Elements of successful integrated assessment

Based on the collective experience of the Integration and Application Network (past and present forms)

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Science Communication Course
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Overview

- Integrated assessment approach
- Temporal and spatial assessment
- Annual forecast-assessment cycle
- Ecosystem health report cards
Use a staged approach

- **Freshwater and Watersheds**
  - Sources of Sediment and Nutrients
  - Urban Stormwater; Erosion Processes

- **Whole-of-catchment**
  - Sustainable Loads and Targets (*diffuse and point sources*)

- **Scoping**
  - Point Sources (STP’s)
  - Estuarine and Bay

- **Stage 3 (1999-2002)**
  - *Freshwater and Watersheds*
  - *Whole-of-catchment*

- **Stages 1/2 (1996-1999)**
  - Scoping
  - Point Sources (STP’s)
  - Estuarine and Bay

- **Partnership (2002 onwards)**

- • Breaks overall goal into manageable sized tasks
- • Learn from each stage - improve latter stages
- • Ensure some immediate progress (e.g. point sources)
Need well defined objectives

E.g.

– Assess management actions
– Provide effective evaluation and communication of results
– Regional and local scale

• Ensure assessment conducted for the agreed reasons
• All stakeholders have same expectations
• Keeps program focused
Aim for one program

- Many monitoring activities
- Many agencies/organizations
- Many funding sources

→ One monitoring program

- Easier to coordinate and manage
- Provide unified communication approach
- Improved public profile
Monitoring must meet management needs

- Enables adaptive management
- Often big $ spent on rehabilitation – is investment working?
Need *pressure*, *state* and *response* monitoring

- **Pressure** - factors that affect the health
- **State** - health of the system
- **Response** - effort taken to restore system

- Need for adaptive management approach
- Avoid confusion between effort and results
- Help communication
Use appropriate indicators

Good indicators:

– Are responsive
– Target management actions
– Integrate
– Cost effective
– Include major ecosystem components

…and use appropriate number of indicators
Assess data at range of temporal frequencies

- Events (e.g. floods)
  - Can be “learning moments”
  - Can lead to major shifts in system

Minor flood

Nutrient flushed to Bay

Phytoplankton Bloom
Assess data at range of temporal frequencies

- Intra-annual
  - Seasonality
  - Weather
  - Circannual rhythm
Assess data at range of temporal frequency

- Annual
  - Full seasonal cycle
  - Easy to relate to (report card)
  - Not too long / too short
Assess data at range of temporal frequency

- Long-term (decades)
  - Trends
Provide spatial assessment

- Maps – familiar to most people
- Easy to interpret and understand
- Visually appealing (compared to graphs, tables etc)
- Good geographic presentation of data can illustrate:
  - Source of pollutant / hot spots of impact
  - Patterns and processes
  - Degree of compliance to criteria
Annual health assessment

Summary: 2005 Bay Health Assessment

Water quality indicators

Water quality index
Remote sensing a useful tool

Hurricane Ivan

Water clarity

MODIS

(source: NASA MODIS/Terra)
Hurricane Ivan

+3 days
(20 September 2004)

+5 days
(22 September 2004)

+78 days
(29 November 2004)

(source: NASA MODIS/Terra)
Integrating remote sensing

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Example</th>
<th>Accuracy requirement</th>
<th>Effort to integrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rapid visual</td>
<td>Chl-a (yesterday)</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>• Detecting events</td>
<td>Floods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• State of the Bay reporting</td>
<td>Report cards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Legislation /license assessment</td>
<td>Criteria assessment</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>
# Integrating spatial data sets

<table>
<thead>
<tr>
<th>Source</th>
<th>Integration framework</th>
<th>Management tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote sensing</td>
<td>- Statistical Modelling</td>
<td>• Reduced Uncertainty compliance assessment</td>
</tr>
<tr>
<td>Fixed site monitoring</td>
<td>- Bayesian framework</td>
<td>• Increased power of Spatio-temporal trend analysis</td>
</tr>
<tr>
<td>Underway monitoring</td>
<td>- Interpolator software</td>
<td></td>
</tr>
<tr>
<td>Continuous Monitoring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Annual forecast-assessment cycle

