Conserving aquatic systems

Soggy issues

Why aquatic systems?
- Humans are terrestrial
- Depths are hidden from easy view
- Gravity

Major issues in aquatic conservation
- Habitat alteration
- Invasive species
- Overharvesting
- Eutrophication
- Other pollutants

Adventure Falls, Surfside Beach

Trawling

Mobility matters in Gulf of Alaska

Habitat alteration
- Degradation of benthic habitats due to dredging and trawling
- Shoreline development and riparian zone alteration
- Dams

Bottom trawling scrapes

Shoreline alteration

Table 1. Mean density of sessile & motile species at 6 and 8 reference transects in the eastern Gulf of Alaska, with individual probability levels (p for Wilcoxon signed-rank test. Asterisks denote significance at p ≤ 0.05 level, after Bonferroni correction for multiple tests using the method of Hochberg (1986). Density values indicate only undamaged organisms.

<table>
<thead>
<tr>
<th>Group</th>
<th>Transect</th>
<th>Reference</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sessile organisms</td>
<td>0.94</td>
<td>1.15</td>
<td>0.0125</td>
</tr>
<tr>
<td>Anthozoans</td>
<td>3.7</td>
<td>3.2</td>
<td>0.0010</td>
</tr>
<tr>
<td>Muscle polyps</td>
<td>0.1</td>
<td>0.1</td>
<td>0.0010</td>
</tr>
<tr>
<td>Sessile organisms</td>
<td>0.94</td>
<td>1.15</td>
<td>0.0125</td>
</tr>
<tr>
<td>Asteroidea and ophiocomida</td>
<td>17.1</td>
<td>20.9</td>
<td>0.7472</td>
</tr>
<tr>
<td>Holothurians</td>
<td>3.2</td>
<td>3.6</td>
<td>0.3672</td>
</tr>
<tr>
<td>Annelids</td>
<td>3.4</td>
<td>3.3</td>
<td>0.0981</td>
</tr>
<tr>
<td>Mollusks</td>
<td>0.6</td>
<td>0.6</td>
<td>0.0047</td>
</tr>
<tr>
<td>Echinodermes</td>
<td>9.6</td>
<td>10.7</td>
<td>0.0091</td>
</tr>
</tbody>
</table>

Freese et al. (1999)

Adventure Falls, Surfside Beach

Table 5. Percent cover of macroalgae at 6 transects in the eastern Gulf of Alaska, with individual probability levels (p for Wilcoxon signed-rank test. Asterisks denote significance at p ≤ 0.05 level, after Bonferroni correction for multiple tests using the method of Hochberg (1986). Density values indicate only undamaged organisms.

<table>
<thead>
<tr>
<th>Transect</th>
<th>Reference</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrothyrion</td>
<td>0.84</td>
<td>0.81</td>
</tr>
<tr>
<td>Hydrothyrion</td>
<td>0.84</td>
<td>0.81</td>
</tr>
<tr>
<td>Hydrothyrion</td>
<td>0.84</td>
<td>0.81</td>
</tr>
<tr>
<td>Hydrothyrion</td>
<td>0.84</td>
<td>0.81</td>
</tr>
<tr>
<td>Hydrothyrion</td>
<td>0.84</td>
<td>0.81</td>
</tr>
<tr>
<td>Hydrothyrion</td>
<td>0.84</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Walters et al. (2010)
**Riparian zone degradation**
- Nutrient filtration
- Source of OM
- Moderates thermal regimen

**Dams**
- Breaking upstream-downstream linkages

**Dam-Nation?**
- Only 42 free-flowing streams >200 km long remaining in lower 48

**Major issues in aquatic conservation**
- Habitat alteration
- Invasive species
- Overharvesting
- Eutrophication
- Other pollutants

**Invasive species**
- Phragmites australis
- Lionfish

**Destruction to the rescue?**
- Only 2% of US river miles of high enough quality to be protected federally

**Shoreline Development Drives Invasion of Phragmites australis and the Loss of Plant Diversity on New England Salt Marshes**

