Communicating science effectively to engage decision-makers

Bill Dennison

18 November 2010
Laternoll Conservation Symposium
Ontario, Canada
I am not the first William Dennison to come to Toronto

William Dennison (Toronto Mayor; 1966-1972)

William Dennison (Laternoll speaker; 2010)
Objectives

- **Provide** some overarching science communication principles
- **Introduce** you to science communication resources
- **Illustrate** effective science communication using report cards
- **Inspire** you to enhance your science communication skills
What is science communication?

Successful dissemination of knowledge to a wide range of audiences (science and non-science)

### Scientific writing
- Providing scientific context (references)
- Text > graphics
- Authorship exclusive
- Focus on results & interpretation

### Science communication
- Providing societal context (examples)
- Text ≈ graphics
- Authorship inclusive
- Focus on conclusions & recommendations
Principles of good science communication

- Provide synthesis, visualization & context
- Respect your audience
  - Relate to audience
  - Simplify terms but not content
  - Prepare for & invite ?s
- Don’t be a geek
  - Lose the jargon, dude
  - Define all terms
  - Minimize AU (acronym use)
- Make it look good
  - Assemble self-contained visual elements
  - Consistent style and format
  - Use color, but use it judiciously

Adapted from Thomas et al. 2006
You can teach anything to anybody as long as you provide . . .

Synthesis

Synthesized data

Visualization

Illustrate key points

Context

So what?
Science communication requires...

• **Enthusiasm** counts: get excited

• **Quality time** needed: schedule it

• **Feedback & revision** essential: seek it out
Good science communication uses visuals

- **Conceptual diagrams:** context and synthesis

- **Maps:** geographic context and information-rich

- **Photos:** describe methods, study site description, processes and relevance

- **Tables and figures:** scientific data without ‘chart junk’
Web: Conceptual diagram creator

Book: Integrating and Applying Science

- Management
- Engaging the community
- Building community knowledge
- Analyzing environmental data
- Obtaining environmental data

Integration & Application
Network
Good science communication can make a difference

- Cholera outbreak in London
- John Snow mapped cholera cases
- Cholera cases linked to pump locations
- Pump handle removed; cholera subsided
Communicating science can lead to social change

1500-1550

1550-1600

1600-1650

1650-1700

1700-1750

Copernicus

Galileo

Kepler

Newton

Linnaeus

Astronomy

Physics

Astronomy

Physics

Biology

1750-1800

1800-1850

1850-1900

1900-1950

1950-2000

Lavoisier

Lyell

Darwin

Einstein

Watson & Crick

Chemistry

Geology

Evolution

Physics

Biology

Greeks

Sustainability

2000-2050
Environmental report cards are an effective science communication tool

- **Peer pressure** is a powerful human motivator

- **Educational report cards** are a common experience

- Report cards *synthesize* large amounts of data
Environmental report cards provide “truth to power” opportunities that engage stakeholders.

Increasing communication quality

Most modern politicians

Stakeholders

Increasing science quality

Most modern scientists
Environmental report cards benefit management, research & monitoring

COMMUNITY
- catalyze ecohealth improvements
- guide restoration effects
- resolve transboundary differences

MANAGEMENT

ORGANIZED PARTICIPATION
- Shared vision

RESEARCH
- discover new insights
- create new indicators
- develop scaling approaches

MONITORING
- justify continuous monitoring
- accelerate analyses
- stimulate research

COMMUNITY
COMMUNITY
COMMUNITY

INTEGRATION & APPLICATION
NETWORK
Catalyze improvements in ecosystem health through peer pressure of communities seeking to improve report card grades.

Reduced sewage plumes

Murrumba Downs Wastewater Treatment Plant - Total Nitrogen Discharge

Reduced sewage nutrients
Guide restoration efforts by creating a targeting scheme for resource allocations.

Step 1:
How should funds be allocated between watersheds?

Step 2:
What is the relative importance of each nutrient source in each watershed?

Step 3:
How should funds be allocated between nutrient sources within a watershed?
Resolve transboundary differences with transparent data analyses through an inclusive process that builds trust among partners.
Citizen scientists can help with monitoring

<table>
<thead>
<tr>
<th>Tributary/Waterbody</th>
<th>Indicators</th>
<th>First year of production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chester River</td>
<td></td>
<td>2007</td>
</tr>
<tr>
<td>Coastal Bays (MD)</td>
<td></td>
<td>2009</td>
</tr>
<tr>
<td>Magothy River</td>
<td></td>
<td>2003</td>
</tr>
<tr>
<td>Nanticoke River</td>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>Patuxent River</td>
<td></td>
<td>2008</td>
</tr>
<tr>
<td>Sassafras River</td>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>Severn River</td>
<td></td>
<td>2009</td>
</tr>
<tr>
<td>South River</td>
<td></td>
<td>2007</td>
</tr>
<tr>
<td>West and Rhode Rivers</td>
<td></td>
<td>2009</td>
</tr>
</tbody>
</table>
Report cards can be created for any habitat type.
### Forest habitat

