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Fisheries *refugia* : A regional initiative to improve the integration of fisheries and habitat management

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Original Article

Abstract

Fisheries of southeast Asia are characterised by high levels of small-scale fishing. Increasing fishing pressure, coupled with continued decline in the expanse and quality of coastal habitats critical to the life-cycles of most species, has raised serious concerns regarding the long-term sustainability of fisheries in the region. This paper presents the process on establishment of fisheries *refugia* and the outcomes of a regional initiative under the UNEP/GEF South China Sea Project (2002-09) to improve the integration of fisheries and habitat management. The Fisheries *refugia* concept is defined as "spatially and geographically defined marine or coastal areas in which specific management measures are applied to sustain important species [fisheries resources] during critical stages of their life cycle". To support the fisheries *refugia* approach, the ASEAN-SEAFDEC ministries responsible for fisheries endorsed the supplementary guidelines to substantiate the Regional Guidelines for Responsible Fisheries in Southeast Asia in 2006. In addition, the ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security toward 2020, adopted in 2011, also support the establishment of Fisheries *refugia* for enhancing fisheries resources of the Southeast Asian region.

Keywords: *fisheries refugia, fisheries management, sustainable use, habitat management.*

Introduction

The South China Sea, including the Gulf of Thailand, is a global centre of shallow water marine biological diversity that supports significant fisheries that are important to the food security and export income of Southeast Asian countries. These fisheries are characterised by high levels of fishing effort from the small-scale sector. Consequently, the inshore waters of the South China Sea basin are subject to intense fishing pressure. Growing global demand for fisheries products, coupled with strong coastal community dependence on fisheries, is driving continued increases in fishing capacity and effort (UNEP, 2007a).

An obvious impediment to the reduction of inshore fishing effort is that small-scale operators are often entirely dependent on fish for income, food and well-being (Paterson *et al.*, 2006). As a result of 'fishing down marine food webs' (Christensen, 1998), small pelagic species now dominate landings as most demersal fisheries are overfished (Lundgren *et al.*, 2006). Consequently, the investment of time and household expenditure on fuel for fishing has increased in coastal communities attempting to secure adequate dietary nutrition and income from fishing (UNEP, 2007a).

This situation of intense small-scale fishing pressure and declining fisheries resources has contributed to the adoption of unsustainable fishing methods to maintain catch and increase incomes in the short-term. These include the use of destructive fishing gear and practices, such as operation of demersal trawls and push nets in seagrass areas, the use of explosives and release of fish poisons in coral reef areas. Small-scale inshore fishing pressure has therefore been identified as a significant cause of the degradation and loss of coastal habitats in the South China Sea (UNEP, 2008a).

Although action aimed at reducing the rate of loss of coastal habitats has been implemented by countries bordering the South China Sea, the decadal rate of loss of such habitats remains high, e.g., seagrass beds (30%), mangroves (16%), and coral reefs (16%) (UNEP, 2008a). This continued decline in the total area of habitats critical to the life cycles of most aquatic species, combined with the high levels of coastal community dependence on fish, has raised serious concerns for the long-term sustainability of small-scale fisheries in the region.

With fish production being intrinsically linked to the quality and area of habitats and the heightened dependence of coastal communities on fish, a need exists to improve the integration of fish habitat considerations and fisheries management in the region. The dilemma for the fisheries and environment sectors is that conservation of habitat does not necessarily result in increased fish stocks while lowering fishing effort does not necessarily result in the improvement of habitat. Therefore, given the complexity of the key threats to fish stocks, fish habitats and associated biodiversity in Southeast Asia, it is imperative that mechanisms for effective cross-sectoral consultation and coordination be established, particularly in terms of the identification and designation of priority 'places' (Pauly, 1997) for management.

The fisheries *refugia* concept defined as "spatially and geographically defined, marine or coastal areas in which specific management measures are applied to sustain important species [fisheries resources] during critical stages of their life cycle, for their sustainable use" (UNEP, 2005) was developed as a novel approach to the identification and designation of priority areas to integrate fisheries and habitat management. This paper reviews barriers to the effective integration of the work of fisheries and environment departments and ministries in the context of high and increasing levels of small-scale fishing pressure in the South China Sea and Gulf of Thailand. The effectiveness of the fisheries *refugia* concept in harnessing stakeholder support for the use of area-based planning to strengthen the integrated management of critical fishery and habitat linkages is highlighted. Country experience in applying the *refugia* approach via an initiative to establish a regional system of fisheries *refugia* is presented in terms of improved communication between the fisheries and environment sectors and enhancing community acceptance of area-based management tools.

