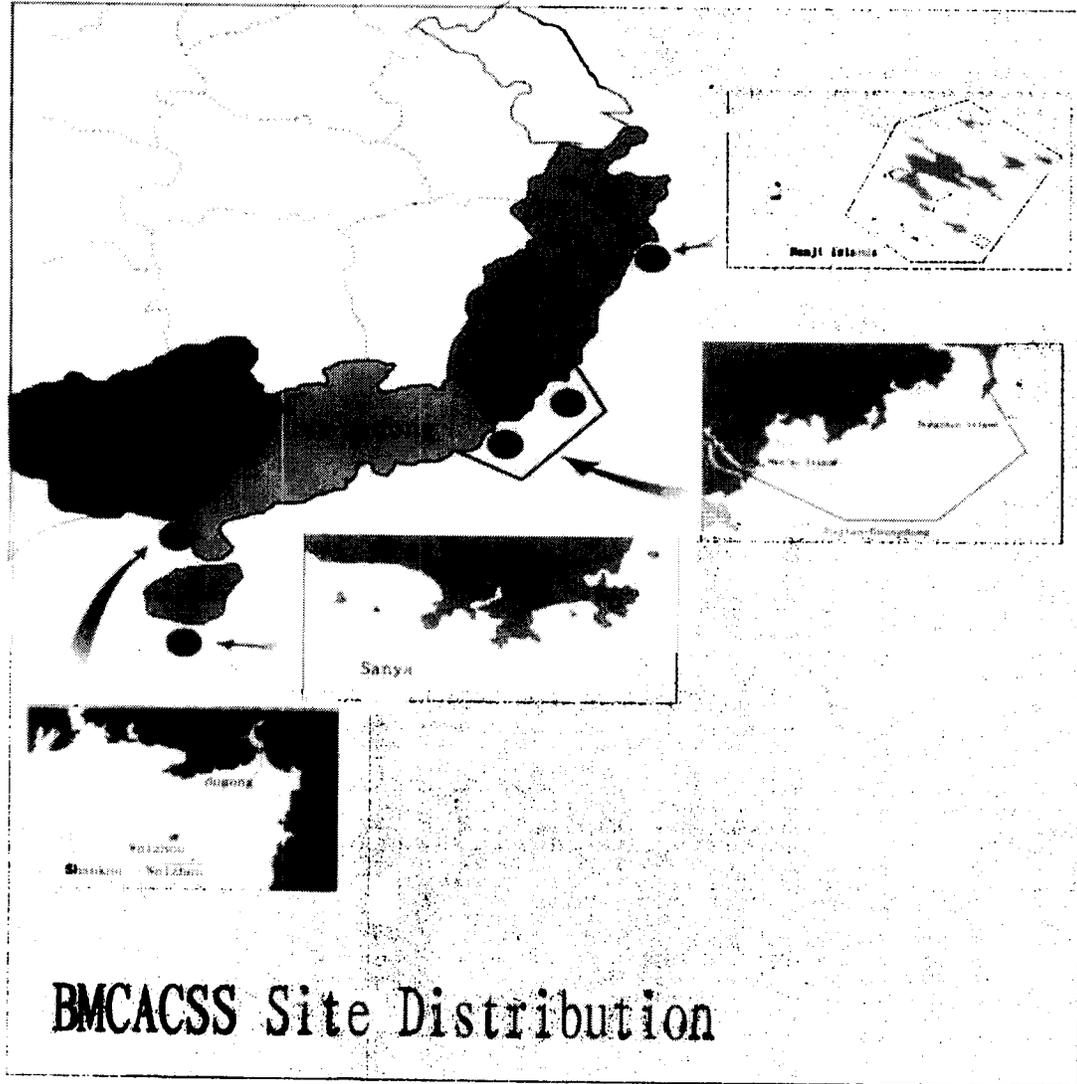


Annex E: Maps of the project sites

Map 1



Endorsement letter

MINISTRY OF FOREIGN AFFAIRS

100-1100000000

TO: [REDACTED]

FROM: [REDACTED]

SUBJECT: [REDACTED]

DATE: [REDACTED]

TO: [REDACTED]

FROM: [REDACTED]

SUBJECT: [REDACTED]

DATE: [REDACTED]

TO: [REDACTED]

FROM: [REDACTED]

SUBJECT: [REDACTED]

DATE: [REDACTED]

TO: [REDACTED]

FROM: [REDACTED]

SUBJECT: [REDACTED]

Dear Sirs,

[REDACTED]

Yours faithfully,

[Handwritten signature]

Chief Clerk

Ministry of Foreign Affairs

100-1100000000

100-1100000000

100-1100000000

**Annex G: Response to GEF Secretariat and Council comments
(to be provided at the time of CEO endorsement)**

SEE APPENDIX 10 OF PRODOC

Annex H: Threats to Biodiversity and Underlying Causes

The definition of threats to biodiversity and underlying causes at the project sites represented a central goal of the consultation and information-gathering process undertaken during the PDF-B. The steps taken in developing the threats analysis included:

1. *Site visits to the candidate sites by the project formulation team:* A minimum of two-three visits was undertaken to each of the project sites, by various members of the project formulation team (including both international and national consultants).
2. *Consultations with local stakeholders:* Consultations were undertaken with members of villages and local communities located around all of the candidate sites. These consultations included discussions of threats to biodiversity and local livelihoods as perceived by the local communities themselves.
3. *Consultations with Government stakeholders:* Meetings and discussions were held with key Government stakeholders at the provincial, city and county levels to ascertain their main priorities and concerns, and to obtain their perspective on problems and threats affecting the project sites. These included a 3-day local workshop at each of the project sites as well as a 2-day National Workshop where the final threats analysis, as well as the resulting logical framework (see Annex B) were presented.
4. *Literature reviews and desk research.* Key texts and reference materials were collected by the local sub-contractor, and where necessary these materials were translated into English for review by the international consultants.

The results of these various analytical and consultative steps were condensed into the threats and underlying causes tables presented below for each candidate site.

In reviewing the following matrices, the reader's attention is drawn to the third column denoting proposed activities to address the underlying causes of threats facing the project sites, and in particular to the numbers showing the relevant outputs under which the specific threats are being addressed. While it would perhaps have been more straightforward to design the project with one component for each site, this was deliberately not done in order to achieve a more integrated effect, to emphasise the importance of demonstration components and to allow for within-project replication to take place. Thus, threats will be addressed in three ways:

- through strengthening of the conservation capacities of MPAs (Immediate Objective 1);
- through demonstration components targeting issue of particular importance facing an MPA or a marine area (Immediate Objective 2); and
- through a process of within-project replication, using lessons learned and demonstrations made during the the project to help address sustainable use issues; these activities will be concentrated mainly during the latter period of the project and will rely primarily on Government co-financing (Immediate Objective 3).

THREATS, CAUSES AND ACTIVITIES MATRIX I – NANJI ISLANDS

Description of threat and proximate causes	Underlying Causes	Proposed Activity Areas (# of output under which activity will take place)
<p>1. The development of aquaculture activities to date has created some localized pollution problems, including occasional red tide incidents. However, future development strategies are expected to place increasing emphasis on aquaculture as an engine of growth, job creation, etc. Such a strategy brings risks of future ecological disruption due to changes in population dynamics of marine organisms and potential impacts from the introduction of non-native commercial species.</p>	<ul style="list-style-type: none"> o Aquaculture development under the baseline scenario will not be comprehensively planned or adequately coordinated with MPA and biodiversity conservation concerns o Current and future aquaculture activities are not regulated or monitored closely enough by responsible authorities (MPA, provincial DOF) who have insufficient data, understanding and awareness of the problems and do not have the technical capacities to adequately assess biological impacts o Low levels of previous investment in pollution control, including sewage treatment and solid waste management o Tourism development is taking place without careful planning, coordination or assessment of the islands' long-term carrying capacity for tourism o Island residents are not sufficiently involved or participating in decisions regarding development and conservation of the islands 	<ul style="list-style-type: none"> o Preparation of an integrated township and MPA master plan that places careful limits, and provides enforceable guidelines, on aquaculture development in line with the Precautionary Principle (output 2.1) o Increased awareness and technical capacities of authorities responsible for oversight of aquaculture development activities (output 1.1) o Improved biodiversity monitoring, data collection and management throughout the MPA (output 1.1)
<p>2. Increased tourist visitation is placing pressure on renewable resources (increased demand for freshwater, fish and shellfish) and exacerbating pollution problems (erosion / sedimentation, sewage and solid waste), some of which are also contributing to red tides. Further substantial increases could have serious impacts on marine biodiversity</p>	<ul style="list-style-type: none"> o Low conservation / enforcement capacities of MPA, also linked to limited financing o Livelihood pressures from local communities 	<ul style="list-style-type: none"> o Preparation of an integrated township and MPA master plan that places careful limits, and provides enforceable guidelines, on tourism development, in line with the Precautionary Principle (output 2.1) o New investments in solid waste management and sewage treatment (outputs 3.1 & 3.2 based on demonstration output 2.2) o Increased awareness and technical capacities of authorities responsible for oversight of tourism development activities (output 1.1) o Improved biodiversity monitoring throughout MPA (output 1.1)
<p>3. Over-harvesting and occasionally destructive harvesting methods for fish and shellfish</p>	<ul style="list-style-type: none"> o Low conservation / enforcement capacities of MPA, also linked to limited financing o Livelihood pressures from local communities 	<ul style="list-style-type: none"> o Improve conservation capacities of MPA, including compliance monitoring (output 1.1) o Develop system for sustainable financing (outputs 3.1 & 3.2 based on demonstration output 2.3) o Alternative sustainable livelihoods for local residents, e.g.: (i) increased involvement in MPA management (guards, etc.); (ii) involvement in tourism economy, including direct employment and micro-enterprise development (handicrafts, etc.); (iii) offshore fishing opportunities associated with creation of artificial reef. (outputs 3.1 & 3.2 based on demonstration output 2.4)

