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**Fisheries *refugia*: a novel approach to integrating fisheries and habitat
management in the context of small-scale fishing pressure**



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Fisheries *refugia*: a novel approach to integrating fisheries and habitat management in the context of small-scale fishing pressure



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ABSTRACT

Fisheries of the South China Sea, including the Gulf of Thailand, are characterised by high levels of small-scale fishing effort. 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 Southeast Asian fisheries. This paper reviews the development of a UNEP/GEF South China Sea Project initiative to address the regional need to improve the integration of fisheries and habitat management.

The concept of fisheries *refugia* was developed as a novel approach to the identification and designation of priority areas in which to integrate fisheries and habitat management in the context of high and increasing levels of small-scale fishing pressure in the South China Sea. Specific regional, national and local actions in establishing a regional system of fisheries *refugia* are outlined and discussed in terms of the effectiveness of the *refugia* concept in overcoming barriers to integrated management. The fisheries *refugia* approach is shown to provide an adequate platform for building partnerships and enhancing communication between the environment and fisheries sectors.

The *refugia* concept also 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 Marine Protected Area concept that is elicited from fishing communities and fisheries officers at the local and provincial levels. 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 so substantial.

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1. 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. Accordingly, all 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). The most important fish species are considered fully fished or over-exploited. 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 high 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 the operation of demersal trawls and push nets in seagrass areas, and the detonation 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 percent), mangroves (16 percent), and coral reefs (16 percent) (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 in which 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 many things, 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.

2. Development of the fisheries *refugia* concept

2.1. Fisheries component of the UNEP/GEF South China Sea project

The project entitled "Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand"² 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.³ Planning commenced in 1996; the project became fully operational in February 2002; and was formally closed at the end of January 2009.

The fisheries component⁴ of the 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 focussing on habitat degradation and loss, land-based pollution, and regional coordination within the broader management framework of the project (see Pernetta and Jiang, 2013).

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 Viet Nam. 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

² Referred to hereafter as the UNEP/GEF South China Sea Project.

³ Cambodia, China, Indonesia, Malaysia, Philippines, Thailand and Viet Nam.

⁴ China did not participate in this project component.

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) the low level of community acceptance of 'protected' area approaches to marine management in Southeast Asia.

2.2. Barriers to effective integration of fisheries and habitat management

2.2.1. 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". The Reykjavik Conference requested the FAO to prepare "guidelines for best practices with regard to introducing ecosystem considerations into fisheries management" and the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, 2002, considered the Reykjavik Declaration in adopting a political declaration and plan of implementation in relation to capture fisheries. In the WSSD declaration, the Heads of State agreed to "develop and facilitate the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive practices ... and the integration of marine and coastal areas management into key sectors".

In 2003, FAO released 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) (FAO, 2003). In a note regarding the preparation of the document, FAO highlights that "at the time of writing (the guidelines), there was little practical experience in implementing EAF anywhere in the world". The background to the document goes on to state that, "these guidelines attempt to translate the requests for an ecosystem approach to fisheries into operational guidelines that can be applied to marine capture fisheries". 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).

From the perspective of improving the integration of fish stock and habitat management considerations and the adoption of the ecosystem approach promoted by the above mentioned international and regional instruments, most approaches to fisheries management in Southeast Asia do not effectively integrate environmental considerations. From an examination of trends in national fisheries and aquaculture policy, the Asia-Pacific Fisheries Commission (APFIC) concluded that the limited uptake of ecosystem approaches in the region "may be because of limitations in understanding about ecosystems, and challenges in making ecosystem approaches to fisheries management operational" (FAO, 2006). In this connection, the RWG-F 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).

2.2.2. 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,⁵ 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 utilised by fished species at different phases of their life-cycle, the RWG-F 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).

National and regional fisheries statistics provide little insight into the role of habitat in fisheries production. Fisheries production data in all countries bordering the South China Sea is recorded by place of landing, typically with species grouped into broad generic categories. Information about the fishing gear and practices used (e.g., gear type, mesh size, time of day) is rarely recorded. The general lack of data regarding the specific locations in which fish species were harvested, coupled with poor information about the efficiency and selectivity of the fishing gear used, makes it extremely difficult to link fisheries production data to a given habitat type or fishing area. The RWG-F noted that this lack of information regarding the broad scale role of habitats in fisheries production not only hinders the identification of priority areas for management but constrains initiatives to increase the understanding of stakeholders regarding the importance of fish habitat and life-cycle linkages (UNEP, 2006a).

2.2.3. 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 (see Roberts and Polunin, 1993; Gell and Roberts, 2003)⁶ 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

⁵ The generalised three phase ontogeny for marine fish species involving (1) pelagic larvae and pre-settlement juveniles, (2) dispersal to shallow inshore habitats, and (3) migration to deeper offshore habitats and spawning grounds.

⁶ For example, Gell and Roberts (2003) concluded that "Nature conservation in the oceans cannot be achieved without marine reserves, neither, we would contend, can the world's fisheries be made sustainable".

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 respectively (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.

2.3. Approach of the Regional Working Group on Fisheries

2.3.1. Addressing barriers to integration

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 agreed that the initiative would need to address the barriers to integration outlined above and specifically noted that it should:

- 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;
- 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
- 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 emphasise 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.

2.3.2. Consideration of Marine Protected Area definitions and applicability

The term 'Marine Protected Area' (MPA) is widely used around the world but its meaning in any one country or region may be quite different from that in others. There are many terms related to MPA. These include SPA (Specially Protected Area), SCA (Special Conservation Area), MCZ (Marine Conservation Zones – a type of MPA in English waters), MR (Marine Reserve), MP (Marine Park), NTZ (No Take Zone) (or closed area in fisheries management) and ASCC (Area of Special Conservation Concern). Each of these terms has specific types of restriction associated with them as defined by the laws of the countries concerned. In the international arena, there has been the development of a comparable plethora of concepts including, for example, 'Particularly Sensitive Sea Areas' and Special Areas. The 2002 WSSD plan of implementation called for "the establishment of Marine Protected Areas consistent with international laws and based on scientific information, including representative networks by 2012" while the Durban Action Plan, developed at the Fifth World Parks Congress in 2003, called for regional actions and targets to establish a network of protected areas by 2010 within the jurisdiction of regional environmental protocols. That congress recommended the establishment of protected areas for 20–30% of the world's oceans by the target date of 2012.⁷

In contrast, the Convention on Biological Diversity (CBD) recommended that nations should set up marine parks that are controlled by a national central organization before integrating them into regional systems. In this connection, Decision VII/28 of the seventh meeting of the Conference of Parties to the CBD in 2004 laid out the following timelines:

- by 2006, complete area system gap analysis at national and regional levels;
- by 2008, take action to address the underrepresented marine ecosystems in existing national and regional systems of protected areas taking into account marine ecosystems beyond areas of national jurisdiction in accordance with applicable international laws;
- by 2009, designate the protected areas identified through the gap analysis; and
- by 2012, complete the establishment of comprehensive and ecologically representative national and regional systems of Marine Protected Areas.