The question arises as to how the concept of fisheries *refugia* differs from other forms of area-based management used in fisheries. Marine reserves, for example, have been called by many names, including 'no-take zones', 'fishery reserves', 'fully protected marine reserves', 'highly protected marine reserves' and, recently, 'fish stock recovery areas' (Roberts and Hawkins, 2012). Regardless of the name applied, the underlying principles are the same, i.e., restriction or banning of fishing activity in fishing grounds. In contrast, the fisheries *refugia* concept focuses on the nature of the particular habitat and its critical significance to the life-history of the fished species. Management of *refugia* therefore focuses on the habitat rather than simply restricting access, either temporally or spatially, to fishing grounds. This paper presents the outcomes of a regional initiative to improve the integration of fisheries and habitat management from the project entitled "Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand", which was funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) in partnership with seven riparian states bordering the South China Sea. Planning commenced in 1996; the project became fully operational in February 2002; and was formally closed at the end of January 2009. The outcomes were recently published as part of a Special Issue of the journal 'Ocean and Coastal Management' on the UNEP/GEF South China Sea Project (Paterson *et al.*, 2012).

The complexity of the key threats to fish stocks and their habitats in the South China Sea necessitate adequate cross-sectorial consultation between fisheries and environment departments, particularly in relation to the identification and designation of priority places for the integration of fisheries and habitat management. The dilemma for the fisheries and environment sectors is that conservation of habitat does not necessarily result in increased fish stocks while lowering fishing effort does not necessarily result in the improvement of habitat.

Development of the fisheries *refugia* concept

Fisheries component of the UNEP/GEF South China Sea project

As mentioned earlier, the fisheries component of the UNEP/GEF SCS project entitled "Over Exploitation of Fisheries in the Gulf of Thailand" focused on the links between fish stocks and

coastal habitats and was designed to secure agreement on the establishment of a regional system of fisheries *refugia* to maintain important transboundary fish stocks. This was aimed at the achievement of one of the overall objectives of the project, specifically "Improved integration of fisheries and biodiversity management in the Gulf of Thailand". This component was nested with other project components focusing on habitat degradation and loss, land-based pollution, and regional coordination within the broader management framework of the project.

National activities of the fisheries component were executed by departments or research institutes of the government ministries responsible for fisheries in Cambodia, Indonesia, Malaysia, Philippines, Thailand and Vietnam. Government nominated focal points for fisheries from these countries led the execution of regional activities through the Regional Working Group on Fisheries (RWG-F). Ten formal meetings of the RWG-F were convened between 2002 and 2008. The work of this group benefitted from the participation of 5 regional experts on fisheries, and senior advisors and technical staff of the Southeast Asian Fisheries Development Center (SEAFDEC), the Food and Agriculture Organization of the United Nations (FAO), the WorldFish Centre and the International Union for the Conservation of Nature (IUCN).

The direct linkages and feedback loops that were established between and among these fisheries experts and the habitat specialists, pollution scientists, lawyers, and economists involved in the broader UNEP/GEF South China Sea project was a first for a marine fisheries working group in Southeast Asia. The collaboration between the RWG-F and SEAFDEC was established to ensure that fisheries component activities complemented, rather than duplicated, work being undertaken as part of larger SEAFDEC and FAO fisheries projects and programmes.

During its preliminary planning stages, the RWG-F realised that initiatives to integrate fisheries and habitat management in Southeast Asia would be constrained by the following factors: (1) limited experience in national fisheries and environment departments and ministries with respect to the implementation of integrated fisheries and habitat management approaches; (2) limited information regarding fish life-cycles and critical habitat linkages and the role that coastal habitats play in sustaining fisheries; and (3) low level of community acceptance of 'protected' area approaches to marine management in Southeast Asia.

Barriers to effective integration of fisheries and habitat management

In developing the framework for a regional system of fisheries *refugia*, specific regional, national and local actions were planned from the perspective of overcoming barriers to the integration of fisheries and habitat management. The RWG-F identified key barriers as follows:

1. Limited practical experience in integrating fisheries and environmental considerations:

The need to integrate fisheries and habitat management has received high-level international recognition, particularly within the framework of the approved Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem (FAO, 2002). The Reykjavik Declaration states that in an effort to reinforce responsible and sustainable fisheries in the marine ecosystems, States "will individually and collectively work on incorporating ecosystem considerations into that management to that aim". In a note regarding the preparation of the Technical Guidelines for Responsible Fisheries dealing specifically with the ecosystem approach to fisheries (EAF) as part of the FAO Code of Conduct for Responsible Fisheries (CCRF) in 2003 (FAO, 2003, the FAO highlights that "at the time of writing (the guidelines), there was little practical experience in implementing EAF anywhere in the world". Similarly, the ASEAN-SEAFDEC Regional Guidelines on Responsible Fisheries in Southeast Asia provide guidance with regard to minimising the negative impacts of fishing on the environment and critical fisheries habitats (SEAFDEC, 2006). In this connection, the RWG-F also identified, in the early stages of its work, that a central problem faced by fisheries ministries and departments in building environmental considerations into fisheries management is a lack of examples relevant to the region on how to implement such policies at the local level (UNEP, 2006a).

