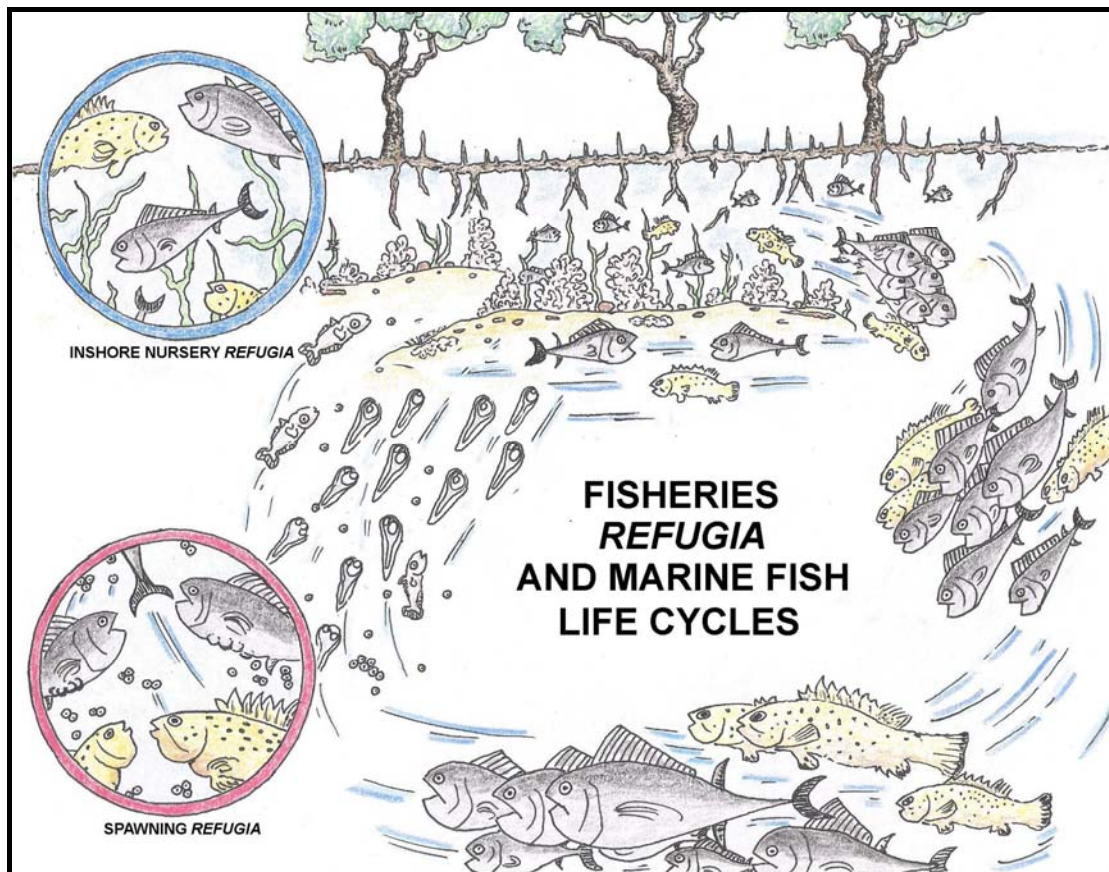




**Procedure for Establishing a Regional System of Fisheries *Refugia*
in the South China Sea and Gulf of Thailand
in the Context of the UNEP/GEF Project Entitled:
“Reversing Environmental Degradation Trends in the South China
Sea and Gulf of Thailand”**





First published in Thailand in 2007 by the United Nations Environment Programme.

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Cover Illustration: Schematic representation of types of *refugia* in relation to the generalised life-cycle of demersal marine fishes.

For citation purposes this document may be cited as:

UNEP, 2007. Procedure for Establishing a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand in the context of the UNEP/GEF project entitled: "*Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*". South China Sea Knowledge Document No. 4. UNEP/GEF/SCS/Inf.4

Procedure for Establishing a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand

BACKGROUND

The South China Sea and Gulf of Thailand is a global centre of shallow water marine biological diversity, supporting a significant world fishery that is important to the food security of, and as a source of export income for, Southeast Asian countries. Landings from this area contribute approximately 10 percent of reported global fisheries production per annum and make significant contributions to the economies, of countries bordering the Gulf of Thailand and the South China Sea. The majority of fisheries are small-scale in nature, and fish are landed in a large number of decentralised locations for distribution through complex marketing networks at the community level. As a consequence estimates of fisheries production are considered to be gross underestimates and do not adequately reflect the importance of the artisanal or subsistence production to the fisheries sector as a whole.

The majority of Southeast Asian countries are among the top 20 capture fisheries producing countries in the world, with some experiencing annual increases in production of up to 5 percent. Pelagic fishes dominate landings by volume and value, as most demersal fisheries are over-exploited (Lundgren *et al.* 2006). It is well accepted, however, that regional fisheries statistics rarely reflect: (a) production from small-scale coastal fisheries, (b) the high level participation of coastal communities in fishing, or (c) the social and economic importance of artisanal and subsistence fishing to coastal communities.

Fish stocks in the South China Sea and Gulf of Thailand are subject to high levels of fishing effort, such that stocks of most economically important species are considered to be fully fished or overexploited. Increasing global demand for fisheries products; and the dependence of coastal communities on fish for food and income results in a continued increase in fishing effort. This has led to “fishing down the marine food chain in the region”, coupled with an increasing dependence of the artisanal sector on small pelagic species due to declining availability of demersal species.

The fisheries and habitat components of the UNEP/GEF South China Sea Project focus on the critical role that habitats such as mangroves, coral reefs, seagrass, and wetlands play in sustaining fisheries production in the South China Sea and Gulf of Thailand. These habitats are known to act as refuges for most economically important fish species during critical stages of their life-cycles including as larvae, for spawning, and for feeding. These habitats therefore play an important role in recruitment and maintenance of fish stocks.

Declining fish availability, coupled with over-capacity and the dependence of the small-scale sector on coastal fisheries for income generation, has led to the adoption of destructive fishing practices by some fishers in order to maintain incomes and food production in the short-term. Fisheries trends suggest that production from capture fisheries will decline over coming years unless total fishing effort and capacity are reduced (Lundgren *et al.* 2006). The obvious problem in the reduction of fishing capacity is that most fisheries are small-scale with the majority of participants (and their families) being highly dependent on fisheries for income, food and well-being.

The fisheries *refugia* concept as developed by the Regional Working Group on Fisheries (RWG-F) is based on the use of area-based or zoning approaches to fisheries management aimed at maintaining the habitats upon which fish stocks depend, as well as minimising the effects of fishing on stocks of important species in areas and at times critical to their life cycle. The fisheries *refugia* concept promotes the sustainable use of fish stocks and their habitats, and the use of criteria for the selection of sites for fisheries and habitat management interventions that focus on fish life-cycle and critical habitat linkages.

THE PROBLEMS

Whilst actions aimed at reducing the rate of loss of coastal habitats of significance to fisheries have been implemented by the countries bordering the South China Sea, the decadal rates of loss of such habitats remain high: seagrass (30%); mangroves (16%); and coral reefs (16%) (UNEP, 2007a). Increasing levels of fishing effort, coupled with continued decline in the total area of habitats critical to the life-cycles of most species, have raised serious concerns for the long-term sustainability of artisanal fisheries in the region.