Later, in 2006, the eighth meeting of the Conference of Parties to the CBD also endorsed Decision VIII/15 that called for "Effective conservation of 10% of each of the world's ecological regions by 2010".

A common point of concern is over terminology. What exactly is a Marine Protected Area? One general definition indicated that it is a marine area that meets the definition of a 'Protected Area' as initially defined by the then World Conservation Union (now the International Union for the Conservation of Nature (IUCN)) for terrestrial ecosystems. This and similar definitions relating to MPAs are shown in Box 1 below.

Accordingly, the term 'Marine Protected Area' could cover generically any area that meets the World Conservation Union's definition regardless of shape, size, purpose and management approach. Due to the diverse terminology and confusion

⁷ Given the practical impossibility of achieving such a target one's confidence in the scientific merit of such a recommendation is undermined.

Box 1. Definitions of Marine Protected Area

The International Union for the Conservation of Nature defined MPA as: *A clearly defined geographical space, recognized, dedicated, and managed, through legal or effective means, to achieve the long-term conservation of nature with associated ecosystem service and cultural value.*

The Convention on Biological Diversity, meanwhile, has adopted a slightly different definition of MPA as: *A geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives.*

Both of these definitions would require that the site must be set aside principally for conservation in order to be designated a Marine Protected Area. More specifically, the World Conservation Union also went further and defined a Marine Protected Area as: *Any area of intertidal or sub-tidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all enclosed environment.*

The Convention on Biological Diversity attempted to solve the definitional problems of a Marine Protected Area that includes adjacent land by defining the broader term of 'Marine and Coastal Protected Area' (MCPA, for short) as being: *Any defined area within or adjacent to the marine environment, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by legislation or other effective means, including customs, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings.*

Box 2. Protected Area Management Categories (IUCN, 1994)

Category created mainly for:

- I. Scientific purposes or as a strict nature reserve; wilderness protection.
- II. Ecosystem protection and recreation (often National Park).
- III. Conservation of specific natural features (often National Monument).
- IV. Conservation through close management and monitoring of species.
- V. Landscape/seascape conservation and recreation (no protection assigned).
- VI. Sustainable use of natural ecosystems.

surrounding protected areas, the six protected area management categories shown in Box 2 were developed by IUCN in 1994 and endorsed in 2004 by the Conference of Parties to the CBD.

These definitions and their implicit purposes suggest that the over-riding goal of MPAs is to protect and maintain biological diversity and ecosystem processes that result in the provision of ecological services and the dynamic stability of natural systems. The emphasis in most of these definitions is on 'protection' rather than 'sustainable use', which is unfortunate in the light of the emphasis on sustainable use in the outcomes of the World Summit on Sustainable Development (WSSD) in 2002. Indeed the UNEP World Conservation Monitoring Centre reported in 2008 that "areas managed in order to ensure a sustainable fishery rather than to protect biodiversity are generally not recognised as protected areas in the IUCN sense, even where these are more strictly protected, such as trawl-ban areas, than some areas set aside for marine biodiversity conservation" (UNEP-WCMC, 2008). A further difficulty arises if most fishing communities and local fisheries officers continue to widely understand MPAs as areas that are closed to fishing.

The experience of the Philippines with lack of compliance with no-take 'fish sanctuaries'⁸ lays stress on the importance of focussing on the concepts of sustainable use and fishery-critical habitat

linkages in communicating with government officials and coastal fishing communities in Southeast Asia about spatial fisheries management tools. These concepts are more easily understood and likely accepted at the fisheries community level than either the science of no-take areas or the concept of biodiversity and its conservation. Given the ubiquity of small-scale fishing and community dependence on fisheries in the SCS region, the RWG-F concluded that any approach developed should result in tangible benefits in terms of the maintenance of critical fisheries habitats (and hence fisheries production) while at the same time minimising the costs borne by fishing communities in terms of reductions in household income and food production (UNEP, 2006a).

2.3.3. Consideration of the purported fisheries benefits of Marine Protected Areas

In order to achieve maximum benefits, the selection of areas as MPAs must give adequate consideration to the links between specific locations and the life-cycle of important species (Russ and Alcala, 1996; Jennings, 2001; Hilborn et al., 2004). The RWG-F identified that these linkages are currently not given adequate consideration in the selection of sites for MPA systems in the South China Sea despite the promotion of these systems on the basis of their purported fisheries benefits (UNEP, 2006a). It is unfortunate that the creation of MPAs in Southeast Asia has often been 'sold' to fishing communities in terms of the fishery benefits. In reality, traditionally established and well managed MPAs are frequently associated with increased abundance, biomass and sizes of both focal and other species within the no take areas of an MPA (Russ and Alcala, 2004). The RWG-F considered whether MPAs, as currently designed, would actually result in any economic or food security benefits associated with increased fish availability at the fishery level in light of intense inshore small-scale fishing pressure. It was concluded that, at least in the short-term, the reverse could occur because the catch per unit effort declines as a result of increased effort in other areas of the fishery by fisherfolk displaced by the establishment of the MPA (UNEP, 2006b).

It has been recognised that, via the export of juveniles and adults, catch per unit effort (CPUE) in areas adjacent to MPAs can be enhanced (Russ, 2002). However, there are few examples of increased abundance and catch of fish adjacent to MPAs in the South China Sea. The Nha Trang Marine Reserve in Viet Nam, for example, has shown little evidence of benefits either in increased fish stocks or increased income of fishing communities outside the protected area. While it is indisputable that biomass in strictly enforced no-take MPAs may increase over time, the RWG-F identified that, with the limited information available, it may be unwise

⁸ The "Philippine Coral Reefs through Time" report (Philreefs, 2003) identified lack of compliance and poaching as a key threat to fish sanctuaries established along the South China Sea coast. For example, in the case of a sanctuary established at San Salvador Island in Masinloc municipality, compliance issues had resulted in growing tension between the municipal people's organization and the "Bantay Dagat" (a civilian fisheries enforcement group made up of volunteers).

to anticipate increased production across the entire geographic range of the fisheries as a result of the establishment of such areas. It is important to reiterate the RWG-F view that, in effect, fisherfolk displaced from fishing areas following the establishment of an MPA will likely intensify their effort in other areas and that this may result in a decline in CPUE at the fishery level.