2. Limited knowledge of fish life-cycle and critical habitat linkages:

Regarding the lack of knowledge concerning fish life-cycles and critical habitat linkages in the South China Sea basin, the RWG-F noted that, while the life-cycles of most fished species in the region were thought to follow the generalised three-phase ontogeny of marine fishes very little information existed at the regional level regarding specific habitats and locations used by most fish species during critical phases of their life-cycles (UNEP, 2005; 2006a). Spawning sites and the influence of ocean processes on transport of fish larvae are also poorly known (UNEP, 2006b). This situation results from past fisheries research programmes having focused on determining sustainable yields of fish stocks with little emphasis being placed on fish life-cycle research. Most fish life-cycle and habitat data and information in the region are qualitative in nature, providing general information regarding the presence or absence of fish and the life-cycle phase of fish species observed in a given habitat area.

While this work is useful in developing an inventory of habitats and locations utilized by fished species at different phases of their life-cycle, the RWG-F therefore identified the need for regional level research on the role of specific habitat areas in terms of fisheries production and sustaining fish stocks under scenarios of increased fishing effort (UNEP, 2006b).

3. Low level community acceptance of 'protected' area-based approaches:

During the meetings of the RWG-F it was noted that Marine Protected Areas (MPAs) were increasingly being promoted, or conceived, as essential fisheries management instruments (Roberts and Polunin, 1993; Gell and Roberts, 2003) and that the FAO had initiated an evaluation of the effectiveness of Marine Protected Areas as management and conservation tools for fisheries. It was agreed that, while fisheries ministries and departments in the region would need to improve their working relationships with organisations promoting MPAs, the key barrier would be in achieving acceptance among communities at the local level of the value of MPAs. The consensus view within the working group was that MPAs in Southeast Asia were widely understood by fisheries stakeholders to be areas that were closed to fishing.

The initial global promotion of the MPA concept clearly distinguished between the establishment of MPAs for the protection of biodiversity and fisheries (Hilborn *et al.*, 2004). The distinction between these two purposes has recently been blurred by MPA advocates who have presented general MPA benefits not only in terms of biodiversity protection but also in terms of enhanced fisheries yields. The RWG-F noted with concern that most MPAs in Southeast Asia had been established under a broad banner of 'improving the state of fisheries', whereas the criteria for the selection of MPA sites had typically related to the achievement of objectives for biodiversity conservation or political gain rather than for fisheries management (UNEP, 2006a). This was complicated further when an objective review of the various MPA definitions suggested that the entire Exclusive Economic Zones (EEZs) of Southeast Asian countries are, technically, MPAs because fishing in these EEZs is restricted through long-standing fisheries management measures.

Approach of the Regional Working Group on Fisheries

A review of fisheries and habitat management initiatives in the Southeast Asian region revealed that no initiative with a direct focus on improving the integration of fisheries and habitat management in the South China Sea either existed or had previously been implemented. It was agreed that, given the important role of fisheries habitats in sustaining fish stocks and production, the trends in the degradation and loss of these habitats, and the intense small-scale fishing pressure in inshore areas, a regional system of fisheries management areas (fisheries *refugia*) would be established in the South China Sea and Gulf of Thailand. This system would focus on the improved management of the critical links between fish stocks and their habitats toward the longer-term goal of building resilience of Southeast Asian fisheries to the effects of high and increasing levels of small-scale fishing pressure (UNEP, 2006a).

The RWG-F for the UNEP/GEF South China Sea Project agreed that any approach aimed at fostering integrated management should:

a) Build the capacity of fisheries and environment departments and ministries to engage in meaningful dialogue regarding how broader multiple use planning can best contribute to improving the state of fisheries habitat management in areas of the South China Sea and the Gulf of Thailand;

b) Improve understanding among stakeholders, including fisherfolk, scientists, policy makers and fisheries managers, of habitat and fishery linkages as a basis for integrated fisheries and habitat management; and

c) Enhance and sustain the participation of local fishing communities and the private sector in management interventions for improved fisheries habitat management and biodiversity conservation through a focus on sustainable use rather than the prohibition of fishing.

The RWG-F further recommended that the initiative should address the barriers to integration by drawing on fisheries management concepts that are easily understood by fishing communities and emphasis sustainable use rather than simply the prohibition of fishing. The latter is considered detrimental to efforts to harness community support for area-based approaches to fisheries management in Southeast Asia. The first step involved consideration of the applicability of the Marine Protected Area concept in addressing these barriers.

Supporting evidence

In developing the framework for a regional system of fisheries *refugia* in the South China Sea, the RWG-F recognised the need for two separate but related sets of goals and objectives as shown in Table 1. The first is related to the resource itself and the second to the institutional framework under which management is brought about. Overall, the resource related goal is to enhance the resilience of regional fish stocks to the effects of fishing. The institutional goal is to integrate fisheries and habitat management at the national level, a task which is formidable given the past history of interactions between

Table 1. Goals and objectives for a regional system of fisheries *refugia*.