The dilemma for the fisheries and environment sectors is that conservation of habitat does not necessarily result in increased fish stocks and lowering of fishing effort does not necessarily result in improved habitat condition. Although fish production is intrinsically linked to the quality and extent of habitats; and although the dependence of coastal communities on fish for food and income is high; understanding of this linkage is limited, such that intensive fishing in inshore areas has been identified as the key factor contributing to the continued loss of habitats and biodiversity in the region (UNEP, 2006a). The use of inappropriate and destructive gear and practices, such as the use of demersal trawls and push nets in seagrass areas, and the use of poisons and explosives to catch fish in coral reef areas, is of continuing concern with respect to the degradation and loss of habitats and biodiversity.

The expert members of the regional working groups on fisheries and coastal habitats of the South China Sea Project have agreed that intensive, inshore fishing presents numerous threats to coastal habitats and biodiversity in the South China Sea and Gulf of Thailand including:

- Degradation and loss of habitats and biodiversity caused by intensive use of inappropriate and destructive fishing gear and practices in sensitive habitat areas;
- Reduced biomass of fish species of transboundary significance caused by growth and recruitment over-fishing resulting from the targeting and capture of juvenile fish, fish in spawning aggregations, and pre-recruits;
- Changes in marine community structure caused by direct reductions of populations representing specific trophic levels of the community; and
- Decreased abundance and geographical range of rare and endangered species caused by fishing activities conducted in critical habitat areas.

These threats coupled with the fact that many marine fisheries in Southeast Asia are over-capitalised, unregulated, and subjected to illegal fishing have provided the impetus for the development of innovative approaches to the management of fisheries in the region. Significant efforts are being made in most countries to decentralise the responsibility for fisheries management to the local level with the aim of establishing co-management particularly of demersal fish stocks. However, the intrinsic relationship between fish stocks and their habitats necessitates that fisheries management involving decentralised and rights-based systems will need to incorporate strategies that foster the improved management of fish life-cycle and critical habitat linkages.

BARRIERS TO EFFECTIVE ACTION

Managing Fish Life-Cycle and Critical Habitat Linkages

The complexity of the key threats to habitats and biodiversity as a result of intensive inshore fishing necessitate adequate cross sectoral consultation between fisheries and environment departments in each country. This is particularly important in relation to the designation of Marine Protected Areas and other habitat management zones in order to ensure that areas designated for protection by environment ministries are, whenever possible, congruent with critically important habitat areas for fish stocks. It is equally important to integrate habitat and biodiversity conservation considerations into fisheries management systems.

The notion of improving the integration of considerations regarding fish habitats with other aspects of fisheries management represents a significant challenge in that it involves the merging of two related but, until recently, very distinct management domains. The first, habitat management, aims to maintain the functional integrity and biodiversity of ecosystems through actions focused on the biophysical attributes of these systems. The second, fisheries management, aims to secure sustainable returns from resource use through actions focusing on the relationship between fishing activities and target species. The RWG-F identified that initiatives to integrate fisheries and habitat management in Southeast Asia would be constrained by the following barriers to effective action:

- Limited information regarding fish life-cycle and critical habitat linkages, and the role that marine habitats play in sustaining fisheries;
- Low level of understanding amongst stakeholders, including fisher folk, scientists, policy makers, and fisheries and habitat managers of the linkages between fish stocks and habitats;
- Low level of community acceptance of “protected” area-based approaches to marine management in Southeast Asia; and

- Limited experience in national fisheries and environment departments and ministries with respect to the implementation of integrated fisheries and habitat management approaches (UNEP, 2006b).

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 whilst the life-cycles of most fished species in the region were thought to follow the generalised three-phase ontogeny of marine fishes¹ (Figure 1), 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. 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.

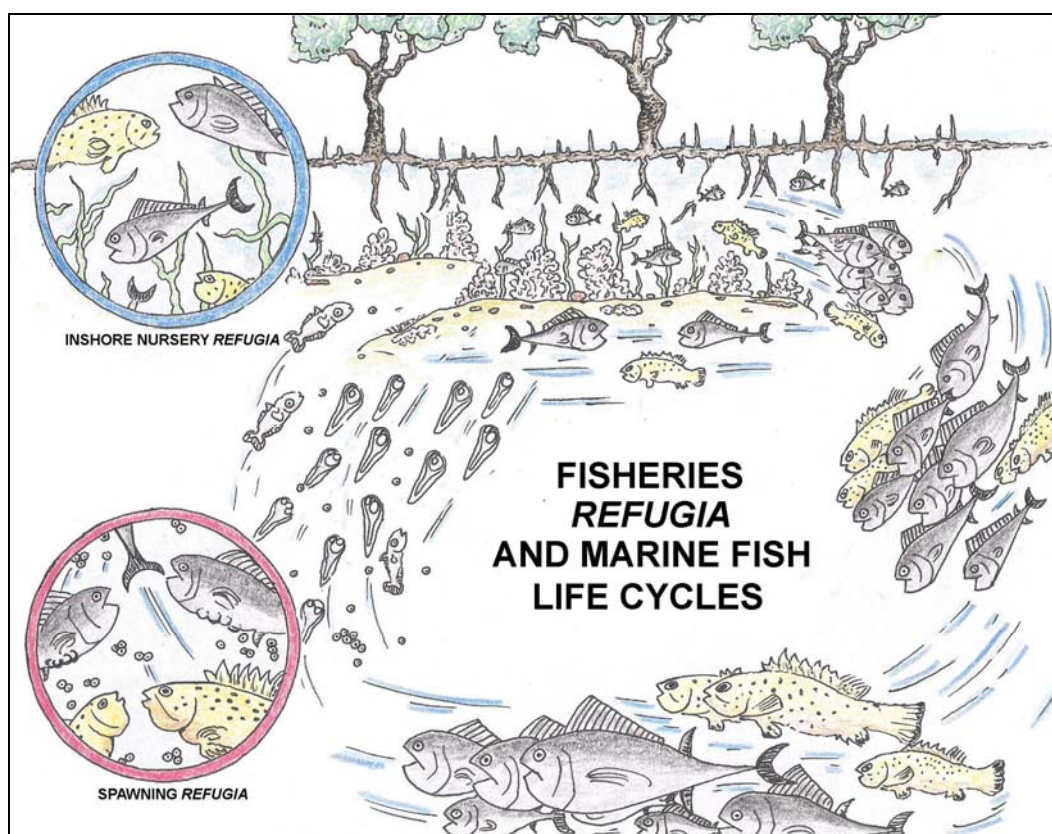


Figure 1 Schematic representation of types of *refugia* in relation to the generalised life-cycle of demersal marine fishes.

Most fish life-cycle and habitat data and information in the region are qualitative in nature, providing information regarding the presence or absence, and life-cycle phase, of fish species in given habitat areas. Whilst this work is useful in developing an inventory of habitats and locations utilised by fished species at different phases of their life-cycles, the RWG-F has 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.

Regional fisheries statistics provide little insight into the role of habitats 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

¹ 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

link fisheries production data to a given habitat type or 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 of the importance of fish habitat and life-cycle linkages.

Low Level Community Acceptance of “Protected” Area-Based Approaches

The RWG-F has noted that Marine Protected Areas (MPAs) are increasingly being promoted or conceived as fisheries management instruments, and noted further that the Food and Agricultural Organisation of the United Nations (FAO) had recently initiated an evaluation of the effectiveness of marine protected areas as management and conservation tools for fisheries. Whilst fisheries ministries and departments in the region will need to improve their working relationships with organisations promoting MPAs, the key challenge lies in achieving acceptance amongst communities at the local level of the purpose of marine protected areas.