Such short term declines in CPUE would likely be expected as MPA theory dictates that spill-over benefits depend on the accumulation of at least one generation of new recruits. The period of time in which this accumulation might be expected to occur also depends on the life-history of the species concerned. For example, longer periods are required for building stocks of long-lived species (Caddy and Seijo, 1998). Russ et al. (2005) reported on the experience of MPA use in the Philippines, indicating that at one site it took four years of strict compliance to enable detection of small increases in biomass of high trophic level predatory species within a no-take MPA. It was further noted by Russ and Alcala (2004) that fish density and biomass were still increasing after nine years at one MPA in the Philippines and 18 years in another.

Hilborn et al. (2006) noted that three generalisations can be drawn from models of the effects of MPAs on fisheries yields: (1) MPA establishment may increase yields when fishing effort cannot be controlled and stocks would otherwise be overfished but is unlikely to improve yields of lightly fished stocks; (2) they may reduce inter-annual variability in catch in the face of stochastic events such as recruitment failure; and (3) that greatest fisheries benefits from MPAs are expected for species with intermediate rates of movement. Models suggest that MPAs are typically not effective for highly mobile species and that fishery level benefits are rarely observed for species with low rates of movement.

Hilborn et al. (2006) modelled the effects of MPA establishment within a regulated, single species fishery with a defined Total Allowable Catch based on Maximum Sustainable Yield (MSY). This demonstrated that when a stock is managed at MSY, or is overfished, the establishment of an MPA results in a decrease in abundance and catch across the fishery due to increased fishing pressure on the stock outside the MPA. Only in a heavily overexploited fishery where the stock is heading towards extinction will the establishment of an MPA not result in reduced fish availability and yield. It was concluded that, in all cases, fishing effort must be reduced outside an MPA for its establishment to result in any tangible fishery benefits.

Such outcomes suggest that simply establishing an MPA without consideration of the ecology and population characteristics, particularly the adult dispersal rates of the target species, is likely to be ineffective in enhancing fish catch. This is confirmed by the findings of a recent review of MPA effectiveness undertaken in connection with the proposal to establish a network of 'fish stock recovery areas' in Europe (Roberts and Hawkins, 2012). This review highlights the quantification of the number and biomass of the lobster *Palinurus elephas* spilling over from Columbretes Islands Marine Reserve (CIMR) in Spain and their contribution to local fishery catches reported by Goñi et al. (2010). In terms of the number of lobsters emigrating from the CIMR, spill-over did not account for the loss of fishing grounds associated with reserve establishment, although it did in terms of weight because the mean size of the lobsters emigrating from the reserve was larger than those outside it. These findings place further emphasis on the need to consider fish life cycle and habitat linkages in the designation of such management areas for fisheries. Particularly when they are considered in relation to the unique life history characteristics of palinurid lobsters, which incorporate aspects of both *r*- and *K*-selection (Sastry, 1983), and the role of stochastic forces and density dependent regulation in the population dynamics of palinurids (Caddy, 1986).

From the perspective of fisheries habitat management, it is also unlikely that MPAs designed without adequate consideration of fish life-cycle and critical habitat linkages will lead to effective management of habitat areas important to fisheries. Fishing communities in Southeast Asia often possess intimate knowledge of fish life-cycles and dynamics (see Ruddle, 1994). The establishment of MPAs that appear incompatible with this community-based information or cannot promise direct fishery benefits is unlikely to receive support from fishing communities.

2.3.4. Natural *refugia* and defining fisheries *refugia*

Against the background of widespread over-exploitation of South China Sea fish stocks as well as the lack of sound empirical evidence for the value of MPAs in enhancing fish stocks and catch in the region, the RWG-F noted that numerous fisheries observers, including Walters (1998), Caddy (1999) and Pauly et al. (2005), had recently reviewed the concept of 'natural *refugia*' and their role in the sustainability of fisheries. During its sixth meeting the RWG-F (UNEP, 2006a) gave consideration to the role of *refugia* in fisheries in other regions, noting the example of high recruitment of hake in the Mediterranean during the 1980s despite a complete lack of input and output controls and a high percentage of juvenile fish being caught by inshore trawlers. It was noted that this is believed to have occurred due to larger spawning fish occupying deeper areas of the continental shelf in 'natural *refugia*' resulting from the inability of the fine inshore trawls to successfully catch fish at that depth. In that scenario, the large unfished individuals were thought to make a major spawning contribution to the adjacent fishery⁹.

Pauly (1997) suggested that even very low rates of fishing mortality may be unsustainable in long-lived demersal stocks unless a sizable fraction of the spawning adults are made completely inaccessible to fishing activities by occupying some natural refuge (underwater canyons, large boulders, etc.). This contention was based on the fact that many demersal species in temperate waters and large predators on coral reefs are long-lived with natural mortalities of 0.1–0.2 year⁻¹ implying that sustainable fishing could not extract more than about 10% of the stock biomass per year. Pauly (1997) also explained that such exploitation rates quickly remove the accumulations of large and old females that are the source of most eggs and subsequent recruitment to stocks of long-lived fishes. In addition, he also suggested that the relationship between fish size and fecundity is highly non-linear with large females being far more fecund than an equivalent weight of small individuals. As an example, he cited the case of the red snapper (*Lutjanus campechanus*) in which a single female (61 cm and 12.5 kg) contained the same number of eggs (9,300,000) as 212 females (42 cm and 1.1 kg each).

As fishing technology has developed and the size of fishing fleets has increased, the extent of natural *refugia* for fish stocks has declined, particularly in Southeast Asia where intensive and destructive fishing practices such as trawling and push netting have seriously disturbed large areas of soft bottom habitats (Pauly and

⁹ The concept of natural *refugia* is well developed in the fields of terrestrial ecology and wildlife management. For example, Novaro et al. (2000) noted that wildlife hunting studies have shown that sustainability in these systems is often due the presence of inaccessible and undisturbed habitat that act as natural *refugia* for hunted species and provide a source function for rebuilding populations in areas depleted by hunting. In this connection, sustainability of resource use is evaluated on the basis of information relating to the geographical range, life-cycles, and migratory patterns of hunted species between *refugia* and hunting sites. The use of spatial controls recognising the "source-sink" nature of these systems are utilised to regulate harvests and often provide an effective platform for engagement with local communities, resource users, and policy makers.

