and managing MPAs. We present SPICE results with relevance to CTI goals, and introduce research activities planned until 2015. We conclude by identifying research gaps in addressing CTI goals and strategic areas for collaboration.

Key words: SPICE, Indonesia, management, MPA, livelihoods.

Introduction

Marine resources in the Coral Triangle region in South East Asia support the livelihoods of several hundred million people (Whittingham et al. 2003). It is the area with the highest marine biodiversity, but also the region with the highest proportion of reefs threatened by anthropogenic impacts (Roberts et al. 2002; Burke et al. 2011). In order to sustain the marine ecosystems in the region and the livelihoods of the communities that depend on them, six countries within the Coral Triangle region together have formed the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI).

Announced by Indonesia in 2007, the CTI has culminated in the drafting of a legally non-binding Regional Plan of Action (RPOA) which was agreed by the CTI country leaders during the CTI Summit in Manado in May 2009 (Clifton 2009). The RPOA lists five overarching goals: *i*) the designation and effective management of priority seascapes, *ii*) the application of an ecosystem approach to management of fisheries and other marine resources, *iii*) the establishment and effective management of marine protected areas (MPAs), *iv*) the achievement of climate change adaptation measures, and *v*) an improved status of threatened species (CTI Secretariat 2009). Each member country has developed an individual National Plan of Action (NPOA), which lists country-specific targets and activities to reach these overarching goals.

One of the guiding principles of the RPOA stipulates that the 'CTI should be based on solid science' (CTI Secretariat 2009:8). Currently, the scientific basis underpinning of the CTI is still inadequate (Clifton 2009), and this realization has led to targeted efforts at generating scientific information in support of CTI goals (e.g., Fernandes et al. 2012).

The interdisciplinary Indonesian-German research program 'Science for the Protection of Indonesian Coastal Ecosystems' (SPICE) was initiated in 2003, entered its third phase in March 2012, and contributes to a number of CTI goals (Fig. 1). While results have been presented in regional and national workshops and in scientific publications, stronger links to parallel activities, in particular by NGOs, and to regional initiatives such as the CTI are needed to increase the effectiveness and policy impact of SPICE activities, and to utilize its potential for CTI goals.

Here, we review previous SPICE results and assess them for their relevance to CTI goals. Research activities planned until 2015 are also discussed in light of CTI goals, and further research needs in addressing CTI goals and strategic areas for collaboration are identified.

Material and Methods

As the SPICE Program focuses specifically on Indonesia, the Indonesian National Plan of Action (NPOA) was used as the reference framework (MMAF 2009). Those results from the previous two SPICE phases, and research projects planned in the third SPICE phase, which were found to be relevant to the five overarching goals as stated in the NPOA are reviewed and presented. Research methods consisted of various social science and reef ecology approaches, such as participatory research methods (focus groups, participatory observation, seasonal calendars), quantitative surveys and qualitative techniques, as well as line transects, recruitment studies, incubation experiments, molecular biological analyses, and transplantation experiments.

In a second step, related activities ongoing in Indonesia are reviewed, existing gaps identified, and opportunities for strategic collaboration discussed.

Results

Research in the first two phases of SPICE was organized into research clusters, two of which were of particular relevance with respect to the CTI: *i*) Coral reef-based ecosystems and resources, and *ii*) Governance and management of coastal social-ecological systems. These have yielded results relevant to goals 2-5 of Indonesia's national CTI Plan of Actions. Below, relevant SPICE results in relation to these CTI goals are presented.

Goal 2: Ecosystem approach to management of fisheries (EAFM) and other marine resources fully applied

The ecosystem approach to fisheries management recognizes the interlinked social-ecological nature of fisheries systems and integrates various stakeholders, in particular local communities, in management efforts. It also aims at sustainable use of fisheries resources by improving the available data, monitoring activities, and the enforcement of regulations to reduce destructive and illegal fishing. It also includes efforts to improve the livelihoods of coastal communities by supporting alternative income options, aquaculture and small-scale enterprises (MMAF 2009; US CTI 2011a).

In the Spermonde Archipelago, SPICE work analyses how prevailing patron-client relationships (in which fishers depend on affluent patrons for access to capital, equipment and markets) drive and enable destructive fishing and overexploitation of resources such as ornamental species, sea cucumbers and live reef fish (Dumestre 2010; Schwerdtner Máñez and Ferse 2010; Glaeser and Glaser 2011). At the same time, these relationships hinder ecological feedback in the system. Management efforts need to acknowledge the central role played by the patron-client system, and integrate ecological data from the local level into regional and national fisheries management e.g. through monitoring staff within local communities (Ferse et al. in review-a). Ferse et al. (in review-b) underline that active management approaches are needed to strengthen the adaptive capacity of the reef fishery in Spermonde.