- Continual assessment, forecasting and reporting
- Defined target audience (interested public)
- Based on defendable science
Annual forecast-assessment cycle

Dissolved oxygen

Forecast → Annual assessment → Tracking → Look-back
Report card an essential element of annual assessment and forecast cycle

- Grades all waterways from ‘A’ (Excellent) to ‘F’ (Fail)
- Very high-profile
  Media Interest → Public Awareness → Political Interest → Action
- Directs / focuses management action (where the problems are)
- Impetus for some costly (but environmentally important) intervention
  → Report Card needs to be robust and defendable
The Ecosystem Health Index (EHI)

- Aggregate and compare a diverse range of ecosystem health parameters
- Link monitoring program outcomes directly to management objectives

1 year of monthly monitoring data

Median values calculated and spatial prediction between sites

Compliance area calculated for each river or region of Moreton Bay

Average

Process repeated for each indicator
Ecosystem Health Report Card

- Waterway / region of bay
  - A
  - B
  - C
  - D
  - F

~ Proportion of the waterway’s area that complies with the established objectives
Regional overviews

- Comparison between waterways
- Prioritization of action

Nutrient Concentration (mg/L)

- **Total Nitrogen (mg/L)**
- **Total Phosphorus (mg/L)**
- STP discharge into system

Bremer
Brisbane
Albert
Logan
Pimpama
Caboolture
Pine
Noosa
Maroochy
Nerang
Mooloolah
Currumbin
Coomera
Tallebudgera
Pumicestone
Coombabah
Bramble Bay
Deception
Broadwater
Southern
Waterloo Bay
Central Bay
Eastern Bay
Eastern

0.0 1.0 2.0 3.0
Local waterway synthesis

All data for one waterway analyzed, synthesized and presented

### Southern Moreton Bay

Southern Moreton Bay is an estuarine ecosystem with significant ecological and economic value. The bay is located in southeast Queensland, Australia, and is the largest natural sheltered coastal lagoon in Australia. It is known for its diverse flora and fauna, including numerous species of birds, fish, and other marine life.

#### Estuarine & Marine Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>North of Logan River</th>
<th>Main Channel</th>
<th>Sources &amp; Sediments</th>
<th>Climate &amp; Water Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>10°C</td>
<td>15°C</td>
<td>20°C</td>
<td>25°C</td>
</tr>
<tr>
<td>Salinity</td>
<td>30 ppt</td>
<td>32 ppt</td>
<td>34 ppt</td>
<td>36 ppt</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>8 mg/L</td>
<td>9 mg/L</td>
<td>10 mg/L</td>
<td>11 mg/L</td>
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<tr>
<td>pH</td>
<td>8.5</td>
<td>8.6</td>
<td>8.7</td>
<td>8.8</td>
</tr>
</tbody>
</table>

#### Biological Indicators

The Southern Moreton Bay ecosystem is home to a diverse range of marine life, including fish, crustaceans, and shellfish. The bay is also a breeding ground for many species of birds, such as seagulls and pelicans. The ecosystem is supported by a complex network of waterways and lagoons, which provide a habitat for a wide variety of plant and animal species.

#### Physical Features

- **Area**: Approximately 250 square kilometers
- **Water Volume**: 100 billion cubic meters
- **Average Depth**: 4 meters
- **Average Tide Range**: 2 meters

Southern Moreton Bay is an integral part of the broader Moreton Bay system, which encompasses several other major waterways, including the Logan River and the Albert River. The interplay between these waterways and the bay itself forms a complex network of interconnected ecosystems, each with its own unique characteristics and ecological challenges.

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**Integration and Application**

- **Integration**: The Southern Moreton Bay ecosystem is integrated into the broader Moreton Bay system, which includes several other major waterways.
- **Application**: Management strategies for the Southern Moreton Bay ecosystem need to consider the influence of the larger waterways and their impact on water quality and ecosystem health.

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**Network**

- **Network**: The Southern Moreton Bay ecosystem is part of a larger network of interconnected waterways and ecosystems, each with its own unique characteristics and ecological challenges.
- **Connections**: The Southern Moreton Bay ecosystem is connected to the Logan River and the Albert River, as well as several other major waterways in the Moreton Bay system.