Chuenpagdee, 2003). Furthermore, the degradation and loss of coastal habitats, such as mangrove forests, as a consequence of coastal infrastructure development, has dramatically reduced the expanse of habitats that have important nursery functions for commercial and subsistence species. The RWG-F identified that the maintenance of natural *refugia* critical to the life-cycle and sustainability of fished species or the establishment of *refugia* in cases where natural *refugia* no longer exist, should be an important priority in managing intense small-scale fishing pressure, particularly from the perspective of the food security objective for Southeast Asian fisheries management.¹⁰ In this context, the RWG-F developed the concept of fisheries *refugia* (Box 3) (UNEP, 2005; 2006a).

This definition focuses on sustainable use and clearly states that *refugia* will not simply be no-use areas. The intent of the RWG-F in defining fisheries *refugia* was that the concept should not be substituted for permanent closures or no-take MPAs and *vice versa*. Fisheries *refugia* differ from the short term area and seasonal closures commonly used in fisheries management (e.g., spot closures and closed seasons) that are often implemented in small well-defined areas of fishing grounds. The fisheries *refugia* concept, in contrast, is based on areas of critical importance to the life-cycle of the species. This means that areas located outside fishing grounds for a given species, which are critical to the life-cycle for that species, might need to be managed as fisheries *refugia*. Such management may include, for example, interventions aimed at reducing the impacts of the incidental capture of juveniles of a given species by another fishery operating in areas critical as inshore nursery *refugia* for that particular species. It may also include interventions to provide habitat protection, to ensure that areas important for egg deposition are not disturbed and/or to safeguard habitats that provide protection for juveniles from predators, such as mangroves and seagrass. Spot closures and closed seasons would form part of the suite of available management actions that could be used within a designated *refugia* management regime but the designated area or 'place' (Pauly, 1997) is the *refugia* itself. The distinction between *refugia* and other forms of area-based management in fisheries is the focus in the case of *refugia* on the nature of the habitat rather than simply the area *per se*.

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 resource¹¹ 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

Box 3. Definition of fisheries *refugia*

"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".

Thus, fisheries *refugia* should:

- not be simply 'no take zones';
- have the objective of sustainable use for the benefit of present and future generations;
- provide for some areas within *refugia* to be closed due to their critical importance [essential contribution] to the life cycle of a species or group of species;
- focus on areas of critical importance in the life cycle of fished species, including spawning and nursery grounds, or areas of habitat required for the maintenance of brood stock;
- have different characteristics according to their purposes and the species or species groups for which they are established and within which different management measures will apply; and
- have management plans.

Management measures that may be applied within fisheries *refugia* may be drawn from the following [non-exhaustive] list of classical fisheries management actions:

- exclusion of a fishing method (e.g. light luring, purse seine fishing);
- restricted gears (e.g. mesh size);
- prohibited gears (e.g. push nets, demersal trawls);
- vessel size/engine capacity;
- seasonal closures during critical periods of fish life cycles;
- seasonal restrictions (e.g. use of specific gear that may trap larvae); and
- limited access and use of rights-based approaches in small-scale fisheries.

level, a task which is formidable given the past history of interactions between 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.

3. Establishing a regional system of fisheries *refugia*

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

3.1.1. Dissemination of 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.

¹⁰ In adopting the 2001 ASEAN Resolution on Fisheries and Food Security and the Plan of Action on Sustainable Fisheries for Food Security, the Ministers of the ASEAN-SEAFDEC member countries who are responsible for fisheries resolved *inter alia* to "work towards the conservation and rehabilitation of aquatic habitats essential to enhancing fisheries resources". Furthermore, in adopting the 2011 Resolution on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020, the Ministers responsible for fisheries resolved *inter alia* to "Implement effective management of fisheries through an ecosystem approach to fisheries that integrates habitat and fishery resource management aimed at increasing the social and economic benefits to all stakeholders".

¹¹ The RWG-F developed and agreed listings of pelagic and demersal fish species, cephalopods, and crustaceans of transboundary significance during its second meeting in October 2002. In considering the species of transboundary significance for which the development of a regional system of fisheries *refugia* should focus, the RWG-F revised these lists during its ninth meeting convened on Phu Quoc Island, Viet Nam from 10th–13th July 2007. The agreed species listings are contained in Annex 5 of the report of that meeting (UNEP, 2007c).

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 |
| <p>Longer-term objectives</p> <p>Increased average size of important species. Increased egg production of important species. Increased recruitment of important species. Increased biomass of important fish species.</p> <p>Shorter-term objectives</p> <p>Safeguarding of natural <i>refugia</i>. 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.</p> | <p>Longer-term objectives</p> <p>Community-based management of fisheries <i>refugia</i> 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.</p> <p>Shorter-term objectives</p> <p>Community-based management of fisheries <i>refugia</i> 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.</p> |

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.¹²

3.1.2. 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,¹³ while the same circumstances in offshore areas may cause recruitment over-fishing¹⁴ 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 life-cycle 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 over-fishing (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 by 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 below.

3.1.3. 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

¹² <http://refugia.unepscs.org>.

¹³ Growth overfishing is caused by levels of fishing beyond that required to maximise yield per recruit, and typical involves a size at first capture in the fishery that results in an unsustainably high percentage of juveniles and pre-recruits being captured (Pauly, 1984).

¹⁴ Recruitment overfishing is caused by a level of fishing in which the adult stock is reduced to the extent that recruits produced are insufficient to maintain the population (Pauly, 1984).

