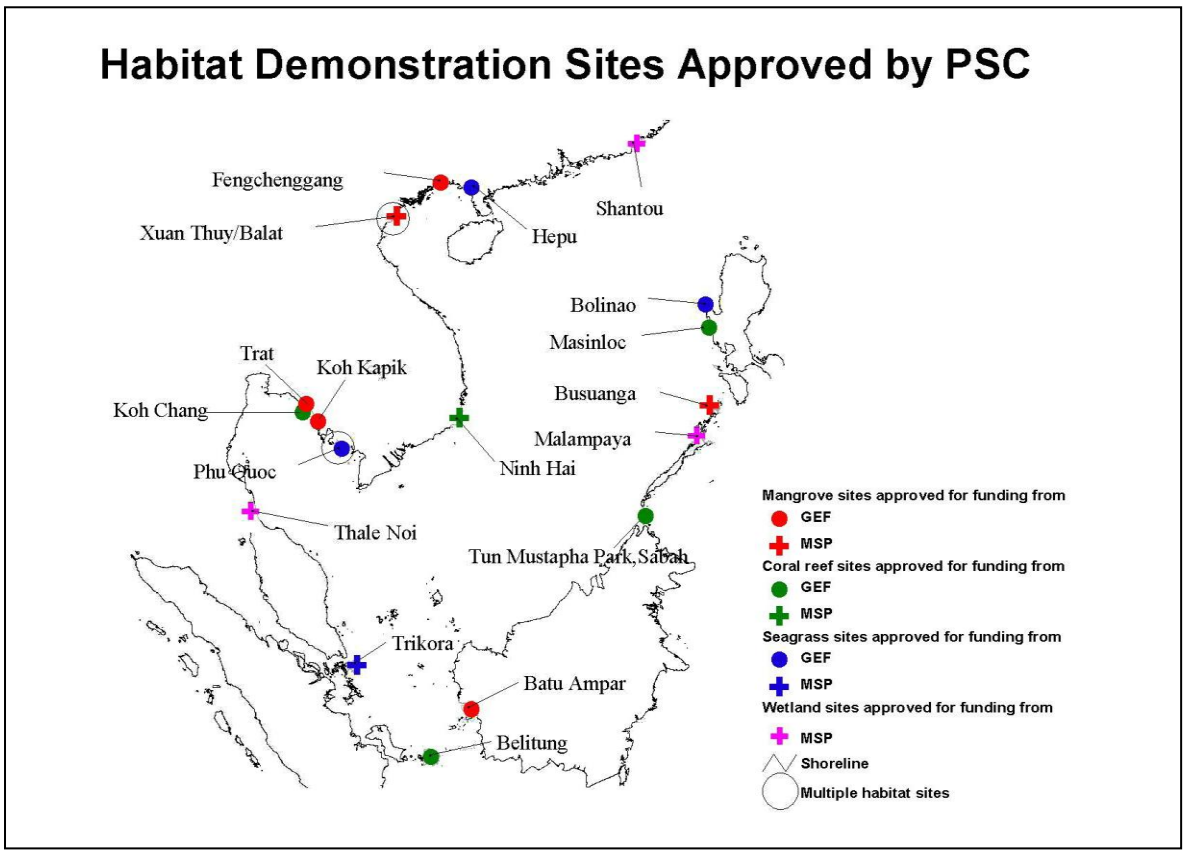
# Procedure for Selection of Demonstration Sites in the context of the UNEP/GEF Project Entitled:

## *"Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand"*

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Cover Illustration: Habitat Demonstration Sites approved by the Project Steering Committee of the UNEP/GEF Project Entitled: "*Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*".

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# PROCEDURE FOR SELECTION OF DEMONSTRATION SITES IN THE CONTEXT OF THE UNEP/GEF PROJECT ENTITLED: *"REVERSING ENVIRONMENTAL DEGRADATION TRENDS IN THE SOUTH CHINA SEA AND GULF OF THAILAND"*

## INTRODUCTION

The project entitled "Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand" is funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) in partnership with seven coastal states bordering the South China Sea[1]. A brief history of the development of the project and the Management Framework can be found in the South China Sea Knowledge document UNEP/GEF/SCS/Inf.1. Planning commenced in 1996 and the project became fully operational in February 2002.

The Project is complex since it addresses three priority areas of concern identified in the Transboundary Diagnostic Analysis (TDA)[2], (Talaue-McManus, 2000) namely: the loss and degradation of coastal habitats; over-exploitation of fisheries in the Gulf of Thailand; and, land-based pollution. Of these three substantive project components, the first, relating to habitat degradation and loss, is the largest being divided into four sub-components. The fourth component of the project is concerned with regional co-ordination including facilitation of national level execution and securing inter-country agreement on project related matters. The financial appropriations approved by the GEF Council are presented in Table 1 in which it can be seen that the allocations from all sources for the priority habitats (mangroves, coral reefs, seagrass and wetlands) total just over 21 million US dollars or 65% of total project costs.

Table 1 Project Budget Summary and Component Financing in Million US$.

| Project Activities | GEF | Co-financing | | Grand Total |
|---|---|---|---|---|
| | | Governments | Other Sources | |
| **1. Habitat Degradation & Loss** | | | | |
| **1.1 Mangroves** | 2.733 | 2.374 | 1.585 | 6.692 |
| **1.2 Non-oceanic Coral Reefs** | 2.587 | 2.326 | 1.560 | 6.473 |
| **1.3 Seagrass** | 2.529 | 2.305 | 1.585 | 6.419 |
| **1.4 Wetlands** | 0.975 | 0.400 | 0.082 | 1.457 |
| **2. Over-exploitation of fisheries in the Gulf of Thailand** | 1.650 | 0.735 | 0.960 | 3.345 |
| **3. Land-based Pollution** | 1.760 | 0.461 | 0.110 | 2.331 |
| **4. Project Co-ordination and Management** | 3.580 | 0.294 | 0.505 | 4.379 |
| **EA Overheads** | 0.600 | | | 0.600 |
| **Project Total** | **16.414** | **8.895** | **6.622** | **31.931** |
| **PDF-B** | 0.335 | 0.176 | 0.076 | 0.587 |
| **Grand Total** | **16.749** | **9.071** | **6.698** | **32.518** |

The project was designed to be implemented over a period of five years and involved the signing of Memoranda of Understanding (MoUs) between UNEP, as the GEF Implementing Agency, and seven focal Ministries, (the Ministries responsible for Environment in each country) and thirty-one Specialised Executing Agencies (SEAs) in the seven participating countries that are each responsible for one component or sub-component[3].

[1] *Cambodia, China, Indonesia, Malaysia, Philippines, Thailand and Viet Nam.*

[2] *All project related documents cited in this paper can be found on the project website at www.unepscs.org.*

[3] *In the case of Cambodia, the limited human capacity resulted in the coral reef and seagrass sub-components being combined under the responsibility of a single Specialised Executing Agency, the Department of Fisheries. The mangrove and wetlands sub-components were similarly combined resulting in the creation of only four rather than six national committees in Cambodia.*

## THE PROBLEM

The GEF allocation for demonstration sites was stated in the Project Brief that was approved by the Project Steering Committee during its first meeting (UNEP, 2000a, Appendix) as being 3 demonstration sites in each of the habitat sub-components of Mangroves, Coral Reefs and Seagrass. The size of each allocation for demonstration sites, by habitat sub-component, was as follows:

| | |
|---|---|
| Mangroves: | 1.2 million US$ over 3 years |
| Coral Reefs: | 1.2 million US$ over 3 years |
| Seagrass: | 1.1 million US$ over 3 years |
| Wetlands[4]: | no allocation |

These funds were "blocked" in the project document and their purpose identified but the sites were not chosen at that time since the preparatory activities during the first two years of project implementation were intended *inter alia* to develop the process of site selection.

The consequences were quite clearly that:

- With seven participating countries, no one country could "expect" a demonstration site in each habitat sub-component;
- If the principal of equity were to be applied, each country could only "expect" 1.3 demonstration sites (more realistically 5 countries would get one site each and two would get two);
- "Wetlands" would have no demonstration sites unless the Project Co-ordinating Unit (PCU[5]) could raise additional funds.

Potentially, therefore, the process of site selection could have been divisive and acrimonious. It might also have resulted in the choice of sites that neither adequately represented the range of biological and environmental conditions found throughout the South China Sea nor, satisfied the achievement of the global environmental benefits anticipated from GEF interventions.

## THE APPROACH

Past practice in regional programmes has generally been based on "equity" considerations such that the available resources tend to be divided equally, or nearly equally, between all participating countries. In addition, decisions on specific site-related activities in the framework of UNEP's regional seas action plans, for example, has reflected individual national priorities with little attempt being made to either determine, or take into consideration, regional priorities independently of national priorities. Regional priorities have been generally derived from a process of consensus building on the basis of the nationally-defined priorities with each party recognising that they would get "something". National, regional and global priorities are, however, rarely congruent.

Past experience has shown that, where a limited pool of resources is to be divided amongst a large number of possible recipients, there is a general trend for those with the best command of written English to prepare proposals that are superficially more attractive; if the decision, is taken by "consensus" during an open meeting with few or no guidelines, the individuals with the greatest facility in spoken English (or who shout the loudest) have a higher probability of winning their argument. Selection of demonstration sites in other contexts is therefore frequently based upon "perceptions" of what are good sites; thus, individuals in the Southeast Asian region will quote Apo Island in the Philippines as a good example of community-based coral reef management, even though the site is small and the current operation is no longer as successful as it was initially.