THREATS, CAUSES AND ACTIVITIES MATRIX II - SNCRNR

Description of threat and immediate causes	Causes	Proposed Activity Area
<p>1. Increasing numbers of visitors to the reserve for tourism, particularly for diving, are increasing wastewater and solid waste discharges and directly damaging coral reefs by removing or stepping on corals.</p>	<ul style="list-style-type: none"> o Tourists and tour operators are not always aware of the damages they cause to coral reefs. 	<ul style="list-style-type: none"> o Baseline survey of coral reef conditions and species distributions within areas of the reserve where diving takes place (output 1.2) o Ongoing monitoring to determine and quantify impacts of diving and related impacts (e.g., boat anchors) (output 1.2) o Create designated tourist zones for divers, using transplanted reefs and substrate creation, while strictly limiting tourist visitation to high biodiversity areas (output 1.2) o Improve coverage by wastewater treatment facilities to cover hotels and other establishments catering to tourists (output 2.2)
<p>2. Untreated wastewater discharges, including municipal and limited industrial effluents, have damaged reef communities by increasing turbidity and sedimentation and lowering water transparency. The problem has been only partly resolved by the recent construction of a wastewater treatment facility for Sanya City. A preliminary review has identified the following key remaining sources of wastewater: (i) stormwater discharges from sewage treatment system; (ii) sewage entering Luhuitou Bay from peninsular sources not connected to system; (iii) island residents and tourists (especially at Ximaozhou).</p>	<ul style="list-style-type: none"> o In the absence of clear ecological and environmental monitoring data, it will not be possible to demonstrate the positive effects of wastewater treatment or the extent of remaining threats. This may curtail future needed investments and prevent these from being directed towards priority contaminants and locations, based on their effects on biodiversity. o Decision-makers are not aware of, or do not pay heed to, impacts of wastewater and other contaminants on sensitive coral reef ecosystems and potential implications for, e.g., sustainability of ecotourism 	<ul style="list-style-type: none"> o Ecological monitoring to locate and assess current impacted areas and to strengthen the baseline for future monitoring (output 2.2) o Ensure effective operation of newly constructed sewage treatment plant (output 2.2) o Establish two biodiversity monitoring stations (output 1.2) o GIS-based mapping of biodiversity hotspots (output 1.2) o Building on currently available information, identify, quantify and assess land-based pollution sources having the greatest potential ecological impacts on viable reef ecosystems at SNCRNR (output 2.2) o Raise awareness concerning environmental economic value of reef ecosystems and resulting need for appropriate levels of investment in waste control (outputs 2.2 & 2.3) o Develop and implement a programme of targeted priority investments aimed at mitigating key remaining threats (output 2.2)
<p>3. Unsustainable and/or illegal fishing and marine resource harvesting within and surrounding the MPA, including the use of destructive fishing methods, though sharply reduced, continues to slow the reefs' ecological recovery and causes further damage to habitat.</p>	<ul style="list-style-type: none"> o Pressures from subsistence fishing by local communities o Low conservation / enforcement capacities of MPA, related to limited levels of financing 	<ul style="list-style-type: none"> o Strengthen conservation and enforcement capacities of MPA authorities (output 1.2) o Develop system for sustainable financing (output 2.3) o Continue to develop alternative livelihood activities which improve incomes and standards of living of local people without damaging MPA (outputs 3.1 & 3.2)
<p>4. Development in the coastal zone is not effectively coordinated with management of the Protected Area, and impacts of development activities (e.g., land reclamation) are not adequately assessed.</p>	<ul style="list-style-type: none"> o Inter-sectoral cooperation between various agencies is ineffective or non-existent 	<ul style="list-style-type: none"> o Improved inter-sectoral coordination mechanisms (outputs 3.1 & 3.2) o Strengthened, consistent, comprehensive EIA regulations and procedures (outputs 3.1 & 3.2)

THREATS, CAUSES AND ACTIVITIES MATRIX III – SHANKOU ET. AL.

Description of threat and immediate causes	Causes	Proposed Sub-Outputs and Activities (see Logical framework matrix and brief text for additional details of planned activities) (# indicates relevant output)
<p>Harvesting of marine organisms and other mangrove products (fruit, bird's eggs, etc.) in mangrove area involves turning over sediments and leads to: (i) damage to mangrove tree seedlings, (ii) damage to existing tree roots, especially to trees with extensive root systems, such as <i>Avicennia marina</i>, and (iii) disturbance to migratory birds, e.g., <i>Platalea minor</i> due to human activity (SMR).</p>	<ul style="list-style-type: none"> o Difficulty of changing traditional livelihood practices of local villagers o Limited availability of data on which to design harvesting standards and limits o Few alternatives to traditional harvesting activities o Limited capacities and practical difficulties of regulatory enforcement 	<ul style="list-style-type: none"> o Effectively prevent harvesting in core zone (outputs 1.3 & 2.4) o Regulate and create participatory systems to ensure sustainable harvesting in buffer and experimental zones (output 2.4) o Increase public awareness of sustainability issues (output 2.4) o Alternative livelihood support for local people affected by reduced harvesting, including participation in ecologically sustainable tourism and aquaculture (output 2.4) o Improved community-based enforcement capacity (output 2.4) o Develop sustainable financing plan for the MPA (outputs 3.1 & 3.2 based on output 2.3)
<p>Shrimp farming in buffer zone (15 ha) and experimental zone (55 ha.) with plans to enlarge and intensify through conversion of existing paddy (not mangrove) implies some actual and potential pollution risk related to eutrophication and introduction of antibiotics. Fortunately, shrimp mariculture is not taking place within immediate vicinity of more globally significant mangroves, but rather on western side of Sthian Peninsula. (SMR)</p>	<ul style="list-style-type: none"> o Limited capacity to monitor and enforce MEPL regulations, particularly where many non-point sources of pollution are involved o Ineffective development planning, which did not take sufficient account of the potential impact of shrimp farming on the mangroves, and/or was unable to control patterns of land occupation o Low levels of awareness and technical understanding of potential threat o Inconsistency among relevant laws, regulations and policies and limited co-ordination among relevant Government agencies 	<ul style="list-style-type: none"> o Ecological monitoring of impacts on mangroves (output 1.3) o Awareness raising among policy makers concerning risks of over-concentration / intensification of shrimp farming (output 2.4) o Development of a mechanism for co-ordination, co-operation and integrated planning among Government agencies (output 1.3) o Revise relevant laws, regulations and policies affecting the MPA (output 1.3)
<p>Hunting of birds in mangrove areas is having a direct impact on remaining populations of three globally threatened species as well as on other migratory species. Involves both local subsistence hunting as well as 'recreational' hunting (SMR)</p> <p>Genetic degradation of <i>Rhizophora stylosa</i> due to its limited extent leading to a potential loss of species viability at the site (SMR)</p>	<ul style="list-style-type: none"> o Low levels of enforcement of hunting regulations and priority given to birds in the MPA o Public awareness about birds' importance is limited o Breeding barriers to natural expansion / dispersal o Impacts from human activities 	<ul style="list-style-type: none"> o Biological monitoring and reporting on bird populations (output 1.3) o Community-based enforcement mechanisms, with emphasis on globally significant species (output 2.4) o Improve public awareness concerning bird significance, including identification of globally significant species (output 2.4) o Afforestation (50-100 ha) in buffer zone (Dandou Bay) (output 1.3)
<p>Damage to dugong habitats: (i) seagrass beds damaged by bottom trawling; (ii) rapid increase in</p>	<ul style="list-style-type: none"> o Uneven enforcement of fishing ban due to limited financial resources for monitoring. 	<ul style="list-style-type: none"> o Detailed assessment of seagrass habitat (output 1.3) o Development and implementation of habitat restoration plan as

¹ Initials following description of threats refer to the site location in question: SMR – Shankou mangrove reserve; DR – Dugong reserve; WI – Weizhou Island.

Description of threat and immediate causes	Causes	Proposed Sub-Outputs and Activities (see Logical framework matrix and brief text for additional details of planned activities) (# indicates relevant output)
shrimp farming and pearl culture in shallow waters; (ii) tidal channels are being filled in by sediments suspended due to erosion and sand dredging for port development (DR)	<ul style="list-style-type: none"> o Poorly developed and enforced regulations for man-aging area 	<ul style="list-style-type: none"> o part of overall management plan for the reserve (output 1.3) o Increased conservation capacity of reserve (training, equipment, etc.) (output 1.3) o Development of local regulations to limit fishery activities within reserve (output 1.3) o Enforcement of fishery regulations through fishery administration taskforces (output 1.3) o Limit and adjust mariculture activities within the reserve in accordance with Guangxi Large-scale Marine Functional Zonation Scheme (output 1.3) o Improved enforcement of regulations concerning coastal soil conservation and coastal dredging (output 1.3) o Develop sustainable financing plan for the MPA (outputs 3.1 & 3.2 based on output 2.3)
Live corals being removed for aquarium trade (WT)	<ul style="list-style-type: none"> o Limited capacity for regulatory enforcement, since MPA not yet established 	<ul style="list-style-type: none"> o Increased conservation capacity through MPA establishment (output 2.5)
Destructive fishing methods including dynamite, cyanide, bottom trawling and anchoring in areas with coral distribution (WT)	<ul style="list-style-type: none"> o Limited capacity for regulatory enforcement, since MPA not yet established o Coral areas not effectively marked to allow boats to avoid anchoring o No effective sewage and solid waste treatment system 	<ul style="list-style-type: none"> o Increased conservation capacity through MPA establishment (output 2.5) o Signage indicating coral areas and MPA boundaries (output 2.5) o Development of non-damaging anchorage system (output 2.5) o Local Government to establish sewage treatment plant and improved solid waste disposal system for island (outputs 3.1 & 3.2 based on output 2.2)
Domestic sewage and solid waste from main town may be having negative effects on corals, including eutrophication (WT)	<ul style="list-style-type: none"> o Limited capacity for regulatory enforcement, since MPA not yet established and because Beihai Ocean Management Bureau is located far from the island 	<ul style="list-style-type: none"> o Review, approve and adjust sea area use projects in accordance with marine functional zonation scheme of Guangxi and Beihai City (12; ref. demonstration output #4) o MPA will establish and enforce regulations re. mariculture development and operations in buffer and experimental zones (output 2.5)
Uncontrolled mariculture development, including fish cages, pearl oysters and scallop culture on rafts; abalone and fish culture in sunk cages and bottom culture of sea cucumber and shell-fishes(WT)	<ul style="list-style-type: none"> o No effective solid waste management system o People engaged in marine activities (fishers, aquaculturists, etc.) have limited awareness or marine environmental protection and biodiversity issues o Limited environmental controls over these industries 	<ul style="list-style-type: none"> o Establish MPA and strengthen monitoring and management of mariculture activities (output 2.5) o Improve awareness of importance of MPA and coral reefs among target groups (output 2.5)
Solid waste from marine activities, including abandoned nets and aquaculture facilities, is entering coral reef, blocking light, etc. (WT)	<ul style="list-style-type: none"> o Limited environmental controls over these industries 	<ul style="list-style-type: none"> o Damaged area being excluded from newly established protected area (output 2.5) o Environmental monitoring to determine impacts on MPA (output 2.5) o Develop and implement regulatory controls on industrial pollution of MPA (outputs 3.1 & 3.2 based on output 2.2)
Wastewater and oil from oil-gas separation terminals and carbon black processing facilities is damaging a portion of the coral reef (WT)		