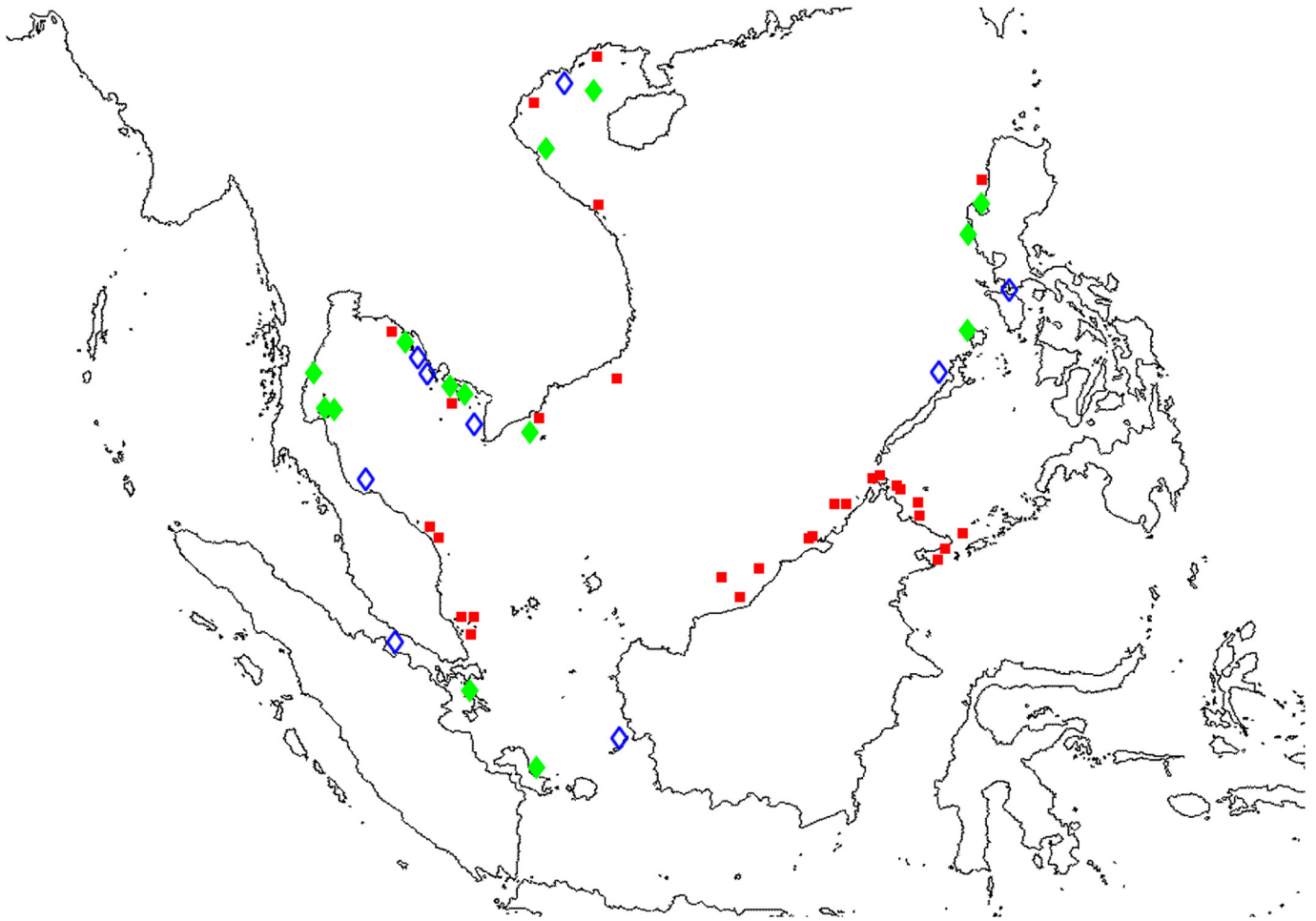


Fig. 1. Location of: initial sites selected for inclusion in the regional system of *refugia* [◆]; sites of high priority for inclusion in the regional system once the initial set have been established [◇]; and other known spawning and nursery areas for fish species of transboundary significance [■].

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.¹⁵

3.1.4. 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 South China Sea 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

¹⁵ See Annex 5 of the Eighth RWG-F Meeting Report (UNEP, 2007b) entitled “Distribution and Abundance of Fish Larvae in the Gulf of Thailand and South China Sea”.

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 South China Sea 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’¹⁶ on the fisheries *refugia* concept involving staff of national and provincial fisheries and environmental agencies.

3.2. Incorporation of targeted actions for a regional system of fisheries *refugia* in the revised strategic action programme for the South China Sea

3.2.1. Agreeing objectives and targets for a regional system of fisheries *refugia*

A key consideration in the future development of the regional system of fisheries *refugia* was the development of clearly defined goals and objectives for the system. The RWG-F identified specific resource-related and institutional-related objectives for the system that were used as the basis for the design of regional and national plans for the regional *refugia* system. The regional plan was developed within the framework of the revised fisheries component of the Strategic Action Programme (SAP) for the South China Sea (UNEP, 2008a) with the fisheries *refugia* initiative being central to both the regional and national aspects of planned SAP implementation.

The revised broad objectives of the fisheries component of the SAP as developed by the RWG-F and subsequently approved by the Project Steering Committee in August 2008, following extensive national and regional consultations, are to:

- build the resilience of Southeast Asian fisheries to the effects of high and increasing levels of fishing effort;
- improve the understanding among stakeholders, including fisherfolk, scientists, policy-makers, and fisheries managers, of ecosystem and fishery linkages as a basis for integrated fisheries and ecosystem/habitat management; and
- build the capacity of fisheries departments/ministries to engage in meaningful dialogue with the environment sector regarding the improvement of fisheries and management of interactions between fisheries and critical marine habitats.

The agreed targets for the fisheries component of the Strategic Action Programme are:

- by 2012, to have established a regional system of a minimum of twenty *refugia* for the management of priority transboundary, fish stocks and endangered species; and
- by 2012, to have prepared and implemented fisheries management systems in the identified *refugia* based on, and consistent with, the ASEAN SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia.

More specifically the planned activities are expected to achieve the following outcomes in addition to the targets specified above:

- improved integration of habitat and biodiversity conservation considerations in the management of fisheries in the South China Sea and Gulf of Thailand;
- improved national management of the effects of fishing on critical habitats within fisheries *refugia*; and,
- enhanced uptake of good practice in integrating fisheries management and biodiversity conservation in the design and implementation of regional and national fisheries management systems and Marine Protected Areas.

3.2.2. Planned national actions for fisheries *refugia*

It was recognised that the achievement of the SAP targets depend on successful national management of fisheries *refugia*. The final three meetings of the RWG-F during 2007–2008, including an *ad-hoc* meeting of the group, were used to elaborate costed national fisheries *refugia* plans that focused on: strengthened national coordination mechanisms to accommodate effective planning, monitoring and evaluation of *refugia* designation and management; development of the institutional enabling environments for fisheries *refugia* at national and provincial levels; development and implementation of national fisheries *refugia* science programmes; and operation of the priority fisheries *refugia* sites. These national action plans contained 250–300 national activities per country, each including identification of the role of key national partners, timing, availability of national recurrent budget sources and donor assistance required for implementation, and a detailed description of the basis for the cost estimates.