Resource-related goal: increased resilience of regional fish stocks to the effects of fishing	Institutional-related goal: fisheries and habitat management conducted in an integrated manner
Long-term objectives Increased average size of important species. Increased egg production of important species. Increased recruitment of important species. Increased biomass of important fish species.	**Long-term objectives** Community-based management of fisheries *refugia* for integrated fisheries and habitat management. National and regional level commitments for integrated fisheries and ecosystem management. Appropriately represented fisheries agenda in broader multiple use marine planning initiatives.
Short-term objectives Safeguarding of natural *refugia*. Reduced capture of juveniles and pre-recruits of important species in critical fisheries habitats. Reduced targeting and capture of important species when forming spawning aggregations. Reduced targeting and capture of migrating fish.	**Short-term objectives** Community-based management of fisheries *refugia* for fisheries management. Understanding among fishing communities of critical habitats and fish life-cycle linkages. Enhanced capacity of fisheries departments/ministries to engage in meaningful dialogue with the environment sector.

fisheries and environmental managers in most countries in the region. Consideration of these goals and objectives enable evaluation of whether or not areas subject to seasonal closures and fisheries management zones within multiple-use MPAs can be classified as fisheries *refugia* and form part of a regional *refugia* system.

Building capacity for the identification, designation and management of fisheries *refugia*

Defining and disseminating information on the fisheries refugia concept

The RWG-F identified two key assumptions regarding the potential success of the fisheries *refugia* concept in improving fisheries and habitat management in Southeast Asia. The first was that cross-sectoral co-ordination of activities between the fisheries and environment sectors in the participating countries would be successful. The second assumption was that small-scale fishing communities would support the initiative and interventions proposed as many fishing families, fisheries managers, and local government officials in the region equate area-based approaches to fisheries management (zoning) as the equivalent of no-take MPAs.

As noted above, the latter are often viewed as unacceptable at the community level because they are rarely designated in locations of importance to the life-cycle of fished species and neither improve fish stocks nor the community's income. The net result of such MPA establishment is largely viewed as a loss of fishing areas for small-scale fishers and non-compliance with fisheries management measures in the 'protected' areas as a result of minimal buy-in from communities. In order to promote mainstreaming of the concept within the fisheries and environment sectors and to enhance and sustain community participation in the initiative, the RWG-F disseminated information on the *refugia* concept through: regional and national fisheries and environmental forums; national expert, stakeholder, and community consultations; regional and national publication of a series of popular articles about the concept; and online syndication of information via the Fisheries *refugia* Information Portal of the South China Sea Project website.

Identification of fisheries refugia: critical spawning and nursery areas

The Sixth Meeting of the RWG-F noted that most fish populations are vulnerable to the impacts of over-fishing in areas and at times where there are high abundances of (a) stock in spawning condition, (b) juveniles and pre-recruits, or (c) pre-recruits migrating to fishing grounds. The impact of over-fishing is intensified in instances where small-scale fishers and commercial fishers share the same stock, often leading to disputes regarding the relative impact of each group (UNEP, 2006a).

The RWG-F agreed that this situation is characteristic of the over-fishing problem in many marine fisheries in the South China Sea. Juveniles and pre-recruits are often caught in inshore areas by small-scale fishers while commercial fisherfolk catch adults of the same species offshore. In circumstances such as this, high levels of fishing effort in inshore waters may drive growth over-fishing, while the same circumstances in offshore areas may cause recruitment over-fishing of the same stock. FAO (2007), for example, reports that 18-32 percent of low value 'trash' fish caught primarily by demersal trawling in the Gulf of Thailand are juveniles of commercially important species often targeted by other fisheries.

The RWG-F agreed that management of 'nursery *refugia*' to safeguard fish during the juvenile and pre-recruit phases of their lifecycle and the habitats utilised as nurseries can assist in the prevention of growth over-fishing. Similarly, management of 'spawning *refugia*' may assist in the prevention of recruitment overfishing (Annex 5 of UNEP, 2006a). In considering the work of the RWG-F, the Regional Scientific and Technical Committee (RSTC) of the UNEP/GEF South China Sea project discussed *refugia* approaches that have often been used as a fisheries management tool when more conventional techniques, such as effort or gear restrictions, have failed to achieve the desired

management objectives, particularly in regions where fisheries are subject to intense and unmanageable fishing pressure, such as in the Gulf of Thailand. In other instances, fisheries *refugia* have been used to separate potentially conflicting uses of coastal waters and their limited resources. The RSTC noted that the effectiveness of fisheries *refugia* will likely depend on an appropriate consideration of known critical spawning and nursery areas in the selection of sites. In this connection, the RSTC directed the RWG-F to: review known spawning areas for fish stocks of transboundary significance with the aim of evaluating these sites as candidate spawning *refugia*; and evaluate South China Sea habitat sites as potential juvenile/pre-recruit *refugia* for significant demersal species (UNEP, 2006c).

