Marine Ecological Capital Assessment:
Theories & Application in China Seas

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1. What is Marine Ecological Capital (MEC)?

- **Capital:** natural capital, man-made capital, human capital and social capital.
- Marine ecological resources are the important component of natural capital.
- **MEC** is defined as marine ecological resources which have direct or indirect contributions to humans’ social and economic production and provide benefits for humans.
2. MEC value: constituent elements & assessment index

- MEC value: the monetized benefits for humans from marine ecological capital, including standing stock value of marine ecological resources and marine ecosystem service value.

- Marine ecological resources (MER): marine living resources and their habitats (i.e. seawater, surface seabed), as well as the marine ecosystem that they act as a whole.
Marine Ecological Capital Value

Value of Ecosystem Services

Existing value of MER

Existing value of habitat resources

Standing stock value of living resources

Fishing production

Mariculture production

Oxygen production

Climate regulation

Waste treatment

Recreational service

Scientific service

Species maintaining service

Ecosystem diversity maintaining

Seawater

Surface seabed

Fish, Shellfish, Crustaceans, Cephalopods, Macro-algae etc.
3. Assessment methods
   national directives

1. How to decide:
   element of MEC value

2. How to select:
   assessment index, calculating equations

3. How to get raw data

4. How to calculate each element
   and total value

5. How to draft assessment report
3. Assessment methods:

Arc GIS + MEGA-MES V1.0
4. Application

• National-scale: 100 000 km$^2$
• Provincial-scale: 10 000 km$^2$
• County-scale: 100 km$^2$
### National assessment (2005-2011)

<table>
<thead>
<tr>
<th></th>
<th>Assessed area (km²)</th>
<th>Total value (Billion CNY/year)</th>
<th>Average value (mil. CNY/(km².year))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bohai Sea</td>
<td>34 359</td>
<td>215.2</td>
<td>6.26</td>
</tr>
<tr>
<td>Yellow Sea</td>
<td>43 541</td>
<td>328.8</td>
<td>7.55</td>
</tr>
<tr>
<td>ECS</td>
<td>56 719</td>
<td>1 911.4</td>
<td>3.37</td>
</tr>
<tr>
<td>SCS</td>
<td>58 498</td>
<td>2 986.6</td>
<td>5.10</td>
</tr>
<tr>
<td>Total</td>
<td>193 119</td>
<td>1 034.1</td>
<td>5.57</td>
</tr>
</tbody>
</table>

China’s coastal ecosystem provided 1,034 billion CNY of ecosystem services in 2008, which supported 1,740 billion CNY of marine industrial output.
High value zone

Bohai Sea

Yellow Sea
High value zone

Shenzhen-Huizhou

Qinzhou-Beihai

Lingao

South China Sea
Provincial Assessment:

Shandong coastal waters: 31,600 km$^2$, 2008 year
Spatial distribution of ecosystem service

Shandong Province

Million CNY/km².year

- From onshore to offshore, value decrease
- High value in maricultural and recreational area

Bohai Sea

Yellow Sea

Yantai
Ecosystem service: 3 kinds of utilization model

- **P-Model**: Provisioning-dominated
  - 5.73 billion CNY/year
  - 573,100.74 billion CNY

- **PC-Model**: Balance
  - 54.23 billion CNY/year
  - 5,422,792.29 billion CNY

- **C-Model**: Cultural service-dominated
  - 58.19 billion CNY/year
  - 5,819,089.29 billion CNY

- **Total**: 88.78 billion CNY/year
  - 8,847,908.28 billion CNY

Billion CNY/year
Shandong coastal waters:
Standing stock value of living resources: 19.41 billion CNY
Value of ecosystem services: 154.3 billion CNY

Each dollar of living resources support 8 dollars of service output!
County Assessment:

Dongshan bay: \( \sim 200 \text{ km}^2 \), 2008 year
County Assessment: Dongshan Bay

Assessed area: 248km^2

Density
- Maricultured area: 16.8mil
- Recreational area: 764.55mil
- MPA: 92.25mil
- Whole bay: 9.48mil

High value in maricultural and recreational regions

CNY/ha.year
Dongshan bay:
Standing stock value of living resources: 0.09 billion CNY
Value of ecosystem services: 8.57 billion CNY

Each dollar of living resources support 95 dollars of service output!
5. Summary

1. Value of ecosystem services shows decreasing trend from onshore to offshore

2. Maricultural and recreational activities make major contribution to ecosystem services value and control its spatial distribution pattern

3. The assessment methods we developed are approved to be valid to valuate ES.

4. As supporting tool for Payment for Ecosystem Service or Eco-Compensation policy.
Applications of MES theory

As one of principles to marine spatial zoning and marine development planning
  Setup ecological red line: no-reclamation, no-discharge,
  Setup Protected Area:
As assessment indicators of marine management effectiveness & blue economic policy
  Increases in both economic value and MES
As baseline of eco-compensati or payment for ecosystem service policy
  Baseline value-> damaged value->compensation amount
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