3.2.2.1. Enhancing national coordination. The national coordination elements of the action plans focus on strengthening linkages between National Fisheries Committees (NFCs) and the National Inter-Ministerial Committees (IMCs) established or revitalised through the UNEP/GEF South China Sea project. Specific planned actions involve revision of NFC terms of reference to accommodate overarching responsibility for the establishment of national fisheries *refugia* and the establishment of feedback mechanisms between the NFCs and IMCs for national level monitoring and evaluation of *refugia*. This component also embodies expansion of national coordination to include establishment of provincial or community level cross-sectorial management boards at priority *refugia* sites with responsibility for day-to-day oversight of *refugia* management and reporting to the NFCs.

3.2.2.2. Strengthening the enabling environment. National plans focus on strengthening the enabling environment for formal designation and operational management of *refugia*. Preparatory activities include legal reviews to identify, *inter alia*: legal terminology for describing *refugia*; formal procedures for demarcating boundaries of spatial management areas such as *refugia*, including requirements for assessing the socio-economic impacts of management measures and stakeholder consultation; and provisions for decentralising *refugia* management to the community level via development of co-management and rights-based approaches. These national reviews are intended to enable the drafting of any required policy and legislative amendments for adoption by competent authorities. As all the participating countries have endorsed the ASEAN-SEAFDEC Regional Guidelines on the Use of Fisheries *Refugia* for Sustainable Capture Fisheries Management in Southeast Asia (SEAFDEC, 2006) via the inter-governmental SEAFDEC Council process, it is envisaged that strengthening of the policy

¹⁶ So-called, because they were intended to “echo”, at the national level, the content of the regional training course.

enabling environment will be largely facilitated through drafting and approval of national guidelines on the establishment and operation of fisheries *refugia* for dissemination through national IMCs, NFCs, local *refugia* management board networks, and various national fisheries and environment forums.

3.2.2.3. Building the national and site-level science and information base. Key science activities include development and update of national fisheries databases for use in preparing annual syntheses of new and additional information and data relating to the status of stocks of priority fish, crustacean and mollusc species for dissemination at national and regional levels. Important elements of these synthesis reports are assessments of biomass trends, recruitment and fish size derived from abundance surveys, as well as volume and value of landings by fishing area and fishing gear used. To build on foundational fish early life history science capacity, developed through the UNEP/GEF South China Sea project, participating countries plan to establish and populate national databases of fish egg and larvae distribution and abundance. Individual country plans include actions to develop combined national Geographical Information Systems (GIS) on fisheries and marine biodiversity featuring information on locations and management status of coastal habitats, fisheries *refugia*, MPAs, and critical habitats for threatened and endangered species. It is envisaged that these national GIS databases will be used in the preparation of annual syntheses of new and additional data relating to the science and management of fish life-cycle and critical habitat linkages.

The development of fisheries and habitat data collection programmes at *refugia* sites are included in this component of national activities. Initial planned steps include compilation of information sources into site characterisations focussing on the quality and expanse of habitats, trends in annual production and value of harvests, the number and type of fishing vessels and gear used in the area and village/community level socio-economic information. Site level survey programmes will include regular collection of information and data on: the number and types of fishing vessels operating in the *refugia* area; the species and size selectivity of the principal fishing gear used; gonadosomatic index and size frequency of priority species utilising the area; the role of fisheries *refugia* in the production (and economic value) of priority fish, crustacean, and molluscs; and usage of *refugia* by threatened and endangered marine species. Stakeholder consultations aimed at obtaining the support of fishing families and fish buyers in community-based information and data collection are also included.

3.2.2.4. Planning operational management of *refugia*. The final set of planned national activities relates to the establishment of operational management at priority fisheries *refugia*. The establishment and operation of site-level management boards highlighted above is to enhance communication among stakeholders involved in fisheries management and biodiversity conservation at the sites, including provincial government officials, fisheries officers, staff of environment agencies, community representatives, NGOs and enforcement agencies. It is envisaged that *refugia* management boards will be served by management teams comprising a site manager and technical supporting staff from provincial fisheries and environment agencies. Operational *refugia* management will be supported via the establishment of networks of community-based fisheries and habitat management volunteers. Plans include community capacity-building workshops on aspects of fisheries and habitat management, such as information and data collection, responsible fishing gear and practices, habitat and biodiversity conservation, and co-management.

Community-based *refugia* management plans are anticipated outputs of this component of national plans. Proposed supporting

activities include consultative processes to facilitate agreement among stakeholders on the boundaries of fisheries *refugia*, identification of key threats to *refugia* sites, recording of fishing community views regarding appropriate fisheries and habitat management measures, and eliciting stakeholder inputs to management plan review. *Refugia* management plans will provide rules *inter alia* on operating requirements for the use of particular classes of fishing vessels or fishing gear within *refugia*, procedures for adjusting management measures over time, and mechanisms for enforcement. Specific direction is given to drafting of regulations and ordinances required in support of plan implementation. All countries have identified the need for management plans to contain community education and awareness programmes, mainly with a focus on participatory activities to monitor the status of fish habitats within the *refugia*, collect lost and abandoned fishing gear, and develop responsible fishing practices at the community level. Several countries, namely Viet Nam and Philippines, extended this to include the development of collaborative observer programmes among community volunteers and national and provincial fisheries enforcement agencies to detect illegal and destructive fishing activities in fisheries *refugia* and adjacent areas of sensitive habitats.

3.2.3. Planned regional actions for fisheries *refugia*

The revised South China Sea SAP presents a shared vision regarding the actions that need to be undertaken at the regional level in support of national actions. Regional level actions include, *inter alia*, networking, capacity building, public awareness and education, and applied research into management techniques and approaches that maximise the level of sustainable use without adverse environmental impact. In terms of the ongoing development of a regional network of fisheries *refugia* sites, key regional supporting actions were planned to assist countries with ongoing identification of fishery and critical habitat linkages and in improving the management of fish stocks and critical habitats for fish stocks of transboundary significance.

3.2.3.1. Regional Information and Data Management. Specific actions were planned to support countries through the development of protocols for delineating the boundaries of critical habitat areas that act as fisheries *refugia* and the regional compilation of information and data into a regional GIS on the distribution of coastal habitats, fisheries *refugia*, locations of Marine Protected Areas and fisheries management zones, as well as fish egg and larvae distribution and abundance. The development of a modelling system, linking known sources and sinks of fish larvae to ocean circulation patterns and nutrient/chlorophyll concentrations in the South China Sea and Gulf of Thailand, was also given priority as a means of improving regional understanding of fish early life history and links to critical habitats.