**Data source: American Rivers**

**Boom + 1 year**

**Boom + 1 year**
Invader insight from Moyle & Marchetti (2006)

- No one set of characteristics always predict “success” of invaders, but 5 significant factors for CA fishes are:
  - Successful invasion elsewhere
  - Invading a habitat similar to native one
  - Invading species-rich areas
  - >100 individuals introduced repeatedly
  - Species-specific characteristics that aid success at multiple steps required for successful invasion

Multiple steps to invasion

Factors important in predicting California fish invasions

1. Transport
2. Survival
3. Establishment
4. Spread
5. Integration

Source pool (native area) —> Transport —> Survival —> Establishment —> Spread —> Integration

Moyle & Marchetti (2006)

Figure 2: Diagrammatic view of the invasion process (not drawn to scale).

Major issues in aquatic conservation

- Habitat alteration
- Invasive species
- Harvesting
- Eutrophication
- Other pollutants

Adventure Falls, Surfside Beach

Harvesting

- Over-harvesting
- By-catch

Over-harvesting of ocean fishes

166 stocks worldwide

Decline of 22% since 1959

Uses all available data
Worm et al. (2009)
“one-third for the birds”

Bycatch

- 39 of 49 commercial fisheries along East Coast had bycatch (Zollett, 2009)

Major issues in aquatic conservation

- Habitat alteration
- Invasive species
- Overharvesting
- Eutrophication
- Other pollutants

Eutrophication

- HABs, too

Dead zones on the rise

- Exponential spread since the 1960s
- Covers > 245,000 km²

Major issues in aquatic conservation

- Habitat alteration
- Invasive species
- Overharvesting
- Eutrophication
- Other pollutants

Adventure Falls, Surfside Beach

HABs, too
Some other pollutants

- Sedimentation
- Pesticides
- Endocrine disruptors

Tributary to the Chattahoochee River, GA

Endocrine disruptors (1)

We in the business community prefer — a cautious ‘wait-and-see’ approach over needless media scare-mongering...

Endocrine disruptors (2)

- Ecoestrogens mimic estrogen
- Many compounds, e.g., DDT
- Can be bioconcentrated and passed to offspring

Whole-lake experimental effects

Kidd et al. (2007)

Locally?

Widespread occurrence of intersex in black basses (Micropterus spp.) from U.S. rivers, 1995–2004

Jo Ellen Hinkin1, Vicki S. Blazer3, Christopher J. Schmitt2, Diana M. Papoulias3, Donald E. Tillett4

Pesticides

Stone et al. (2014)

http://spo.nos.noaa.gov/projects/agchemuse/pesticide_use_map.gif
Some tools

- Marine sanctuaries
- Wild and Scenic Rivers
- Index of Biotic Integrity (IBI)

MPA extent

Lubchenco & Grorud-Colvert (2015)

Can they work?

Fig. 4. Recovery of diversity and ecosystem services in marine protected areas and fisheries closures. Shown are the response ratios (before versus outside the reserve or before and after protection ±95% CI of 100 species diversity and 10 ecosystem services that correspond to fisheries productivity, ecosystem stability, and tourism revenue, respectively. Positive values indicate increase in the reserve relative to the control; error bars not intersecting zero indicate statistical significance P < 0.05. Solid circles represent unweighted averages; open circles are weighted by sample size (see supporting online methods for details). The number of studies is shown in parentheses. CRW, catch per unit of effort.

What does an MPA need?

- No take
- Law enforcement
- >10-years old
- > 100 km²
- Isolated
IBI vs. Impervious for Fairfax Co, VA

Figure 9  Trend line indicating that Biological integrity, as measured by an Index of Biotic Integrity (IBI) for benthic macroinvertebrates, generally decreases with increasing percent imperviousness. Appendix B includes information on the statistical significance of the data presented.

Fairfax County Stream Protection Strategy: Baseline Study (2001)