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[4] *It should be noted that the definition of wetlands in the context of the project excluded the three itemised habitat types and restricted consideration to coastal wetlands, such as estuaries, mudflats, and lagoons.*

[5] *It should be noted that although the consequences of the original allocations were accepted by the representatives of the participating countries, they resulted in significant lowering of morale amongst the expert focal points who saw their colleagues having the prospect of substantial activities during the operational phase of the project whilst they, on the other hand, could potentially have nothing to show in concrete terms from the preparatory phase activities.*

Recognising these problems, it was decided to attempt to construct a more "objective" approach to selecting demonstration sites in the framework of the South China Sea Project. This required that, at the very least:

- All parties accept that the funds were limited and that equitable (equal) division of the resources among all countries would compromise the integrity and success of the demonstration sites[6];
- The process of site selection be fully transparent and comprehensible to all parties, both technical and political, and that it be based as far as possible on "objective" quantifiable criteria and indicators; and,
- The criteria used for assessing the comparative importance of the sites should reflect their importance from the perspectives of biological diversity, transboundary relevance and the regional and global significance of the site.

**STEPS IN THE PROCESS:**

**Defining the data and information needs**

The first action required securing agreement at the regional level regarding the data and information needed to characterise individual sites. Such characterisation, for example, would include: indicators of environmental state, such as percentage seagrass cover; indicators of biological diversity, such as presence or absence of individual mangrove genera; and/or the numbers of hard coral species.

This process was initiated during the first meeting of the Regional Scientific and Technical Committee (RSTC) (UNEP, 2002a) during which specific guidance was developed for each regional working group regarding the "types" of data that should be considered and selected within each habitat sub-component.

The first meeting of each Regional Working Group (RWG) (UNEP, 2002b; UNEP, 2002c; UNEP, 2002d; UNEP, 2002e) defined the data and information required to characterise specific sites. Tables 1 and 2 provide, as examples, the lists of properties and variables initially identified by the mangrove and coral reef regional working groups. In all instances, these lists were comprehensive and overly ambitious, listing properties and variables that were difficult to obtain from published information and existing databases. Subsequent to this, a regional GIS meeting was convened (UNEP, SEA START, 2002) and SEA START RC[7] prepared GIS data formats based on the lists of properties and variables prepared by each regional working group. During the inter-sessional, six month, period between the first and second regional working group meetings, national focal points in each SEA commenced the process of assembling site-specific data sets from existing published and unpublished sources[8].

The second meeting of each regional working group (UNEP, 2002f; UNEP, 2002g; UNEP, 2003a; UNEP, 2003b) reviewed the initial data sets that had been compiled and, in most instances, agreed to drop from consideration properties and variables that were either generally unavailable throughout the region or which were too difficult to standardise across countries. In addition, clarification of the exact interpretation of defined properties and variables was required. For example, mangrove data relating to the density of trees were clearly not comparable between and among countries with some data sets reflecting the occurrence of all classes of "tree" including seedlings, saplings and mature trees. This property was re-defined as the density of mangrove trees exceeding 1.5 metres in height, thereby excluding seedlings but not excluding species with low maximum mature height. During its second meeting, the RSTC (UNEP, 2003c) reviewed the properties and variables selected by each working group and provided some comments and guidance to the RWGs.

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[6] *In this context the GEF Project brief was explicit in stipulating 3 demonstration sites in the three habitat sub-components. The approval of the project budget by the Project Steering Committee at its first meeting resulted in implicit acceptance of this limitation by the participating countries.*

[7] *South East Asian Regional Centre for START (SysTem for Analysis, Research and Training).*

[8] *In the case of China, the absence of any national data sets regarding the distribution and/or diversity of seagrass habitats was addressed through substantial co-financing made available through the central government to enable the SEA to prepare distribution maps based on remotely sensed images and assemble basic data through field surveys. The outcome was the first internationally-available data sets regarding seagrass in China.*

Table 1 Details of properties and variables, Data and Information requirements for Mangrove Site Characterisation.

| | Properties and Variables | Data & Information needed |
|---|---|---|
| **Geographic information** | Co-ordinates | Latitude & Longitude central position of areas <50 Ha; GPS Boundary or number (min 4) of paired co-ordinates for larger areas; end points for linear strips. |
| | Area | (Units $Km^2$ or Ha) |
| **Physical Environment** | Substrate (soil) | Proportion of sand, silt, clay |
| | | Bulk Density |
| | Freshwater regime | Mean monthly rainfall (mm) |
| | | Mean monthly River discharge ($m^3sec^{-1}$) |
| | Tidal regime | Range (m) |
| | | Diurnal, semi-diurnal, mixed |
| | Slope | Degrees (tangent) |
| | Temperature | Mean, max, min, monthly (°C) |
| | Soil Salinity | Range (psu) |
| | Water quality | Total suspended solids |
| | | Contaminant concentration/flux |
| | | Other parameters as available |
| | Geomorphic class | Description, lagoon, tidal flats, estuaries, islands etc. |
| **Environmental state information** | Present status | Vegetation Canopy Cover (% area) |
| | Pressure (threats) – present | % loss of species or area or canopy cover in last five years |
| | Pressure (threats) – future | Estimated future losses from known development plans |
| **Social & use information** | Ownership | Description: Federal, State, Community, private |
| | Management regime | Description: Land-use planning, Institutional framework, stakeholder co-ordination, forestry practices, restoration replanting, stakeholder investment, fishery practices. |
| | Current use | Description: Commercial, subsistence |
| | Potential use | Alternative livelihoods |
| | Significance/national importance | Use designation in national/state master plans |
| **Biological data** | Natural/Managed | Proportions of total area natural and replanted |
| | Species diversity | (True) Mangrove[9] tree species Density (no $ha^{-1}$) |
| | | Crustacea – Crab genera, density |
| | | Molluscs – Bivalve genera, density |
| | | Molluscs – gastropods genera, density |
| | | Fish – Residents, species abundance |
| | | Fish – Transient for breeding, species abundance |
| | | Mammals, resident |
| | | Birds, resident species |
| | | Birds, migratory species |
| | | Reptiles, resident species |
| | | List others as available (e.g. mud lobster) |
| | Genetic diversity | |
| | Heterogeneity | Formations – number of canopy layers (strata) |
| | | Average and range Height (m), by species |
| | | Average and range Girth, (cm) by species |
| | | Zonation – number of zones by dominant species |
| | | Ecotones – average width (m), major species |
| | SCS Endemic species | List species and abundance |
| | Endangered or threatened species (IUCN criteria) | List species and abundance if data available |
| **Stress-pressure Information** | Intrinsic/internal sources of change | Resident human population |
| | | Natural e.g. frequency of typhoon throw, change in allochthonous sediment inputs, marine based flooding |
| | Extrinsic/external sources of change | Changes in catchment basin e.g. dam construction water diversion etc. |
| | Rates of change, historical review | Rates of loss of cover and/or species over the period 1990-2000 |
| | Social and economic drivers of change in environmental state | Description, quantitative if possible e.g. pop'n growth, immigration, income/livelihood, demand/ consumption, management regime) |
| **Economic valuation[10]** | Values of direct use | Timber, charcoal, living marine resource extraction Yr 2000 local currency total |
| | Values of indirect use | Carbon sequestration, ecotourism, nursery areas for shrimps Yr 2000 local currency total |
| | Values from environmental services | Coastal protection, sediment stabilisation, water quality enhancement, contaminant sink, reduction of wave energy & erosion |
| | Value of investment | Restoration, replanting |
| | Values of potential (commercial) sustainable use | |
| | Total Economic Value | Yr 2000 local currency total |

[9]

[10] *Barbier, E.B. 1997. Economic Valuation of wetland: A guide for policy makers and planners. RAMSAR Convention Bureau, IUCN.*

Table 2 Details of properties and variables, Data and Information requirements for Coral Reef Site characterisation.

| | Parameter | Data & Information needed |
|---|---|---|
| **Geographic information** | Co-ordinates | Latitude & Longitude central position of areas, GPS Boundary or number (min 4) of paired co-ordinates for larger areas; end points for linear strips. |
| | Area | (Units $Km^2$ or Ha) |
| **Physical Environment** | Reef type | Fringing (mainland & island), barrier, atoll, patch, other |
| | | Slope Degrees (tangent) |
| | Bathymetry | Depth contour |
| | Climate | Prevailing wind; sea surface temperature, (seasonal mean, max & min); rainfall mean monthly rainfall (mm) |
| | Current pattern | Seasonal current pattern |
| | River discharge | Sediment load, quantity of freshwater discharge salinity |
| | Tidal regime | Range (m) |
| | | Diurnal, semi-diurnal, mixed |
| | Water quality | Nutrients, total P, N, nitrite, total suspended solids |
| | | Turbidity |
| | | Other parameters as available |
| **Environmental state information** | Present status | Live coral cover, dead coral cover, algae, abiotic |
| | | Level of exploitation (indicator species, catch per unit) |
| | Present threats | Sedimentation |
| | | Destructive fishing (no. of cases, both bombing & poisoning, reported per year |
| | | Pollution (no. pop'n & distance to the sources of pollutants) |
| | | Crown of Thorns (COT) infestation (density of COT, no. of cases, and infested areas) |
| | | Bleaching (% bleaching of live coral, % of covered ) |
| | | Others |
| | Trends | Increase or decrease of live coral cover |
| | Pressure (threats) – future | Development plan & distance to the coral reef area |
| **Social & use information** | Ownership | Description: Federal, State, Community, private, common property |
| | Management regime | Description: Land-use planning and coastal zoning, Institutional framework, stakeholder co-ordination, restoration, stakeholder investment, fishery practices |
| | Current use | Description: Commercial, subsistence, fishing ground, tourism and/or MPA |
| | Traditional use | Description of |
| | Potential use | Tourism and MPA (sustainable use) |
| | Significance/national importance | Use designation in national/state master plans |
| **Biological data** | Species diversity | No. of species and coverage of hard coral |
| | | No. of species and coverage of soft coral |
| | | Molluscs – species and density (no. per $m^2$) |
| | | Crustacean- species and density (no. per $m^2$) |
| | | Fish – coral reef fish, species abundance |
| | | Fish – Transient for breeding, species abundance |
| | | Mammals |
| | | Reptiles |
| | | Echinoderm |
| | | No. species of algae |
| | | Other species |
| | | Diversity index |
| | Genetic diversity | |
| | SCS Endemic species | List species and abundance |
| | Endangered or threatened species (IUCN criteria) | List species and abundance |
| | Source & sink of larvae | Location & types (breeding ground), density of larvae |
| | Migratory species | List species and abundance |
| | Ecosystem diversity | Description of complexity of habitats |
| | Interaction with other ecosystems | Description of associated ecosystems |
| **Economic valuation**[11] | Extractive | Reef related fish landing (mt/$$) |
| | | Subsistence fishery (no. of fishers dependent on reef – mt/$) |
| | | Commercially (live fish and fish landing – mt/$) |
| | Non extractive (tourism) | No. of visitors. ($ generated) |
| | | No. of people involved in industry (income generated) – no. of chalets/hotels operators - no. ferry/boats operator - no. guide/agents |
| | | Environment services |
| | | Education |
| | | Others |