3.2.3.2. Targeted demonstration activities. Actions to support and guide National Fisheries Departments in establishing coastal fisheries management systems in priority fisheries *refugia* were identified. Building on experiences with the habitat demonstration site approach developed by the UNEP/GEF South China Sea project, it was agreed that two *refugia* in each country would be used to trial rights-based and co-management approaches to fisheries *refugia* management. Sites would be selected in each country to identify and trial approaches to reducing the effects of trawl and push net fishing on seagrass habitat, as well as to test the use of fishing gear and practices that reduce the capture of juveniles, pre-recruits and fish in spawning condition.

3.2.3.3. Capacity development. Development of human resource capacity for the identification and management of fisheries *refugia*

and improving information management and dissemination represented the second core group of regional supporting activities. Annual regional training workshops on fisheries *refugia* management, larval fish identification and fish early life history science, development of a regional Information and Education Campaigns (IEC) for small-scale fishing communities on the critical links between fish stocks and their habitats and the preparation of guidelines on how to empower communities to enforce agreed management rules in fisheries *refugia* form priority SAP actions. It was agreed that this activity component would support the development of indicators to monitor the effectiveness of coastal fisheries management systems established in priority fisheries *refugia*. A regional programme for the compilation of standardised fisheries statistics for use in identifying and managing fisheries *refugia* would be developed to support monitoring and evaluation.

3.2.3.4. Supporting regional fisheries management. It was also agreed that actions would be implemented in support of regional fisheries management arrangements. Specific planned actions included, *inter alia*: promotion in regional forums and media of the role of the regional system of fisheries *refugia* in harmonizing fisheries and environmental management; establishment of a regional collaborative network of experts to guide the scientific, policy, and legal arrangements for the management of *refugia* in national waters; and the establishment of joint fisheries management frameworks between and among countries that share the use of critical habitat areas for fish stocks of transboundary importance and rare and endangered species. It was further agreed that the generation and uptake of good coastal fisheries management practices would be supported via the development of guidelines on managing the effects of fishing on coastal habitats and biodiversity.

3.3. Development of a regional project to implement the fisheries component of the South China Sea strategic action programme

Progress and achievements of the initiative to establish a regional system of fisheries *refugia* were considered in detail during the South China Sea Project's Third Mayors' Round-Table and Third Regional Scientific Conference convened in November 2007. These events were convened to provide members of the UNEP/GEF South China Sea project network an opportunity to review and assess the project's overall progress, accomplishments and output to date; and to share their respective implementation experiences, concerns and issues. The fisheries *refugia* initiative received high praise from fisheries and habitat experts participating in those meetings as a novel approach to improving communication between fisheries and environment sectors.

This uptake and acknowledgement of the approach prompted the RWG-F to consider the development of a proposal for a GEF project in support of the implementation of the fisheries component of the SAP aimed at making the planned regional *refugia* system operational. The eighth meeting of the UNEP/GEF South China Sea Project's Regional Scientific and Technical Committee (RSTC) and seventh meeting of the Intergovernmental Project Steering Committee (PSC), both convened in December 2007, considered a draft Project Identification Form (PIF) developed by the RWG-F for a proposed GEF project entitled "*Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand*". The RSTC agreed that the RWG-F should continue with the development of this project and that this should be recommended to the PSC. The PSC subsequently directed the RWG-F to proceed with national level consultations regarding this project and prepare an update for review during its eighth meeting.

Discussions between the then UNEP Division of Global Environment Facility Coordination (UNEP/DGEF) and the GEF

Secretariat indicated that, given the alignment of the project with the strategic objectives of both the GEF International Waters and Biodiversity focal areas, GEF support should be sought for a multi-focal area funded project through the GEF's 4th replenishment (GEF-4). It was recommended that countries work to programme national allocations for biodiversity under the GEF's Resource Allocation Framework (RAF) for national level *refugia* activities that aligned with the GEF-4 strategic objectives for biodiversity on "*Catalyzing Sustainability of Protected Area Systems and Strategic Program on Increasing Representation of Effectively Managed National Marine Protected Areas in Protected Area Systems*" and "*Mainstreaming Biodiversity in Production Landscapes/Seascapes and Sectors*". Support from the international waters focal area was to be sought for implementation of regional actions and coordination.

Through the application of the fisheries *refugia* approach, the project would be intended to contribute to the achievement of GEF biodiversity objectives by enhancing understanding of the effectiveness of different forms of marine biodiversity protection and how to combine conservation goals with the generation of local benefits in the fisheries sector in the light of intense small-scale fishing pressure in a global centre of shallow water marine biodiversity. The project was also intended to contribute to the GEF-4 International Waters focal area Strategic Objective 1 "*To play a catalytic role in addressing transboundary water concerns by assisting countries to utilize the full range of technical assistance, economic, financial, regulatory and institutional reforms that are needed*" and the International Waters Strategic Program on Restoring and Sustaining Coastal and Marine Fish Stocks and associated Biodiversity and, further, support policy, legal and institutional reforms and multi-agency partnerships that contribute to WSSD targets for sustaining fish stocks.

It was planned that the project would be linked to the network of the UNEP-administered Regional Seas Programme and the Action Plan for the Protection and Development of the Marine and Coastal Areas of the East Asian Region. The planned involvement of SEAFDEC as a regional project Executing Agency was for the purposes of establishing greater political support and enhanced mainstreaming of fisheries habitat and ecosystem considerations with broader fisheries management initiatives in Southeast Asia. Both the RSTC and PSC recommended that the PIF for this project should be submitted as soon as possible in order to ensure smooth transition to implementation.

By February 2009, all countries had secured GEF Operational Focal Point endorsement and co-financing commitment letters in support of the project, including substantial contributions of national biodiversity allocations toward project implementation. SEAFDEC had also indicated its willingness to contribute significant cash and in-kind co-financing to the project. At the time of the SCS project closure on 31st January 2009, plans were in place to seek endorsement of this project for inclusion in the April 2009 GEF inter-sessional work programme. However, UNEP/DGEF did not submit the PIF to the GEF during 2009 and, while actions were taken during 2010–2012 to revitalise efforts to seek GEF Chief Executive Officer endorsement of this project under the GEF's fifth replenishment (GEF-5), the project had not been submitted at the time of preparing this article.