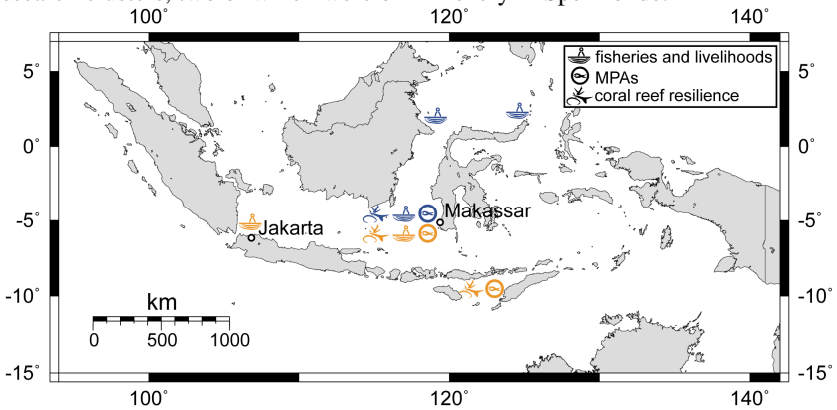

Figure 1: Overview of the locations in Indonesia of previous (blue symbols) and planned (orange symbols) work of the SPICE Program dealing with fisheries and livelihoods, MPAs, and coral reef resilience.

As the largest supplier of marine ornamentals to the aquarium trade and a major source of life reef food fish, Indonesia strives to improve the management of its ornamental and life food fisheries. Madduppa (Madduppa 2012), Knittweis et al. (2009a; 2009b) and Knittweis and Wolff (2010) provide information on the populations of and fishing impacts on two important marine ornamental species, arguing that current fishing levels and certification schemes do not meet ecological prerequisites for sustainability. Syakir (2006) and Ferse et al. (in review-a) for the first time examine the livelihoods of ornamental fishermen and provide recommendations for management. They find that ornamental fishery is seldom a specialized activity, but rather part of a portfolio of fishing strategies, and strongly embedded in patron-client networks.

In order to secure coastal communities' livelihoods, aquaculture development is frequently advocated as an alternative livelihood. The implementation of community-based aquaculture projects has been assessed in East Kalimantan by Bosboom (in prep.) and in North Sulawesi by von Essen (2010). Both authors conclude that adoption of mariculture especially by fishing communities should not be taken for granted, and that previous experiences, local attitudes, and ongoing external support are key factors determining the success or failure of such attempts.

Goal 3: Marine protected areas (MPAs) established and effectively managed

The establishment of a region-wide network of MPAs that cover ecologically sensitive areas, improve regional coral reef resilience, involve local communities in management, and enable the sustainable use of marine resources is a primary CTI objective (MMAF 2009; US CTI 2011b).

To meet the biophysical objectives of MPA networks, network design needs to incorporate genetic connectivity (Fernandes et al. 2012). Yet, studies on marine population genetics from Indonesia are still scarce. Molecular biological work in SPICE yielded information on ecological connectivity of invertebrate (Kochzius and Nuryanto 2008; Kochzius et al. 2009; Nuryanto and Kochzius 2009) and fish species (Timm and Kochzius 2008; Timm et al. 2008) throughout the Indonesian archipelago and within the Spermonde shelf region (Knittweis et al. 2009b; Madduppa 2012), with recommendations for management.

The successful involvement of local communities in MPA implementation can be decisive for their success and failure. Examining the implementation of MPAs in Spermonde within the frame of the Coral Reef Rehabilitation and Management Program (COREMAP), Glaser et al. (2010a) observe that the existence of MPAs in island waters remained unknown to a major part of the island community over a year after implementation, calling for a better involvement of local people. They also propose that locally emerging, informal rules possess as yet untapped potential for marine conservation. Deswandi (2012) describes the emergence of these local institutions in detail. Ferse et al. (2010) review socioeconomic shortcomings in MPA design and offer an overview of strategic principles that can help to improve the role of local communities in MPA implementation. The strongly hierarchical social structure within Indonesian society potentially hinders participatory management methods developed elsewhere and may require novel approaches, e.g. role playing games, in order to allow all members of a local community to voice their views and meaningfully participate in a decision-making process (Glaser et al. 2010b).