This information was compiled and reviewed during the seventh meeting of the RWG-F and was subsequently considered during the eighth meeting of the RWG-F and used to list and characterise known fish spawning and nursery areas in the Gulf of Thailand and the South China Sea (UNEP, 2007b). The RWG-F reviewed the list of sites in relation to: information on the distribution and abundance of fish eggs and larvae in the South China Sea during the post northeast monsoon periods from 1996 to 1999; and the outcomes of country consultations on the identification of fisheries *refugia*. The group subsequently agreed on 14 priority sites for inclusion in an initial system of fisheries *refugia* and an additional 9 sites for which additional information was required prior to their inclusion in the system. National maps of the agreed locations for *refugia* sites are included in Annex 6 of the eighth RWG-F meeting report (UNEP, 2007b). The locations of these sites are depicted in Fig. 1.

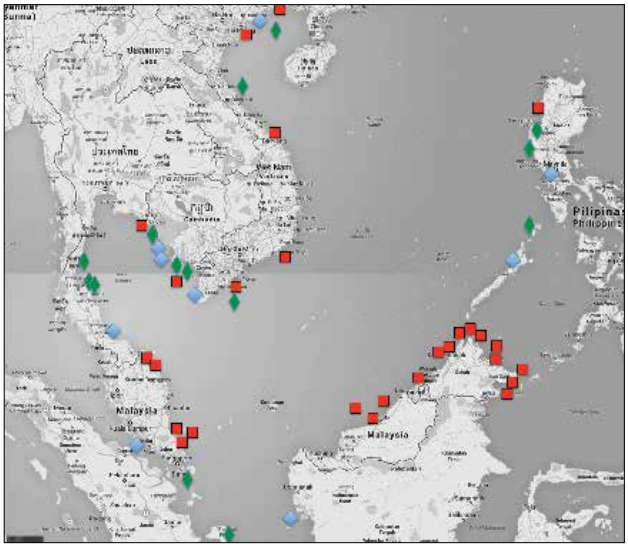

Fig.1. Location of initial sites selected for inclusion in the regional system of refugia [♦]; sites of high priority for inclusion in the regional system once the initial set have been established [◆]; and other known spawning and nursery areas of fish species of transboundary significance [■]

Improving the scientific basis for the identification of fisheries refugia

As noted above, a constraining factor in the further development of a regional system of fisheries *refugia* is the scarcity of information relating to the early-life history of the majority of significant transboundary species in the South China Sea and Gulf of Thailand. This led, during 2006-2008, to the development of a collaborative programme of technical consultations, working group meetings and training workshops with SEADFEC aimed at improving the scientific basis for the identification of fisheries *refugia*. This involved a comprehensive review of past and ongoing fish early-life history research and the compilation of information on known spawning and nursery areas for important fish species in the Gulf of Thailand and South China Sea. It was noted that past research activities conducted in the 1970s and 1980s largely focused on the identification of spawning areas and migratory routes for short mackerel (*Rastrelliger* spp.), round scads (*Decapterus* spp.), anchovy, and neritic tuna. The RWG-F agreed that there may be some limitations in the use of this research for the identification of spawning *refugia* due to possible effects, during recent decades, of oil and gas industry development in the Gulf of Thailand on fish migratory routes (UNEP, 2007b).

The RWG-F concluded that information and data collected through collaborative research activities initiated by SEAFDEC in the mid-1990s would provide a temporally relevant information base for use in identifying current spawning and nursery areas. These research activities involved cruises conducted using the SEAFDEC Research Vessel *M.V. SEAFDEC* in the following areas: the Gulf of Thailand and the East Coast of Peninsular Malaysia; the West Coast of Sabah, Sarawak, and Brunei Darussalam; the West Coast of Luzon, Philippines; and in Vietnamese waters. Larval fish sampling was undertaken at 249 stations using bongo nets in the period of the post-northeast monsoon (April-May) from 1996 to 1999. The results of these larval fish surveys were used to assist in developing a better understanding of spawning (sources) and nursery (sinks) locations for important species. Drawing on these data, the group worked with SEAFDEC scientists to map the distribution and abundance of the larvae of important demersal and pelagic fish species in the South China Sea.

Building regional capacity for the operation of a regional system of fisheries refugia

A key constraint in the future development of the regional system of fisheries *refugia* is a shortage of information regarding fish life-cycles and critical habitat linkages in

Southeast Asia. SEAFDEC has been working to fill this information gap by including larval and juvenile fish surveys as part of its regular fisheries research cruises; however, the region has faced difficulties in the processing of samples due to limited expertise in national fisheries departments. In this connection, a joint UNEP/GEF SCS Project-SEAFDEC "Regional Training Workshop on Larval Fish Identification and Fish Early Life History Science" was convened at the SEAFDEC Training Department from 16th to 31st May 2007. This course was aimed at building regional capacity in the processing and identification of larval fish samples collected during regular SEAFDEC research cruises. This was followed by an "Advanced Regional Training Workshop on Larval Fish Identification" (25th May to 14th June 2008) and enabled the formal establishment of a 'Network of Southeast Asian Larval Fish Scientists' within the framework of SEAFDEC.