The consensus view within the working group is that MPAs are widely understood by fisheries stakeholders to be areas that are closed to fishing. Experience in the region suggests that completely closing areas to fishing is a difficult if not futile task. The Philippines for example has trialled the use of no-take areas in fisheries, or fish sanctuaries². Due to problems of non-compliance and a lack of acceptance by local communities the government is working to redefine the term “fish sanctuary” to emphasise sustainable use rather than prohibition of fishing (Paterson *et. al*, 2006.). It is vital to focus on the concept of sustainable use rather than the prohibition of fishing when discussing spatial fisheries management tools with government officials and coastal communities in Southeast Asia.

The initial global promotion of the MPA concept clearly distinguished between the establishment of MPAs for protection of biodiversity and fisheries. The distinction between these two purposes has been blurred recently by MPA advocates who have presented general MPA benefits not only in terms of biodiversity protection but also in terms of enhanced fisheries yields. IUCN noted on their website in 2006 for example that “*No take marine reserves have been internationally recognized as critical tools in the preservation of marine biodiversity and the maintenance of sustainable fisheries*” <<http://www.iucn.org/themes/wcpa/biome/marine/programme.htm>>³. The working group noted with concern that most MPAs in the region have been established with a broad objective of “*improving the state of fisheries*”, whereas the criteria for the selection of MPA sites typically relate to the achievement of objectives for biodiversity conservation or political gain rather than for fisheries management (UNEP, 2006c).

There is a lack of sound scientific evidence suggesting that no-take Marine Protected Areas increase the amount of fish available to neighbouring fishing communities. Regional examples of increases in the abundance of fish within MPAs following their establishment, such as in the Nha Trang Marine Reserve in Viet Nam, have shown little evidence of benefits either to fish stocks or to fishing communities outside the protected area. There is little dispute that biomass in strictly enforced no-take MPAs may increase over time, but it may be unwise with the limited information available to anticipate increased production across the entire geographic range of a fishery as a result of the establishment of such areas. As a counterbalance to this argument one must also consider the effects of displaced fisher folk intensifying fishing efforts in areas adjacent to the MPA.

Limited Practical Experience in the Integration of Fisheries and Environment Considerations

The need to integrate fisheries and habitat management has received high-level international recognition, over the recent past, particularly within the framework of the approved *Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem (sic)*. 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

² Section 32 of the Philippines Fisheries Decree of 1975 defines a fish sanctuary as...“a protected water area where fish are able to spawn, feed and grow undisturbed and where fishing and other activities are absolutely prohibited.”

³ The specific text referring to no-take marine reserves was apparently deleted from the website sometime after August 22nd 2006.

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 ...the integration of marine and coastal areas 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*” (FAO, 2003: p.4). In brief, the document recognises that: fisheries have the potential to alter the structure, biodiversity and productivity of marine ecosystems; ideally, natural resources should not decrease below their level of maximum productivity, and that ecosystem-based approaches to fisheries should abide by a series of EAF principles.

Most approaches to fisheries management in the South China Sea marine basin have not effectively integrated spatial considerations into the management framework. The success or failure of past management has largely been determined by the ability of the management system to control fishing effort so as not to exceed predetermined catch limits that are based on biological and, to a lesser extent, the economic attributes of fisheries. The Regional Working Group on Fisheries has noted that according to the FAO guidelines on the ecosystem approach to fisheries:

- a) Fisheries should be managed to minimise their impact on the ecosystem to the extent possible;
- b) Ecological relationships between harvested, dependent and associated species should be maintained;
- c) Management measures should be compatible across the entire distribution of the resource that is across jurisdictions and sectoral management plans;
- d) The precautionary approach should be applied where knowledge of ecosystem processes is incomplete; and
- e) Governance should ensure both human and ecosystem well-being and equity.” (FAO 2003: p.15).

The ASEAN-SEAFDEC Regional Guidelines on Responsible Fisheries in Southeast Asia provide similar guidance with regard to minimising the negative impacts of fishing on the environment and critical fisheries habitats, but the central problem faced by fisheries ministries and departments is a lack of regionally relevant examples of how to implement such policies at the local level. The RWG-F has noted that many of the fisheries management measures proposed in the Reykjavik Declaration and WSSD Declarations, and FAO and ASEAN-SEAFDEC guidelines, promote the safeguarding of marine habitats and resources from fishing. There is however a need for fisheries management initiatives that result in tangible benefits in terms of the maintenance of fisheries habitats (and hence fisheries production), whilst at the same time minimising the costs borne by fishing communities in terms of reductions in household income and food production.

THE RESPONSE OF THE REGIONAL WORKING GROUP ON FISHERIES

The RWG-F agreed that, given the feed back loops between fish stock and habitat quality on the one hand, and fishing activities and habitat quality on the other it was necessary to develop a regional initiative aimed at improving the effective management of the linkages between fish stocks and habitats. The group agreed that the initiative would need to address the barriers identified above and noted specifically that, the initiative should:

- Improve the understanding amongst stakeholders, including fisher folk, scientists, policy makers, and fisheries managers, of habitat and fishery linkages, as a basis for integrated fisheries and habitat management;
- 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; and

- Enhance and sustain 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 prohibition of fishing.

Following a review of existing fisheries and habitat management initiatives in the region, the RWG-F noted that few of these focused on the above objectives and agreed to elaborate a system of fisheries management areas (fisheries *refugia*) in the South China Sea and Gulf of Thailand that focuses on the critical links between fish stocks and their habitats. The longer-term goal of this system would be to build the resilience of Southeast Asian fisheries to the effects of high and increasing levels of fishing effort (UNEP, 2006b).

THE RWG-F APPROACH: ESTABLISHING A REGIONAL SYSTEM OF FISHERIES *REFUGIA*

The regional fisheries *refugia* initiative addresses the present problems by drawing on fisheries management concepts that: are easily understood by the fishing community; and emphasise the sustainable use of fisheries resources and their habitats rather than the prohibition of fishing. It focuses on building fishing community support for area-based approaches to fisheries and habitat management, through which fisheries management and biodiversity conservation objectives can be achieved simultaneously. This activity has been recognised by regional and International fisheries organisations as a unique regional initiative in that it represents one of the first attempts to develop integrated fisheries and environmental management for regional benefit.

In evaluating the factors contributing to the resilience of fish stocks to the effects of high levels of fishing effort, and how spatial fisheries management tools could effectively contribute to enhancing that resilience in Southeast Asian fisheries, the RWG-F has focused initially on the concept of natural *refugia*. Specifically, the group has considered the following “theoretical” types of natural *refugia* and how they may relate to regional fisheries:

- *Refugia* reflecting the depth stratification of the population or the selectivity of fishing gear that results in parts of the population having a very low probability of capture;
- Migrations to spawning areas located outside the fishing grounds; and
- A scenario where part of the population is located in the fishing ground, with another part of the population occupying areas that are not fished thus providing a source of new recruits to the fished area.

During its Sixth Meeting in Sabah, Malaysia the RWG-F (UNEP, 2006b) recognised the inability of the group to link these *refugia* scenarios with important fish stocks in the region, largely due to a lack of information about the biology and population dynamics of most species at that time. There was, however, consideration of the role of *refugia* in fisheries in other regions, with discussion of the example of high recruitment and catches of hake in the Mediterranean during the 1980s despite a complete lack of input/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 *refugia* resulting from the inability of the fine inshore trawls to successfully catch fish at that depth. These large fish make a major spawning contribution to the adjacent fishery.