THREATS, CAUSES AND ACTIVITIES MATRIX IV – DONGSHAN-NAN'AO

Description of threat and immediate causes	Underlying causes	Proposed Output or Activity
Reduction of fishery resources on which the migratory species depend, due to overfishing and marine pollution, as well as illegal & destructive fishing methods	<ul style="list-style-type: none"> o Measures to reduce fishing effort (e.g., closed fishing season) have been only partly successful 	<ul style="list-style-type: none"> o Reduce the number of coastal fishing boats through job transformation (to mariculture or offshore fishing) and through incentives for removal of boats o Deploy artificial reefs in order to: (i) conserve and restore habitats and feeding grounds of fishes; (ii) create physical obstacles to bottom trawling o Fishery enhancement through release of artificially hatched fries to promote stock restoration
Direct loss of migratory species (threatened sea turtles and Chinese white dolphins) as by-catch of fishing effort	<ul style="list-style-type: none"> o An effective conservation programme involving targeted regulatory controls on fishing efforts (closed areas, seasons, etc.) requires additional information on species distributions, migratory routes and biological features of the target species o Fishermen not always aware of, or paying heed to, importance of migratory species o Injured animals often die without urgent medical attention 	<ul style="list-style-type: none"> o Biodiversity survey for collecting information on distribution, migratory routes and biological features of migratory species. Includes fieldwork conducted through fishermen's associations to gather detailed information on by-catch o GIS-based approach to assessing risks to migratory species within corridor and proposing mitigating measures that may involve legislative changes, new regulations, etc. o Based on newly gathered data and analysis, formulate inter-provincial action plan for Dongshan-Nan'ao area o Implementation of regulatory and / or technological solutions to address target fisheries, locations and seasons. Effort will include a fishermen's outreach programme for informing and educating fishermen about marine conservation and migratory species conservation, including dissemination of main points of action plan in a manner which is accessible to non-specialists, including fishermen. o Establishment of a migratory species rescue centre o Economic compensation for fishermen who give timely support to injured migratory animals
Plastic, old fishing nets and other solid waste in water column causes marine mammals to become entangled	<ul style="list-style-type: none"> o Most people are not aware of threats caused by these items 	<ul style="list-style-type: none"> o Beach cleanups involving school groups o Enhanced public awareness efforts will be built into action plan
Overly dense concentration of aquaculture facilities, especially cage culture and nets, which leads to blocking of migratory routes	<ul style="list-style-type: none"> o Incomplete development and implementation of functional zonation scheme 	<ul style="list-style-type: none"> o Complete the development of large-scale functional zonation scheme o Implement scheme, including movement of cage culture operations to offshore waters
Sand mining is leading to destruction of turtle egg-laying habitat	<ul style="list-style-type: none"> o Insufficient enforcement o Limited awareness 	<ul style="list-style-type: none"> o Enactment and enforcement of moratorium on approval of sand mining permits on pre-identified beaches o Survey to assess 'Top 5 marine turtle destinations' within broader FG landscape as part of biodiversity survey o Revisions to large-scale zonation scheme to ensure no sand mining or other harmful activities on key beaches o Disseminate information and raise awareness through fishermen's associations and public broadcasting o Develop joint FG habitat protection and recovery strategies, especially during egg-laying season, with community participation

ANNEX I: Stakeholder Participation Plan

1. Introduction

Participation by local stakeholders is now recognized as a key element in ensuring the success of a project's objectives. Participation strengthens the ownership and commitment of local stakeholders (e.g. elected representatives, academia, community-based organizations, etc) by giving them a voice and vote in the project's decision-making process as well as avenues for participation in the implementation of project activities. In formulating "Biodiversity Management in the Coastal Area of the South China Sea" (BMCACSS), project developers have sought to define its objectives and activities through a wide process of stakeholder consultation. As other experiences suggest, long-term resource use and biodiversity conservation have a better chance of success if one provides genuine avenues for the participation of local stakeholders in the management of biodiversity resources.

Participation by local stakeholders in a project's formulation, decision-making process and implementation is a relatively new concept in China. Prior to the 1990s, the process of development planning in China, particularly the preparation of five-year plans, was shaped by a strong tradition of centralized planning characterized by a highly sectoral, technocratic and top-down nature. Reforms introduced in the last decade have allowed for increased input by local stakeholders in planning. The process of increasing the involvement of the public in decisions that will affect their daily life may be somewhat slow, but it is nevertheless ongoing steadily in the form of successive incremental changes in the status quo.¹ The growth in the number of local groups involved in one way or another in environmental protection activities reflects this increased openness.²

In summary, BMCACSS objectives and activities have been defined with particular attention to the involvement of local stakeholders. This process took place in an environment in which this type of participation is only beginning to be accepted as common practice; as a result, in some cases, resistance and concerns over the approach could still be found. The BMCACSS received genuine support from the executing and implementing agencies in ensuring that the project as formulated contains solid avenues for the participation of local stakeholders in the decision-making process and in the implementation of project activities.

This Annex is structured as follows. Section 2 presents a description of the consultation process and the method selected for consultations. Section 3 presents a brief summary of main findings of the stakeholder analysis, including potential conflicts among stakeholders and interest alignment between the project and local groups. Section 4 introduces the framework for participation of stakeholders in the project decision-making process. Finally, Section 5 describes participation of stakeholders in the design and implementation of project activities at each site.

2. Description of consultation process

The consultation process involved several visits to the sites and extensive discussions with local authorities and local people. The process was characterized by successive iterations and the topics for consultations gained an increasing focus in each round of visits.

The first round of visits was undertaken in between February and March of 2001. A joint team comprising representatives from the Hong Kong University for Science and Technology (HKUST), the Third Institute of Oceanography at Xiamen, and a GEF Senior Project Advisor visited nine candidate

¹ For example, recently the national planning and development committee set up a homepage and e-mail address to welcome publics giving suggestions and recommendations on planning for the Five-year Plan of National Development of Economy and Society.

² There are approximately 1600 associations (or groups) involved in environmental protection. These include local associations for environmental protection, academic associations, funds and others.

project sites that had been preliminary identified during the formulation of the PDF-B project document. The purpose of these visits was to meet with potential partners and stakeholders at each of the candidate sites, gather their opinions and suggestions regarding biodiversity conservation, undertake a first assessment of the level of support from local stakeholders towards tentative project objectives, and gather general information for the purpose of making a final site selection. One of the results of this round of consultations was to decrease the number of candidate sites from 9 to 5.

The second round of field consultations took place in December 2001. It comprised three weeks of intense fieldwork and covered the 5 sites short-listed during the first mission. The team comprised experts from HKUST, the project executing agency (UNOPS) the implementing agency (SOA), UNDP, foreign experts and the GEF Senior Project Advisor.

The method for consultation was jointly defined by local and international experts. Three options were discussed and comprised (i) combination of household survey data with semi-structured interviews and focus groups; (ii) a combination of PRA techniques (semi-structured interviewing, focus groups, preference ranking, mapping and modelling), and (iii) roundtables with "best-informed" individuals from each pre-selected stakeholder group. Because of data availability and logistical issues, the team selected option (iii).

In each site, local and international experts undertook roundtable meetings with local stakeholders. Depending on the site, these comprised fishermen and representatives from fishermen associations, people engaged in subsistence activities like crab picking or fishing with small nets along the shore, tourism operators, aquaculture farmers and representatives from aquaculture associations, local authorities, researchers from local institutes and universities, teachers at primary and secondary schools, and students from secondary schools.

The roundtables were structured with the purpose of obtaining information for the stakeholder analysis and the preliminary design of the participation plan. The process of selection of participants for roundtables was of critical importance. A great effort was undertaken to ensure that roundtable composition involved best-informed individuals and that roundtables were not biased towards the interests of any particular group. The project team feels confident that no interest group dominated the outcomes of roundtables and interviews. As an additional check and balance, information was triangulated among roundtables, interviews and workshops.

The roundtables were divided into two main parts. The first part was devoted to understanding the main constraints and incentives faced by resource users, like fishermen, aquaculturists, people engaged in extractive activities nearby mangroves, etc. The second part was devoted to collecting opinions about problems facing the project sites, their suggestions for potential solutions, and their ideas for participation. In the case of government authorities, the interviews also involved gaining an understanding of formal and informal characteristics of the decision-making process in each site, the role of each agency and formal and informal avenues for conflict resolution.

Together with the roundtables and interviews with local stakeholders, the team undertook logical framework workshops in each site, focusing in particular on analysing threats, underlying causes and proposed activities. These counted with the participation of local authorities, representatives from local resource users and academia. There was a constant flow of information between the workshops and the consultations (roundtables and interviews). A great deal of effort was put into identifying the impact of project activities on specific groups, particularly the most vulnerable, and in the collection of opinions and suggestions for alternative project activities.

While the December rounds of consultation succeeded in providing enough information to prepare a draft stakeholder analysis and participation plan, some gaps remained. Between April and June of 2002, a local expert undertook a third round of consultations that included the 5 project sites. The topics were specific for each site and aimed at closing specific information gaps. The method applied

involved a combination of roundtables with best-informed individuals, interviews with local authorities and short questionnaires. Finally, in June of 2002, the project's National Planning Workshop undertook a further exercise in logical framework, adoption of the participation plan and budgetary discussions. The workshop counted on the presence of a representative cross-section of stakeholders from all sites.

3. Summary description of results from stakeholder analysis

The following is an abstract of main findings by category of stakeholder³. The composition of stakeholders shows remarkable similarities across sites. In general, the incentives and constraints of stakeholders also show noticeable similarities among sites. Fishermen were the most uniform group and tourism the most diverse.

Offshore Fishermen. The impact of the project on this group will likely be neutral. In general, they operate outside the boundaries of the project target sites.

Small fishermen. This is a group that deserves attention because it can be affected (positively or negatively) by a GEF alternative. They operate in and nearby the project target sites and have a direct impact on the conservation of the marine environments. The group seems to have limited capacity to adapt to changes and looks vulnerable to further restrictions in their activities. Though no figures were available, their income appears to be on average slightly above the subsistence level. This group engages in small fishing activities because of lack of options. It is likely that they would willingly switch to other income generating alternatives if opportunities were available. In the particular case of small fishermen, the results from the rounds of consultations suggest that their relatively low education level and their lack of capacity to acquire capital assets stand as two main constraints to switch to other activities.

Extractive Activities. This group is most relevant nearby the Shankou Mangrove Reserve and shows similar vulnerabilities as in the case of small fishermen. Extractive activities are characterized by a low productivity and often people engage in them because of simple need and lack of other options. Consultations strongly suggested that project activities in Shankou aimed at protecting mangroves be designed and implemented with the full participation of this group. First, their members stand to gain or lose much as a significant proportion of their income can come from extractive activities. Second, in several round of consultations this group showed an intimate knowledge of the project site in general and the many interactions between mangrove conservation and sustainable livelihoods in particular.

Aquaculture farmers. The impact of the GEF alternative on this group varies from neutral to negative depending on the project site. For example, in Guangxi, established farms could be having a negative impact at the margins of the mangrove area though opinions are not unanimous on this matter. In contrast, in Dongshan, the general opinion was that the sector is a significant contributor to water pollution and therefore to the conservation of the marine environment. Nanji Island cuts a middle ground and the sector has been mentioned as a contributor to water pollution but of a lesser emphasis than in Dongshan.

³ Restriction of space has limited this section to its most relevant findings. Further information (e.g. list of stakeholders consulted in each site; transcripts of roundtables and interviews) is available in various reports produced by local and international experts. The reader may wish to contact the UNDP office in Beijing for these documents (maria.suokko@undp.org).

The group of aquaculture farmers is a complex one to deal with. First, the activity took off with the explicit support of the government, apparently, as one of the responses to counteract the effect of declining fish stocks. Second, the sector appears to be a relatively significant contributor to some of the local economies. Third, though the sector's impact in terms of water pollution is not ignored, not all authorities agree on the extent to which growth of the sector poses a threat to local biodiversity. Fourth, at present, the status quo (baseline situation) appears to pose little threat to the interests of those involved in aquaculture and therefore incentives for change are not that great. Fifth, people involved in aquaculture systematically appeared to be better off than other groups and highly aware of their rights. In summary, this group has a considerable weight. The project needs to avoid confrontation with this group and to fully involve its members in any decision process that has the potential to lead to decreases in aquaculture activities.

Tourism. The impact of the project on this group will likely vary from positive to highly positive depending on the particular site. The interest of the tourism sector and the project are most aligned in Sanya, a place in which the GEF alternative finds a strong ally in the tourism industry. A similar situation could happen in Nanji Island depending on the particular characteristics of the GEF alternative.