**Degraded**

- **Indicators**
  - Density of Exotic Shrubs and Trees: high
  - Presence of Insect Pests: high
  - Presence of Forest-Dwelling Bird Species: low
- **Deer Population**: high
- **Native Seedling Regeneration**: low
- **Forest Connectivity**: low
- **Percentage of Impervious Surface**: high

**Desired**

- **Indicators**
  - Density of Exotic Shrubs and Trees: low
  - Presence of Insect Pests: low
  - Presence of Forest-Dwelling Bird Species: high
- **Deer Population**: low
- **Native Seedling Regeneration**: high
- **Forest Connectivity**: high
- **Percentage of Impervious Surface**: low

Degraded forest habitat has high numbers of exotic shrubs and trees, high % of impervious surface, and large deer populations. Native seedling regeneration and diversity of forest-dwelling bird species are low in patch forest with high occurrence of insect pests.

Desired forest habitat has low numbers of exotic shrubs and trees, low % of impervious surface, and small deer populations. Native seedling regeneration and diversity of forest-dwelling bird species are high in continuous forest with low occurrence of insect pests.
Wetlands habitat

**DEGRADED**

Degraded wetland habitat has eroded streambanks 🌿 and no shade ☀️, high nutrients NO₃, TP, NaCl, and salinity NaCl, resulting in turbid water 🌊, low oxygen levels 🐠, and low populations of fish 🐟, amphibians 🐸, and benthic invertebrates 🐒.

**Desired**

Desired wetlands habitat has intact streambanks 🌿 with shade ☀️, providing roots 🌿 and debris 🌿, low nutrients TP, NO₃, and salinity NaCl, results in high oxygen 🐠, clear water 🌊, and high populations of fish 🐟, amphibians 🐸, and benthic invertebrates 🐒.

**Indicators**

- **Total Phosphorus (TP)**
  - High
  - Desired: Low
- **Salinity (NaCl)**
  - High
  - Desired: Low
- **Nitrate (NO₃)**
  - High
  - Desired: Low
- **Dissolved Oxygen (O₂)**
  - Low
  - Desired: High
- **Benthic Invertebrates**
  - Low
  - Desired: High
- **Area Occupied by Adult Amphibians**
  - Outside
  - Desired: Within
- **Physical Habitat Index**
  - Low
  - Desired: High
Environmental report cards are increasingly popular

• ‘Stat-ing’ is being used by governments

• *Diffuse pollution* is more complex than point source pollution

• *Data gathering capacity* increasing
Several basic steps are involved in producing report cards

Step 1: Create conceptual framework
Step 2: Choose indicators
Step 3: Define thresholds
Step 4: Calculate scorecard
Step 5: Communicate results
Step 1: Create conceptual framework

**Diagram**

- Riverine: Catchment, Turbid
- Estuarine: Sewage impacted
- Marine: Fluvial, Soil disturbance

**Ecosystem Health Indicators**

- Turbidity due to resuspension of fine grained sediments
- Seagrass loss resulting from high turbidity from resuspension and catchment inputs
- Sewage nitrogen plumes (ascertained using del15N)
- Water column nutrient concentrations (total phosphorus used as representative value; highly correlated with nutrients)
- Phytoplankton concentration measured as chlorophyll a concentration
- *Lyngbya*, a toxic cyanobacteria, grows on seagrasses

**Key Features**

- Light limitation
- Nutrient limitation
- Dugong, turtles, and seagrass
- Riparian vegetation
- Oceanic flushing
- Humic rich runoff
- Photosynthetically Active Radiation
- Light attenuation

**Legend**

- Fine grained sediments
- Coarse grained sediments
Step 2: Choose indicators that convey meaningful ecological information and can be measured reliably.

![Graph showing standard error vs. number of metrics]

- Maximum standard error
- Mean standard error
- Minimum standard error

Optimal Range:
- $n/2$
**Step 3: Define thresholds**
and reporting regions to establish environmental benchmarks and spatial details

**Dissolved oxygen (mg·L⁻¹)**

- **Binary**
  - Score: 100%
  - 5.0

- **Linear**
  - Score: 50%
  - 8.0 to 6.0 to 4.0 to 2.0
  - 5.8
Step 4: Calculate scorecard for dissemination to decision-makers, resource managers, and interested public

Chesapeake Bay report card

Bay health scale
- Very poor
- Very good

INTEGRATION & APPLICATION
Step 5: Communicate results effectively through mass media with supporting material in technical or web-based venues
Conclusions

- Conservation deals with complex problems: incredibly difficult but incredibly rewarding
- Engaging the broader community with good science communication is important
- Environmental report cards in Ontario can be an important science communication tool
O Canada! Our home and native land! Turn data into report cards as our stakeholders command. With glowing powerpoint we see thee rise, The True Science strong and free! From far and wide, O Canada, we communicate science for thee. God keep our symbols glorious and free! O Canada, we communicate science for thee. O Canada, we communicate science for thee.
www.ian.umces.edu

Integration & Application Network