Notwithstanding the lack of readily available regional examples of the role of natural *refugia*, the group agreed that the identification of natural *refugia* should be the focus of efforts to establish management areas for regional fisheries as: it is “*refugia*” that most likely contribute to the resilience of fisheries to the effects of fishing; the concept is likely to be more easily understood by fishers and align closely with the traditional knowledge of fishers; and it may be easier to manage these areas with limited research and monitoring, control and surveillance resources than other technical-based measures.

The group was also of the opinion that it is unlikely that many natural *refugia* remain in the Gulf of Thailand, considering the: multi-gear/sector/jurisdiction nature of fisheries; the combined problems of over-exploitation and community dependence on fisheries; reported ecosystem effects of fishing; and the large scale fisheries habitat losses associated with the development of shrimp farming activities.

Defining the Fisheries Refugia Concept

The RWG-F is promoting the use of a broad based definition of *refugia* (see Information Box 1) for the identification of fisheries *refugia* to “replace” those lost due to over-exploitation and the destruction of fisheries habitats. There is now a common and widespread understanding that fisheries *refugia* relate to specific areas of significance to the life cycle of particular species, and that they should be defined in space and time, and serve to protect spawning aggregations, nursery grounds, and migration routes.

THE RWG-F DEFINITION OF FISHERIES REFUGIA

Fisheries *refugia* in the context of the UNEP/GEF South China Sea Project are 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.”

Fisheries *refugia* should:

NOT be “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 permanently 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,

Have management plans.

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

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,

Seasonal restrictions (e.g. use of specific gear that may trap larvae),

Limited access and use of rights-based approaches in small-scale fisheries.

The action of establishing *areas where management measures are applied to sustain important species during critical stages of their life cycle* (e.g. nursery areas, spawning areas, migratory routes) is seen as a reasonable starting point for developing a regional system of *refugia*. Information needs will become apparent over time, enabling identification of future areas for research on fish stock life histories, and for the development of a better understanding of the linkage between critical habitats and the life cycles of important demersal species.

Dissemination of Information on the Fisheries Refugia Concept

The RWG-F identified two key assumptions (UNEP, 2006b) 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. Many small-scale fishing communities, fisheries managers, and local government officials in the region equate area-based approaches to fisheries management (zoning) as the equivalent of no-take MPAs. As noted above the latter are often viewed as unacceptable at the community level since they are rarely designated in locations of importance to the life-cycle of important fish species and neither improve fish stocks, nor the community's income. The net result of such activities has been the loss of fishing areas for small-scale fishers and non-compliance with fisheries management measures in the “protected” areas.

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 has disseminated information on the *refugia* concept through: regional and national fisheries and environment fora; national expert, stakeholder, and community consultations; publication of a series of popular articles on the concept; and promoted the concept online via the South China Sea Project website. The

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. For example, the concept was used successfully during 2006 to resolve a long running conflict between the fisheries and environment sectors in the Philippines regarding the utilisation of fish stocks in areas of critical habitats in the Visayan Sea (UNEP, 2006c).

The *refugia* concept has been well received at the regional level and has led to the Southeast Asian Fisheries Development Centre inviting the RWG-F to prepare “*Regional Guidelines on the Use of Fisheries Refugia for Sustainable Capture Fisheries Management in Southeast Asia*” for publication as part of the ASEAN-SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia. These guidelines were subsequently prepared by the RWG-F, approved by SEAFDEC Council, and published in April 2006 (SEAFDEC, 2006). They provide participating countries with an effective policy platform for the elaboration of the concept at both national and regional levels. The outcomes of extensive community and stakeholder consultations in the participating countries during 2005 and 2006 suggest that the *refugia* concept is also well accepted by small-scale fishing communities and local officials (UNEP, 2007b).

To date fishing communities in Cambodia, Philippines, and Viet Nam have expressed their strong support for the establishment and management of fisheries *refugia* in areas of critical fisheries habitats. Thailand is successfully using the concept to achieve the sustainable use of 50,000 km² of critical habitats along the western coast of the Gulf of Thailand for regionally significant species, and have proposed plans to develop an additional area as *refugia* in the eastern Gulf of Thailand (UNEP, 2007b; 2007c). Similarly, the Research Institute for Marine Fisheries of Viet Nam’s Ministry of Fisheries has recently partnered with the Departments of Environment and Science of Kien Giang Province to establish and manage a fisheries *refugia* site covering a 10,000 ha seagrass area on the east coast of Phu Quoc Island (UNEP, 2007c).

Identification of Fisheries Refugia: Critical Spawning and Nursery Areas

The Sixth Meeting of the RWG-F (UNEP, 2006b) 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. It was highlighted that the impacts of over-fishing are intensified in instances where small-scale fishers and commercial fishers share the same stock, often leading to disputes of the relative impacts of each group.

The Working Group agreed that this situation is characteristic of the over-fishing problem in many marine fisheries in the Gulf of Thailand and the South China Sea. Juveniles and pre-recruits are often caught in inshore areas by small-scale fishers, while commercial fishers catch adults of the same species offshore. In circumstances such as this, high levels of fishing effort in inshore waters may drive growth over-fishing, while the same circumstances in offshore areas may cause recruitment over-fishing of the same stock. FAO (2007) for example, reports that 18-32% of low value “trash” fish caught in the Gulf of Thailand is juveniles of commercially important species. It was agreed that the use of inshore nursery *refugia* to protect fish during the juvenile and pre-recruit phases of their life-cycle can assist in the prevention of growth over-fishing. Whereas spawning *refugia* may assist in the prevention of recruitment over-fishing (Annex 5 of UNEP, 2006b).

In considering the work of the RWG-F, the Regional Scientific and Technical Committee (RSTC) noted that fisheries *refugia* have often been used as a fisheries management tool when more conventional techniques, such as effort or gear restrictions, have failed to achieve desired management objectives, particularly in regions where fisheries are subject to intense and unmanageable fishing pressure, such as in the Gulf of Thailand (UNEP, 2006d). In other cases, fisheries *refugia* have been used to separate potentially conflicting uses of coastal waters and their limited resources. However, 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 recommended that the RWG-F should: review known spawning areas for pelagic and invertebrate species, with the aim of evaluating these sites as candidate spawning *refugia*; and, evaluate each of the project’s habitat demonstration sites as potential juvenile/pre-recruit *refugia* for significant demersal species.

During the seventh meeting of the RWG-F (UNEP, 2006c) a preliminary inventory of known spawning areas in the Gulf of Thailand for significant pelagic, demersal, and invertebrate species was prepared and the group agreed to compile information on critical spawning and nursery areas for important fish species during the inter-sessional period and to: identify which of the UNEP/GEF South China Sea Project's Habitat Demonstration Sites are critical inshore nursery *refugia* for important demersal species; identify locations in the South China Sea and Gulf of Thailand that are utilised by important pelagic species for spawning; and to evaluate which existing fisheries management areas might qualify as fisheries *refugia*.

The compilation of this information was considered during the eighth meeting of the RWG-F (UNEP/GEF/SCS/RWG-F.8/5) and the information sources reviewed included:

- National Reports on Fisheries;
- National Reports on Coral Reefs, Seagrass, Mangroves, and Wetlands;
- Habitat Site Characterisations;
- Habitat Demonstration Site Project Documents;
- The South China Sea Online Meta-Database; and
- Information contributed directly by fisheries and habitat focal points.

