National Report: Progresses of the monitoring of ocean acidification in Thailand

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Breakout Session 1 (20 Jan 2015) Review

There is significant existing capacity for carbonate chemistry analysis in the region. Many groups are already measuring the standard parameters adopted by other OA observing programs (GOA-ON and NOAA): T, S, O$_2$, DIC, TA.

Some modifications in methods will be necessary to measure OA, e.g., replace pH electrode methods with the standard spectrophotometric pH method. Some labs will be able to make modifications with access to published Guide to Best Practices for Ocean CO$_2$ Measurements. WESTPAC can help plan training session(s) for some labs to gain experience with pH and other methods.

There are some labs that may be able to serve as “centers of excellence” for carbon measurements and process samples from other groups that do not have access to a full carbon analytical laboratory.

**ACTION ITEM:** Before next WESTPAC OA workshop, consult resources section below and make steps towards implementing standard operating procedures. Report back at next workshop on successes/challenges and participate in training.

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The Results from the first training workshop in January 2015: (Carbonate Chemistry of Seawater)
The Results from the first training workshop in January 2015: (Carbonate Chemistry of Seawater)
Monitoring of Sea Surface Temperature in the Andaman Sea, Thai’s Waters

- Similan, Every 6 months
- Maiton, Every 1 month
- Ravee, Every 6 months
- Racha, Every 3 months
### Research and Monitoring of Carbonate Chemistry in Seawater of Andaman Sea, Thai’s Waters

**Sampling Sites**

<table>
<thead>
<tr>
<th>Sampling Sites</th>
<th>Max-Min</th>
<th>pH</th>
<th>TA (umol/l)</th>
<th>pCO₂ (uatm)</th>
<th>HCO₃⁻ (umol/kgSW)</th>
<th>CO₂ (umol/kgSW)</th>
<th>Ω₀₂Ar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maiton Is.</td>
<td>Max</td>
<td>8.05</td>
<td>2205</td>
<td>561</td>
<td>1773</td>
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<tr>
<td></td>
<td>Min</td>
<td>7.97</td>
<td>2080</td>
<td>449</td>
<td>1625</td>
<td>165</td>
<td>2.72</td>
</tr>
<tr>
<td></td>
<td>Ave.</td>
<td>8.01</td>
<td>2132</td>
<td>498</td>
<td>1696</td>
<td>176</td>
<td>2.92</td>
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<tr>
<td>Patong Bay</td>
<td>Max</td>
<td>8.09</td>
<td>2228</td>
<td>639</td>
<td>1831</td>
<td>16</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td>Min</td>
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<td>1995</td>
<td>387</td>
<td>1566</td>
<td>10</td>
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<tr>
<td></td>
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<td>476</td>
<td>1693</td>
<td>12</td>
<td>3.02</td>
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<tr>
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<td>2218</td>
<td>810</td>
<td>1857</td>
<td>20</td>
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<tr>
<td></td>
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<td>2005</td>
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<td>2133</td>
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<tr>
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<td>Avrg. Profiles of Line Transact</td>
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<td>1247</td>
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<td>2052</td>
<td>362</td>
<td>1601</td>
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<td>Ave.</td>
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<td>2169</td>
<td>503</td>
<td>1725</td>
<td>13</td>
<td>2.94</td>
</tr>
</tbody>
</table>

**Sampling Dates:** October 2015 to June 2016

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**Map:**

- Maiton Is.
- Patong Bay
- Nai-yang Beach
- Hae Is.
- Racha Is.

**Oct 2015 to June 2016**
Research and Monitoring of Carbonate Chemistry of Seawater in the Andaman Sea, Thai’s Waters

October 2015 and June 2016

Coral Reefs

<table>
<thead>
<tr>
<th>pH</th>
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<tbody>
<tr>
<td>$\Omega_{\text{arag}}$</td>
<td>3.05 (2.87-3.79)</td>
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</table>

Profiles

<table>
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<tr>
<th>pH</th>
<th>8.010 (7.89-8.02)</th>
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</thead>
<tbody>
<tr>
<td>$\Omega_{\text{arag}}$</td>
<td>2.94 (1.28-3.54)</td>
</tr>
</tbody>
</table>

$\Omega_{\text{arag}}$ is about the border of marginal and unsuitable class

Habitat characterization for the tropical/subtropical and the temperate coral communities.

<table>
<thead>
<tr>
<th></th>
<th>Tropical/subtropical</th>
<th>Temperate</th>
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<tbody>
<tr>
<td></td>
<td>SST</td>
<td>$\Omega_{\text{arag}}$</td>
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<tr>
<td>Suitable</td>
<td>$18 \degree C &lt; \text{SST} &lt; 30 \degree C^\circ$</td>
<td>$\geq 3.5^e$</td>
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<tr>
<td>Marginal</td>
<td>Un-defined</td>
<td>$3 \leq \Omega_{\text{arag}} &lt; 3.5^e$</td>
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<tr>
<td>Unsuitable</td>
<td>$\geq 30 \degree C^\circ$</td>
<td>$\Omega_{\text{arag}} &lt; 3^e$</td>
</tr>
</tbody>
</table>

Sources: 1 Kleyzas et al. (1990), 2 Kleyzas et al. (1994), 3 Germain et al. (2003), 4 this study.
Pilot sites for the WESTPAC Ocean Acidification Monitoring

Sattahip, Chonburi Province
Gulf of Thailand

N12° 35’ 54” E100° 56’ 60”
N12° 35’ 12” E100° 57’ 10”
Pilot sites for the WESTPAC Ocean Acidification Monitoring
Pilot sites for the WESTPAC Ocean Acidification Monitoring

ARMs deployment and Carbonate Chemistry in seawater monitoring sites
Pilot sites for the WESTPAC Ocean Acidification Monitoring

East of Racha Island

Jan 2016

June 2016

West of Racha Island

June 2016
Pilot sites for the WESTPAC Ocean Acidification Monitoring

East of Racha Island

January 2016

West of Racha Island

June 2016
The Results from the first training workshop in January 2015: (Biological part)

Breakout Session 2 (21 Jan 2015) Goals

1) Devise draft outline for carbonate monitoring in the region’s OA network, including proposed temporal and spatial design. One option would be to adopt and modify a plan similar to NOAA’s coral monitoring plan (NCRMP, see Table 4). Class 0 represents water sampling conducted at a subset of random stratified sites; Classes 1, 2, and 3 represent fixed sites exhibiting an increasingly comprehensive suite of observations at increasingly fewer locations. Identify gaps (in addition to analytical training) to implementation.

2) Report out to biological break out group. Meet together with biological group to map out potential OA monitoring sites as a start to the region’s OA network.

ACTION ITEM: Before next WESTPAC OA workshop, share and discuss draft plan with other colleagues interested in OA. Report back at next workshop on comments received.
The implement of the monitoring biodiversity on the reef:
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Prokaryotic diversity in site E and site W

Kingdom level

Phylum level

Prokaryotic phyla based on 16S rRNA gene sequence
The implement of the monitoring biodiversity on the reef:

Prokaryotic diversity between site E and site W

E site

- Proteobacteria: 40%
- Cyanobacteria: 31%
- Bacteroidetes: 11%
- Actinobacteria: 8%
- SAR406: 1%
- Unclassified: 7%

W site

- Proteobacteria: 34%
- Cyanobacteria: 50%
- Bacteroidetes: 5%
- Verrucomicrobia: 3%
- SAR406: 0%
- Unclassified: 7%
- Actinobacteria: 3%