4. Discussion

4.1. Experiences in the uptake of the fisheries *refugia* concept

4.1.1. 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 Viet Nam in the use of fisheries *refugia* as a tool for integrated fisheries and habitat management in the Phu Quoc Archipelago. The extensive seagrass meadows adjacent to the Ham Ninh commune of Phu Quoc represent 8 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 netting, traps, intertidal gleaning and raking, and hookah diving (UNEP, 2007d).

The intensity of fishing operations in the nearshore 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 Phu Quoc 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, 2007d).

The fisheries *refugia* concept was well received by the Kien Giang 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.

4.1.2. *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 Phu Quoc 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 longer-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 Kien Giang'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).

4.1.3. *Focus on fish life-cycle – 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 inshore 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 Phu Quoc 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, 2008c).

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 Viet Nam'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 Phu Quoc (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's 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.

4.2. Comparing Marine Protected Areas 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.

The characteristics of traditional no-take MPAs and fisheries *refugia* are compared in Table 2. 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 Sections 4.1.1–4.1.3 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 over-exploitation 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 life-cycle 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.

Table 2

Comparisons between the objectives, benefits, site selection criteria, use and acceptability of traditional MPAs and fisheries *refugia*.

| | Marine protected areas | Fisheries <i>refugia</i> |
|---------------------------------|--|--|
| Strategic objectives | Protection of biodiversity tourism increased fish production | Improved management of fish stock and habitat links increased resilience of stocks |
| Purported fisheries benefits | Enhanced stock inside MPA leads to bigger catches outside | Safeguarding fish in places and at times critical to their life-cycle will reduce growth and recruitment over-fishing |
| Site selection criteria | Species diversity/richness, uniqueness of the site, site's representativeness | Importance to the life-cycle of economically important species and likelihood to improve stocks |
| Use status | Strict protection – multiple use (typically no-take fisheries zones in SCS) | Based on sustainable use rather than prohibition of fishing |
| Acceptability to communities | Concern that costs outweigh benefits enforcement is costly | Objectives and scientific basis well accepted by fishing communities and local officials |

4.3. 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.

As noted previously, the decadal rates of decline in total area of critical habitats such as seagrass, coral reefs, and mangroves in the region are currently estimated at 30 percent, 16 percent, and 16 percent respectively. Fishing contributes to the loss and degradation of seagrass and coral reef habitats. The achievements of the fisheries *refugia* initiative of the UNEP/GEF South China Sea project have been significant in developing the scientific, institutional and policy basis required to reduce the rates of loss of globally significant habitats and biodiversity due to fishing. This is considered important because of the potential global fisheries benefits associated with effective fisheries and habitat management at the local level, which is particularly important in the case of Southeast Asia due to the continuing importance of fisheries to food security and the maintenance of livelihood.

Many Marine Protected Areas established around the world have been promoted in terms of their potential to improve the state of fisheries and their habitats, but in the South China Sea have rarely included mechanisms to ensure the effective integration of fisheries considerations into management. In contrast, fisheries departments and ministries largely focus on achieving sustainable yields from fish stocks. Experience in the South China Sea Project suggests that cross-sectoral co-ordination can be achieved through the fisheries *refugia* concept that has provided a platform for building partnerships and enhancing communication between the environment and fisheries sectors. Indeed, the joint development of a project proposal and national commitments to resource the implementation of the regional system of fisheries *refugia* was a significant step by these sectors. The national level agreements reached between environment and fisheries ministries during 2008–9 to programme national GEF biodiversity allocations and significant national recurrent public budget sources in support of this initiative reflect national priorities regarding biodiversity conservation.

The political acceptance of the *refugia* approach is evidenced by the intergovernmentally approved guidelines for the establishment of fisheries *refugia* that constitute part of the ASEAN SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia (see SEAFDEC, 2006). In this connection, the 2008 intergovernmental meeting of the SEAFDEC Council urged SEAFDEC member country governments to develop projects and initiatives aimed at ensuring more ecosystem based approaches to fisheries management in the region.¹⁷ At that time, the fisheries *refugia* concept was included in the following 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 Viet Nam. This represents the first time that regional consensus has been reached on the use of area-based management to build the resilience of Southeast Asian fisheries to the effects of high and increasing levels of small-scale inshore fishing effort. This is to be achieved by enhancing the knowledge and capacity among stakeholders of ecosystem and fishery linkages as a basis for integrated fisheries and habitat management. The outcomes of extensive community and stakeholder consultations and pilot initiatives in the participating countries also suggest that the *refugia* concept is well accepted by small-scale fishing communities and local officials.

5. Conclusions

Given the limited integration of the work of fisheries and environment ministries observed in Southeast Asia and many other parts of the world, the establishment and operation of the regional system of fisheries *refugia* provides an opportunity to learn from a regional fishery sector led initiative to collaborate with the environment sector on integrating fisheries and coastal habitat management. The South China Sea is a global hotspot of marine biodiversity subjected to high and increasing levels of small-scale fishing pressure. Various fisheries management reforms are required to fashion a sustainable future for the fisheries of this marine basin. As such, it is important that the *refugia* initiative is not viewed as a proposed 'panacea' to the fisheries problems of Southeast Asia, rather one of a series of complementary management strategies being promoted regionally, including efforts to curb the high and increasing levels of fishing pressure. However, given the high rates of habitat loss and the high levels of community dependence on small-scale fisheries, it is imperative that efforts to operate the regional fisheries *refugia* system be sustained.

The experience of the UNEP/GEF South China Sea project suggests that the fisheries *refugia* concept has provided an adequate platform for building partnerships and enhancing communication between the environment and fisheries sectors. It also appears to be a successful approach to addressing a significant barrier to the effective 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. By emphasising the sustainable use aspects of *refugia* rather than the no-take approach adopted by many ministries of environment in their approach to MPAs, such adverse reactions are avoided. Perhaps, more importantly, the emphasis of the concept on critical fish stock and habitat linkages provides a suitable platform for dialogue between government institutions responsible for environment and for fisheries in the identification, designation, and management of priority 'places' for fisheries and habitat management. It is anticipated that the experience gained in the South China Sea region will be suitable for application in other marine areas such as the Yellow Sea where over-fishing and the use of inappropriate fishing gear are significant impediments to more sustainable exploitation of fisheries resources and the use of coastal habitats.

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¹⁷ This political resolve was strengthened in 2011 via the adoption of policy guidance to develop projects and initiatives aimed at ensuring more ecosystem based approaches to fisheries management in the region by Southeast Asia's ministers responsible for fisheries (SEAFDEC, 2011).

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