Identification of Important Coastal and Marine Biodiversity Areas (ICMBA) to strengthen the Marine Protected Areas Network in India

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Existing Marine Protected Areas (MPAs) in India

18 Marine Protected Areas cover 6158 km²

MPAs form 3.85% of total area under PAs in India and 4.97% of coastal zone of peninsular India
Why identify Important Coastal and Marine Biodiversity Area (ICMBA) in India?

- Poor representation of coastal and marine biodiversity areas in the Protected Area Network of India
- Lack of detailed studies on
  a. Estuaries
  b. Backwaters
  c. Sand Dunes
  d. Intertidal zones
  e. Rocky shorelines
  f. Seagrass meadows
  g. Lagoons
  h. Intermediate open sea

resulting in the need for identification and prioritization of potential sites
Overall objectives of ICMBA study

• To examine all coastal and marine biodiversity areas along coastline of India

• To develop ICMBA criterion

• To identify ICMBAs based on the criteria and assign the sites as possible conservation / protection category

• To prioritize ICMBAs which requires immediate inclusion into a conservation category
Existing Marine Protected Areas in India

- Gulf of Kachch
- Gulf of Mannar
- Bhitarkanika
- Gulf of Mannar
- Lohabarrack
- Cingue
- Cothbert
- Galathea
- Malvan
- Piti
- Kadalundi
- Lothian
- Halliday
- Sajnakhali
- Bhitarkanka
- Bhitarkanika
- Gahirmatha
- Chilika
- Coringa
- Krishna
- Pulicat
- Point Calimere
- Wandur
- Middle Button
- North Button
- Rani Jhansi
- South Button
- Lohabarrack
- North Reef
- Mangrove
- South Reef

- Marine National Parks
- Wildlife Sanctuaries
- Community Reserve
- No Conservation Reserves
METHODOLOGY

Part I

Literature survey, gathering of secondary information about biodiversity values and finalization of criteria for identification of ICMBAs in India using similar existing global and national criteria

Part II

Primary data collection through field surveys in 350 potential sites all along Indian coasts

Application of newly developed criteria for identification of ICMBAs from 350 sites surveyed
Methods: Part I
Review on existing methodologies to identify ICMBAs in India

Global (macro-level) priority setting approaches for biodiversity conservation

**Biodiversity hotspots**
- Habitat based, e.g., rain forests
  (Myers, 1988)

**Major tropical wilderness areas**
- Ecosystem based, e.g., high biodiversity tropical areas
  (Myers, 1990; Mittermeier, 1990)

**Mega-diversity countries**
- Country based biodiversity assessment method e.g., B-17
Available methodology in India

- Untawale, 2000
  - based on threatened taxa status

- Singh et al., 2000
  - both on taxa and habitat types
  - suggested 12 sites along Indian coastline
• Important Bird Areas (IBAs) – Birdlife International
• Key Biodiversity Areas (KBAs) – Birdlife International
• Special Area Conservation (SAC) – EU’s Habitat Directive
• Marine Ecoregions – WWF & Nature Conservancy
• Important Coastal & Marine Biodiversity Areas (ICMBAs)
Criteria for identification of ICMBAs

Six following “Conservation amplifiers” were picked up from standard methods for criteria development

1. Ecosystem resilience
2. Ecosystem function
3. Biodiversity uniqueness
4. Cultural, Religious & Aesthetic significance
5. Socio-economic potential
6. Land tenure
CRITERION 1

Coastal ecosystem resilience

Indicators

1. Considerable area

2. Ecosystem contiguity

3. Habitat diversity (mangrove, mud flat, coral, seagrass, sand beach etc)

4. Adequacy of the site to maintain ecosystem level processes (nutrient flow, salinity changes)

5. Wildlife corridor (connected by vegetation, water or others)
Ecosystem functions

**Indicators**

1. Freshwater discharge/recharge function
2. Coastal erosion control
3. Carbon sequestration value
4. Natural protection against disaster
Biodiversity uniqueness

Indicators
1. Presence of Globally threatened species
2. Presence of Regionally threatened Species (IWPA 1972)
3. Presence of restricted range species
4. Presence of flagship species
5. Presence of endemic species
6. Nursery and Breeding site provisions for species of conservation significance
7. Congregation area for species of conservation significance
8. Congregation area for migratory species
Cultural, Religious & Aesthetic significance

Indicators
1. Cultural value
2. Religious value
3. Historical value
4. Aesthetic value
Socio-economic potential

Indicators
1. Renewable natural resource extraction opportunity
2. Ecotourism prospects
3. Support for agriculture
4. Aquaculture and Fisheries
Land tenure

Indicators

1. Government ownership or other private ownership
How were sites chosen?

- Collected Secondary information from
  a. State Forest Departments,
  b. Institutions and
  c. NGOs

- All 350 potential sites were visited and rapid assessment on certain taxon groups have been carried out.