In addition to the larval fish identification training initiative, the RWG-F also identified the need to build capacity among middle to senior level fisheries managers for the establishment and management of fisheries *refugia* in the region. A joint UNEP/GEF SCS Project-SEAFDEC 'Regional Training Workshop on the Establishment and Management of Fisheries *refugia*' was therefore convened at the SEAFDEC Training Department from 28th October to 10th November 2007 with 25 young fisheries and environment professionals attending from SCS project countries. The participants in these training events subsequently conducted national 'echo-seminars' on the fisheries *refugia* concept involving staff of national and provincial fisheries and environmental agencies.

Targeted actions for a regional system of fisheries *refugia* in the revised strategic action programme for the South China Sea

Strengthened enabling environment

Regional guidelines on the use of fisheries *refugia* in capture fisheries management were developed and endorsed inter-governmentally for inclusion in the ASEAN SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia. The *refugia* concept was then included in the following national fisheries policies and plans as a priority tool for improved fisheries habitat management: Fisheries Law of Cambodia; South China Sea Fisheries Management Zone Plan in Indonesia; the Comprehensive National Fisheries Industry Development Plan in the Philippines; Thailand's Marine Fisheries Policy; and the National Plan for the Management of Aquatic Species and Habitats in Vietnam. On the basis of this, a programme of targeted actions for operating a regional system of fisheries *refugia* was developed and included in the intergovernmental Strategic Action Programme for the South China Sea.

Development of a regional project to implement the fisheries component of the South China Sea Strategic Action Programme

In this connection, the 44th meeting (June 2013) of GEF council endorsed the development of a full-sized GEF International Waters project entitled "Establishment and Operation of a Regional System of Fisheries *refugia* in the South China Sea and Gulf of Thailand" to test the *refugia* approach. This project will be executed regionally by SEAFDEC in partnership with six participating countries.

Experiences in the uptake of the fisheries refugia concept: Use of a concept relevant to stakeholders

The fisheries *refugia* concept has been well received at all levels and has been utilised within the participating countries to build partnerships and to enhance communication between the fisheries and environment sectors. A relevant example is the experience of Vietnam in the use of fisheries *refugia* as a tool for integrated fisheries and habitat management in the PhuQuoc Archipelago. The extensive seagrass meadows adjacent to the Ham Ninh commune of PhuQuoc represent eight percent of the total known area of seagrass in the South China Sea (UNEP, 2008b). They support a variety of economically important species, including swimming crab, cuttlefish, shrimp, rabbitfish, octopus, strombus snail, and seahorse. The species are harvested using a wide range of fishing gear and practices, including gill nets, demersal seines, pelagic purse seines, demersal trawl, push nets, traps, intertidal gleaning and raking, and hookah diving (UNEP, 2007c).

The intensity of fishing operations in the near shore waters of the site are such that serious community concern was expressed regarding the degradation and loss of seagrass habitat as a result of fishing and consequent effects on the longer-term availability of local fish resources critical for local income and food. The widespread use of active fishing gears, such as demersal trawls and push nets, in seagrass areas of the site was noted as a key source of conflict among fisherfolk. As a strategy to improve communication between fisheries and environment managers in addressing this issue, the fisheries *refugia* concept was introduced to the PhuQuoc Management Board responsible for coral reef and seagrass management as a means of improving the management of fish stocks and habitat links at Ham Ninh (UNEP, 2007c). The fisheries *refugia* concept was well received by the KienGiang Provincial Department of Science and Technology (DoST) and

Department of Fisheries (DoF), as well as representatives of the Ham Ninh commune, as it aligned closely with local knowledge on fish migrations and patterns of availability, seasons of reproduction and areas in which fish are caught. It was noted in several commune consultations at that site that the *refugia* concept and its focus on life cycle and habitat linkages was more relevant to local stakeholders than scientific concepts such as representativeness, comprehensiveness, and uniqueness that community members had previously been introduced to in discussions on MPA planning.

Emphasis on sustainable use rather than prohibition of fishing

Subsequent consultations undertaken with commune fisherfolk, fish traders, and women involved in inshore gleaning and processing at Ham Ninh revealed that, by emphasising the sustainable use aspects of *refugia* rather than the no-take approach adopted as part of conventional MPA systems, adverse reactions at the community level were avoided. This was viewed as being a necessary prerequisite to any dialogue regarding improved fishing practices within the site. The acceptance of the approach enabled the development of a collaborative pilot activity by DoST, DoF, and the PhuQuoc MPA Authority, border army, fisherfolk and fish traders of the Ham Ninh Commune to establish and manage a pilot fisheries *refugia* site at the Ham Ninh seagrass area. The objective of this pilot initiative is to improve the integration of fisheries and seagrass habitat management at Ham Ninh through the establishment and management of fisheries *refugia* to improve the long-term security of fisheries yields and to reduce the rate of seagrass degradation and loss. Specific activities included: development of an inventory of fisheries *refugia* sites for important fish species, including seasonality of spawning and age/size of recruitment from nursery areas for key species; preparation of a fisheries profile for Ham Ninh commune; identification of specific fisheries and habitat management issues at the site; and ongoing cooperative management of the Ham Ninh *refugia* site by KienGiang's Department of Fisheries and local MPA Authority.

