Rapid Ecological Assessments: Basic Principles & Approaches

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Empowered lives.
Resilient nations.

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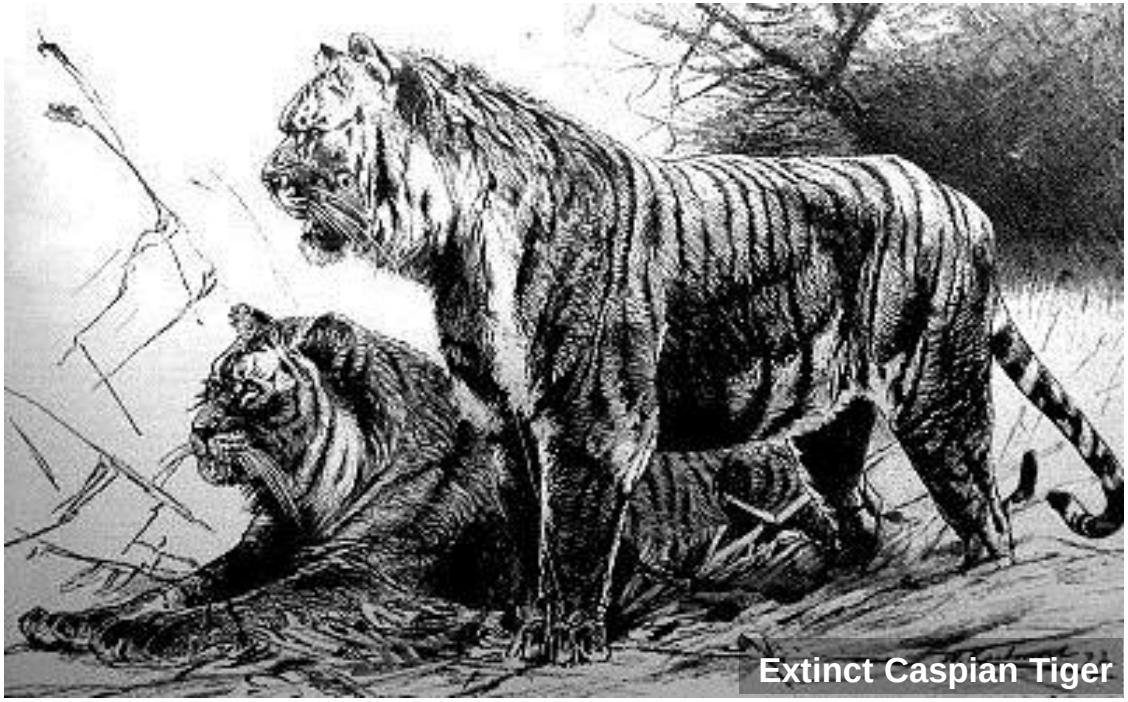
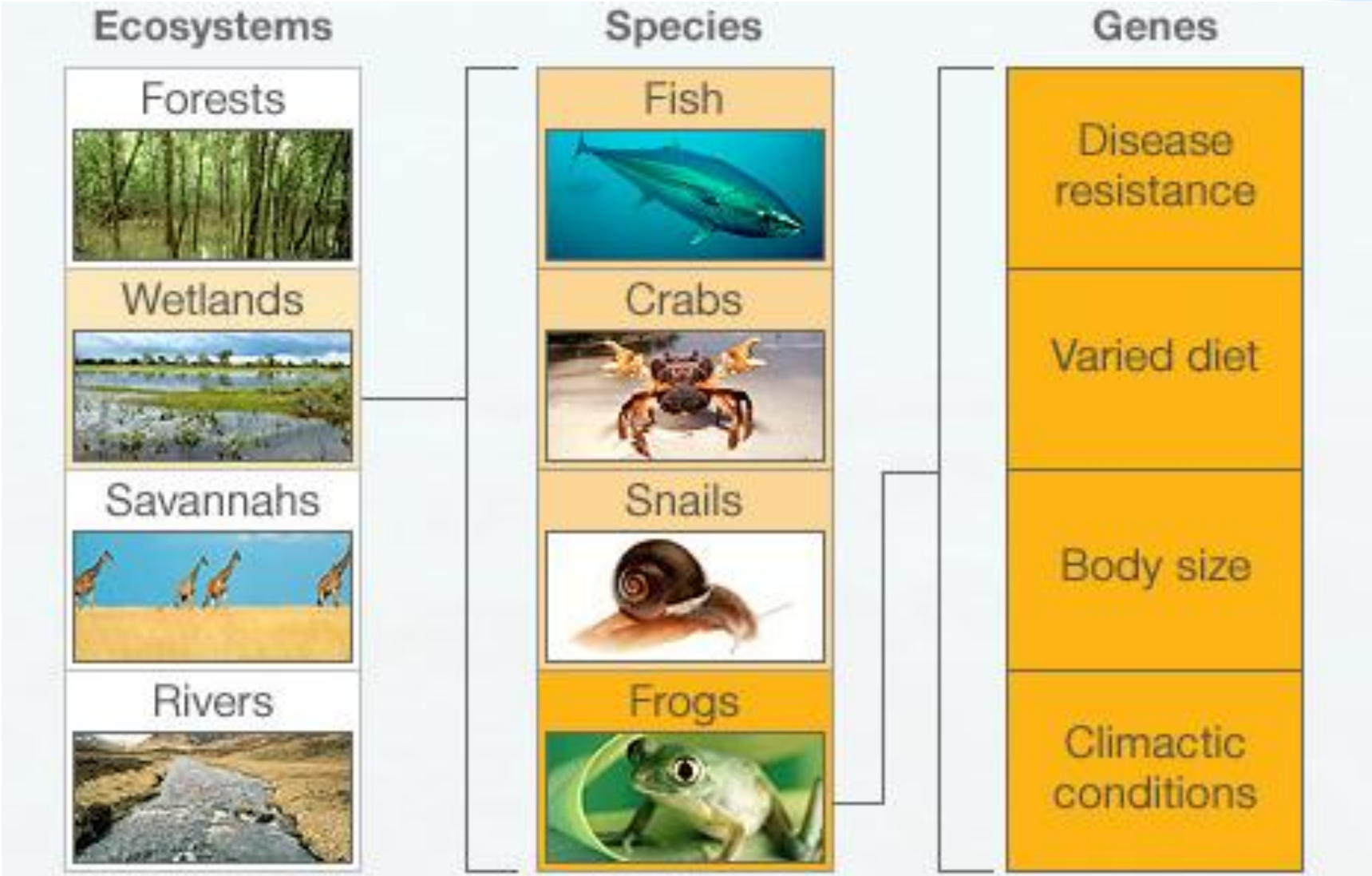
Origin of REAs:
Conservation in the Face of Mounting Threats