- All sites were surveyed minimum twice and maximum thrice
Survey for identification of ICMBAs

Number of sites visited and examined

<table>
<thead>
<tr>
<th>Coast</th>
<th>States</th>
<th>Coastal Length (Km)</th>
<th>Number of sites surveyed and examined *</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>Gujarat</td>
<td>1610</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Maharashtra</td>
<td>720</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Goa</td>
<td>120</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Karnataka</td>
<td>280</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Kerala</td>
<td>590</td>
<td>75</td>
</tr>
<tr>
<td>East</td>
<td>West Bengal</td>
<td>210</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Orissa</td>
<td>480</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Andhra Pradesh</td>
<td>1014</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Tamil Nadu &amp; Pondicherry</td>
<td>950</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5974</strong></td>
<td><strong>350</strong></td>
</tr>
</tbody>
</table>

* within 5 km on the landward side
Scoring system for identification of ICMBA

- Collected information from 350 sites were used to prepare a Data Matrix against 26 indicators spread over 6 criterion

- Binary coding method was followed to score sites against each indicator

- The candidate site must fit to at least 1 indicator for each criterion and should score the minimum of 13
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicators</th>
<th>Threshold</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal ecosystem resilience</td>
<td>Total area (km²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;5 sq.km</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-10</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10-15</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;15</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Ecosystem continuity to the nearest ICBA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continuous</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Separate patches</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Habitat diversity (mangrove, mud flat, coral, seagrass, sand beach etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 to 2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 to 4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Adequacy of the site to maintain ecosystem level process</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adequate</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Needs addition</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Whether a prominent wildlife corridor (connected by forest, water etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Life Support Systems</td>
<td>Significant</td>
<td>Marginal</td>
<td>Not at all</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-------------</td>
<td>----------</td>
<td>------------</td>
</tr>
<tr>
<td>Freshwater discharge</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Coastal erosion control</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Carbon sequestration value</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Natural protection against disaster</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Unique Biodiversity (fauna and flora)</td>
<td>Number of Globally threatened species</td>
<td>Number of Regionally threatened Species (IWPA 1972)</td>
<td>Number of restricted range species</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------------------------------------</td>
<td>---------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td>&lt;2</td>
<td>&lt;5</td>
<td>&lt;2</td>
</tr>
<tr>
<td></td>
<td>3 to 5</td>
<td>6 to 10</td>
<td>3 to 5</td>
</tr>
<tr>
<td></td>
<td>6 to 8</td>
<td>11 to 15</td>
<td>6 to 8</td>
</tr>
<tr>
<td></td>
<td>&gt;9</td>
<td>&gt;16</td>
<td>&gt;9</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- Number of Globally threatened species: categories are <2, 3 to 5, 6 to 8, >9.
- Number of Regionally threatened Species (IWPA 1972): categories are <5, 6 to 10, 11 to 15, >16.
- Number of restricted range species: categories are <2, 3 to 5, 6 to 8, >9.
- Number of flagship species: categories are <2, 3 to 5, 6 to 8, >9.
- Number of endemic species: categories are <2, 3 to 5, 6 to 8, >9.
- Nursery and Breeding site provisions for species of conservation significance: categories are 3 to 5, 6 to 8, >9.
- Congregation area for species of conservation significance: categories are 3 to 5, 6 to 8, >9.
- Congregation area for migrant species: categories are Yes, No.
Conservation Priority Index (CPI)

- The total score of a site was divided by total number of indicators to obtain score ratio (= CPI of site)

- A Candidate site was selected as ICMBIA if its CPI is $\geq 0.5$
## Identified ICMBAs sites in India