[11] *Barbier, E.B. 1997*. Economic Valuation of Wetlands: A guide for policy makers and planners. *RAMSAR Convention Bureau, IUCN, Gland, Switzerland.*

**Defining the process:**

Also, at its second meeting, the RSTC (UNEP, 2003c) considered the process of site selection and ranking. It agreed to recommend to the PSC a three-step process involving: characterisation of the sites; a cluster analysis to identify major groupings of similar sites; and ranking of sites within each cluster, using both environmental and socio-economic criteria. It is important to note that only at the end of the first year was a discussion initiated as to how sites would be selected; the reason being that by assembling preliminary data sets without specifying that these might ultimately be used in site selection and ranking, some objectivity could be ensured in the process, thereby preventing individuals from presuming the purpose and outcome.

The recommendation of the PCU to the RSTC to use cluster analysis was based on the fact that each RWG had prepared site characterisation sheets for in excess of forty sites and the selection of three sites without some form of preliminary screening would have been a difficult, if not an impossible, task. The argument presented was that clustering resulted in sites being grouped on the basis of their similarity and that identifying at least three major clusters and then selecting one priority site from each cluster, would ensure maximum coverage of the range of biological diversity exemplified by sites bordering the South China Sea[12]. The rationale, in simple terms, was that three contrasting sites would be preferable as demonstration sites, rather than three similar ones if global and regional biological diversity objectives were to be addressed. This approach maximises the range of different environmental and biological conditions encompassed by the three sites selected as demonstration sites within each habitat type.

This recommendation was adopted by the Project Steering Committee (UNEP, 2003d) during its second meeting and involved the PCU essentially providing, to both RSTC and PSC members, a "short course" in the statistics of cluster analysis as well as presenting the arguments as to why a preliminary screening was required.

**Evaluating the data:**

During the third meetings of the RWGs (UNEP, 2003e; UNEP, 2003f; UNEP, 2003g; UNEP, 2003h)., the data and information were reviewed, anomalies identified and discussed, and a series of preliminary cluster analyses conducted using different data sets and transformations. At the same time, criteria to be used in the ranking process were discussed and agreed upon and preliminary rankings using the environmental criteria were prepared. The outcomes of these activities were presented to the third meeting of the RSTC (UNEP, 2003i) that reviewed them in some detail. The RSTC made specific comments and criticisms and recommended modifications or changes prior to their finalisation. It also agreed that supporting data for certain parameters must be provided in order to verify the data quality.

During the inter-sessional period, data were reviewed, anomalies corrected and the data sets finalised for the conduct of a final clustering in advance of the fourth meeting of the RWGs. Agreed principles used in the final analysis were that any site for which less than fifty percent of the agreed data set was available would be dropped from further consideration and any parameter for which fewer than 50% of the sites had data would also be excluded from further consideration.

During the fourth meetings of the RWGs (UNEP, 2004a; UNEP 2004b; UNEP, 2004c; UNEP, 2004d), the data sets were subjected to final review prior to their acceptance and the system for determining ranking scores was also reviewed in the light of the empirical data collected for the sites on the list. The final data sets used in the cluster analysis are presented in Tables 3, 4, 5, 6 and 7.

Where data could not be verified via species lists and/or published surveys, the sites were discussed and reviewed individually and the majority excluded from further consideration. In the case of the Regional Working Group on Mangroves, for example, data were initially assembled for forty-four mangrove sites, of which twenty-six data sets were judged by the Regional Working Group[13] to be sufficiently well documented to merit inclusion in a regional comparison.

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[12] *It is well recognised in the field of ecology that ecosystems at the margins of the overall global distribution differ quite significantly in terms of their species composition, productivity and ecosystem processes from those located at the "centre" of the distribution. Were mangrove sites to be selected, for example, solely on the basis of their species diversity, then the three most diverse sites would quite likely to be found in Indonesia and the particular associations characteristic of Northern Viet Nam and southern China, with their very different species composition, would have been unlikely to have been selected.*

[13] *At the time of this decision the ten person working group had combined experience of research and mangrove management totalling 191 person years.*

One consequence of these decisions was that sites of potential regional or global significance for which data were not available could not be included in the ranking procedure. This risk was not considered significant because most sites of global and/or regional significance are also considered of national significance[14]; hence data sets are generally available for such sites. An exception to this occurs in the case of Cambodia where basic data relating to coastal habitats are generally lacking; accordingly some funds were allocated to Cambodian focal points during the preliminary phase to conduct basic habitat surveys.

Whilst each regional working group considered and critically reviewed the data and information available for each site, the value of a higher-level body reviewing the outcome is demonstrated in the insights and comments provided by the RSTC on the outcome of the wetlands analysis. In the case of the wetlands sites, the excessively large size of some potential sites was questioned in terms of the uniformity of the habitats contained therein and the RSTC was of the opinion that integrated management of these areas was unlikely to be achieved due to the multiple administrative jurisdictions associated with the sites concerned. Furthermore, the RSTC noted that the wetlands component of this project focused on only five wetland types (inter-tidal, unvegetated mudflats; coastal brackish water lagoons; estuaries; coastal freshwater peat swamp forest; and coastal swamp forest). Hence, if each site was designated according to its major habitat type, the maximum number of additional (associated) ecosystems/or habitats that would be included would be four. These and other queries resulted in a second review and reconsideration of the data by the working group resulting in the final cluster analysis being completed only during the sixth meeting of the working group.

**Cluster Analysis**

Recognising that there exist sub-regional differences in the biological diversity contained in the seagrass, coral reef and mangrove habitats bordering the South China Sea, it was agreed that a statistical comparison of all sites be undertaken in order to determine the relative similarity (and differences) among the sites. These data are presented in Tables 3, 4, 5, 6 and 7. It can be seen that: in the case of mangroves, 12 properties and variables for a total of 26 sites were used in the analysis; for seagrass and coral reefs, 11, and 8 properties and variables and 26, and 44 sites respectively were included. In the case of mangroves 17 cells (5.4%) in Table 3 lack entries while for seagrass and coral reefs missing data represented 5.2%, and 15.6% of the comprehensive data sets. In the case of the wetlands sites, it was finally agreed to analyse the sites on the basis of wetland types, namely estuaries, inter-tidal mudflats, coastal lagoons and peat and non-peat swamp. The data for the first three habitats are presented in Table 6 including six properties and variables for 15 estuaries, 12 for inter-tidal mudflats and 7 for coastal lagoons. The data for seven properties and variables for 4 peat swamp and 2 non-peat swamp forest locations are presented in Table 7.

All of the data sets used in the cluster analysis, represent a compromise between a fully comprehensive and descriptive set of data and that available for the largest number of sites.

A cluster analysis was performed using the Clustan Graphic 6 software that enables estimation of missing values. All values were transformed to z scores, thus giving equal weight in the analysis to each variable. The resulting dendrograms are presented in Figures 1 to 6.

It can be seen that the mangrove sites fall into three clusters, two of which are comparatively small (four sites each). These two small clusters encompass sites in China, Thailand and Viet Nam representing the northern and northwestern margins of the South China Sea. The larger central cluster of 18 sites is more heterogenous, encompassing both insular and mainland sites generally lying in the southern and eastern portions of the region.