In the case of Dongshan, the tourism sector stands, in principle, as an ally of the project but the strength of interest alignment will depend on the costs of attaining water quality levels required to protect marine environment and the prospects of attracting tourists whose interests also include biodiversity in addition to enjoying the local beach and the food (Dongshan is popular on both scores). Attracting a substantial number of this kind of tourist will demand a long-term effort. Officials in Dongshan expressed their concern that the bay may not be able to compete with places like Sanya, already widely known by the presence of coral reefs. Whether this is a real barrier remains to be explored. In the case of Guangxi, the tourism sector stands in principle to gain from the project's activities particularly in the case of Weizhou Island.

Government units including research facilities. These groups are supportive of the project and full support should be expected from them. As far as government units are concerned, all consultations highlighted the importance of consensus on decision-making, even when the decision making process is highly vertical (as among provinces, counties and villages). Even though consensus is always sought in GEF projects, it will be of particularly importance in this one.

4. Framework for Stakeholder Participation in decision-making and project implementation

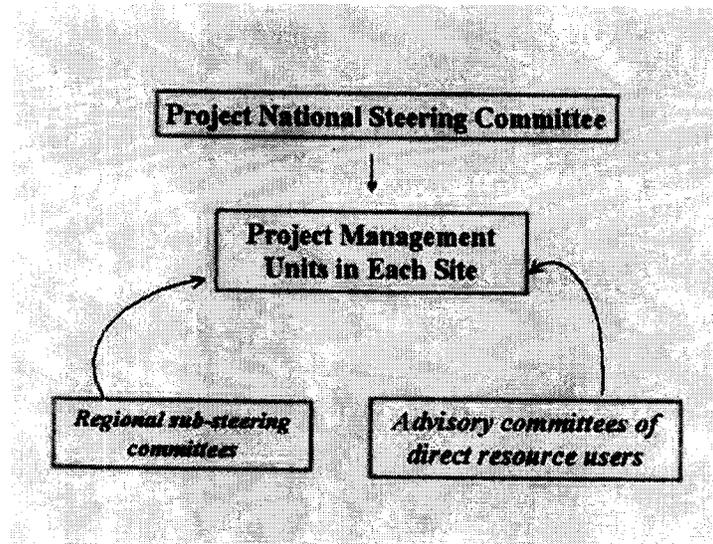
This section presents a summary description of the framework for stakeholder participation. This framework has been designed paying attention to both formal and informal decision-making structures and formal and informal mechanisms for conflict resolution in China. Formal and informal institutions play crucial roles in the definition of resource access and conflict resolution and, therefore, in the definition of a participation plan⁴.

The project will have two main vehicles for participation in the decision making process. These comprise "advisory committees of direct resource users" and "project's sub-steering committees" in each project site. The general structure for participation is presented in the Figure 1 below. Please,

⁴ An example of a "formal" institution" is the country government, the village leader or the People's Congress. "Informal" institutions comprise conventions and codes of conduct, are dependent on existing values and heavily influence the actions of formal institutions. Examples include the respect given to elders in a village, the social acceptability of having women at decision-making levels, or the preference for consensus over majority voting as a vehicle for social choice.

note that while each site will apply this structure for participation, committee's composition will vary.

Figure 1: Basic framework for participation in project decision-making



We will first turn attention to the characteristics and importance of advisory committees of direct resource users. The rounds of consultations strongly suggested that resource users whose livelihoods can be affected heavily by the GEF alternative have a formal structure for participation and a direct communication link with the local and international experts involved in the management of the project. This formal and direct participation is even more important when resource users present a relatively high degree of vulnerability, as has been observed in several project sites.

Representative from fishermen associations and aquaculture associations are candidates for these committees. In the case of fishermen, the project should ensure that small fishermen form part of the association in question. If not, they should be sought separately. Other candidates for these committees comprise representatives from people engaged in extractive activities. Often, the latter group is not organized by means of association or other similar structures. The project will have to undertake an effort either to foster the creation of associations or help the group in selecting candidates that fully represents their interests in the project's decision-making process.

The committees might include representatives from the tourism sector though this might need to be further evaluated on a site-by-site basis as there may be significant asymmetries in power and influence between tourist operators as a group, and fishermen, aquaculture farmers and people engaged in extractive activities as another. These asymmetries can have undesirable effects on the work of the committees whenever the interests of resource users diverge. If not in the "advisory committees of direct resource users", the tourist operators can enter the sub-regional steering committees (see below).

The "advisory committees of direct resource users" will provide independent inputs into the definition, implementation and evaluation of project activities. As its name indicates, their role would be of an advisory nature and their recommendations would not be binding. However, their recommendations would constitute formal annexes of the project annual review and formal annexes

to the minutes of the project sub-steering committee meetings (see next paragraph). This should ensure that the opinions and interests of those most vulnerable enter the project's decision-making process.

In addition to these advisory committees, the project will have sub-steering committees in each project site. These will comprise representatives from the formal structures of government, other stakeholders in each site and at least one member of the "advisory committee of direct resource users". The presence of village leaders within these sub-steering committees would be highly desirable. These committees would provide guidance to project activities, serve as one of the main vehicles for stakeholder input, and review, approve and monitor the quarterly workplan for each project site. Their maneuverability and degree of freedom would be limited by the boundaries given by the overall framework of activities defined by the project document and the National Project Steering Committee.

Finally, the objective of having these two types of committees acting simultaneously is two-fold. The first objective is to ensure the participation of stakeholders in the formal project decision-making process (mainly done through the Sub-steering committee). The sub-steering committees are endowed with formal tools to influence the design and implementation of project activities. The second objective is to provide a backup channel ("advisory committees of direct resource users") that can make sure the interest of most vulnerable groups are not diluted whenever sub-steering committees comprise relatively big numbers of participants or present significant power asymmetries. Together, these structures are aimed at ensuring that project management units have access to inputs from all relevant stakeholders, that stakeholders have the tools to participate in project activities, and that the most vulnerable groups are heard and not disproportionately affected by any alternative.

5. Participation of stakeholders in the design and implementation of project activities

A regular finding from the rounds of consultation has been the strong desire of stakeholders to participate in the design and implementation of project activities. Participation comprises the undertaking of surveys for the purpose of gathering data, monitoring of project sites, design and implementation of management plans, design and implementation of enforcement systems, design and implementation of educational campaigns and public awareness programs. The rest of this section provides a summary description of participation at each site.

Sanya

Stakeholders at Sanya confirmed their willingness to take the lead in strengthening the capacity of the Sanya Coral Reef National Reserve (SNCRNR). These activities include the (i) participation in the management of the reserve; (ii) strengthening of the monitoring system including better enforcement of regulations; (iii) training and capacity building; and (iv) public awareness activities.

Collaboration among stakeholders in the management and monitoring of common resources is not new in Sanya and the project builds upon a body of experience from Ximao Island. Before the development of this GEF proposal, local authorities and communities of the island had already been discussing problems of habitat loss, environmental pollution, garbage disposal, removal of coral reef and overfishing. There are ongoing efforts aimed at promoting a shift from fishing and coral reef removal to aquaculture and tourism. Some results have been achieved in the form of diminished trawling, increased collection of solid waste and decreased removal of coral reef. At present, a bit more than 500 people have found employment in the tourism sector while another 500 persons are expected to switch to other activities in the presence of limited support and incentives.

The local tourism companies, whose benefits greatly depend on the quality of the reef, showed a genuine interest in participating in the management of the marine protected area and

implementation of project activities. Local companies will also contribute towards demarcation of tourism areas, transplantation of coral reef, surveillance and prevention of dynamite fishing.

The strengthening of the monitoring and enforcement of regulations at SNCRNR will count with the participation of local communities, particularly those located in Ximao Island, and the local Fishermen Association. These two groups can contribute greatly to the monitoring of activities in the project site. In particular, they are well positioned to engage in a process of dialogue with people involved in illegal fishing activities and coral removal in order to find alternatives that can minimize conflicts. The Fishermen Association has also expressed its desire to be involved in the design and implementation of public awareness programs. The Association feels confident that it has good access to the campaign's targets and that it is perceived as a respected institution. The Association will count with the participation of school staff and students in the implementation of public awareness activities⁵.

Project activities aimed at defining and implementing new financing mechanisms for the SNCRNR will count with the participation of reserve management, local authorities, representatives from associations, representatives from the private (industrial) sector and the tourism industry. As proposed in Output 6, the project will bring together these stakeholders to re-examine current arrangements for MPA financing and related pollution control including fees and penalties that could be used to ensure long-term financing for sustainable development and conservation at the site. The project will provide stakeholders with a forum to explore and discuss the introduction of instruments aimed at internalizing ecological damages such as those arising from anchors on coral, illegal sewage or waste discharges from boats, etc.

Based on the results from the round of consultations, the project expects that some conflicts may arise among stakeholders in the design of such mechanisms. It will be the task of the project unit, which will be supported by the executing and implementing agencies, to provide stakeholders with a space to discuss and agree as much as possible on issues related to the protection and financing of the SNCRNR. In bringing stakeholders together to discuss these issues the project builds upon existing efforts. For example, the application of the polluter-pays and user-pays principles is accepted as part of China's environmental policy stance and Sanya is investing efforts in having water use fees covering the costs of sewage treatment. In a similar venue, the private sector is already contributing towards conservation of marine resources. Under the terms of their licensing, tourism companies provide some support for equipment and monitoring of the SNCRNR.

Nanji Islands

Stakeholders will lead the process of developing an integrated township and MPA master plan as outlined in Output 4. Some stakeholder groups will also participate in the design and implementation of monitoring activities and public awareness and training programs. Nanji Island is a relative small community and this greatly facilitates the dialogue among fishermen, people involved in mariculture, reserve management, local authorities and hotel operators. The communities in Nanji Islands are relatively well organized, have fairly easy access to their local authorities and their inputs are usually taken into account into management and planning.

The design and implementation of project activities aimed at integrating the township and reserve management plans will have the active participation of the local government office, the MPA management, the Association of Hotel Services, the local Fishermen Association, representatives from people involved in mariculture, and village leaders. Integrating the reserve and township management plans with the objective of ensuring that future development is compatible with biodiversity conservation will require some degree of compromise from all stakeholders involved. However, as previ-

⁵ In the final round of consultations in Sanya, local people and representatives from the private sector proposed the establishment of an "association of coral reef conservation volunteers". This association, they explained, would facilitate the participation of individuals in the conservation of coral reefs. It was agreed that the idea would be explored and discussed during project implementation stage.

ously mentioned, these stakeholders have gathered experience in coming together to discuss issues related to resource management (for instance, reserve regulations), zoning schemes, systems for resource use rights and the problems arising from the growth of the tourism sector (scarcity of water). In fact, participants in the rounds of consultations at Nanji proved to be surprisingly open in discussing sensitive issues, like water resource distribution between the tourism sector and the local inhabitants, and quite innovative in suggesting alternative systems for resource access.