The fisheries *refugia* concept was also used successfully by the National Fisheries Research and Development Institute of the Philippines' Bureau of Fisheries and Aquatic Resources to facilitate the resolution a long-running conflict between the fisheries and environment sectors in the Visayan Sea. As a result of intensive inshore fishing pressure, environmental NGOs had lobbied for the prohibition of fishing that was not feasible, at least, in the short term, due to high levels of local community dependence on fishing. Parties to the dispute subsequently reached agreement on the use of the fisheries *refugia* approach to identify critical areas of habitat to be regulated and managed rather than adopting total closure (UNEP, 2007b).

Focus on fish life-cycle and critical habitat linkages

While many Southeast Asian communities have traditions of local fisheries management the rapid development of fisheries over the past 50 years has contributed to the erosion of these structures. Prior to the rapid uptake of demersal trawl fishing in the 1960s, fisheries were characterised by the use of mainly passive fishing gear to target small pelagic species supplying local markets (Pauly and Chuenpagdee, 2003). Community level management at that time included rules controlling the times and locations of fishing based on community knowledge of fish movements and reproduction (Ruddle, 1994). In contrast, the imposition of closed areas and seasons by central governments over past decades has largely focused on restricting the levels of overall trawl fishing effort. While this has recently been refined to restrict the use of destructive push nets and trawl fishing in some areas, existing closed areas have rarely been designated from the perspective of the nature of the habitats contained in such areas and the essential contribution of those habitats to fisheries (UNEP, 2007a). This emphasis on fish life-cycle and critical habitat linkages will likely assist with regional efforts to develop co-management in small-scale fisheries as it will allow for the design of community level rules that align more narrowly and explicitly to the needs of communities.

At the time of the Ham Ninh pilot activity development, information regarding the links between fish stocks and habitats at PhuQuoc was scarce. Little or no data on the distribution and abundance of fish eggs and larvae were available for the identification of spawning locations or important nursery locations for fish stocks. This problem was largely overcome by the high level of local commune fisherfolk involvement in all consultations and exercises to identify *refugia* sites. The level of acceptance by fisherfolk of the *refugia* concept was such that they ultimately led activities to identify specific spawning and nursery areas in consultation with local fisheries and environment department staff and border army officials (UNEP, 2008 c).This provided a sufficiently high level of interaction among all sectors that management issues and solutions could often be discussed and agreed at sea aboard small-scale fishing vessels. Such dialogue was necessary to enable the degree of sharing of ideas and perspectives among stakeholders that was required to identify solutions to problems directly related to the primary source of food and income for the local community. The involvement of scientists from Vietnam's Institute of Oceanography assisted in the interpretation of knowledge in the local community and among fisherfolk. This enabled

the identification of critical spawning and nursery areas using inputs from local fisherfolk that has led to a high level of community ownership of the resultant maps of fisheries *refugia* at PhuQuoc (UNEP, 2008c).

In the Philippines, academics have supported efforts to model fish egg dispersal and larval settling in the Coron Bay area of Palawan Island. Oceanographic information and fish egg and larvae data were used to identify spawning *refugia* (sources) and nursery *refugia* (sinks) for fish species of significance in that area of the South China Sea coastline. This information was used in local stakeholder consultations on the designation of *refugia* sites. In Thailand, the fisheries *refugia* concept focus on fish life-cycle and critical habitat linkages has recently been used to manage demands from the fishing sector to reduce the area of Prachuap Khiri Khan - Chumpon seasonal closure for short mackerel (*Rastrelliger brachysoma*) in the western Gulf of Thailand by 3000 ha. The *refugia* concept is now seen as a key tool in reducing the impact of intensive fishing on stocks of this species at times and in places when it is most vulnerable. Pilot activities focused on developing management at priority *refugia* sites have also been initiated with the support of fishing communities at Kampot in Cambodia and in Indonesia's West Kalimantan Province.

Comparisons of MPAs and fisheries refugia

Empirical evidence of an overall increase in fishery benefits following the establishment of an MPA is still controversial as increased catches frequently do not compensate for the decreased area of fishing grounds. In addition, MPA models have shown that, the effects on fisheries yield are highly dependent on a number of factors, e.g., dispersal in the larval, juvenile and adult stages, configuration of the reserve, and the status of the fishery. It is argued here that traditional MPAs are unlikely to enhance fish stocks and catch in the South China Sea as they are directed towards achieving the wider objectives of biodiversity conservation that often precludes adequate consideration of the life history and population dynamics of fishery species. The fisheries *refugia* concept has been developed to redress this imbalance. Experience in its application suggests that the *refugia* approach may potentially bring greater long-run benefits to the fisheries and environmental sectors in achieving mutually acceptable outcomes.