[14] *In contrast, the reverse is not necessarily true; sites of national importance may be insignificant from a regional or global perspective. See below.*

Table 3 Selected physical and biological properties and variables for mangrove potential demonstration sites bordering the South China Sea. (M = data unavailable)

| Site | Present Area | Zones spp. assoc | % change in area | True mangrove spp. | Density >1.5m high /Ha | % cover | No. Crustacean. spp. | No Bivalve | No. Gastropod spp. | No Fish spp. | No Bird spp. | No migratory bird spp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **China** | | | | | | | | | | | | |
| Shangkou | 812 | 4 | 11 | 9 | 11,980 | 90 | 65 | 40 | 33 | 95 | 28 | 76 |
| Quinglangang | 1,189 | 6 | -56 | 25 | 10,183 | 80 | 60 | 50 | 62 | 90 | 39 | 32 |
| DongXhaiGang | 1,513 | 5 | -14 | 16 | 8,433 | 80 | 32 | 24 | 27 | 84 | 43 | 35 |
| Futien | 82 | 3 | -26 | 7 | 10,233 | 80 | 29 | 16 | 21 | 11 | 58 | 99 |
| Fangchenggang | 1,415 | 4 | -10 | 10 | 12,300 | 90 | 67 | 62 | 40 | 71 | 42 | 145 |
| **Indonesia** | | | | | | | | | | | | |
| Belitung Island | 22,457 | 5 | 0 | 8 | 467 | 100 | 5 | 26 | 43 | 71 | **M** | **M** |
| Angke Kaput | 328 | 9 | -2 | 12 | 569 | 70 | 29 | 21 | 4 | 22 | 40 | 4 |
| Batu Ampar | 65,585 | 5 | 0 | 21 | 2,391 | 100 | 11 | 15 | 17 | 51 | 19 | 27 |
| Ngurah Rai | 1,374 | 6 | 27 | 25 | 660 | 100 | 38 | 10 | 32 | 34 | 38 | 42 |
| Bengkalis | 42,459 | 7 | -15 | 18 | 490 | 99 | 12 | 8 | 9 | 3 | 16 | 15 |
| **Philippines** | | | | | | | | | | | | |
| Busuanga | 1,298 | 5 | -5 | 24 | 7,550 | 90 | 6 | 15 | 36 | 9 | 45 | 27 |
| Coron | 1,296 | 5 | -50 | 26 | 7,080 | **M** | 7 | 15 | 37 | 13 | 42 | 34 |
| San Vicente | 133 | 5 | -15 | 14 | 3,780 | 80 | 6 | 15 | 36 | 13 | 36 | 40 |
| Ulugan | 790 | 4 | -10 | 16 | 5,100 | 85 | 8 | 15 | 36 | 13 | 42 | 39 |
| San Jose | 483 | 4 | -80 | 25 | 3,180 | 60 | 7 | 13 | 34 | 7 | 48 | 37 |
| Subic | 148 | 3 | -20 | 23 | 1,420 | 90 | 8 | 14 | 35 | 16 | 44 | 57 |
| Quezon | 1,939 | 5 | -40 | 32 | 4,000 | 80 | 5 | 14 | 37 | 11 | 44 | 37 |
| **Thailand** | | | | | | | | | | | | |
| Trad Province | 7,031 | 5 | 2 | 33 | 1,100 | 90 | 32 | **M** | **M** | 55 | 98 | 24 |
| Thung Kha Bay - Savi Bay | 3,543 | 4 | 34 | 23 | 1,628 | 90 | 58 | **M** | **M** | 36 | 13 | 8 |
| Pak Phanang Bay | 8,832 | 3 | 2 | 25 | 1,282 | 56 | 36 | **M** | **M** | 85 | 72 | 45 |
| Kung Kraben Bay | 640 | 2 | 0 | 27 | 6,100 | 80 | 19 | **M** | **M** | 35 | 75 | 16 |
| Welu River Estuary | 5,478 | 3 | 31 | 33 | 1,400 | 60 | 25 | **M** | **M** | 52 | 69 | 15 |
| **Viet Nam** | | | | | | | | | | | | |
| Tien Yen | 2,537 | 2 | -25 | 13 | 7,000 | 60 | 51 | **M** | **M** | 79 | **M** | **M** |
| Xuan Thuy | 1,775 | 3 | 98 | 11 | 9,500 | 75 | 61 | 25 | 30 | 90 | 31 | 62 |
| Can Gio | 8,958 | 3 | 100 | 32 | 6,000 | 80 | 28 | 17 | 32 | 103 | 96 | 34 |
| Ca Mau | 5,239 | 3 | 60 | 30 | 7,500 | 85 | 12 | 6 | 15 | 36 | 18 | 53 |

Table 4 Biodiversity and other environmental properties and variables for selected seagrass sites in the South China Sea. (M = data unavailable)

| Site Name | Area (ha) | % cover | Depth range | Seagrass spp. | Penaeid spp. | Gastropod spp. | Siganid spp. | Urchin spp | Threatened spp. | Associated ecosystems | Migratory species |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cambodia** | | | | | | | | | | | |
| Kampot | 25,240 | 45 | 2 | 6 | **M** | **M** | **M** | **M** | 2 | 2 | 2 |
| **China** | | | | | | | | | | | |
| Hepu | 540 | 85 | 4 | 4 | 5 | 12 | 1 | 3 | 3 | 1 | 2 |
| Liusha | 900 | 90 | 3 | 2 | 5 | 11 | 1 | 1 | 2 | 2 | 2 |
| LiAn | 320 | 82 | 3.2 | 5 | 4 | 17 | 1 | 1 | 3 | 2 | 2 |
| Xincun | 200 | 87 | 2 | 4 | 4 | 6 | 1 | 1 | 2 | 2 | 1 |
| **Indonesia** | | | | | | | | | | | |
| Trikora Beach | 280 | 95 | 2 | 9 | 3 | 16 | 3 | 4 | 6 | 2 | 3 |
| Mapur | 275 | 85 | 3 | 9 | 3 | 11 | 3 | 4 | 5 | 2 | 3 |
| **Malaysia** | | | | | | | | | | | |
| Tanjung Adang Laut Shoal | 40 | 80 | 1.2 | 9 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| Tanjung Adang Darat Shoal | 42 | 80 | 0.7 | 9 | 2 | 2 | 1 | 1 | 2 | 1 | 2 |
| Merambong Shoal | 30 | 80 | 0.7 | 10 | 2 | 2 | 2 | **M** | 2 | 1 | 2 |
| Sungal Paka Shoal | 43 | **M** | 4 | 2 | **M** | 2 | **M** | 2 | 1 | 1 | 1 |
| Pulau Tinggi Mersing | 3 | 70 | 3 | 6 | **M** | **M** | 2 | 2 | 2 | 1 | 2 |
| Setiu Terengganu | 3 | 70 | 6 | 3 | **M** | 3 | 2 | M | 1 | 1 | 1 |
| Pulau Besar Mersing | 3 | 70 | 4 | 5 | **M** | 1 | 2 | **M** | 2 | 1 | 2 |
| **Philippines** | | | | | | | | | | | |
| Cape Bolinao | 2,500 | 75 | 1.7 | 9 | 7 | 23 | 6 | 4 | 3 | 2 | 1 |
| Puerto Galera | 114 | 95 | 4.5 | 9 | 3 | 11 | 2 | 3 | 3 | 2 | 1 |
| Ulugan Bay | 11 | 90 | 2.5 | 8 | 3 | 10 | 2 | 5 | 4 | 2 | 0 |
| Puerto Princesa/Honda Bay | 670 | 90 | 4 | 8 | 4 | 18 | 4 | 5 | 3 | 2 | 1 |
| **Thailand** | | | | | | | | | | | |
| Kung Krabane Bay | 700 | 80 | 4 | 5 | 4 | 5 | 2 | **M** | 2 | 1 | 1 |
| Surat Thani | 500 | 65 | 3 | 6 | 2 | 73 | 3 | 1 | 2 | 1 | 2 |
| Pattani Bay | 273 | 80 | 3 | 4 | 8 | 35 | 5 | **M** | 2 | 1 | 2 |
| **Viet Nam** | | | | | | | | | | | |
| Bai Bon, Phu Quoc Is | 2,000 | 70 | 6 | 7 | 3 | 46 | 1 | 3 | 5 | 2 | 2 |
| Rach Vem, Phu Quoc Is | 900 | 65 | 6 | 6 | 3 | 30 | 1 | 3 | 3 | 2 | 2 |
| Con Dao Island | 200 | 25 | 9.6 | 10 | 8 | 45 | 1 | 3 | 4 | 2 | 4 |
| Phu Qui Island | 300 | 50 | 2.5 | 6 | 2 | 35 | 3 | 3 | 3 | 2 | 2 |
| Thuy Trieu (Khan Hoa) | 800 | 60 | 1 | 7 | 4 | 10 | 3 | 2 | 4 | 2 | 0 |

Table 5 Properties and variables for potential coral reef demonstration sites used in determining similarities and differences among sites. (M = data unavailable)