This information was used to list and characterise known fish spawning and nursery areas in the Gulf of Thailand and the South China Sea, (Annex 4 of 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 1996-1999; and the outcomes of country consultations on the identification of fisheries *refugia*. The group agreed on 14 priority sites for inclusion in an initial system of fisheries *refugia*, and an additional 9 sites for which additional information is required prior to their inclusion in the system. The location of these sites is presented in Figure 2.

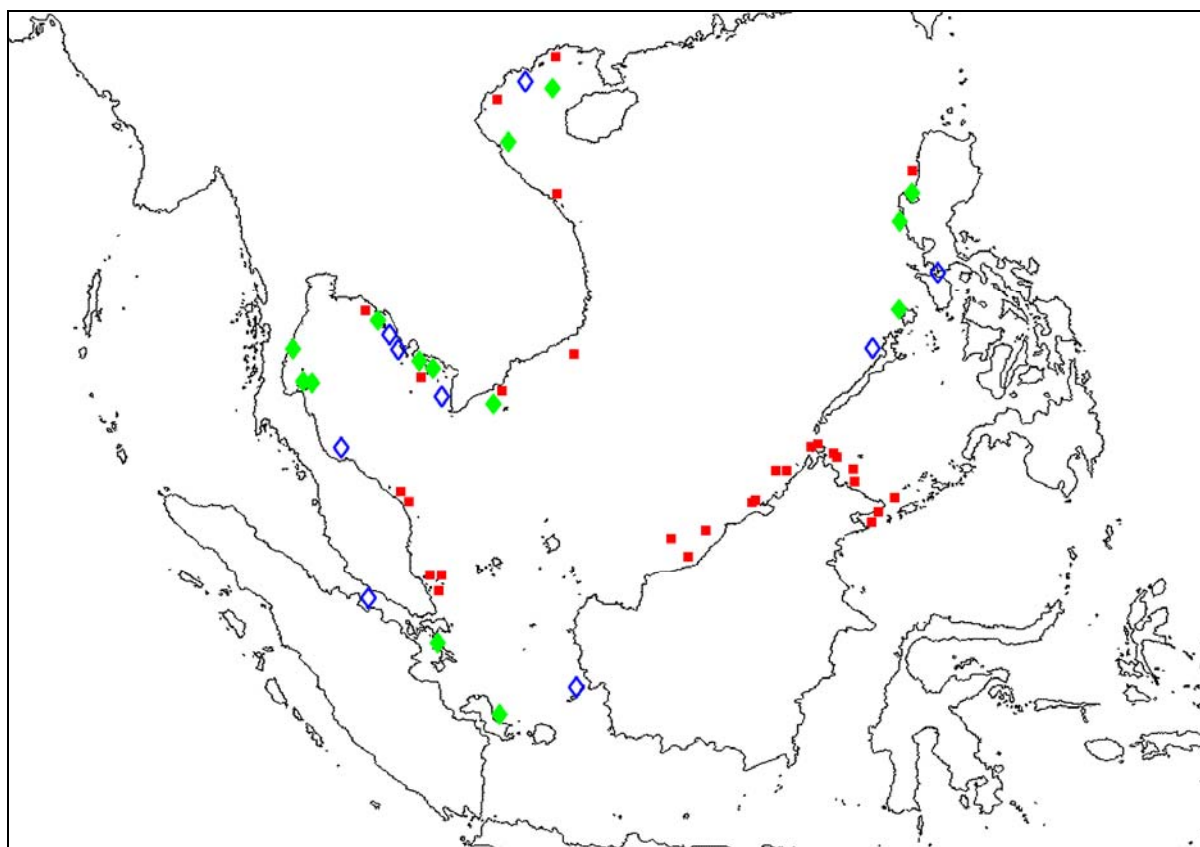


Figure 2 Location of: known spawning and nursery areas of transboundary demersal fish species [■]; initial sites selected for inclusion in the regional system of *refugia* [◆]; sites of high priority for inclusion in the regional system once the initial set are established [◇].

IMPROVING THE SCIENTIFIC BASIS FOR THE IDENTIFICATION OF FISHERIES *REFUGIA*

As noted above a key constraint to the further development of a regional system of fisheries *refugia* is the lack of information regarding the early-life history of the majority of significant transboundary species in the South China Sea and Gulf of Thailand. In this connection, the development of a collaborative programme of technical consultations, working group meetings, and training workshops, aimed at improving the scientific basis for the identification of fisheries *refugia* was agreed between the South China Sea Project and the Southeast Asian Fisheries Development Centre during 2006.

SEAFDEC has worked with members of the RWG-F to develop a programme of work to review past and ongoing fish early-life history research work, and to compile information on known spawning and nursery areas for important fish species in the Gulf of Thailand and South China Sea. Past research activities conducted in the 1970s and 1980s largely focused on the identification of spawning areas and migratory routes for Indo-Pacific Mackerel (*Rastrelliger neglectus*), round scads (*Decapterus* spp.), anchovy, and neritic tunas. There are some limitations in the use of this research for the identification of spawning *refugia* including reported ecosystem changes in the Gulf of Thailand over recent decades.

Data collected through research activities initiated by SEAFDEC in the mid 1990s may provide a more accurate information base for use in identifying current spawning and nursery areas. These activities involve cruises conducted using the SEAFDEC Research Vessel M.V. SEAFDEC in the following areas: Gulf of Thailand and East Coast of Peninsular Malaysia (81 stations); West Coast of Sabah, Sarawak, and Brunei Darussalam (79 stations); West Coast of Luzon, Philippines (31 stations); and in Vietnamese Waters (58 stations). A total of 249 larval fish samples were collected using bongo nets in the period of the post-northeast monsoon (April-May) from 1996-1999.

Information collected from fishing communities, processors, and past research suggests that many economically important species in the Gulf of Thailand and South China Sea spawn during the period from January to March each year. Consequently the results of larval fish surveys conducted by SEAFDEC during the post northeast monsoon (April-May) may assist in developing a better understanding of spawning (sources) and nursery (sinks) locations for important species. Species based maps of the distribution and abundance of the larvae of important demersal and pelagic fish species in the South China Sea during the post northeast monsoon periods from 1996-1999 have been developed, an example of which is provided in Figure 3.