REAs have their origin in scientists "…caught between the uncertainty of relatively superficial knowledge of biological diversity and the imperative to advance conservation rapidly in the face of a powerful array of destructive forces" (p. xvii, Sayre et al. 2000)

(image source: Wikipedia.org, Caspian tiger)

What is Biodiversity?



(figure source: http://www.bbc.co.uk/news/science-environment-11388779)

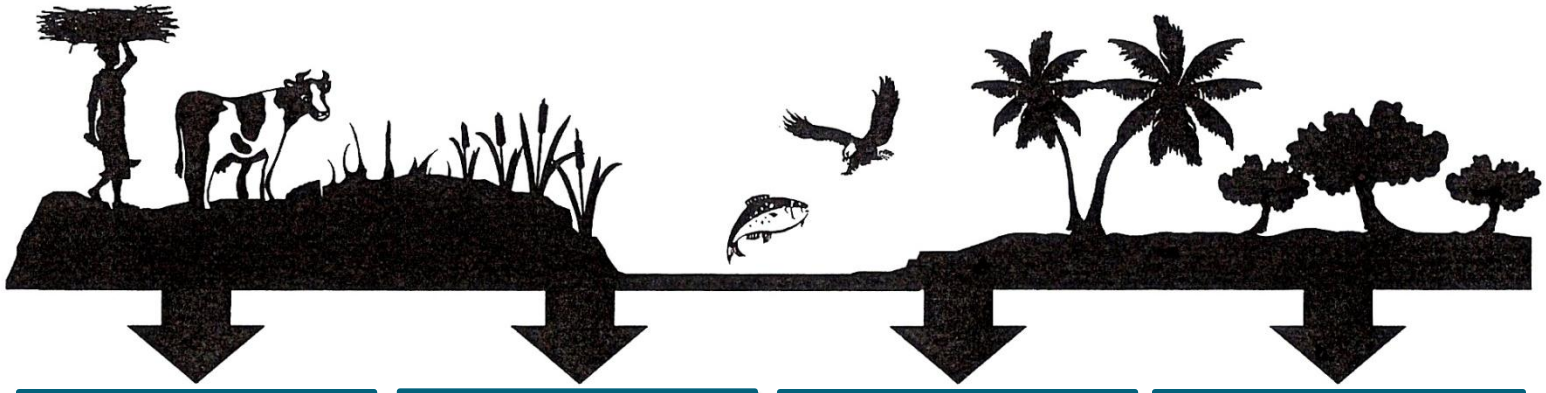
Why Value Biodiversity?

- **Humans depend on biodiversity**
- **Biodiversity = Indicators to Ecosystem "Health"**
- **Ecosystem "Health" includes Biological Integrity**

  EU Water Framework Directive (WFD) requires Member States to employ ecologically-based classification systems for biological monitoring of surface waters to assess system biointegrity.