In terms of designing and implementing specific project activities, different stakeholders volunteer for a wide range of actions. Local communities will participate in the development and implementation of measures aimed at promoting more sustainable livelihoods, the promotion of off-shore fishing, co-management of coastal and marine areas, and an improved system for collection of solid waste. The private sector, mainly the Association of Nanji Hotel Enterprises, will actively participate in the development of measures intended to foster eco-tourism, the introduction of measures aimed at diminishing sewage discharge, and the design and installation of tourism-related infrastructure compatible with the island resources and conservation of the MPA. The Fishermen Association will have a strong role in the development of measures aimed at co-management of marine areas and in re-training programs while the school staff and students will lead the development and implementation of public awareness and educational campaigns.

Shankou-Weizhou Island

GEF activities in this project site comprise the establishment of an MPA in Weizhou Island, the strengthening of capacities at Shankou National Mangrove Reserve (SNMR) and Hepu National Dugong Reserve (HNDR), and participatory co-management in the buffer zone of the SNMR and areas nearby.

The definition and implementation of co-management of resources in the buffer zone and around the mangrove reserve will count with the active participation of people involved in harvesting activities, people involved in aquaculture, the reserve management, local authorities and village leaders. Among this set of stakeholders, the participation of those involved in harvesting activities will be most important. It has been mentioned in the stakeholder analysis that harvesting in and around the mangrove reserve is an activity of a subsistence nature and that people engaged in it are usually among the poorest. The group appears vulnerable to more than moderate restrictions in resource access (closing mangrove or beach areas) because of their difficulties to finance the transition to other activities and their low level of education. In addition, there is no association of harvesters and therefore the group as such is not well organized. People engaged in harvesting activities belong mostly to villages nearby the reserve.

There will be a place for representatives of harvesters in the advisory committee of resource users in order to give them a formal place in the project decision-making structure. It may be possible that the project will have to take the lead into fully integrating their members into the definition and implementation of project activities. This is because this group lacks tradition and experience in participating in the design of co-management structures. In promoting the participation of harvesters in the design and implementation of project activities, the project counts with the support and guidance of the village leaders, who are best positioned to facilitate a process of dialogue with this group. Village leaders are elected among the old and most respected people in the community and therefore their suggestions and recommendations carry weight.

The rounds of consultations suggested that the process of establishing a co-management structure and ensure sustainable harvesting in and around the mangrove reserve may not be a pure win-win situation. Though no conclusive data was available, the results from the rounds of consultations suggested that the damage to mangroves from harvesting originates not only from inappropriate harvesting techniques but also from a moderately high harvesting pressure. Some conflicts may arise if a reduction in harvesting pressure is needed. Through the participation in the design of co-management structures, the project will provide stakeholders with a forum for discussion on how these conflicts, if they exist,

can be resolved. It is expected that those most dependent on harvesting for earning a living will be given priority to stay if reductions in harvesting pressure are required. It is also expected that, if needed, those that are less dependent on harvesting for subsistence would be supported in the transition to other alternatives,

Participation of local communities in the strengthening of capacities at Shankou National Mangrove Reserve and Hepu National Dugong Reserve will take place mostly through the design and implementation of educational and public awareness campaigns and monitoring/enforcement systems. In doing so, the project builds upon a rich experience. The mangrove reserve is already receiving the help of communities in the monitoring of reserve regulations. For instance, members that are respected in communities have been helping the reserve in patrolling mangroves and boundaries for trespassers. These individuals are well positioned to talk and reach consensus with people breaching reserve regulations. In turn, village leaders have supported educational and public awareness campaigns. In the case of strengthening the capacities of the Hepu National Dugong Reserve, the Fishermen Association is an important partner for improving current regulations and incentives, and undertaking public awareness and educational campaigns. School staff and students, as it has been observing other sites, show strong willingness to participate in educational programs and research activities.

The establishment of the MPA at Weizhou Island will count with a series of public forums co-organized by representatives of the tourism sector, local, regional and national authorities, research institutions and academia, the private sector (oil), the fishermen association, representatives of people engaged in mariculture and village leaders. These forums will be open to the public. In addition, these stakeholders will have a place at the sub-steering and advisory committees. The participation of stakeholders in the process of establishment of the MPA is important, as the reserve will result in some areas closed to the public. The round of consultations at Weizhou Island indicates that local stakeholders favour the existence of the reserve and conflicts in the process of its establishment are not expected.

Fujian-Guangdong

GEF activities for the corridor of Fujian-Guangdong focus on establishing mechanisms for co-operation in migratory marine species management. Fujian and Guangdong share an important portion of China's South Sea coast. Effective management of the migratory corridor that runs along the coast of these provinces requires effective co-operation between the authorities, academia and research institutions, and civil organizations.

The project will provide a forum for discussion and agreement to a comprehensive set of stakeholders who will take the lead in defining changes to current coordination mechanisms. The stakeholders identified through successive round of consultations are strongly related to the use of marine resources in the migratory corridor and comprise the following: i) the State Oceanic Administration; (ii) Department of Marine & Fishery Management of Fujian Provincial Government; (iii) Department of Marine & Fishery Management of Zhangzhou Municipal Government; (iv) Fishermen Association of Fujian Province; (v) Fishery Institute of Fujian Province; (vi) Minnan Marine Wild Animal Rescuing Center; (vii) Dongshan No.2 Middle School; (viii) the Third Institute of Oceanography; (ix) Xiamen ICM Center; (x) Xiamen and Jimei universities; (xi) Department of Marine & Fishery Management of Guangdong Provincial Government; (xii) Bureau of Marine & Fishery Management of Nan'ao County; (xiii) Bureau of Marine & Fishery Management of Shantou Municipal Government; (xiv) Bureau of Environmental Protection of Nan'ao County; (xv) Houzai Township of Nan'ao County; (xvi) Nanpeng Special MPA; and, (xvii) Shen'ao Township of Nan'ao County.

The number of stakeholders and their geographical dispersion poses some challenges to the project, mainly in the form of coordination and transaction costs. However, these agencies and organization

have experience in working with others listed above. Formal and informal contacts and exchange of information among them are frequent and issues and problems related to inter-provincial coordination are not new to them. In addition, the rounds of consultations showed that stakeholders do support the project objective of increased inter-provincial coordination and that their collaboration in project activities is certain. No serious conflicts among stakeholders are expected.

BIODIVERSITY SIGNIFICANCE REPORT

Introduction

The present report is made on the basis of a contract between UNOPS and TIO for providing technical support in terms of biodiversity significance in the project sites to the Brief of *Biodiversity Management in the Coastal Areas of the China South Sea* (BMCACSS,CPR/00/G41).

The report consists of three parts. The first gives a general physical marine environments and marine fauna and flora in Chinese waters as a general picture. The second part describes in detail the biodiversity significance in the project site area as a whole. Finally, the third part describes biodiversity significance at each proposed site from north to south in the Donghai Sea (the East China Sea) and the Nanhai Sea (the South China Sea) along Zhejiang, Fujian, Guangdong and Hainan provinces and Guangxi Zhuang Autonomous Regions.

PART I. Marine Biodiversity Significance in China

I. THE PHYSICAL ENVIRONMENT IN CHINA'S SEAS

1. China's Coastal Seas

China borders the Bohai Sea, the Huanghai Sea (the Yellow Sea), the Donghai Sea and the Nanhai Sea. The Bohai Sea is an internal sea of China bordering northeastern and northern China, with a total area of 78 000 km² and an average depth of 18 m. The Bohai Sea is connected to the Huanghai Sea by the Bohai Strait, which runs between Dalian and Yantai. The Huanghai Sea has an area of about 380,000 km² and an average depth of 44m. The Donghai Sea borders China in the west, the Huanghai Sea in the north, the Pacific Ocean in the east by passing the Honshu Island and Ryukyu Islands of Japan and Taiwan and the Nanhai Sea in the south. It has a total area of 770,000 km² and an average depth of 72 m. The Nanhai Sea has a total area of 3,500,000km² and an average depth of 1,212m. The demarcation line between the Donghai Sea and Nanhai Sea is the line from Nan'ao to E'luanbi at the southern tip of Taiwan Island.^{1,2} It is the southern part of the Donghai Sea and the northern part of the Nanhai Sea that the project highlights.

¹ Editor Committee, 1996, *Marine Geography*, China Science Press, Beijing pp.535;

² Li Wenwei, 2000, Name and zonation evolution of Bohai, Huanghai and Donghai of China, *Ocean Development and Management*, Vol. 17, No. 4. p.75-80

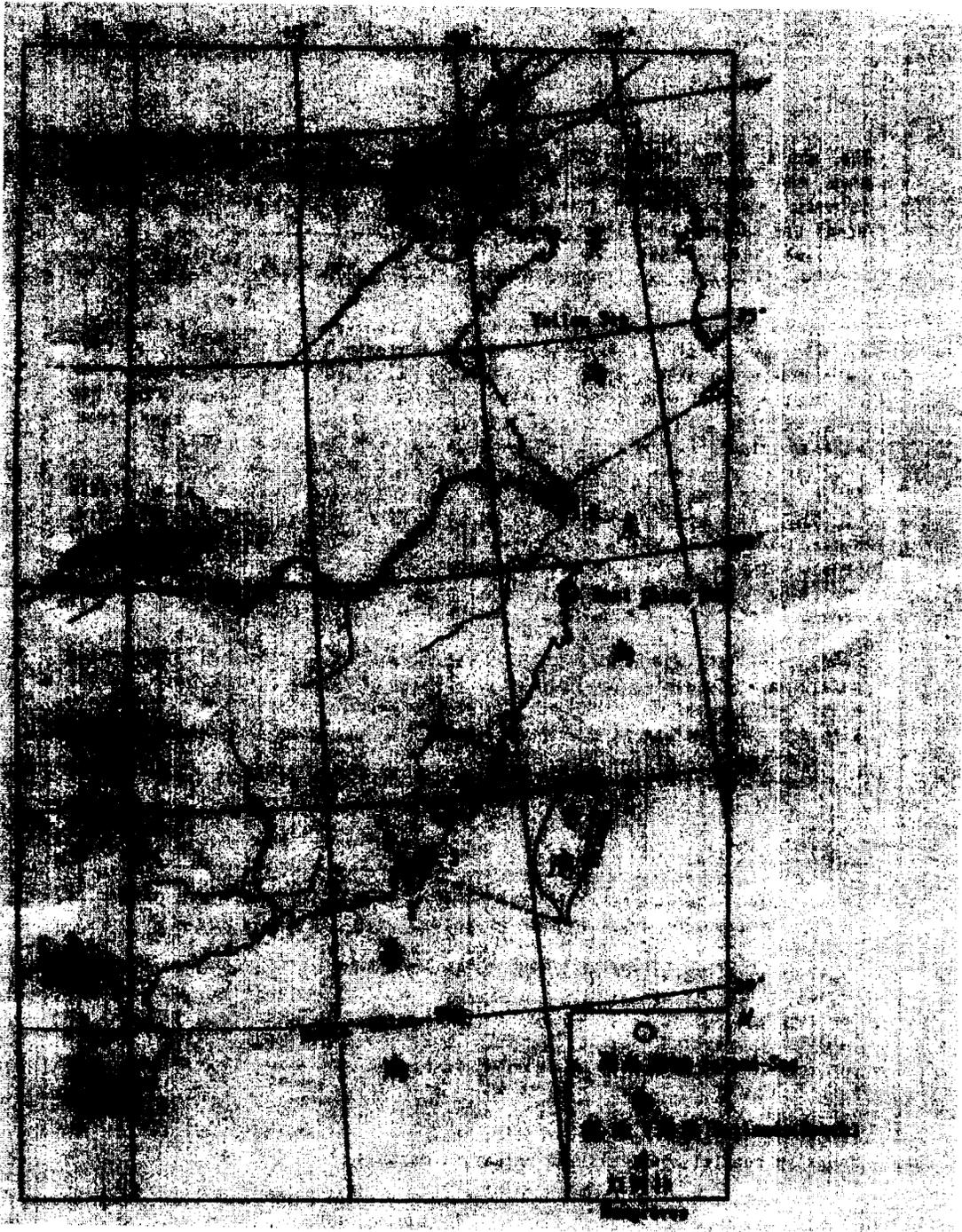


Fig. 1 China's Coastal Seas

Source: Action Plan for Marine Biodiversity Protection in China, SOA,

2. Climatic Zones of China's Coastal Seas

Along the continental coastline of 18,000 km, there are 6,500 islands. Both Bohai and Huanghai are in the warm temperature zone, the southwest and northeast parts of the Donghai Sea and the northern part of the Nanhai Sea are in the subtropical zone while the southern part of the Nanhai Sea, the southeast part of the Donghai Sea and the waters to the east of Taiwan are in the tropical zone. Among various ecological factors, seawater temperature is the most important one that