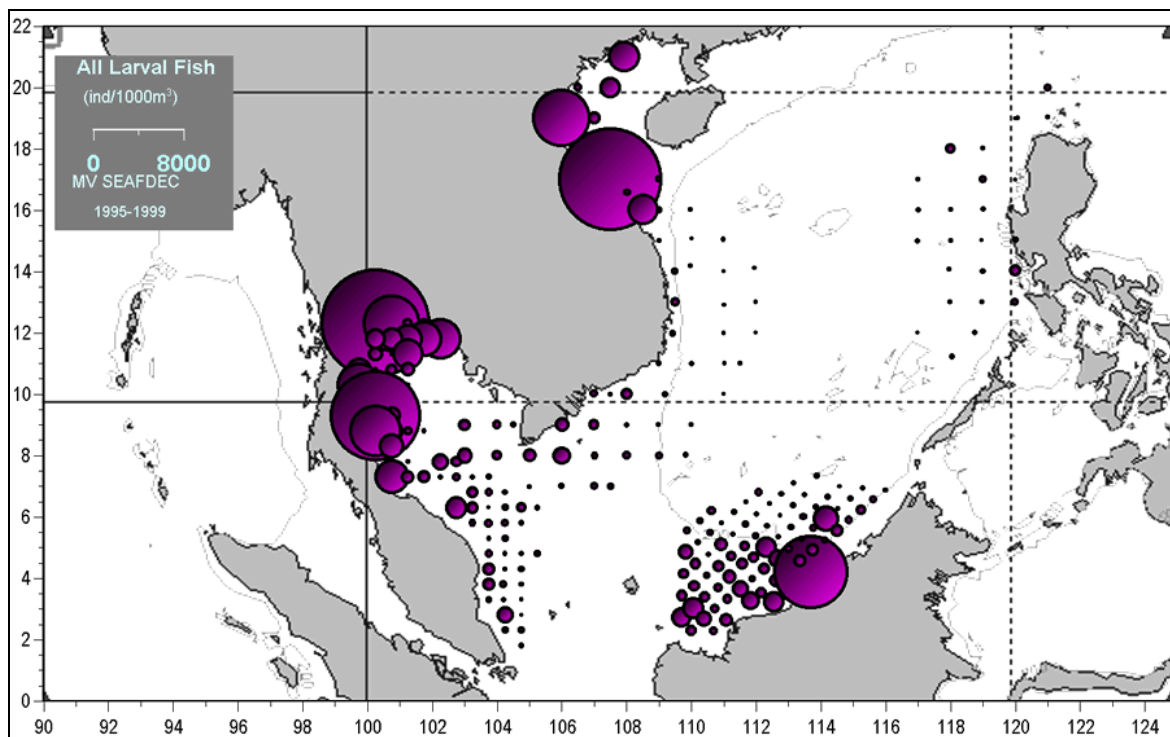


Figure 3 The distribution and relative abundance of fish larvae in the Gulf of Thailand and South China Sea during the post northeast monsoon period (1996-1999) (all larvae combined).

SEAFDEC has been utilising the M.V. SEAFDEC 2 to conduct fisheries resources assessment surveys in the South China Sea since 2004, and fish eggs and larvae have been sampled at survey sites over this period. Due to a shortage of technical expertise in the participating countries however, very few larval fish samples have been processed to date. In collaboration with SEAFDEC a Regional Training Workshop on Larval Fish Identification and Fish Early Life History Science was convened from 16th-31st May 2007, aimed at building regional capacity to process and identify larval fish samples collected as part of SEAFDEC's regular research cruises. Course participants will form national teams responsible for the processing of larval and juvenile fish samples with the aim of enhancing the scientific basis for the identification of important fish spawning and nursery areas.

FUTURE DEVELOPMENT OF THE REGIONAL SYSTEM OF FISHERIES *REFUGIA*

There are significant differences between countries in primary planning objectives, and in the design and implementation of spatial approaches to natural resource and environmental management. Such differences include for example: the preferred types of management, protection or multiple use; the method of delineating the management unit, administrative or natural system boundaries; and the responsible management agencies, environment or resource based agency. They also differ in terms of the procedures used in the establishment and administration of management areas or zones. In considering these inter-country differences, the RWG-F developed a strategic framework for the establishment of a regional system of fisheries *refugia* as shown in Figure 4.

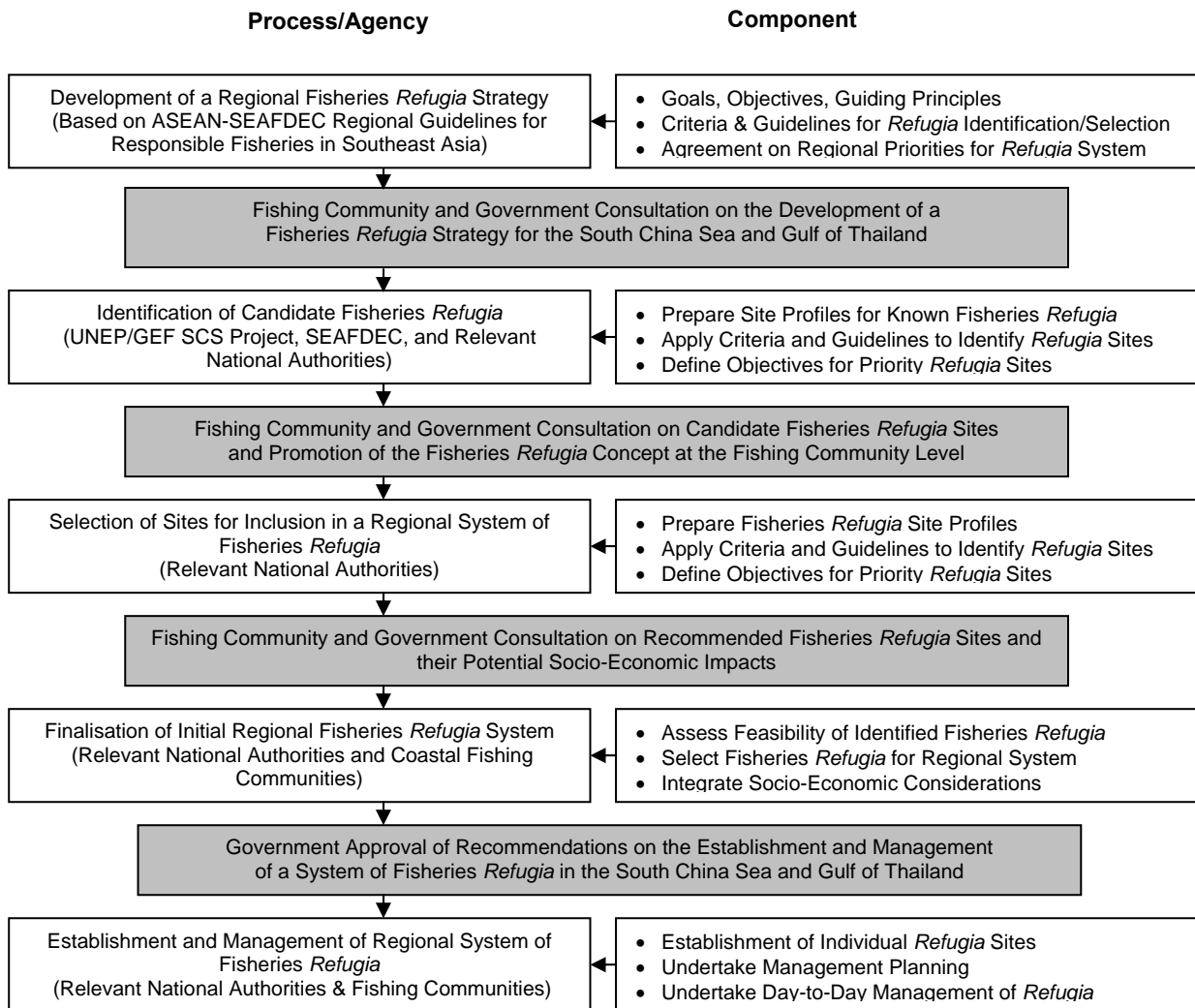


Figure 4 Framework for the development of a regional system of fisheries *refugia* for sustainable capture fisheries.

The fisheries *refugia* initiative is central to the fisheries component of the revised regional Strategic Action Programme for the South China Sea (SAP). The specific targets identified for the fisheries component of the SAP are:

- By 2012 to have established a regional system of a minimum of twenty *refugia* for the management of priority, transboundary, fish stocks and transboundary 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.