- **Healthy, Functioning Ecosystems = Ecosystem Services**

Ecosystem Services



<u>Provisioning</u>
Resources directly exploited by humans, such as food, raw materials, fibers, water, medicines

<u>Supporting</u>
indirectly allows exploitation of resources, such as primary production, pollination

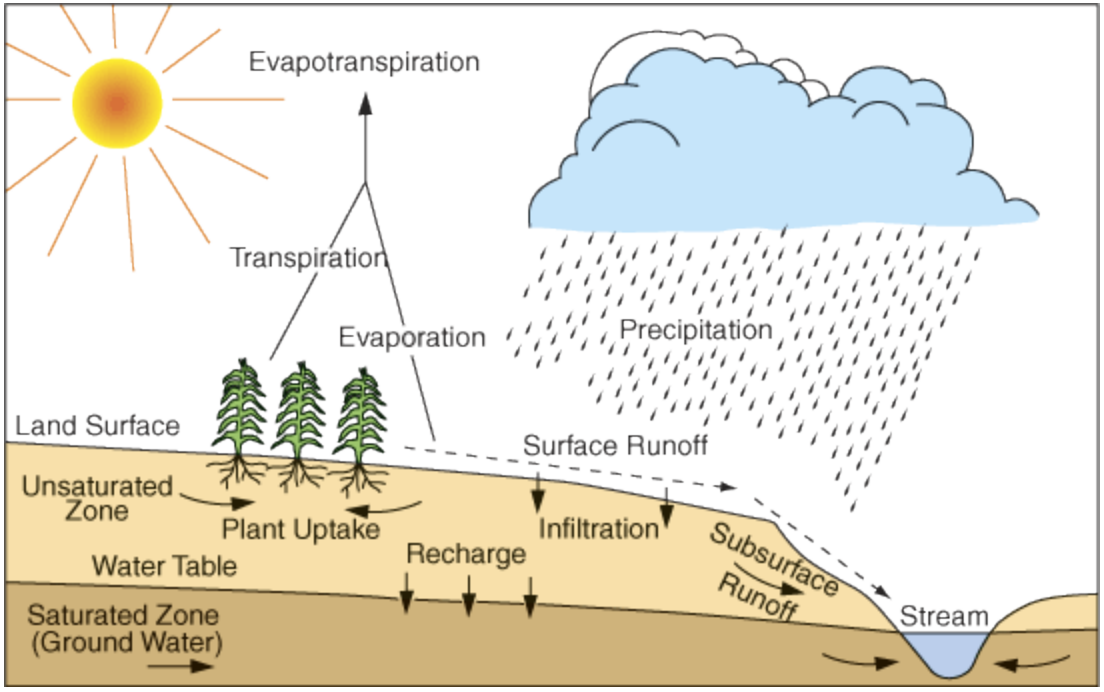
<u>Regulatory</u>
mechanisms responsible for climate regulation, nutrient & water circulation, pest regulation

<u>Cultural</u>
Enhance emotional, psychological, cognitive well-being of people, such as recreational, spiritual purposes

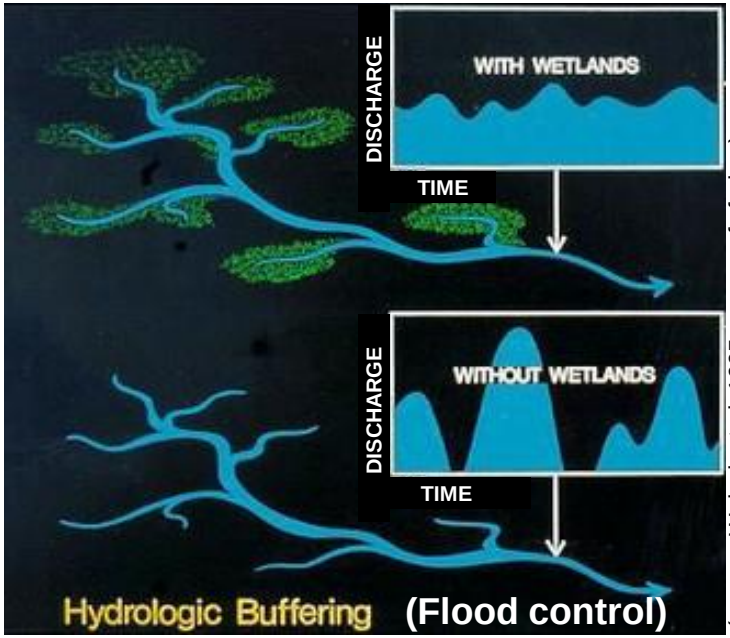
(Figure adapted from Thieme et al. 2005)

Wetlands Play Integral Role in Watershed (Basin) Ecology

- Water quality
- Erosion control
- Flood control
- Climate Change
- Groundwater recharge/discharge