determines the species distribution and fauna of biodiversity. Water temperature is subject to its latitude and geographical location and under the impact of sea currents and continental climate. In addition, salinity, depth, bottom soil and islands have important roles in determining biological distribution. The long-term integrated impact of various environmental factors has resulted in ecosystem diversity. China's seas are characterized by 3 temperate ecosystems, namely (i) warm temperate, (ii) subtropical and (iii) tropical ecosystems, within which the most important are the coral reef, mangrove, sea grass ecosystems and those in the oceanic circulation system such as Kuroshio and the upwelling zones³(Fig. 1).

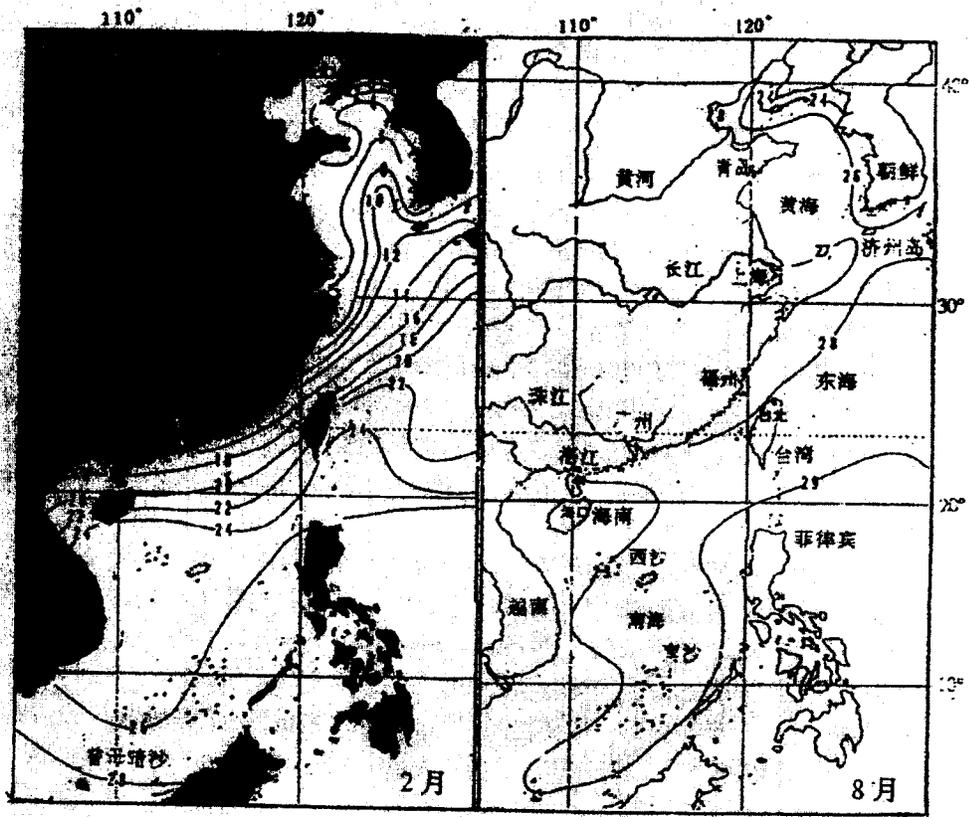


Fig 2 Distribution of surface seawater in China⁰C□□China Natural Geography,1979□

3. Major Current Systems in China's Coastal Seas

The coastal waters of China are subject to the impact of an ocean current system -- the Kuroshio and its branches -- and local current systems, the littoral currents and monsoon drifts. The Nanhai Sea circulation is dominated by the local monsoon. The Kuroshio, originating in the Northern Equatorial Current, comes into the Donghai Sea from the Philippines by passing the Luzon Island and Taiwan Island (Fig. 3.1). To the northeast of Taiwan, a branch goes into the coastal waters of Fujian and Zhejiang; this branch is known as the Taiwan Warm Current (Fig.3.5). The main stream of the Kuroshio flows northeastward along the Donghai Sea continental shelf and branches into the Tsushima Warm Current to the south of Honshu (Fig.3.3). The Tsushima Warm Current further branches into two parts to the southeast of Chejudao Island; the sub-branch going into the Huanghai Sea is called the Huanghai Sea Warm Current (Fig. 3.4). The Kuroshio system with high temperature and high salinity exercises great impact on biological fauna in the Huanghai Sea and outer Donghai Sea, resulting in features of oceanic fauna with most species being warm water

³ Editor Committee,1996, *Marine Geography* , China Science Press, Beijing pp.535;

species, indicating high temperatures and salinity. In comparison with the biological species at the same latitude, the northern distribution boundary of warm water species moves to the north. For example, 230 species of reef-building corals are recorded in the Taiwan waters and very good coral reefs are distributed in the southern part of Taiwan Island ⁴(22°N).

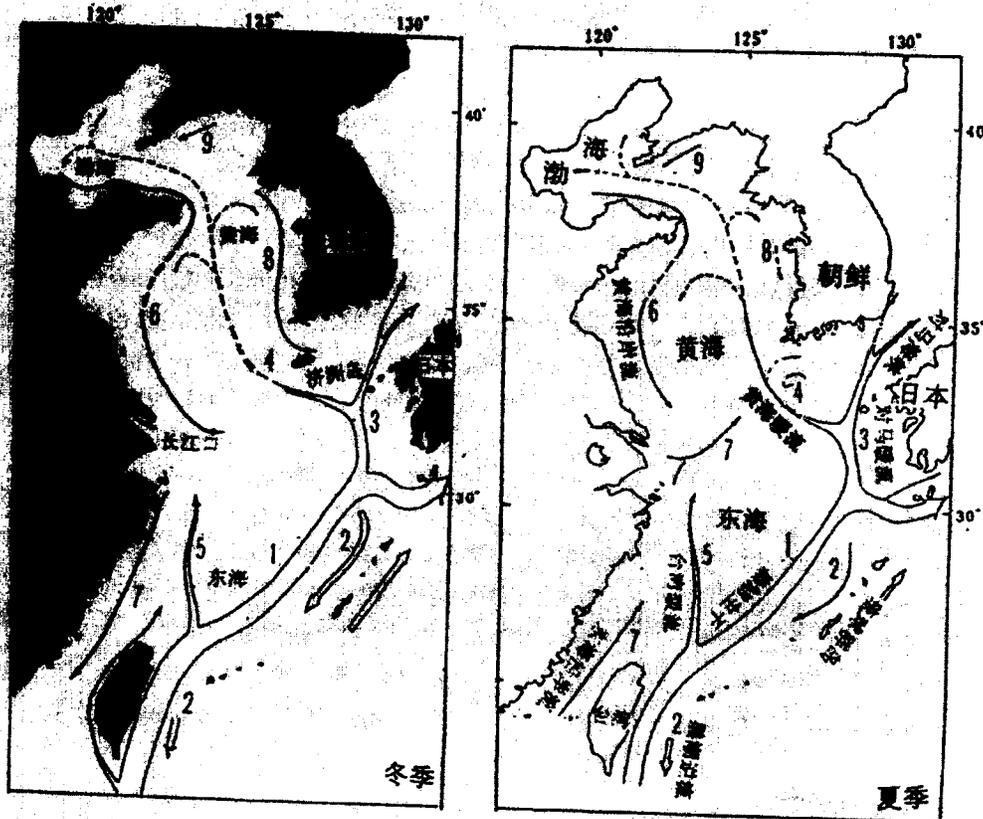


Fig. 3 A sketch map of current systems in the Huanghai Sea, Bohai Sea and the Donghai Sea
 1. Main stream of Kuroshio; 2. Counter Current of Kuroshio; 3. Tsushima Current 4. Huanghai Warm Current ; 5. Taiwan Warm Current; 6. Huanghai Littoral Current; 7. Donghai Littoral Current; 8. West Korea Littoral Current; 9. Liaodong Littoral Current

a. Huanghai Littoral Current

Huanghai Littoral Current flows from the Bohai Sea, by passing coastal Shandong Peninsula and coastal Jiangsu and arrives at the Changjiang estuary (Fig. 3.6) moving always to the south for the whole year round. In the waters under the impact of this current system with low salinity and larger temperature range, the biological fauna is dominated by eurythermal hyposaline species. The coastal ecosystem in the shallow Huanghai Sea is characterized by greater difference in the species composition between summer and winter and greater number of species southward.

b. The Donghai Littoral Current

The Donghai Littoral Current originates from the Changjiang River runoff flows to the south in winter (Fig. 3 left 7) and to the north in summer (Fig. 3 right 7) in the pattern that depends on the size of the runoff and monsoon. The composition of both temperature and salinity results in a rather complicated species composition in the ecosystem that is featured by large seasonal

⁴ Huang Zongguo and Zhu Mingyuan, 1998, Biodiversity in China's seas, coastal and island waters, *China National Report of Biodiversity*, p. 97-108, China Environmental Science Press, Beijing

variation and the dominance of hypohaline and eurytropic species .

II. BIODIVERSITY IN CHINA'S SEAS

The interaction of various current systems has resulted in the different distribution of phytoplankton and of other living resources. In general, the quantitative distribution of phytoplankton biomass in the continental sea along China's coast is higher in the nearshore than in the offshore areas, reaching its highest levels in the estuaries, the frontal zones and the upwelling zones. The biomass is highest in the Donghai Sea, followed by Bohai and Huanghai Sea and the lowest in the Nanhai Sea. In the project site area, surface sea temperature decreases with increasing water depth and salinity fluctuates greatly with the river runoff.⁵⁶⁷⁸⁹

1. Large Marine Ecosystem Diversity in China's Seas¹⁰

The Huanghai and Bohai Warm Temperate Ecosystem is dominated by warm temperate species with small numbers of cold water species as in the middle of the Huanghai Sea there is a cold water mass and with some warm water species at the outer part due to the intrusion of the Kuroshio branches . This ecosystem is dominant in the Bohai Sea and the Huanghai, representing a kind of northern ecosystem in China's seas.