<table>
<thead>
<tr>
<th>Coast</th>
<th>States</th>
<th>Identified ICMBAs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>Gujarat</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maharashtra</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Goa</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Karnataka</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerala</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>62</td>
</tr>
<tr>
<td>East</td>
<td>West Bengal</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orissa</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Andhra Pradesh</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tamil Nadu &amp; Pondicherry</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>106</strong> *</td>
<td></td>
</tr>
</tbody>
</table>

* An ATLAS of 106 ICMBA site prepared
Further prioritization among ICMBAs for immediate attention

Prioritization based on

- Additional biodiversity values of candidate site’s surrounding landscape matrix
- Habitat vulnerability to range of threat
- Land tenure system
## Prioritized ICMBA sites

<table>
<thead>
<tr>
<th>Coast</th>
<th>States</th>
<th>Prioritized ICMBAs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>Gujarat</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maharashtra</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Goa</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Karnataka</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerala</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>East</td>
<td>West Bengal</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Orissa</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Andhra Pradesh</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tamil Nadu &amp; Pondicherry</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>22</strong></td>
<td>*</td>
</tr>
</tbody>
</table>

* Fact Sheets in ICMBA Atlas were coloured in Red
Prioritized ICMBA sites in India

- Chandipur
- Chilka
- Rushikulya
- Naupada
- Bantumilli
- Machilipatnam
- Kaliveli
- Pichavaram
- Palk Bay
- Madhavpur
- Alia Bet
- Purna
- Thane
- Purnagad
- Achra-Malvan
- Kali
- Netrani
- Kundapur
- Kolavipalem
- Vypin-Fort Kochi
- Kumarakom
- Kumbalangi
# Example

## ICMBAs in one of Indian state of Gujarat & Diu - Daman

<table>
<thead>
<tr>
<th>Listed ICMBAs</th>
<th>Prescribed conservation strategy</th>
<th>Designate as</th>
<th>Management agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koteswar</td>
<td>Conservation Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Sangi - Jacau</td>
<td>Community Reserve</td>
<td>GUIDE + SFD</td>
<td></td>
</tr>
<tr>
<td>Lethadi</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Porbandar</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td><strong>Madhavpur</strong></td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Diu</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Katpar - Gopnath</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Navbandar</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Sabarmati</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Wadgham</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td><strong>Alia bet</strong></td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Narmada</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td><strong>Purna</strong></td>
<td>Conservation Reserve</td>
<td></td>
<td>GEER + SFD</td>
</tr>
<tr>
<td>Daman ganga</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
<tr>
<td>Umergaon</td>
<td>Community Reserve</td>
<td></td>
<td>Local Admin. + SFD</td>
</tr>
</tbody>
</table>
Prioritized ICMBAs in Gujarat & Diu - Daman

<table>
<thead>
<tr>
<th>Prioritized ICMBAs</th>
<th>Site significance</th>
<th>Additional values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madhavpur</td>
<td>TNS</td>
<td>Fisheries, sand dune</td>
</tr>
<tr>
<td>Alia bet</td>
<td>Mudflat</td>
<td>Birds, Fisheries</td>
</tr>
<tr>
<td>Purna</td>
<td>Estuary</td>
<td>Mangroves, birds, fisheries</td>
</tr>
</tbody>
</table>

- Candidate sites scores CPI value $\geq 0.8$
Identified ICMBAs in Gujarat & Diu - Daman

Prioritized sites:
- Koteswar
- Sangi
- Lethadi
- Porbandar
- Madhavpur
- Diu
- Alia Bet
- Wadgham
- Sabarmati
- Narmada
- Purna
- Umergaon
- Damanganga
- Kotpar

Mangroves in Purna

Mudflat in Alia Bet

Turtle hatchery in Madhavpur

Prioritized sites
Identified ICMBAs in the state of Tamil Nadu & Pondicherry

- Kaliveli
- Ariyankuppam
- Vetaikaranirupu
- Pichavaram
- Muthupet
- Palk Bay
- Manakudy

Prioritized sites:
- Kaliveli wetland
- Mangroves in Pichavaram
- Palk Bay

Prioritized sites marked in red on the map.
Features in ICMBIA Atlas of India

Fact Sheets

- Site location map with geo-coordinates
- Access route and area
- Habitat description
- Biodiversity values
- Socio-economic importance
- Conservation status
- Threat
- Site significance/justification
- Site score (criterion and indicator)
Thank You