The regional level actions considered necessary to achieve these targets have been categorised into the following SAP components:

- Identification of Fisheries and Critical Habitat Linkages in the South China Sea;
- Improving the Management of Critical Habitats for Fish Stocks of Transboundary Significance;
- Developing Human Resource Capacity for the Identification and Management of Fisheries *Refugia*;
- Improving Information Management and Dissemination;
- Promotion of Regional Fisheries Management Arrangements; and
- Generation and Uptake of Good Coastal Fisheries Management Practices at the National Level.

EVALUATION OF MARINE PROTECTED AREAS AND SEASONAL, OR AREA CLOSURES FOR INCLUSION IN THE REGIONAL SYSTEM OF FISHERIES *REFUGIA*

As the definition of fisheries *refugia* developed by the RWG-F focuses on sustainable use and clearly states that *refugia will not be* no-use areas, *refugia* cannot be substituted for permanent closures or no-take MPAs and *vice versa*. *Refugia* can, however, be compared to seasonal closures and multiple-use MPAs. Priority areas for *refugia* are those in which fish spawn and in which juveniles seek shelter/food, and the identification of initial candidate *refugia* has been undertaken on this basis.

Fisheries *refugia* are very different from the general seasonal closures used in fisheries, and from the short term area and seasonal closures commonly used in fisheries management (e.g. spot closures and closed seasons) which 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 the main fishing grounds for a given species, which are critical to the life-cycle of that species, qualify as fisheries *refugia* and should be managed accordingly. Such management for example, may include 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 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.

The RWG-F understands that individuals taking a “helicopter view” of the definition of *refugia*, and the initial actions of identifying important nursery and spawning areas, may misconstrue that the group is simply identifying areas for a regional system of seasonally managed areas. This is a misperception and an important role for the RWG on Fisheries is to ensure that when such individuals take a “helicopter view” of this activity, they see a regional initiative working to:

- (a) Develop a system of fisheries *refugia*, including “replacement” of lost natural *refugia*, in order to build resilience in regional fisheries; and to
- (b) Provide an institutional mechanism for improved fisheries and habitat management, i.e., management based on the linkages between fish stocks and critical habitats.

One aspect of this involves promoting the actions in terms of goals and objectives, rather than a working definition. General goals and objectives for this activity can be split into two categories: (a) resource-related and (b) institutional-related (see Tables 1 and 2).

Consideration of these objectives enables one to evaluate 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. For instance, short term closures (or spot closures) are often implemented to redirect fishing effort from areas containing concentrations of juvenile fish or

specific age classes of fish. Similarly, closed seasons are often implemented to safeguard spawning fish or to reduce the levels of fishing effort at times when pre-recruits are migrating to fishing grounds. A question regularly asked of the RWG-F is “do such spot closures and closed seasons qualify as fisheries *refugia*?” The answer to this question is “they do if the site has been selected in terms of achieving one or more of the resource-related objectives of the *refugia* system, and can be managed in the context of institutional-related objectives for the regional system of *refugia*.”

A similar and perhaps more contentious question asked of the RWG-F is “do MPAs qualify as fisheries *refugia* and *vice versa*?” The simple answer to this question is **no**, especially if the MPA promotes the no-take concept in relation to fisheries. MPAs are implemented to limit human activity within a designated area of the ocean, with most aimed at achieving goals and objectives of biodiversity conservation. Similarly, the criteria for the identification of MPA sites usually relate to concepts of representativeness, comprehensiveness, and uniqueness, and a particular MPA cannot qualify as a fisheries *refugium* if the site was selected using these criteria. However, parts of multiple-use MPAs, such as fisheries management zones, may qualify as a replacement fisheries *refugium* if:

- Such zones promote the concept of sustainable use rather than prohibition of fishing, and
- The selection of the zone was based on criteria relating to the critical linkage between the area and the life-cycle of the species for which the area is managed.

Table 1 A Preliminary Set of Performance Assessment Criteria and Means of Verification for the Resource-related Objectives of a Regional Fisheries *Refugia* Plan.

Resource-Related Objectives	Performance Assessment Criteria	Means of Verification
Longer-Term Objectives		
1. Biomass of economically important fish (pelagic and demersal) and invertebrate species in the Gulf of Thailand and South China Sea maintained	Biomass trend (multi-year average annual percentage rate of change)	Results of abundance surveys employing relative abundance (CPUE), swept area, acoustic, or egg production methods
2. Average size of economically important fish (pelagic and demersal) and invertebrate species caught in the Gulf of Thailand and South China Sea maintained or increasing	Average fish size relative to historical average	Results of size-frequency analyses of fish landed at key landing places and in markets
3. Egg production of economically important fish and invertebrate species in the Gulf of Thailand and South China Sea maintained or increasing	Abundance of eggs and larvae of economically important species in key spawning areas relative to historical average	Results of surveys of egg and larval fish density in key spawning areas
4. Recruitment of economically important fish and invertebrate species to fisheries the Gulf of Thailand and South China Sea maintained or increasing	Year class strength relative to historical average	Results of abundance surveys employing relative abundance (CPUE) or swept area methods
Shorter-Term Objectives		
1. Reduced capture of juveniles and pre-recruits of economically important fish (pelagic and demersal) and invertebrate species, as well as endangered species, in critical fisheries habitats of the Gulf of Thailand and South China Sea	Abundance of juveniles in fishery <i>refugia</i> areas a) Fishing effort dynamics in fishery <i>refugia</i> areas b) Selectivity of fishing operations conducted within juvenile <i>refugia</i> c) Frequency of inappropriate fishing operations in fishery <i>refugia</i> areas d) Volume and size composition of economically important fish (pelagic and demersal) and invertebrate species landed and traded in main markets	a) Results of fishery dependent and independent surveys b) Interviews of fishers, fishing communities, and traders c) Results of studies of species and size composition conducted within <i>refugia</i> d) Observations/reports of illegal or destructive fishing in fishery <i>refugia</i> areas e) Results of studies of the volume and size of fish landed at main landing places and traded in main market
2. Reduced targeting and capture of economically important fish (pelagic and demersal) and invertebrate species in spawning condition, and when forming spawning aggregations, in the Gulf of Thailand and South China Sea	a) Fishing effort dynamics in fishery <i>refugia</i> areas b) Selectivity of fishing operations conducted within spawning <i>refugia</i> c) Gonosomatic index (GSI) of economically important fish (pelagic and demersal) and invertebrate species landed and traded in main markets d) Abundance of eggs and larvae of economically important species in key spawning areas	a) Interviews of fishers, fishing communities, and traders b) Results of studies of species and size composition of landings during known spawning seasons c) Results of studies of the gonosomatic condition of economically important species landed and traded in main markets d) Results of surveys of egg and larval fish density in key spawning areas
3. System of fisheries <i>refugia</i> , including both juvenile and spawning <i>refugia</i> , which provides for: (a) networks of fisheries <i>refugia</i> across the geographical ranges of individual species, (b) networks of fisheries <i>refugia</i> that include both juvenile and spawning <i>refugia</i> , (c) fisheries management consistent with the RGRFSEA	Total number/size of juvenile <i>refugia</i> and spawning <i>refugia</i> : (a) Number of species for which a network of fisheries <i>refugia</i> has been developed across its geographical range (b) Number of fisheries <i>refugia</i> networks that include multiple <i>refugia</i> types (c) Number of fisheries <i>refugia</i> for which management systems have been developed	The number and size of fisheries <i>refugia</i> as defined in <i>refugia</i> management plans adopted by national governments (a) Description of the species – specific linkages between <i>refugia</i> in management plans for each <i>refugia</i> in a geographical range based network (b) Description of the life-cycle – specific linkages between <i>refugia</i> in management plans for each <i>refugia</i> in a life-cycle based network (c) Adoption of <i>refugia</i> management plans