| Site Name | Hard coral species | live coral cover (%) | No. of algae spp. | No. of crustacean species | No. of echinoderm species | No. of coral reef fish species | Other ecosystem | No. of endangered and threatened species |
|---|---|---|---|---|---|---|---|---|
| **Viet Nam** | | | | | | | | |
| Cu Lao Cham | 131 | 33.9 | 122 | 84 | 4 | 178 | 1 | 4 |
| Nha Trang bay | 351 | 26.4 | 55 | 69 | 27 | 222 | 2 | 3 |
| Con Dao | 250 | 23.3 | 84 | 110 | 44 | 202 | 2 | 4 |
| Phu Quoc | 89 | 42.2 | 98 | 9 | 32 | 135 | 2 | 3 |
| Ninh Hai | 197 | 36.9 | 190 | 24 | 13 | 147 | 1 | 4 |
| Ca Na bay | 134 | 40.5 | 163 | 46 | 26 | 211 | 1 | 3 |
| Ha Long - Cat Ba | 170 | 43 | 94 | 25 | 7 | 34 | 2 | 4 |
| Hai Van – Son Tra | 129 | 50.5 | 103 | 60 | 12 | 132 | 1 | 4 |
| Bach Long Vi | 99 | 21.7 | 46 | 16 | 8 | 46 | **M** | 2 |
| **Philippines** | | | | | | | | |
| Batanes, Basco | **M** | 55.00 | 41 | **M** | **M** | 86 | 1 | 3 |
| Bolinao/Lingayen Gulf | 199 | 40.00 | 224 | **M** | **M** | 328 | 2 | 4 |
| Masinloc, Zambales | **M** | 33.00 | 57 | **M** | **M** | 249 | 2 | 4 |
| Batangas bay/Maricaban | 290 | 48.00 | 141 | **M** | **M** | 155 | 2 | 4 |
| Puerto Galera, Mindoro | 267 | 33.00 | 75 | **M** | **M** | 333 | 2 | 5 |
| El Nido, Palawan | 305 | 40.00 | 129 | **M** | **M** | 480 | 2 | 5 |
| **Thailand** | | | | | | | | |
| Mu Koh Chumporn | 120 | 55 | **M** | 304 | 21 | 106 | 4 | 5 |
| Mu Koh Chang | 130 | 40 | 43 | 250 | 20 | 113 | 4 | 6 |
| Mu Koh Ang Thong | 110 | 55 | 7 | 136 | 21 | 106 | 4 | 1 |
| Mu Koh Samui | 140 | 40 | 7 | 136 | 21 | 106 | 4 | 5 |
| Mu Koh Samet | 41 | 35 | 38 | 134 | 11 | 74 | 4 | 5 |
| Sichang Group | 90 | 20 | 40 | 304 | 11 | 86 | 4 | 2 |
| Sattaheep Group | 90 | 33 | 40 | 304 | 15 | 75 | 4 | 2 |
| Lan and Phai Group | 72 | 18 | 40 | 304 | 15 | 75 | 2 | 2 |
| Chao Lao | 80 | 30 | 33 | 123 | 12 | 105 | 2 | 3 |
| Prachuab | 74 | 40 | 18 | 106 | 16 | 162 | 2 | 4 |
| Koh Tao Group | 79 | 45 | 7 | 136 | 21 | 106 | 2 | 4 |
| Song Khla | 12 | 20 | 2 | **M** | **M** | 30 | 2 | 2 |
| Koh Kra | 80 | 40 | **M** | **M** | **M** | 80 | 1 | 2 |
| Losin | 90 | 40 | **M** | **M** | **M** | 90 | 1 | 2 |
| **Indonesia** | | | | | | | | |
| Anambas | 206 | **M** | 26 | 24 | 25 | 128 | 3 | 2 |
| Bangka | 126 | **M** | **M** | 25 | 23 | 169 | 3 | 2 |
| Belitung | 164 | 38.46 | **M** | 10 | 35 | 170 | 3 | 2 |
| Karimata | 192 | **M** | **M** | 15 | 15 | 200 | 3 | 2 |
| **Malaysia** | | | | | | | | |
| Batu Malang, Pulau Tioman | 96 | 62.6 | 3.8 | **M** | **M** | 123 | 1 | 4 |
| Pulau Lang Tengah | 86 | 41.3 | 3.1 | **M** | **M** | 117 | 2 | 4 |
| Pulau Lima, Pulau Redang | 96 | 46.3 | 10 | **M** | **M** | 113 | 1 | 4 |
| Teluk Jawa, Palau Dayang | 80 | 38.4 | 11.9 | **M** | **M** | 156 | 1 | 4 |
| Tun Mustapha, Sabah | 252 | **M** | 69 | **M** | 45 | 375 | 4 | 4 |
| **Cambodia** | | | | | | | | |
| KKCR2 | 67 | 29.3 | **M** | **M** | 1 | 51 | 2 | **M** |
| SHVCR1 | 34 | 23.1 | **M** | **M** | 14 | 6 | 3 | **M** |
| SHVCR2 | 23 | 58.1 | 3 | **M** | **M** | 51 | 3 | **M** |
| SHVCR3 | 70 | **M** | **M** | **M** | 14 | 42 | 3 | **M** |
| KEPCR1 | 67 | 41 | **M** | **M** | 14 | 51 | 3 | **M** |

Table 6 Final agreed properties and variables used for the cluster analysis of wetland potential demonstration sites. (M = data unavailable)

| Site | Area (ha) | Total no. fish spp. | Total no. birds spp. | No. wetland types | No. migratory spp. | Site specific endemic spp. |
|---|---|---|---|---|---|---|
| **Data set for estuaries** | | | | | | |
| Welu River Estuary | 10,400 | 52 | 74 | 2 | 21 | M |
| Ban Don Bay Estuary | 49,459 | 35 | 46 | 2 | 12 | M |
| Thung Kha Bay-Savi Bay Estuary | 5,204 | 86 | 115 | 2 | 33 | M |
| Pattani Bay Estuary | 6,149 | 215 | 93 | 2 | 43 | M |
| Pak Phanang Bay Estuary | 13,597 | 140 | 226 | 2 | 84 | M |
| Pansipit River Estuary | 15 | 75 | 24 | 1 | 10 | 1 |
| Balat Estuary | 26,397 | 130 | 181 | 2 | 136 | 6 |
| Tien River Estuary | 100,691 | 155 | 41 | 3 | 20 | 2 |
| Dong Nai River Estuary | 49,711 | 155 | 130 | 2 | 22 | 5 |
| Van Uc Estuary | 6,990 | 123 | 118 | 2 | 90 | 2 |
| Bach Dang Estuary | 80,358 | 117 | 153 | 2 | 25 | 5 |
| Tien Yen Estuary | 24,738 | 82 | 57 | 2 | 31 | 5 |
| Beilun Estuary | 1,083 | 145 | 133 | 2 | 93 | 13 |
| Pearl River Estuary | 12,783 | 302 | 227 | 2 | 141 | 37 |
| Koh Kapik Estuary | 12,000 | 25 | 30 | 2 | 6 | 4 |
| **Data set for Inter-tidal Mudflats** | | | | | | |
| Mu Koh Chang National Park Tidal Flat | 65,000 | 11 | 72 | 1 | 16 | M |
| Don Hoi Lord Tidal Flat | 2,490 | 3 | 18 | 2 | 12 | M |
| Mu Koh Ang Thong Marine National Park Tidal Flat | 10,200 | 75 | 53 | 1 | 13 | M |
| Balayan Bay Tidal flats | 75,000 | M | 25 | 2 | 20 | 15 |
| Manila Bay Tidal Flat | 30,000 | M | 25 | 3 | 20 | 10 |
| El Nido, Palawan mudflats | 54,303 | M | 26 | 2 | 10 | 1 |
| Ca Mau Southwest Tidal Flat | 60,711 | 147 | 171 | 2 | 27 | 3 |
| Kim Son Tidal Flat | 12,620 | 132 | 140 | **3** | 54 | 5 |
| Dan zhou lingao Intertidal Flat | 806 | 149 | 157 | **3** | 101 | 21 |
| Hepu Intertidal | 3,951 | 227 | 193 | **3** | 137 | 27 |
| Shantou Inter-tidal | 1,435 | 213 | 179 | **3** | 100 | 15 |
| Russey Srok-Tourl Sragnam Tidal flat | 4,890 | 10 | 9 | **2** | 3 | 2 |
| **Data set for Coastal Lagoons** | | | | | | |
| Tam Giang-Cau Lagoon | 21,600 | 171 | 73 | 3 | 35 | 5 |
| Tra O Lagoon | 2,000 | 67 | 55 | 3 | 25 | 3 |
| Malampaya Sound | 24,500 | 156 | 26 | **3** | 10 | **0** |
| Degi Lagoon (Binh Dinh Province) | 1,600 | 105 | 40 | 2 | 25 | 2 |
| Thi Nai lagoon (Binh Dinh Province) | 5,000 | 119 | 37 | 3 | 25 | 2 |
| Wenchang Lagoon | 218 | 227 | 193 | 3 | 137 | 20 |
| Beung Kachhang Lagoon | 4,503 | 17 | 12 | **2** | 4 | 1 |

Table 7 Final agreed data set used for the cluster analysis of peat and non-peat swamp wetlands potential demonstration sites. (M = data unavailable)

| Site | Area (ha) | Total no. fish | Total no. birds | No. vascular plant spp. | No. resident mammal spp. | No. wetland types | No. migratory spp. |
|---|---|---|---|---|---|---|---|
| **Data set for Non-peat swamp** | | | | | | | |
| Khao Sam Roi Yot National Park freshwater marsh | 9,808 | 34 | 150 | **M** | 14 | 3 | **M** |
| Taal Lake freshwater | 65,720 | 242 | 24 | 26 | 0 | 1 | 76 |
| **Peat swamp** | | | | | | | |
| Thale Noi Wildlife Non-hunting Area Peat swamp | 45,700 | 30 | 202 | 260 | 7 | 2 | 60 |
| Thale Sap Song Khla Non- hunting Area Peat swamp | 36,467 | 106 | 143 | 25 | M | 2 | 63 |
| Phru To Daeng Wildlife Sanctuary Peat Swamp | 20,120 | 42 | 194 | 14 | 61 | 2 | 21 |
| Phru Kan Tulee Peat swamp | 140 | 29 | 47 | 35 | 16 | 1 | 6 |

Figure 1 Cluster diagram of twenty-six mangrove sites bordering the South China Sea based on Euclidean distance and mean proximity.

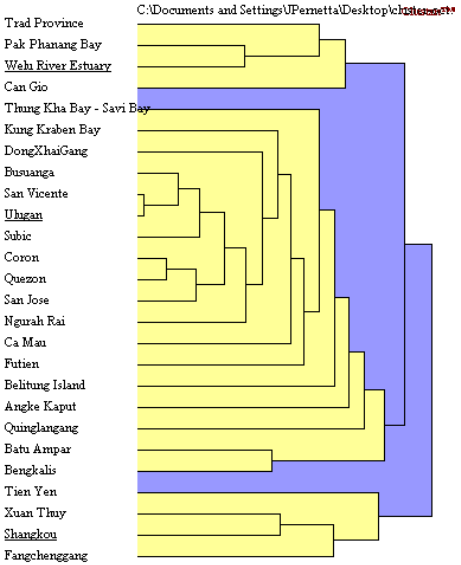



Figure 2 Cluster analysis of twenty-six potential seagrass demonstration sites bordering the South China Sea based on Euclidean distance and mean proximity.