The West Donghai Sea Subtropical Ecosystem is dominated by warm water species with larger spatial and temporal variations due to the interaction between coastal runoff (with low salinity) and offshore warm currents (with higher salinity and temperature). This group has less warm temperate species and occasional cold water species. This Ecosystem is dominant in the coastal waters of the Donghai Sea running along Shanghai, Zhejiang and Fujian. As far as the present project is concerned, the proposed site at Nanji Islands is in the middle section, and the Dongshan-Nan'ao Migratory Corridor Site is located at the southernmost edge of the Ecosystem Belt.

The Northern Nanhai Sea Subtropical Ecosystem is absolutely dominated by warm water species, as there are various large estuaries such as that of the Zhujiang River (the Pearl River) along the coast and because of the greater influence from warmer Nanhai Sea waters moving up from the south. The distribution of reef builders and mangroves in this group indicates the transition from sub-tropical to tropical ecosystems.

The eastern Donghai Sea and southern Nanhai Sea Tropical Ecosystem is absolutely dominated by warm water species, without any cold water species as indicated by 230 species of reef builders around Taiwan, 110 around Hainan Island, 127 in Xisha and 200 in Nansha.

2. Marine Faunal Diversity in China's Seas

China has recorded 20,278 species of marine organisms¹¹ , which may be classified into groups in accordance with their habitat and living patterns such as planktons, nektons and benthos. The marine biological fauna in China belongs to the North Pacific Warm Province and West Pacific Warm Province; the boundary between the two is roughly along a line from the northern bank of the Changjiang estuary to Chejudao Island in Korea. According to water adaptability of marine

⁵ Deng Jingyao and Zhao Chuanyin, et al, 1991, *Marine Fishery Biology*, Agriculture Press, Beijing, pp.686

⁶ Editor Committee, 1996, *Marine Geography* , China Science Press, Beijing pp.535;

Editor Committee, 1993, *Profile of Bays in China-Bays Along Guangxi*, China Ocean Press, Beijing pp.335

⁷ Editor Committee, 1993, *Profile of Bays in China-Bays Along Southern Fujian* , China Ocean Press, Beijing pp.510

⁸ Editor Committee, 1998, *Profile of Bays in China-Bays Along Eastern Guangdong*, China Ocean Press, Beijing pp.403

⁹ Editor Committee, 1999, *Profile of Bays in China-Bays Along Hainani*, China Ocean Press, Beijing pp.426

¹⁰ Huang Zongguo, 2000, *Marine Biodiversity of China and the Strategy for Its Sustainable Use, Proceedings of Biodiversity and Conservation Workshop of Taiwan Straits*, Taiwan Natural Science Museum, Taipei, 179-189

¹¹ China State Oceanic Administration, 1995, *Action Plan For Marine Biodiversity Conservation in China*, Beijing, pp.69

organisms, three groups may be identified in China's seas in accordance with temperature¹²

- *Cold water species*—Proper¹³ temperature lower than 4°C for growth and reproduction—its natural distribution zone with a monthly average temperature not higher than 10°C—This group includes cold and sub-cold species—the former lives well at about 0°C and the latter at 0–4°C.
- *Temperate species*—Proper temperature lower than 20°C for growth and reproduction—its natural distribution zone with a monthly average temperature is 5°C. This group includes cold temperate and warm temperate species—the former lives well at about 4–12°C and the latter at 12–20°C.
- *Warm water species*—Proper temperature higher than 20°C for growth and reproduction—its natural distribution zone with a monthly average temperature is 15°C. This group includes subtropical and tropical species—the former lives well at about 20–25°C and the latter higher than 25°C¹⁴.

3. Species Biodiversity

Chinese waters have complex ecosystems and rich species, taxa and communities (Tables 1 and 2)^{15,16}. Based on studies undertaken during the past 70 years (1922–1992), *Marine Species and Their Distribution in China's Seas* records 20,278 species in 44 families and 5 kingdoms, of which animalia has the most species (12,794 species) and monera has the least species (229 species). This study was based on the joint efforts in 5 years of 132 specialists from 40 units in Mainland China and Taiwan and Hong Kong under the coordination of the Third Institute of Oceanography of the State Oceanic Administration¹⁷. The taxonomy work of all species was made by experienced taxonomists in accordance with model specimens and species index.

The studies of horizontal distribution of marine species in China show that the number of species increases from north to south. Taking the number of commercial fishes as illustration, the Bohai, Huanghai, Donghai and Nanhai seas have altogether 2,500 commercial fish species—of which more than 1,000 are located in the shelf waters and more than 200 in the slope waters (200–1,308 m) of the Nanhai Sea, over 700 in the shelf and over 350 in the outer shelf to the slope (120–1100m) of the Donghai Sea and about 300 in the Huanghai and Bohai Seas. The waters with the highest biodiversity in the Pacific are within the triangle formed by the Philippines, the Malaysia Peninsula and the Papua New Guinea Islands. Thus, as it is near this triangle, it is not surprising that the Nanhai Sea has the highest biodiversity and the Huanghai and Bohai seas have the least in China's seas¹⁸.

Apart from the waters to the east of Taiwan bordering the Pacific, all the other waters represent semi-enclosed continental seas that were subjected to less impact from the Quaternary Glaciations, resulting in the independence and enclosedness of marine biodiversity; as a result, very few of the species found here are of world-wide distribution^{19,20}. China's seas have preserved many ancient

¹² China State Oceanic Administration, 1995, *Action Plan For Marine Biodiversity Conservation in China*, Beijing, pp.69

¹³ Huang Zongguo, 2000, *Marine Biodiversity of China and the Strategy for Its Sustainable Use, Proceedings of Biodiversity and*

Conservation Workshop of Taiwan Straits, Taiwan Natural Science Museum, Taipei, 179–189

¹⁴ Editor Committee, 1996, *Marine Geography*, China Science Press, Beijing pp.535;

¹⁵ China State Oceanic Administration, 1994, *Action Plan For Marine Biodiversity Conservation in China*, Beijing, pp.73

¹⁶ Huang Zongguo, 2000, *Marine Biodiversity of China and the Strategy for Its Sustainable Use, Proceedings of Biodiversity and*

Conservation Workshop of Taiwan Straits, Taiwan Natural Science Museum, Taipei, 179–189

¹⁷ Huang Zongguo, 1994, *Marine Species and Their Distribution in China's Seas*. China Ocean Press, Beijing, pp.920

¹⁸ Lu Shouben, 1999, *Marine Resources and Sustainable Development*, China Science and Technology Press, Beijing, pp.134

¹⁹ China State Oceanic Administration, 1995, *Action Plan For Marine Biodiversity Conservation in China*, Beijing, pp.69

relict species and some primitive or independent taxa that are not found in other sea areas in the Northern Pacific. These include *Tachypleus tridentatus* (there are only four species in the world), three species of *Balanoglossus*, *Branchiotoma belcherii*, *Acipenser sinensis*, *Psiphurus galdius*, *Lingula anatine* and *Terebratella eoreanica*, just to mention a few. Among them Chinese sturgeon (*Acipenser sinensis*) and Chinese paddlefish (*Psiphurus galdius*) are relict species of the Cretaceous Period. The adults live in the coastal waters around the Changjiang River and the Zhoushan Islands and go up into the Changjiang River for spawning²¹. Another good example is Chinese eel, *Anguilla japonica*. Chinese eel spawn in the deep waters in the Pacific, believed to be in the waters to the east of Taiwan Island, and the fry move back to the estuaries from Changjiang Estuary to that along Guangdong coast.

In the coastal shallow waters, certain endemic species can also be identified.²² Some of them are distributed in all Chinese coastal waters such as prawn shrimp *Penaeus chinensis* and small shrimp *Acetes chinensis*, some are only found in the shallow waters of the Donghai Sea such as yellow croaker *Pseudosciaena polyactis*, long arm shrimp *Palaemon gravieri*, *Palaemon temidactylus* and crab *Eriocheir sinensis*, and some are only found in the northern Nanhai Sea, Donghai Sea and southern Huanghai Sea such as yellow croaker *Pseudosciaena crocea* and euphosia *Pseudeuphausia sinica*. Of them the most important fauna that deserve attention are fishes. There are 16 identified endemic fish species in the Nanhai Sea and 16 such species in the Donghai Sea²³. Although they are free swimmers, several dozen species have been found dwelling in the waters along the eastern part of the mainland, without expanding into Japanese waters to east or the Beibu Gulf in the southwest. These species serve well as indicators to the ecological features of coastal China. Chinese white dolphins are inhabitants of tropical to warm temperate coastal waters and they enter rivers, estuaries and mangroves²⁴. 4. *Marine Species under and proposed to be under state protection*

In 1989, the Ministry of Forest and the Ministry of Agriculture jointly promulgated the Name List of Key Wild Animals Under State Protection (Aquatic animals), in which 30 species and one order of marine animals are covered (see Table 2). In addition, the *Action Plan for Marine Biodiversity Conservation in China* proposed to add the following marine species to the Name List of Key Wild Animals under State Protection: *Lingula anatine* (a species of branchiopoda), *Terebratella eoreanica* (another species of branchiopoda), *Barenisia discereta* (a species of entoprocta), *Chlamys sarreri* (scallop), *Haliotis gigantea discus* (giant disc abalone), *Perinereis aibuhitensis* (a species of polychaeta), *Birgus larro linnaeus* (coconut crab), *Tachypleus tridentatus* (horseshoe crab), *Stichopus japonicus* (sea cucumber), *Thelenota ananas* (sea cucumber), *Ostrea gigas* (giant oyster), all species of lobsters, six species of hemichordata, all species of sea horse, *Rana eancrivora* (sea frog) and *Colloallia* spp. (swift swallow)²⁵.

Part II. Biodiversity Significance in the Project Site Area

The proposed project site area consists of the coastal waters less than 20m deep running from 27°N to 17°N, or a total of ten degrees in latitude, covering the southwestern Donghai Sea and the northern Nanhai Sea. Either from physical or ecological conditions, the area can be classified into

²⁰ Deng Jingyao and Zhao Chuanyin, et al, 1991, *Marine Fishery Biology*, Agriculture Press, Beijing, pp.686

²¹ Huang Zongguo, 2000, *Marine Biodiversity of China and the Strategy for Its Sustainable Use, Proceedings of Biodiversity and*

Conservation Workshop of Taiwan Straits, Taiwan Natural Science Museum, Taipei, 179-189

²² Lu Shouben, 1999, *Marine Resources and Sustainable Development*, China Science and Technology Press, Beijing, pp.134

²³ Liu Ruiyu, 1996, *Features of marine fauna and resources and recommendations for their development and utilization, Marine Organisms in the Coastal Zone in China*, China Ocean Press, Beijing, pp.445

²⁴ Jefferson T.A., S. Leatherwood, M. A. Webber, *Marine Mammals of the World*, UNEP/FAO, pp.320

²⁵ China State Oceanic Administration, 1995, *Action Plan For Marine Biodiversity Conservation in China*, Beijing, pp.69

three zones -- the Donghai part that includes Nanji and Dong-shan and Nan'ao, the latter just being at the interface between the Donghai and Nanhai seas, the Nanhai Part that includes Sanya Bay and the Beibu Gulf (Tonkin Gulf) that includes Shankou. The Nanji Islands and the Weizhou Island within the site of Sankou that are far away from the coast, and Sanya Bay that is along the southern coast of Hainan Island, the others are along the coast of mainland China.