If the site for a multiple-use MPA has been identified using criteria that did not relate to fish life-cycle and critical habitat linkages, any fisheries management zone within that MPA may not be worthy of the research, financial, and management resources required for the development of that site as a fisheries *refugium* when compared to sites that were identified purely on critical habitat linkages. Similarly, poorly designed fisheries management zones within multiple-use MPAs may (a) lead to a loss of community support for spatial approaches to fisheries management, and (b) lead to the re-direction of fishing effort towards areas that are more important in terms of critical habitat linkages. Nevertheless, such zones should not be disregarded and may represent a class of *refugia* for consideration in any regional *refugia* system. Comparisons of the appropriateness of fisheries management zones within MPAs as *refugia* and fisheries *refugia* sites identified purely on the basis of fishery-critical habitat linkages will require the consideration of information relating to fish life-cycles and habitat associations at the fishery level.

Table 2 A Preliminary Set of Performance Assessment Criteria and Means of Verification for the Institutional-related Objectives of a Regional System of Fisheries *Refugia*.

Institutional-Related Objectives	Performance Assessment Criteria	Means of Verification
1. Integration of fish life-cycle considerations in fisheries and habitat management in the Gulf of Thailand and South China Sea	Preparation and publication of a management plan for a regional system of fisheries <i>refugia</i> .	Adoption by appropriate regional fora of a management plan for a regional system of fisheries <i>refugia</i> . Management plan to include: a) goals, objectives, target reference points, indicators, and performance measures for each <i>refugia</i> (and <i>refugia</i> network in the system) b) system for reporting on results of analysis of data collected in support of the regional <i>refugia</i> system c) criteria for the identification of new <i>refugia</i> d) research priorities and national commitments of support to the conduct of fisheries research
2. National level commitments to integrate the fisheries <i>refugia</i> concept into fisheries and habitat management	Preparation and publication of National Plans of Action for the Development of the Regional System of Fisheries <i>Refugia</i>	Adoption of plans of action by appropriate Government Ministries.
3. Regionally agreed fisheries <i>refugia</i> science programme, which details: a) Objectives b) Decision-support inputs c) Strategic research partnerships/resourcing d) Research activities	Preparation and publication of a fisheries <i>refugia</i> science programme	Adoption of the programme at a regional expert consultation and then representatives of five SEAFDEC member countries
4. Regionally agreed framework of criteria, target reference points, indicators, and performance measures for identifying and evaluating the performance of <i>refugia</i> that, aim to: (a) reduce the capture of juveniles and pre-recruits of economically important fish, and endangered species, in critical fisheries habitats (b) reduce the targeting and capture of economically important fish in spawning condition, and when forming spawning aggregations (c) contribute to the development of species-specific networks of <i>refugia</i> across (i) the geographical range, and (ii) the life-cycle, of individual species.	Preparation of a framework of criteria, target reference points, indicators, and performance measures for identifying and evaluating the performance of fisheries <i>refugia</i>	Adoption of the framework at a regional expert consultation
5. Regional agreement on standardised methodology for the identification and evaluation of important: (a) juvenile <i>refugia</i> (b) spawning <i>refugia</i> , and (c) <i>refugia</i> that can assist in building geographical range and life-cycle based networks of <i>refugia</i>	Preparation and publication of standards for <i>refugia</i> identification and evaluation methods relating to data collection and storage, and analysis	Adoption by appropriate intergovernmental fora of regional standards
6. Regionally agreed guidelines on the use of the fisheries <i>refugia</i> concept in fisheries management.	Regional agreement on guidelines for the use of the fisheries <i>refugia</i> concept	Adoption by appropriate intergovernmental fora of regional guidelines

Discussion

It would appear that the *refugia* concept is a successful approach to addressing a significant barrier to effective management action that addresses fish stocks and habitats of importance to critical stages of the life history of those stocks, 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. By emphasising the “sustainable use” aspects of *refugia* rather than the “no-take” approach adopted by many ministries of environment in their approach to marine protected areas adverse reactions are avoided. More importantly perhaps the fisheries *refugia* concept since it is being promoted by fisheries departments provides and initial platform for dialogue between the government institutions responsible for environment and for fisheries.

Final outcomes:

The original outcome of the project was simply anticipated as being **“a system of refugia to maintain important transboundary fish stocks in the Gulf of Thailand based on marine protected areas identified as critical habitats for fish stock conservation and protection.”**

The project document provides no guidance regarding a definition of what:

- Constitute “fisheries *refugia*”;
- The criteria for assessing the relative importance of individual areas as potential *refugia*.

What has resulted from the work of the Regional Working Group on Fisheries is:

- A listing of demersal species of fish, crustacea and molluscs of transboundary significance in the region;
- A list of 52 known spawning and nursery areas of which 14 are currently under development as the initial set of *refugia* and a further 9 have been accorded high priority for development as *refugia* once the initial set have been approved;
- Criteria for defining fisheries *refugia*; and,
- Intergovernmentally approved guidelines for the establishment of fisheries *refugia* that constitute part of the ASEAN SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia.

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August 29th 2007.

References

- FAO, 2003. The ecosystem approach to fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl.2. Rome, 112p.
- FAO, 2007. The State of World Fisheries and Aquaculture 2006. Food and Agriculture Organisation of the United Nations. Rome, 180pp.
- Lundgren, R., Staples, D.J., Funge-Smith, S.J. and Clausen, J. 2006. Status and potential of fisheries and aquaculture in Asia and the Pacific 2006. FAO Regional Office for Asia and the Pacific. RAP Publication 2006/22. 62pp.
- Paterson, C., Try, I., Tambunan, P., Barut, N., Saikiang, P., Dao, M.S., and Chullasorn, S. 2006. Establishing a Regional System of Fisheries *Refugia*. *Fish for the People*, 4(1): 22-27.
- SEAFDEC, 2006. Supplementary Guidelines on Co-Management Using Group User Rights, Fisheries Statistics, Indicators, and Fisheries *Refugia*. Southeast Asian Fisheries Development Center, Bangkok, Thailand. 84pp.
- UNEP, 2006a. *Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*. Report of the Seventh Meeting of the Regional Working Group for the Seagrass Sub-Component. UNEP/GEF/SCS/RWG-SG.7/3.
- UNEP, 2006b. *Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*. Report of the Sixth Meeting of the Regional Working Group on Fisheries. UNEP/GEF/SCS/ RWG-F.6/3.
- UNEP, 2006c. *Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*. Report of the Seventh Meeting of the Regional Working Group on Fisheries. UNEP/GEF/SCS/RWG-F.7/3.
- UNEP, 2006d. *Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*. Report of the Sixth Meeting of the Regional Scientific and Technical Committee. UNEP/GEF/SCS/ RSTC.6/3.
- UNEP, 2007a. Revised draft Strategic Action Programme, (Draft 3) July 26th 2007.
- UNEP, 2007b. *Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*. Report of the Eighth Meeting of the Regional Working Group on Fisheries. UNEP/GEF/SCS/RWG-F.8/3.
- UNEP, 2007c. *Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*. Report of the Ninth Meeting of the Regional Working Group on Fisheries. UNEP/GEF/SCS/RWG-F.9/3.