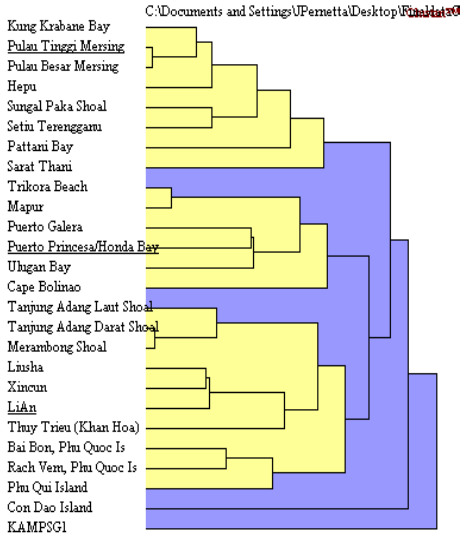



Figure 3 Cluster diagram of 44 coral reef sites bordering the South China Sea based on Euclidean distance and mean proximity.

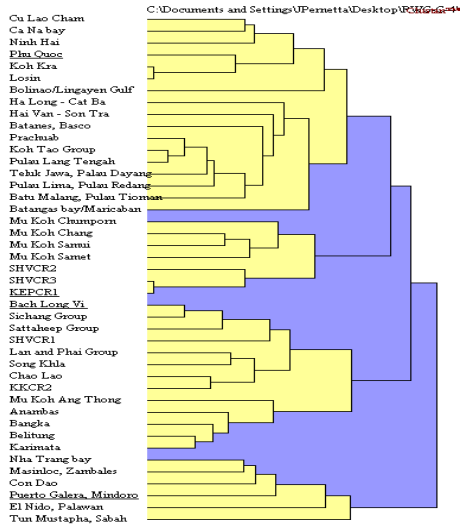



Figure 4 Results of Cluster Analysis of 15 estuarine sites bordering the South China Sea based on Euclidean distance and mean proximity.

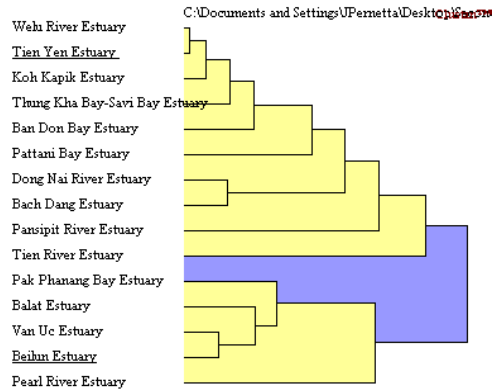



Figure 5 Results of Cluster Analysis of 12 inter-tidal mudflats bordering the South China Sea based on Euclidean distance and mean proximity.

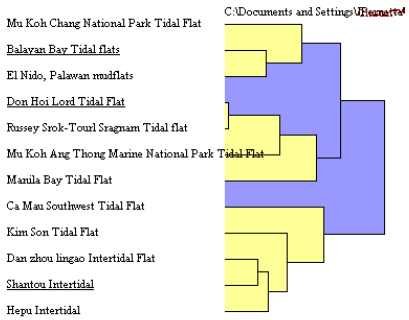
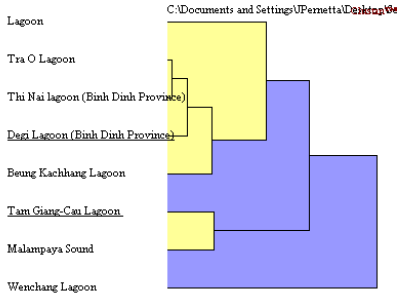



Figure 6 Results of Cluster Analysis of 7 coastal, brackish water lagoons on the margins to the South China Sea based on Euclidean distance and mean proximity.



In the case of the seagrass sites, the resulting dendrogram presented in Figure 2 shows that sites fall into three major clusters with two outlying sites. The clusters in this case do not appear to reflect recognisable geographic sub-divisions of the South China Sea with, for example, the Chinese Hepu site falling into the uppermost cluster comprising principally of sites bordering the Gulf of Thailand.

Figure 3 presents the dendrogram resulting from a cluster analysis of the data for coral reef sites presented in Table 5. Four clusters of sites are apparent, the lower cluster consisting of a grouping of outlying sites that, for various reasons, are somewhat distinct from the remainder of the set.

Figures 4, 5 and 6 present the dendrograms resulting from three separate cluster analyses conducted on the data presented in Table 6. It can be seen that the data for estuaries suggests the existence of two clusters, whilst the data for intertidal mudflats fall into three clusters and those for coastal lagoons into two with a single outlier. The sample size for peat swamp and non-peat swamp forest is too small to permit a meaningful analysis.

The purpose of performing such analyses was to identify groups of similar sites and ultimately to spread the interventions across different groups thus maximising the between site variation covered by the selected demonstration sites.

### DETERMINING REGIONAL PRIORITY OF POTENTIAL DEMONSTRATION SITES

**National and Regional Priority.** Whilst most countries have determined national priorities for intervention including conservation and sustaining coastal biodiversity, such priorities have generally been determined and agreed independently of neighbouring countries. The determination of national priorities may not necessarily include consideration of the regional and or global significance of a particular site or of the species found there. Hence, the top priority mangrove site in one country may fall far below the lower priority sites from a second country when both sets are compared from the perspective of regional or global significance. One major challenge faced by the South China Sea Project was the determination of the comparative significance of different national areas of each habitat that included consideration of transboundary, regional and global factors.

To initiate the process of determining the comparative regional importance of national sites, it was agreed by the Regional Working Groups to develop a set of environmental criteria and indicators reflecting biological diversity and the transboundary and regional significance of each site. A similar system of criteria and indicators was also developed for the social and economic characteristics of the sites. Both sets of criteria and indicators are presented in Appendix 1 of this document and were reviewed by the Regional Scientific and Technical Committee (UNEP, 2003c; 2003i) prior to being applied to data from each site to produce a score representing a regional perspective on priorities.

### Environmental Indicators

Table 8 presents a summary of the major classes of indicator, the number of individual indicators and the weight assigned to them by each working group. It can be seen that all four groups adopted the same four basic classes of indicator but that the number of indicators within each class varied somewhat between the groups.

Within each class of indicator, a series of one or more specific indicators were identified on the basis of the outcome of the initial site characterisations; hence indicators were not included by most groups when it was apparent that the information and/or data were difficult to assemble as evidenced by the frequency of missing data in the preliminary set.

Following a careful analysis of the range of values demonstrated by the site data available to the meetings, the regional working groups considered the number of divisions and weighting that would be appropriate to assign to any individual site value. Hence, for example, the number of migratory bird species recorded from each mangrove site ranged from 13 at Trad Province in Thailand to 145 species at Fangchenggang in China. For this indicator, it was decided to distinguish five categories based on an increment of 30 species and weights were assigned accordingly.

Table 8 Comparison of the number of indicators in each class of environmental indicator and the weight assigned to different classes by the Regional Working Groups on habitats.

| Class | Mangrove | | Coral Reef | | Seagrass | | Wetland | |
|---|---|---|---|---|---|---|---|---|
| | No. Indicators | Weight | No. Indicators | Weight | No. Indicators | Weight | No. Indicators | Weight |
| **Area** | 1 | 35 | 1 | 10 | 2 | 25 | 1 | 10 |
| **Biological Diversity**[15] | *7* | *50* | *8* | *60* | *8* | *60* | *5* | *60* |
| Sub-set 1 - Species | 5 | 30 | - | - | 7 | 52 | - | - |
| Sub-set 2 - Community | 2 | 20 | - | - | 1 | 8 | - | - |
| **Transboundary significance** | 1 | 10 | 3 | 20 | 1 | 5 | 1 | 15 |
| **Regional/Global Significance.** | 2 | 5 | 1 | 10 | 1 | 10 | 2 | 15 |

## Socio-Economic Indicators

Table 9 lists the indicators selected by the regional working groups as being indicative of socio-economic conditions, including indicators of national priority, stakeholder involvement and threats. As in the case of the environmental indicators, each regional working group discussed and agreed the comparative weight that should be assigned to each class of indicator and then to individual indicators within each class, finally deciding on the divisions and weights that should be assigned to the observed values at any one site.

Table 9 Comparison of the number of indicators in each class of socio-economic indicator and the weight assigned to different classes by the Regional Working Groups on habitats.

| Class | Mangrove | | Coral Reef | | Seagrass | | Wetland | |
|---|---|---|---|---|---|---|---|---|
| | No Indicators | Weight | No Indicators | Weight | No Indicators | Weight | No Indicators | Weight |
| **Threats** [116] | 2 | -30 | 5 | +15 | 2 | -10 | 2 | +20 |
| **National Significance** | 1 | 20 | 3 | 25 | 1 | 16 | 3 | 40 |
| **Financial** | 2 | 20 | 1 | 20 | 2 | 22 | 1 | 20 |
| **Stakeholder involvement** | 4 | 30 | 1 | 20 | 4 | 22 | 1 | 20 |
| **Transboundary Management** | - | - | 1 | 20 | - | - | - | - |
| **Management Potential** | - | - | - | - | 3 | 30 | - | - |

It was noted by all groups that a number of the indicators listed in Table 2 were highly subjective. A major issue for discussion at the RSTC concerned the way in which the “threats” category should be scored. Two regional working groups scored it positively with high threats getting high scores whilst two groups scored in the reverse manner with low threats getting high scores. The rationale for the latter being that, if the threat is large or strong enough then there is no possibility of mitigating it with the resources available. The RSTC discussed this matter and agreed that what should be considered is not the threat itself but rather the reversibility of the threat. Hence the “reversibility of threat”, should be scored such that high probability of reversing a threat received a higher score and low probability of reversing the threat received a low score. This procedure was adopted in the final ranking.

