Efforts and case studies in the research and monitoring of impacts of ocean acidification on coral reef ecosystems

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Outline

1. pH change of Xisha Islands in 2005-2009
2. Ecological status of Xisha coral reef ecosystem
3. Related programs of OA in NMEMC
4. Impact of OA on some sensitive organisms
In 2004-2005, 18 typical ecoregions were selected as Ecological Monitoring and Control Zones. Monitoring and evaluation have been conducted in Coastal Ecological Monitoring and Control Zones continuously since then.
• Ship-based time series stations monitoring and observation have allowed us to understand status and change trend of ecological health of typical marine ecosystems in response to anthropogenic activities and climate change.
Climate Change- Ocean Acidification

- The atmospheric partial pressure of CO$_2$ will almost certainly be double that of pre-industria levels by 2100 and will be higher than at any time during the past few millions years.

The correlation between rising levels of CO$_2$ in the atmosphere with rising CO$_2$ level in the ocean.

As more CO$_2$ accumulates in the ocean, the pH of ocean decreases.
pH change in Xisha Islands

According to the monitoring results of Xisha Islands monitoring and control zone in 2005-2009, the acidity of seawater is relatively low.

pH of bottom water (5-10 m) in 2005-2009
### Analysis of bottom pH at monitoring stations

<table>
<thead>
<tr>
<th>pH</th>
<th>8 &lt; pH</th>
<th>8 &lt; pH &lt; 8.1</th>
<th>8.1 &lt; pH &lt; 8.2</th>
<th>pH &gt; 8.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stations</td>
<td>19</td>
<td>29</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Proportion</td>
<td>25.68%</td>
<td>39.19%</td>
<td>14.86%</td>
<td>20.27%</td>
</tr>
</tbody>
</table>

**Total proportion of stations:** 64.87%
Analysis of surface pH at monitoring stations
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Monitoring indicators of coral reef ecosystem

• **Environmental quality of seawater**
  
  nutrients (inorganic nitrogen and active phosphate), pH, temperature, dissolved oxygen, etc.

• **Community structure**
  
  number of species, coverage, disease, recruitment, density of coral reef fish, etc.

• **Habitat condition**
  
  coverage of macroalgae (seaweed)
Staghorn Coral bleaching in Xisha Islands
Coral coverage of Xisha Island

- Live Coral
- Dead Coral

<table>
<thead>
<tr>
<th>Year</th>
<th>Live Coral</th>
<th>Dead Coral</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>2006</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
<tr>
<td>2007</td>
<td>30.0%</td>
<td>45.0%</td>
</tr>
<tr>
<td>2008</td>
<td>45.0%</td>
<td>60.0%</td>
</tr>
<tr>
<td>2009</td>
<td>60.0%</td>
<td>75.0%</td>
</tr>
</tbody>
</table>
Coral recruitment (ind./m²)
Density of coral reef fish in Xisha Islands

(ind. /100 m²)
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Monitoring

- Coastal Ecological Monitoring and Control Zones
- Sensitivity assessment of marine ecoregion to climate change
Research

• *Emiliania huxleyi* used as proxy in monitoring ocean acidification: based on physiologic and morphologic character

• The effect of ocean acidification on sensitive marine organism

• Assessment of CO$_2$ sequestration capacity of seabed in China and pre-study of risk control technology
Assessment of CO\(_2\) sequestration capacity of seabed in China and pre-study of risk control technology

✓ Focus on the potential capacity of geological storage of CO\(_2\) in the Bohai Sea and South China Sea especially.

✓ Assessment of the ecological sensitivity/vulnerability to CO\(_2\) seabed sequestration
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• Some organisms with structures that made of calcium carbonate would be the first ones to feel the effects. Calcified algae, Oyster,

• The whole ocean food chain could be affected. from plant to herbivore or from herbivore to carnivore.
physiological impacts - *Corallina pilulifera*
Impacts of CO$_2$ vent on marine ecosystems

In the Mediterranean Sea effects of releasing CO$_2$ on marine life. The results show a bleak future for marine life as ocean acidity rises, and suggest that similar lowering of ocean pH may have been responsible for massive extinctions in the past.

A unique natural laboratory
Pacific island is natural laboratory to study ocean acidification
Global research efforts are urgently needed.

We need cooperate to investigate the combined impacts of OA and climate change.
Thank you for your attention and support!