In the case of MPAs, the objectives are often broadly focussed at the ecosystem level rather than on fisheries, while the sites are selected on the basis of biodiversity criteria rather than on their significance to the life cycle of the species concerned. Similarly, the focus on protection rather than sustainable use has made MPAs generally less acceptable than *refugia* at the level of the primary stakeholders (fisherfolk and local government officers). In the Southeast Asian region, where the focus of fisheries *refugia* is on the benefits to fisheries in terms of food security objectives rather than a primary focus on biological diversity, this has resulted in its wider acceptance.

The pilot fisheries *refugia* activities described in earlier sections focused on testing the approach as a tool for improving cooperation among fisheries and environment stakeholders. While experience indicates that the *refugia* concept has significant potential for overcoming barriers to integrated fisheries and habitat management, the concept has not been tested from the perspectives of the identified resource-related goals and objectives defined for the regional system of *refugia*. The need to establish and monitor the effectiveness of individual and networks of *refugia* sites was acknowledged by the RWG-F in the development of a detailed results framework for the *refugia* system, which forms a component of the revised South China Sea SAP (UNEP, 2008a). The planned national and regional actions for the *refugia* system aim to build on preliminary initiatives to establish baselines and to undertake both formal scientific and community-level monitoring of *refugia*.

A key perspective in the Southeast Asian region is that overexploitation in fisheries may be a sign of community failure. Community values, norms and knowledge are critically important in guiding sustainable fisheries practices and the erosion of past community arrangements for the management of fisheries, including traditional rules covering the times and locations for fishing, may have opened the door to the adoption of unsustainable practices. In light of the competing demands on fish to drive export earnings and to secure a sustainable supply of protein and income for coastal communities, significant effort has been made in recent years to decentralise the responsibility of fisheries management with the aim of establishing co-management approaches. Accordingly, the ASEAN/SEAFDEC regional guidelines for responsible fisheries call for fisheries *refugia* to be used as a complementary tool to broader regional initiatives focussing on: co-management; illegal, unreported and unregulated fishing; alternative and supplementary livelihood creation in support of broader capacity reduction needs; data collection and statistics; and the promotion of responsible fishing gear and practices. With the designation and management of *refugia* being the responsibility of fisheries ministries and given the evident stakeholder support for the *refugia* approach, the conditions for effective coordination of these complementary initiatives are enhanced. This provides for *refugia* management to be equitable and to best respond to broader drivers in regional fisheries management, including capacity reduction needs.

The question arises as to whether or not MPAs qualify as fisheries *refugia* and vice versa? The simple answer in response

to the traditional no-take MPA is "no". However, parts of multiple-use IUCN category VI 'Sustainable use of natural ecosystems' MPAs, such as fisheries management zones, may qualify as fisheries *refugia* if such zones promote the concept of sustainable use rather than prohibition of fishing and the selection of the zone is based on criteria relating to the critical linkage between the area and the lifecycle of the species for which the area is managed. Similarly, while it is currently not possible to compare the direct resource-related benefits of no-take MPAs and *refugia*, an additional institutional related benefit of the *refugia* approach could potentially be the longer-term broadening of management objectives at individual *refugia* sites to accommodate non-fishery related conservation goals. The *refugia* approach provides a suitable platform for improved dialogue and the development of practical experience in the use of area-based management tools in integrating fisheries and habitat management that had not been previously achieved due to the emphasis on no-take MPAs by environment agencies in Southeast Asia.

Significance of the fisheries refugia approach

At project outset there was a widespread recognition among stakeholders of the need for coordinated action to address fisheries and habitat issues. This had not been previously addressed due to the lack of regionally-relevant management approaches that fostered the establishment of common ground and improved dialogue between the fisheries and environmental sectors and between the community and government. The fisheries *refugia* concept has met this need via a focus on fish life cycle and critical habitat linkages and an emphasis on sustainable use rather than the prohibition of fishing.

Conclusions

The *refugia* concept appears to be a successful approach in addressing a significant barrier to the integration of fisheries and habitat management, namely the adverse reaction to the MPA concept that is elicited from fishing communities and fisheries officers at the local and provincial levels during the past decade. However, in the absence of quantitative evidence on the effectiveness of the *refugia* approach, monitoring of the benefits on a broader spatial scale is important. With the designation and management of *refugia* being the responsibility of ministries of ASEAN and SEAFDEC and given the evident stakeholder support for the *refugia* approach as a fisheries management tool, it is anticipated that the experiences gained from this novel approach to the use of spatial management tools in fisheries management will be suitable for scaling-up in the South China Sea and replication in other aquatic habitats. This experience is considered important because of the potential global fisheries and biodiversity conservation benefits associated with effective fisheries and habitat management at the local level. This is particularly relevant in Southeast Asia where the contribution of fisheries to food security and the maintenance and improvement of the livelihoods of coastal fishing communities is substantial.

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