## Priority sites for intervention and Agreeing the outcome:

Having agreed the criteria, indicators and scoring system and conducted an independent cluster analysis to group similar sites, the rank order within each cluster was determined and a set of demonstration site proposals prepared for consideration by the Regional Scientific and Technical Committee and the Project Steering Committee (UNEP, 2004e; UNEP, 2004f).

[15] *Biological diversity was sub-divided into two levels species and community diversity by two groups.*

[16] *“Reversibility of threat” should be scored; with high probability of reversing a threat receiving a higher score and low probability of reversing the threat receiving a low score.*

By the end of the fourth round of RWG meetings, each group had produced an agreed data set, an agreed final cluster analysis, an agreed set of criteria and indicators for ranking sites and an agreed ranking of individual sites within each cluster. These agreements were presented to the fourth meeting of the Regional Scientific and Technical Committee together with the recommendations from each group regarding the demonstration sites that should be financed from the GEF Project budget. The RSTC reviewed these recommendations and outcomes making some comments and criticisms regarding some aspects of the application of the process but essentially approved the recommendations for consideration by the Project Steering Committee.

The third meeting of the Project Steering Committee considered the recommendations of the RSTC and the RWGs and accepted the recommendations with some minor additions/alterations based primarily on political considerations of "equity".

**FINAL OUTCOMES:**

The procedure was developed in an open and transparent manner, and was based on an agreed objective set of indicators and criteria. The process involved consensus building with all focal points participating such that all parties understood and accepted the final outcome.

The original outcome of the project was anticipated as being nine regional priority demonstration sites, three each focussing on mangroves, seagrass and coral reefs.

**Additional Outcomes not envisaged during project design:**

1. Regionally prioritised listings of sites as follows:
   - 26 mangrove sites;
   - 43 coral reef sites;
   - 26 seagrass sites; and
   - 40 wetlands sites (15 estuaries; 12 inter-tidal mudflats; 7 coastal lagoons; and 6 swamp forest sites)
2. Draft proposals for intervention in 23 sites across all habitats types;
3. An inter-governmentally agreed procedure for determining regional priority[17] which can be used to rank sites either nationally or regionally in the future;
4. A regional GIS database having an extensive number of sites characterised in geographical and environmental, including biological, terms;
5. Application of the approach at the national level in two countries to determine national priorities for intervention;
6. Decisions taken in an amicable manner through consensus among all participating countries;
7. A procedure and process that serves as a potential model for replication elsewhere when choices between alternative sites for intervention must be made based on financial limitations.

John C. Pernetta
July 18th 2007.

[17] *The Regional Priority is not based solely on national priorities but includes national priority as one indicator of significance.*

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## Appendix 1

Table 1 Indicators and weight for criteria used in ranking mangrove systems in terms of biological diversity, transboundary, regional and global significance.

| Class of Indicator | Indicator scale Score | | | | |
|---|---|---|---|---|---|
| **1. Area maximum 35 points** | | | | | |
| 1.1 Total existing natural mangrove area (ha) | < 500 | 500-1,000 | 1,001-5,000 | 5,001-15,000 | >15,000 |
| Score | 7 | 14 | 21 | 28 | 35 |
| **2. Biological diversity 50 points** | | | | | |
| ***2.1 Species diversity Score maximum 30 points*** | | | | | |
| 2.1.1 True mangrove species | < 10 | 10-20 | 21-30 | 30-40 | >40 |
| Score Maximum 14 points | 1 | 3 | 6 | 10 | 14 |
| 2.1.2 Associate mangrove species | <10 | 11-20 | >20 | | |
| Score Maximum 4 points | 1 | 2 | 4 | | |
| 2.1.3 Total fish species4 | <50 | 51-150 | >150 | | |
| Score Maximum 4 points | 1 | 2 | 4 | | |
| 2.1.4 Crustacean | 40 | 41-90 | >90 | | |
| Score Maximum 4 points | 1 | 2 | 4 | | |
| 2.1.5 Resident bird species | < 15 | 16-50 | >50 | | |
| Score Maximum 4 points | 1 | 2 | 4 | | |
| ***2.2 Community diversity 20 points*** | | | | | |
| 2.2.1 Number of zones or associations | 1-2 | 3-4 | >4 | | |
| Score Maximum 11 points | 3 | 6 | 11 | | |
| 2.2.2 Number of trophic levels below the top carnivore in the terrestrial food chain | 1-2 | 3-4 | >4 | | |
| Score Maximum 9 points | 3 | 6 | 9 | | |
| **3. Transboundary significance 10 points** | | | | | |
| 3.2 No migratory bird species include seasonal migratory spp. and long distance migrators | <30 | 30-59 | 60-89 | 90-120 | >120 |
| Score Maximum 10 points | 2 | 4 | 6 | 8 | 10 |
| **4. Regional/Global significance 5 points** | | | | | |
| 4.1 Number of associate and true mangrove species found only in the South China Sea | 0.5 points for each endemic to a maximum of 2.5 | | | | |
| Score Maximum 2.5 points | | | | | |
| 4.2 Number of endangered & threatened species | 0.5 points for each endangered species to a maximum of 2.5 | | | | |
| Score Maximum 2.5 points | | | | | |

Table 2 Indicators for socio-economic considerations used in the ranking of mangrove sites bordering the South China Sea.

| Class of Indicator | Indicator scale Score | | | |
|---|---|---|---|---|
| **1. Reversibility of Threats** | | | | |
| 1. Change of area (% Lost over ten years) | <5 | 6-10 | 11-25 | >25 |
| Score – max 20 | 20 | 15 | 10 | 5 |
| 2. Human population stress (population density, people/Km$^2$) in the site | <40 | 40-199 | 200-400 | >400 |
| Score – max 10 | 10 | 6 | 4 | 2 |
| **2. National significance/priority-Government support** | | | | |
| 1. National priority | Low | Medium | High | |
| Score – max 20 | 2 | 10 | 20 | |
| **3. Financial considerations /co-financing** | | | | |
| 1. Project cost ($US) | <150,000 | 150,000 | >150,000 | |
| Score – max 10 | 10 | 5 | 0 | |
| 2. Co-financing commitment | <1/1 | 1/1 | >1/1 | |
| Score – max 10 | 0 | 5 | 10 | |
| **4. Stakeholders involvement 30** | | | | |
| Local government (in cash/in-kind) | Low | Medium | High | |
| Score – max 8 | 2 | 5 | 8 | |
| Central government (in cash/in-kind) | Low | Medium | High | |
| Score – max 8 | 2 | 5 | 8 | |
| NGOs/Civil Society (in cash/in-kind) | Low | Medium | High | |
| Score – max 8 | 2 | 5 | 8 | |
| Private Sector (in cash/in-kind) | Low | Medium | High | |
| Score – max 6 | 1 | 3 | 6 | |

Table 3 Indicators and weight for environmental characteristics used in ranking of potential coral reef demonstration sites.

| Indicators | Scale of Indicators | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| ***Biological diversity, 60 points*** | | | | | |
| | | | | | |
| No. Hard coral Genera | < 30 | 31-40 | 41-50 | 51-60 | > 60 |
| Maximum score, 10 | 1 | 4 | 6 | 8 | 10 |
| No. Hard coral species | < 100 | 101-150 | 151-200 | 201-300 | > 300 |
| Maximum score, 10 | 2 | 4 | 6 | 8 | 10 |
| Percentage live coral cover | 0-10 | 11-25 | 26-50 | 51-75 | >75 |
| Maximum score, 8 | 1 | 2 | 4 | 6 | 8 |
| Percentage algal cover | >40 | 10-40 | <10 | | |
| Maximum score, 3 | 1 | 2 | 3 | | |
| Number of coral reef fish genera | < 20 | 21-30 | 31-50 | 51-60 | >60 |
| Maximum score, 9 | 1 | 3 | 5 | 7 | 9 |
| Number of coral reef fish species | <100 | 101-250 | 251-400 | 401-600 | >600 |
| Maximum score, 10 | 2 | 4 | 6 | 8 | 10 |
| Number of other ecosystems | <1 | 1-2 | > 3 | | |
| Maximum score, 10 | 0 | 6 | 10 | | |
| ***Transboundary Significance, 20 points*** | | | | | |
| No. of Migratory Species | <5 | 5-10 | > 10 | | |
| Maximum score, 8 | 3 | 6 | 10 | | |
| Tourism (yes or no) | no | yes | | | |
| Maximum score, 5 | 0 | 5 | | | |
| Cross-boundary Fishing (yes or no) | no | yes | | | |
| Maximum score, 5 | 0 | 5 | | | |
| ***Regional/Global Significance, 10 points*** | | | | | |
| | | | | | |
| Number of endangered and threatened species | <5 | 5-10 | >10 | | |
| Maximum score, 10 | 3 | 6 | 10 | | |
| ***Area, 10 points*** | | | | | |
| Area of coral reefs (ha) | < 100 | 101- 500 | > 500 | | |
| Maximum score, 10 | 3 | 6 | 10 | | |