Goal 4: Climate change adaptation measures achieved

The CTI aims to improve the adaptive capacity of coastal and small island areas, which requires baseline data on climate change risks and susceptibility, and the strengthening of positive social-ecological resilience (MMAF 2009; CTI 2011). SPICE work in Spermonde has underlined the threats posed to island communities by changing weather patterns and erosion (Glaeser and Glaser 2010). However, as Schwerdtner Máñez et al. (in review) point out, the limited availability of freshwater may render many small islands uninhabitable long before erosion does.

The ability of coral reef systems to adapt to or mitigate effects of climate change is an aspect that has received the attention of SPICE reef ecologists. Borell and Bischof (2008), Borell et al. (2008) and Sawall et al. (2011) show how heterotrophy may enable certain coral species to cope with anthropogenic stressors such as eutrophication and elevated water temperatures.

Goal 5: Threatened species status improving

The CTI aims to improve the status of threatened marine vertebrates and invertebrates and plant species. This requires baseline data on the status, as well as continuous monitoring and better regulation of the harvesting and trade of endangered species (MMAF 2009).

Research in SPICE has addressed the harvest and trade of stony corals, which are threatened and listed under CITES regulations. Knittweis et al.

(2009a) provide baseline information on the population of *Heliofungia* corals in Spermonde, while Knittweis and Wolff (2010) and Ferse et al. (in review-a) discuss the current harvesting activities and provide recommendations for improved management of the fishery that can be applied to other stony coral species.

Discussion

The Coral Triangle Initiative constitutes an ambitious and wide-reaching effort at sustaining the region's coral reef resources and their future use. To be successful, this initiative needs the scientific support of as many research activities in the area as possible. The bilateral SPICE Program aims to provide data for the protection of Indonesian coastal ecosystems, similar to the CTI. Research in SPICE I and II yielded results relevant to a number of CTI goals. However, as SPICE was planned before the onset of CTI, there was no specific effort to incorporate CTI goals in SPICE research design. For the third program phase, starting in March 2012, research plans align more closely with Indonesia's CTI targets.

Future SPICE research in support of CTI goals

Five of the new SPICE research topics are relevant to CTI goals: *i) Impacts of marine pollution on biodiversity and coastal livelihoods* (relevant for CTI goal 2). This project focuses on Jakarta Bay and will assess how fisheries production and marine resource-dependent communities are affected by pollution and environmental degradation in order to develop policy recommendations. *ii) Carbon sequestration in the Indonesian Seas and its global significance* (CTI goal 4). Conducted predominantly in Sumatra, the project evaluates the role of coastal ecosystems, wetlands and rivers in the global carbon cycle and aims to formulate strategies for adaptation to climate change. *iii) Understanding and managing the resilience of coral reefs and associated social systems* (CTI goals 3, 4 and 5). The project works in Spermonde and, in response to the specific request of the Indonesian project partners, in the newly established Sawu Sea MPA, and will contribute information on MPA network governance, ecological connectivity, and social-ecological resilience. It also aims to provide baseline data for the currently data-deficient Sawu Sea region. *iv) Terrestrial influences on mangrove ecology and sustainability of their resources* (CTI goals 4 and 5). Focusing on the Segara Anakan area of central Java, this project will assess the interactions of environmental changes and mangrove ecosystems, together with an ongoing monitoring of the status of Java's largest remaining mangrove area. *v) Climate versus anthropogenic forcing of Late Holocene environmental change affecting Indonesian marine, coastal, and terrestrial ecosystems* (CTI goal 4). In this project, the relative roles of human activity and climatic drivers in past environmental changes are assessed. This will support the development of climate adaptation strategies by providing an understanding of the kind of environmental changes that can be expected to happen in response to current impacts.

Potentials for collaboration and further research needs

SPICE research will be regionally focused. Complementarities with studies carried out in other parts of the region are actively being sought. The collection of data for the Sawu Sea region will require efforts beyond the capacities of SPICE. For a meaningful synthesis of results, a central data repository and use of common sampling protocols that enable data exchange and joint analysis will be needed. Monitoring protocols, such as those developed by NGOs working in the region in support of CTI (e.g., Green and Bellwood 2009; Wilson and Green 2009), might be agreed upon and adopted in all research efforts. The CTI secretariat could take a leading role in the coordination of sampling and the integration of data. Important information for MPA network design, such as genetic and social connectivity in coastal areas and potential matches between them, is still missing for many areas of Indonesia. The quality and effects of local rules, especially in areas without traditional marine management, warrant further investigation. To bring together all parties which could contribute to CTI goals and to pursue networking and joint study design, regular workshops should be held for each of the goals, to be announced on the CTI webpage. This theme session at the 12th ICRS provides a good example of such networking efforts.

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