Marine ecological capital in China coastal waters: human and climate factors

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1. What is Marine Ecological Capital (MEC)?

- **Capital**: natural capital, man-made capital, human capital, and social 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.
- **MEC value**: the standing stock value of marine living resources and the flow value of marine ecosystem services.
Marine Ecosystem Services

Provisioning Services
1. Food production
2. Material production
3. Oxygen production
4. Provision of genetic resources

Regulating Services
5. Climate regulation
6. Waste treatment
7. Biological control
8. Disturbance regulation

Cultural Services
9. Recreational service
10. Cultural value
11. Scientific service

Supporting Services
12. Primary production
13. Nutrient cycling
14. Species diversity maintenance
2. Assessment methods

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

Technical Directives for Marine Ecological Capital Assessment
2. Assessment methods:

Arc GIS + MEGA-MES V1.0
3. Ecosystem services in China coastal waters

- National-scale: 100,000 km^2
- Provincial-scale: 10,000 km^2
National assessment (2005-2011)

<table>
<thead>
<tr>
<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>BS 34,359</td>
<td>215.2</td>
<td>6.26</td>
</tr>
<tr>
<td>YS 43,541</td>
<td>328.8</td>
<td>7.55</td>
</tr>
<tr>
<td>ECS 56,719</td>
<td>1,911</td>
<td>3.37</td>
</tr>
<tr>
<td>SCS 58,498</td>
<td>2,986</td>
<td>5.10</td>
</tr>
<tr>
<td>Total 193,119</td>
<td>1,034</td>
<td>5.57</td>
</tr>
</tbody>
</table>

- China’s seas provided 1,034 billion CNY of ecosystem services in 2008, which supported 1,740 billion CNY of marine industrial output.
- 1 Dollar of ecological service support 1.7 dollar of marine economic product.
High value zone

Bohai Sea

Yellow Sea
High value zone

Taizhou
台州

East China Sea

Fuzhou-Xiamen
福州-厦门
High value zone

South China Sea

Shenzhen-Huizhou

Qinzhou-Beihai

Lingao
Provincial Assessment:

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

Shandong Province

Million CNY/km².year

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

154.3 Bil CNY

- Bohai Sea
  - Value 5.48
  - Value 1.06

- Yellow Sea
  - Value 5.77
  - Value 6.01

11.30 Million CNY/km².year
Ecosystem service:
3 kinds of utilization model

- **P-Model**: Provisioning-dominated
- **C-Model**: Cultural service-dominated
- **PC-Model**: Balance

- P-Model deeply depends on marine living resources
- C-Model highly depends on marine environmental quality
4. Human and climate factors affecting ecosystem services
Directly use 7 services

Marine Ecosystem Services

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2. Material production
3. Oxygen production
4. Provision of genetic resources

Regulating Services
5. Climate regulation
6. Waste treatment
7. Biological control
8. Disturbance regulation

Cultural Services
9. Recreational service
10. Cultural usage
11. Scientific service

Supporting Services
12. Primary production
13. Nutrient cycling
14. Species diversity maintenance

The provisioning & cultural services are highly dependent on human's use manners
Indirectly use 7 services

Marine Ecosystem Services

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Supporting Services
12. Primary production
13. Nutrient cycling
14. Species diversity maintenance

The regulating & supporting services are less dependent on human's use manners.
1. Food production
2. Material production
3. Oxygen production
4. Provision of genetic resources

5. Climate regulation
6. Waste treatment
7. Biological control
8. Disturbance regulation

9. Recreational service
10. Cultural value
11. Scientific service

12. Primary production
13. Nutrient cycling
14. Species diversity maintenance

The provisioning and regulating services are more sensitive to climate change in sea.
5. Take-home messages

- Average value of ecosystem services in China coastal waters: 0.9 million USD/km².yr.
- Value of ecosystem services shows decreasing trend from onshore to offshore
- Provisioning and cultural services are more dependent on human's use manners than the regulating and supporting services
- Provisioning and regulating services are more sensitive to climate change in sea than the cultural and supporting services
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