Table 4 Indicators for socio-economic considerations of coral reef systems used in the ranking of coral reef sites bordering the South China Sea.

| Indicators | Scale of Indicators | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | |
| ***Threats, 15 points*** | | | | |
| Reversibility of fishing impact | Low | Medium | High | |
| Maximum score, 3 | 1 | 2 | 3 | |
| Reversibility of development impact | Low | Medium | High | |
| Maximum score, 3 | 1 | 2 | 3 | |
| Reversibility of coral mining | Low | Medium | High | |
| Maximum score, 3 | 1 | 2 | 3 | |
| Reversibility of land-based pollution | Low | Medium | High | |
| Maximum score, 3 | 1 | 2 | 3 | |
| Natural impact( typhoon, bleaching and COT star fish) | Low | Medium | High | |
| Maximum score, 3 | 1 | 2 | 3 | |
| ***National significance, 25 points*** | | | | |
| Identified as a national priority | Rest | 3 | 2 | 1 |
| Maximum score, 10 | 0 | 3 | 6 | 10 |
| Level of direct stakeholder involvement in management | Low | Medium | High | |
| Maximum score, 5 | 1 | 3 | 5 | |
| socio-economic value | Low | Medium | High | |
| Maximum score, 10 | 3 | 6 | 10 | |
| ***Finance consideration - co financing, 20 points*** | | | | |
| Potential for co financing | < 1:1 | 1:1 | > 1:1 | |
| Maximum score, 20 | 10 | 15 | 20 | |
| ***Local stakeholder/ community involvement, 20 points*** | | | | |
| Local stakeholder/ community involvement | Low | Medium | High | |
| Maximum score, 20 | 10 | 15 | 20 | |
| ***Transboundary management, 20 points*** | | | | |
| Potential transboundary management | no | yes | | |
| Maximum score, 20 | 0 | 20 | | |

Table 5 Indicators and weight for seagrass systems of biological diversity, transboundary, regional and global significance.

| Class of Indicator | Indicator scale | | | | |
|---|---|---|---|---|---|
| | Score | | | | |
| **1. Area maximum 25 points** | | | | | |
| **1.1 Total area (ha) maximum 15 points** | <20 | 21-100 | 101-300 | 301-500 | >500 |
| Score | 3 | 6 | 9 | 12 | 15 |
| **1.2 Percent coverage maximum 10 points** | <20 | 21-40 | 41-60 | 61-80 | >80 |
| Score | 2 | 4 | 6 | 8 | 10 |
| **2. Biological diversity 60 points** | | | | | |
| **2.1 Species diversity Score maximum 52 points** | | | | | |
| 2.1.1 Seagrass species | <2 | 3-4 | 5-6 | 7-8 | >8 |
| Score Maximum 15 points | 3 | 6 | 9 | 12 | 15 |
| 2.1.2 Gastropods | <20 | 21-40 | 41-70 | 71-100 | >100 |
| Score Maximum 5 points | 1 | 2 | 3 | 4 | 5 |
| 2.1.3 Penaeid shrimps | 0 | 1-3 | 4-5 | 6-7 | >7 |
| Score Maximum 8 points | 0 | 2 | 4 | 6 | 8 |
| 2.1.4 Sea Urchins | 0 | 1-2 | >2 | | |
| Score Maximum 4 points | 0 | 2 | 4 | | |
| 2.1.5 Siganids | 0 | 1-2 | 3-4 | >4 | |
| Score Maximum 8 points | 0 | 2 | 5 | 8 | |
| 2.1.6 Holothurians | 0 | 1-5 | >5 | | |
| Score Maximum 8 points | 0 | 4 | 8 | | |
| 2.1.7 Starfish | 0 | 1-3 | >3 | | |
| Score Maximum 4 points | 0 | 2 | 4 | | |
| **2.2 Community diversity Score maximum 8 points** | | | | | |
| 2.2.1 Number of other aquatic ecosystems | 1 | 2 | >2 | | |
| Score Maximum 8 points | 3 | 5 | 8 | | |
| **3. Transboundary significance 5 points** | | | | | |
| **3.1 Number of migratory aquatic species** | | | | | |
| Score Maximum 5 points | score 1 point per species | | | | |
| **4. Regional/Global significance 10 points** | | | | | |
| **4.1 Number of endangered & critically endangered aquatic species** | | | | | |
| Score Maximum 10 points | score 1 point per species | | | | |

Table 6 Indicators for socio-economic considerations of seagrass systems to be used in the ranking of seagrass sites bordering the South China Sea.

| Class of Indicator | Indicator scale | | | |
|---|---|---|---|---|
| | Score | | | |
| **1. Reversibility of Threats maximum 10 points** | | | | |
| 1.1 From destructive fishing | Low | Medium | High | |
| Score – max 5 | 1 | 3 | 5 | |
| 1.2 From pollution | Low | Medium | High | |
| Score – max 5 | 1 | 3 | 5 | |
| **2. National significance/priority-Government support maximum 16 points** | | | | |
| 2.1 National priority | Low | Medium | High | |
| Score – max 16 | 5 | 10 | 16 | |
| **3. Financial considerations /co-financing maximum 22 points** | | | | |
| 3.1 Project cost ($US) | >150,000 | 150,000 | <150,000 | |
| Score – max 10 | 3 | 6 | 10 | |
| 3.2 Co-financing commitment | <1/1 | 1/1 | >1/1 | |
| Score – max 12 | 4 | 8 | 12 | |
| **4. Stakeholders involvement maximum 22 points** | | | | |
| 4.1 Local government (in cash/in-kind) | Low | Medium | High | |
| Score – max 6 | 2 | 4 | 6 | |
| 4.2 Central government (in cash/in-kind) | Low | Medium | High | |
| Score – max 4 | 1 | 2 | 4 | |
| 4.3 NGOs/Civil Society (in cash/in-kind) | Low | Medium | High | |
| Score – max 6 | 2 | 4 | 6 | |
| 4.4 Private Sector (in cash/in-kind) | Low | Medium | High | |
| Score – max 6 | 2 | 4 | 6 | |
| **5. Management potential maximum 30 points** | | | | |
| 5.1 Accessibility | Low | Medium | High | |
| Score – max 10 | 3 | 6 | 10 | |
| 5.2 Existing institutional framework | Low | Medium | High | |
| Score – max 10 | 3 | 6 | 10 | |
| 5.3 Existing information | Low | Medium | High | |
| Score – max 10 | 3 | 6 | 10 | |

Table 7 Environmental Indicators and Scores for Criteria used in the Ranking of potential Peat and Non-Peat Swamp Wetlands demonstration sites. In the case of inter-tidal mudflats, estuaries and coastal lagoons, the indicator "No. of mammal species" was omitted.

| **Environmental Indicators** | | | | | |
|---|---|---|---|---|---|
| **1. Area (ha) 10%** | | | | | |
| Area 10% | 100 - 10,000 | 10,000-50,000 | 50,000-100,000 | 100,000-150,000 | > 150,000 |
| | 2% | 4% | 6% | 8% | 10% |
| **2. Biological diversity 60%** | | | | | |
| 2.1 No. of Fish species 18% | 1 - 50 | 51 - 100 | 101 - 150 | 151-200 | > 200 |
| | 4% | 7% | 11% | 15% | 18% |
| 2.2 No. of bird species 18% | 1 - 50 | 51 - 100 | 101 - 150 | 151-200 | > 200 |
| | 4% | 7% | 11% | 15% | 18% |
| 2.3 No. of plant species 6% | 1- 100 | 101-200 | 201-250 | 251-300 | > 300 |
| | 1% | 2% | 3% | 5% | 6% |
| 2.4 No. of mammal species 6% | 1-10 | 11- 20 | 21 - 30 | 31-50 | > 50 |
| | 1% | 2% | 3% | 5% | 6% |
| 2.5 Wetland types 12% | 1 | 2 | 3 | 4 | > 5 |
| | 2% | 4% | 6% | 10% | 12% |
| **3. Transboundary Significance 15%** | | | | | |
| 3.1 No. of migratory. Species 15% | 1 - 10 | 11- 20 | 21 - 30 | 31-40 | > 40 |
| | 3% | 6% | 9% | 12% | 15% |
| **4. Regional/Global Significance 15%** | | | | | |
| 4.1 No. of endemic species 7% | 1 | 2 | > 3 | | |
| | 2% | 4% | 7% | | |
| 4.2 No. of endangered. species 8% | 1 - 6 | 7 -10 | > 10 | | |
| | 3% | 5% | 8% | | |

Table 8 Socio-economic Indicators and Scores for wetlands bordering the South China Sea.

| **Socio-Economic indicators** | | | |
|---|---|---|---|
| **1. Threats 20%** | | | |
| 1.1 Reversibility of External sources of change, 10% | Low | Medium | High |
| | 2% | 6% | 10% |
| 1.2 1 Reversibility of Internal source of change, 10% | Low | Medium | High |
| | 2% | 6% | 10% |
| **2. National significance 40%** | | | |
| 2.1 Identified as a national priority, 25% | 1 | 2 | 3 |
| | 25% | 15% | 10% |
| 2.2 Level of direct stakeholder involvement in management, 10% | Low | Medium | High |
| | 2% | 6% | 10% |
| 2.3 Commitments to RAMSAR, 5% | no | planned | yes |
| | 0 | 3% | 5% |
| **3. Financial considerations 20%** | | | |
| 3.1 Potential for co financing (% of potential project budget), 20% | 25 | 50 | 100 |
| | 5% | 10% | 20% |
| **4. Local stakeholder involvement 20%** | | | |
| 4.1 Local stakeholder/community involvement | Low | Medium | High |
| | 2% | 12% | 20% |