I. PHYSICAL DIVERSITY IN TERMS OF COASTAL CURRENTS²⁶

From north to south, the project site area has the following physical diversity in terms of coastal currents. In the Donghai Sea, in addition to the controlling current systems such as the Zhejiang-Fujian Littoral Current, Taiwan Warm Current and Nanhai Warm Current mentioned in Part I, the project site area is subject to coastal and upwelling fronts²⁷ and to the Taiwan Strait Counter Thermocline Layer.²⁸ In the Nanhai Sea, the area is subject to the Fujian-eastern Guangdong Littoral Current, river runoffs from large rivers such as the Zhujiang River and the Kuroshio Branch and Nanhai Warm Current. The site at Sanya is completely under the impact of the Nanhai Warm Current as it is open to the oceanic water, contrasting to the site at Shankou that is additionally under the impact of the enclosed Beibu Bay.

1. Coastal Frontal Zone

The frontal zone is formed due to the interaction among different water masses with differences in velocity, orientation, temperature and salinity. This is identified at Nanji with the interaction of the Jiangsu-Zhejiang coastal water mass moving to the south and the Fujian coastal water mass and Taiwan Warm Current moving to the north. This is identified along the Migratory Corridor Site due to the interaction of the Zhejiang-Fujian coastal water mass and the Eastern Guangdong coastal water mass moving to the south and the Nanhai Warm Current moving to the north. Along the Migratory Corridor Site, the Taiwan Warm Current plays a key role.

2. Taiwan Strait Counter Thermocline Layer

The Taiwan Strait is the channel connecting the Donghai and Nanhai seas. The Strait is about 300 km long and 14-240 km wide with an average water depth of 60m. According to the statistical analysis of ocean observation data in the last four decades, it has been confirmed that there exists a seasonal counter thermocline layer in the waters between 116°121°E, 21°-26° N. The average impact of the counter thermocline layer is largest in spring, second in winter and least in autumn. The area under its impact runs from the waters off Minjiang River in the north to the Dongshan-Nan'ao waters in the south.

3. Nanhai Monsoon Drift Current and Warm Current

Under the impact of monsoon, bottom topography and that from other seas, the surface current in the Nanhai Sea is called a monsoon drift current. In winter, the drift under the impact of the northeast monsoon flows into the Nanhai Sea from the Taiwan Strait and the Bashi Channel (between China and the Phillipines) and goes westward and then southward. In summer, the drift, under the impact of southwest monsoon flows to the northeast and goes to the Pacific through the Bashi Channel or to the Donghai Sea by the Taiwan Strait. Nanhai Warm Current is a branch of the Kuroshio flowing from the Bashi Channel into the northern part of the Nanhai Sea, arriving at the waters near Hainan Island. It extends in winter and shrinks in summer and brings high temperature and salinity to waters in the northeast part of the Nanhai Sea.

II. HABITAT DIVERSITY

²⁶ Su Jilan, 2001, Studies on circulation dynamic mechanisms in coastal China, *Acta Oceanologica Sinica*, Vol.23, No.4, 1-16

²⁷ Pan Yuqiu et al, 1985, Frontal structure, variations and causes in coastal upwelling zone of Zhejiang, *Oceanologia Sinica*, Vol.7, No. 4:402-411

²⁸ Yan Wenbin, 1991, Counter Thermocline Layer in the Taiwan Strait, *Journal of Oceanography in the Taiwan Strait*, Vol. 10(4); 334-337.

The project site covers coastal provinces in southern China running from north to south Zhejiang, Fujian, Guangdong, Guangxi and Hainan, just southward to from the Changjiang River to the southern tip of mainland, from the temperate zone to the tropical zone, from coastal zone to more oceanic waters. In terms of economic strength, however, Guangdong comes to the first and Hainan the last (Table 3). Different geographical locations nourish different habitats that are the bases for the development of marine industries. The project site highlights a great diversity of habitats. In terms of physical environments, there are island, bay, sandy beach and muddy swamp habitats, including fishing grounds and in biological terms, there are mangrove, coral reef, sea grass and migratory species such as marine mammals, horseshoe crabs, turtles and sea bird habitats. It is worth noting that in the project site area, an important migratory route has formed for some globally significant species.

1. *Island Habitat*²⁹

There are 6,500 islands larger than 500 m² in China, mostly in the Donghai Sea (66%), followed by the Nanhai Sea (25%) and the Huanghai Sea and the Bohai Sea. Four characteristics might be identified for Chinese islands. First most of the islands are coastal ones, with those less than 10 km away from the mainland coast accounting for over 67%. Second, most of the islands are basic rock islands (ca.93%) and the others are alluvial islands (ca.6%) and coral reef islands (1.6%). Third, most of the islands are in chains or groups, forming themselves into archipelagos. Fourth, most of the islands are smaller ones with a land area less than 5km² (98%). The project sites are mostly around an island or islands, such as Nanji Islands, Dongshan Island (although it is connected by the mainland now by a causeway two decades ago, this might not have much influences on the existing fauna and flora), Nan'ao Island, Weizhou Island in the Beibu Gulf, and the small islands in the waters of Sanya, without mentioning Hainan, where Sanya is situated, which is itself the second largest island in China. Island habitats, due to their insular effects, might have preserved some endemic species and as islands are away from the continent, they are subject to less impact from the land-based pollution carried in river runoff. In accordance with climatic classification of islands in China, except Nanji Islands that is in the Middle Subtropical Zone, all the others are in the Southern Subtropical Zone. The primary productivity is in general around 3.87mg/m² in spring, 2.48mg/m² in summer, 2.31mg/m² in autumn and 1.43mg/m² in winter.

2. *Bay Habitat*

Dongshan Bay, Nan'ao Bay, Sanya Bay and Tieshan Bay (where Shankou is situated) may be referred to as sites with bay habitats. Dongshan Bay actually consists of three bays, namely Dongshan Bay, Zhao'an Bay and Gongkou Bay. They are semi-enclosed bays formed by basic rocks and estuarine plains. The primary productivity ranges from 0.32 to 17.2 mg/m², with an annual average of 3.33mg/m², lower in winter and spring and higher in autumn. Nan'ao Bay consists of various small bays, such as Houjiang Bay, Qianjiang Bay, Yun'ao Bay, Yandun Bay, Zhuqidu Bay, Qing'ao Bay and Shen'ao Bay, normally 6-12 meters deep. Along the main island of Nan'ao, there is a stretch of 16 km of sandy beach. The primary productivity is in average 2.29 mg/m² in spring and 3.23 mg/m² in autumn. Sanya Bay is at the southernmost tip of Hainan Island and actually consists of three bays connecting each other, namely Yalong Bay, Yulin Bay and Sanya Bay, all with stretches of sandy beaches. The bays cut into land and create calm sea for the development for *Acroporidae* corals to survive with their high and large horns³¹. No primary productivity data is available in the Nanhai Sea.

3. *Sandy Beach Habitat*

In nearly every site, there are sandy beaches. The sandy beaches along Nanji and especially in Dongshan are most impressive. The wide stretches of sandy beach with clean and soft sands are the best nesting ground for sea turtles and Chinese horseshoe crabs (see below for details about habitats of sea turtles and horseshoe crab).

²⁹ Yang Wenhe (Editor-in-chief), 2000, *Chinese Islands*, China Ocean Press, Beijing, pp.560

³⁰ Editor Committee, 1998, *Profile of Bays in China-Bays Along Eastern Guangdong*, China Ocean Press, Beijing pp.403

³¹ Editor Committee, 1999, *Profile of Bays in China-Bays Along Hainani*, China Ocean Press, Beijing pp.426

4. Muddy Mangrove Swamp Habitat

China has about 2.1 million ha of intertidal zone and saline wetlands, among which are about 15,000 ha of mangrove or less than 0.1% of the world total³². It is generally acknowledged that the mangrove distribution area reached 250,000 ha in history and more than 40,000 ha in the 1950s. They are 24 species of exclusive and 11 non-exclusive mangrove species in China. They are naturally distributed in the provinces of Hainan, Guangdong, Fujian and Taiwan and the regions of Guangxi Autonomous Region and Hong Kong and Macao. The northern boundary of natural distribution of mangroves is Fuding city(27°20'N)in the north most of Fujian province. In 1950s, *Kandelia candel* was successfully introduced to Zhejiang province and pushed one degrees northward of its distribution³³. The mangrove MPA in the Shankou highlights the importance of muddy beach for this type of ecosystem. The bay at Sankou where mangrove stands is swamp of volcanic ashes. With only a very small and short river, the landscape is under great impact of ocean currents.

5. Coral reef habitat³⁴

The coral reefs in China are of Indo-Pacific realm, accounting for about one quarter in terms of species in the realm. There are more than 200 species and subspecies in 50 genera of coral distributing in coastal Guangdong, Guangxi, Fujian, Hainan, Taiwan, Hong Kong and Macao.

The coral reef is mainly distributed in 3 sub-regions along the coastal shallow area of Hainan Island:

- The Southern Sub-region

Including most waters of Sanya City and part of Linshui County. The abundant reef areas are located at Yalong Bay□Dadonghai Bay□Yezhu Islet□Xiaodonghai Bay□Luhuitou Peninsula□East and West Maozhou Islets and Wujizhou Islet. The reef-building corals are mainly living on dead reef and large rock or other such hard substrates, both along nearshore of coast and some islands, not far away from half a kilometers. The most abundant reef depth distribution is around 2~10m. The living reef coverage in a few location of this sub-region can reach to 80~90% (e.g. Xipai Reef and Yezhu Islet in the Yalong Bay), though their distributing area is not satisfactory large. The level of bio-diversity is quite high in reef tideland of this sub-region (e.g., the cross-tidal area of Xiaodonghai Bay had been usually chosen as a marine biological surveying and collecting site).

- The Eastern Sub-region:

Including the waters of Qionghai county and part of Wenchang County. The abundant reef areas are located along the coast from Shalao to Qingge town, from Longwan Bay to Tanmen town of Qionghai County, and Qishui Bay at southern part of Wenchang County. The reef-building corals are distributed near of coast in Wenchang County, however, the living reef generally locate at quite far offshore reef belt, about 1 km away, which form a wave-broken area that protect the long nearby sandy shore. The most abundant reef depth distribution is around 4~10m. The living reef coverage in a few locations of this sub-region can reach 70~80% (e.g. Shalao Reef at northern Qionghai coast).

- Northwestern Sub-regions

Including the waters of Lingao County, Danzhou County and part of Chengmai county□Dongfang County and Changjiang County. The abundant reef areas are located along the coast of Lingao Corner of Lingao County and islets named Lingqiangshi and Linchang of Danzhou County. In this sub-region, the reef are quite scatter-distributed, along long coast from Chengmai County, northern Hainan Island, to Changjiang County, western Hainan Island, and their normal coverage is

³²Zhou Qiulin and Yin Weiping, 1999, Studies and Management of Mangroves in China, Workshop of Nature Conservation, Taipei

³³Lin Peng et al 1995□Environmental Ecology and Economic Utilization of Mangroves in China,Advanced Learning Press, Beijing, 1-95

³⁴Chen Gang and Zhou Qiulin, 2000, Coral Reef Resource and Management in China, especially in Hainan Province, National Report to 9th World Conference of Coral Reefs, Indonesia