Technology Opportunity – Inspiring New Ways to Protect Nature for the Benefit of Humanity

Peter Seligmann
CEO + Chairman
Conservation International
CI Mission

Built upon a strong foundation of science, partnership, and field demonstration, CI empowers societies to responsibly and sustainably care for nature for the well-being of humanity.
Using Technology to Maintain Ecosystem Health and Services

Sandy Andelman, Ph.D
Vice President
Conservation International
Inadequate monitoring and understanding of ecological change
scale up ecological knowledge to manage earth’s systems effectively
Early Warning System

Standardized field measurements of climate, tropical biodiversity and ecosystem services.

External data sources
- Climate
- Markets
- Land cover

Data verification, archiving, standardization

Threat analysis hub

OUTPUTS
1. Threats
2. Future Scenarios
3. Advice to Policy Makers
4. Recommended Actions
5. Communication

Data from other observatory networks

Marine
Lakes
Savanna
Sensor Arrays - CENS, UCLA

- Climate sensors
- Camera traps
- Acoustic sensors
- Soil sensors
- “Human sensors”

Varying levels of connectivity
Needs: Scientific Workflow Tools

(e.g., Project Trident, Roger Barga et al.)
Cell phones as platform for ecosystem health
Participatory data collection
Near real time mapping of global issues
Local-scale impact and audit
Feedback to users:

- Fire alert system
- Fire risk / Forest flammability
- Flood alert system
- Agricultural drought alert
- Illegal logging alert
- Encroachment on protected areas
Cell phones to monitor climate change & coffee
1 billion people are moving from poverty into the middle class in China. 500 M people will move from rural to urban areas by 2020.
Decision support tools

Global biophysical & social drivers

Regional climate, landscapes, ecosystems biota, etc.

Soils, sediments, disturbance regime, functional types, etc.

Animal behavior, soluble nutrients, fire, floods, etc.

Regional governance economy, etc.

Property & use rights, wealth & infrastructure, cultural ties to land, etc.

Community income, migration, access to resources, etc.

Institutional response

Ecosystem services

Human actors

Environmental impacts

Social impacts

Faster variables

Slower variables

Regional context

Carpenter et al. 2009
Potential Fresh Water Sources
China - Mekong River
Cambodia: Lake Tonle Sap
Key questions:

**Forecasting**
- How will land use change affect the provision, flows, benefits and values of ecosystem services?
- Where are critical areas for water flows for human uses?
- What will be the effects of climate change on water and food security?

**Conservation planning**
- Where is it most efficient and cost-effective to invest in conservation for the combined provision of biodiversity and important ES?

**Policy optimization**
- What policy tools are likely to be most effective for the maintenance of ES and the minimization of environmental impact?
- How are opportunity costs distributed?
- How are probabilities of land conversion distributed?
- How are liabilities distributed?
Conservation International  Decision Support Tools

- ARIES
- IBAT
- OSIRIS
- CONSVALMAP
The ARIES Project

Artificial Intelligence for Ecosystem Services

- Gund Institute for Ecological Economics
  - Ferdinando Villa, Marta Ceroni, Sergey Krivov, Josh Farley, Kenneth Bagstad, Gary Johnson
- Conservation International
  - Rosimeiry Portela, Miroslav Honzak
- Earth Economics
  - David Batker
- National Science Foundation
ARIES in a nutshell

- Rapid **assessment toolkit** for ecosystem services and their values; not a single model but an intelligent system that customizes models to user goals
- Mapping process for ecosystem service **provision**, **use**, and **flow**
- **Probabilistic Bayesian models** inform decision-makers of likelihood of all possible outcomes; explore effects of policy changes and external events
- **Web based**, customizable for specific user groups, geographic areas and policy goals; custom tools implement specific “bottom line”
Five elements of modeling in ARIES

Provisionshed

Benefitshed

Area of critical ES flow

Sinks
Interactive workflow systems for transparent, repeatable processing of large, complex data sets and algorithms

Visualization tools to enable decision makers and society to understand complex information

Integration of interactive models to forecast future states of ecosystem services and health
Climate Change
CLIMATE CHANGE

IMPACTS

METEOROLOGICAL CONDITIONS EXPOSURES
- Warming
- Humidity
- Rainfall/drying
- Winds
- Extreme events

HUMAN/SOCIAL CONSEQUENCES OF CLIMATE CHANGE
- Displacement (e.g., sea level rise)
- Shift in farming & land-use
- Malnutrition

Examples of health impacts

- Salmonella; mosquito range/activity (malaria, dengue, etc.); physiology/work productivity
- Food yields, quality
- Injury/death; hunger; epidemic outbreak; post-trauma depression
- To urban slums, emigration, health risks
- Infectious agent contacts
- Child stunting; susceptibility to infection

RESPONSES

MITIGATION ACTIONS
- Alternative energy
- Modes of travel
- Livestock production (e.g., Ruminants & CH4)

ADAPTATION ACTIONS
- Crop substitution
- Water shortage
- Urban/housing design

Examples of mitigation actions

- Dams and hydropower (more small-holds for Schistosomiasis)
- Cleaner air: less cardio-respiratory diseases
- More physical activity, social contact
- Diet-related risks/benefits (e.g., red meat & increased colon cancer risk)

Examples of adaptation actions

- Unexpected nutrient deficiencies
- Water quality; mosquito/snail breeding
- Impaired indoor air quality (due to better seals)
IT Sector contributes \(~2\%\) of emissions

20\% of emissions come from the burning and clearing of tropical forests
Key Concepts in REDD

Reduced Emissions from Deforestation & Degradation

- Additionality
- Reference Scenario
- Leakage
Methods are in-hand to measure changes in forest area at pan-tropical, national, and project levels.
Deforestation carbon emissions / year =
Area cleared / year \times \text{biomass removed / unit area}

Need to know:
- original biomass
- emission factors for each component
- time scale of interest

Possible at project level but more difficult at national level.

DeFries 2009
<table>
<thead>
<tr>
<th></th>
<th>Project Level</th>
<th>National Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Area Change</td>
<td>satellite and airborne</td>
<td>satellite</td>
</tr>
<tr>
<td>Biomass</td>
<td>airborne and ground data</td>
<td><strong>extrapolation only</strong></td>
</tr>
<tr>
<td>Emission factor (initial fire, decay, uptake)</td>
<td>modeled; field measurements</td>
<td>modeled</td>
</tr>
</tbody>
</table>
Degradation is harder

Burned peat in central Kalimantan

Logging in southern Amazon from satellite

DeFries 2009
Integrated Multi-Resolution Monitoring

“EcoHawk”

“Eco-sensors”

Northrop Grumman

Hyperspectral instrument

LIDAR instrument
Technology for managing, processing & visualizing data – establish baselines; visualize change

Knowledge Integration Centers – interpret complex information at scales relevant to particular user groups
4 Areas Where Technology Would be Transformational

- Cell Phone Platform for Ecosystem Health
- Workflow Tools
- Decision Support Tools & Integrated Modeling Platforms for Forecasting Change
- Technology to Support Climate Policy & Adaptation
What kind of world do we want for our children?
environmental challenges unprecedented in human history