(figure source: http://www.kgs.ku.edu/Publications/pic22/pic22_2.html)



(source: Welsch et al. 1995; www.na.fs.fed.us)

- Community structure and wildlife support
- Biochemical cycling and storage

Biodiversity of Wetland Ecosystems

Wetlands are among the world's most productive ecosystems. And yet…


www.ibp.ethz.ch


source: Wikipedia (Thomas Rosenau photo)


source: http://rivers.sdsu.edu (Victor M Ponce)

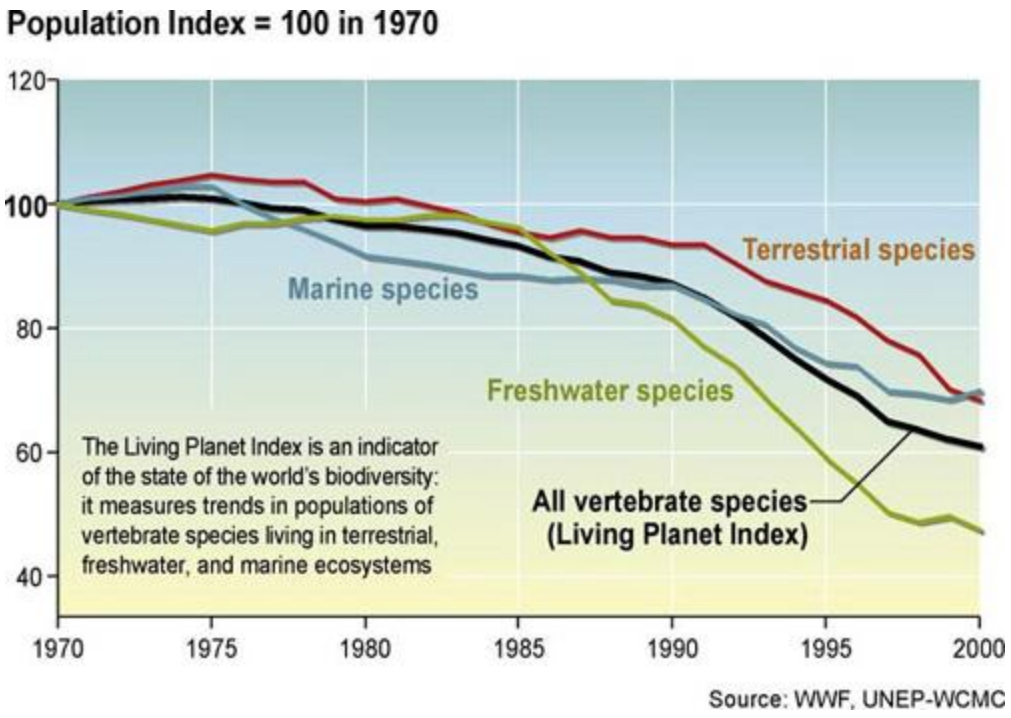
"Freshwater ecosystems tend to have the highest proportion of species threatened with extinction"

(Millennium Ecosystem Assessment 2005)


source: www.redstonestrategy.com

Wetlands and Wetland Biodiversity in Decline

- Conservation of aquatic ecosystems is urgent
  - Multiple environmental stressors threaten rivers that serve 80 percent of the world's population.



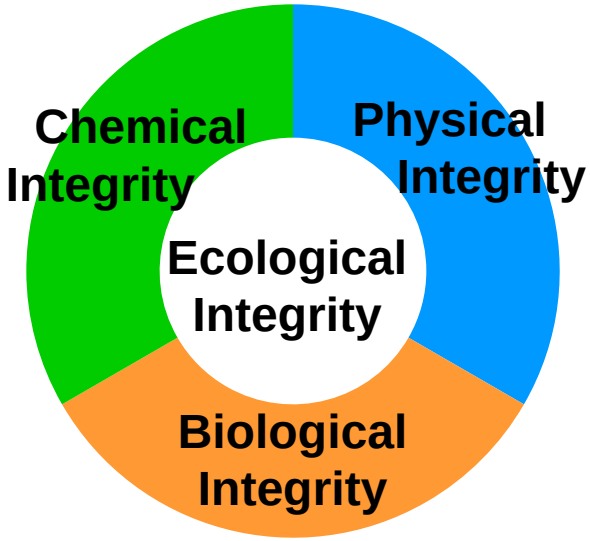
- Freshwater species populations fell about 50% from 1970 to 2000, a sharper decline than terrestrial or marine biomes.
- > 50% world's wetlands disappeared in last 200 yrs
- 60-70% of European wetlands were lost in early 20th c.

Threats ("Stressors") to Wetland/Aquatic Ecosystems

- **Stressors**
  - Pollution/contaminants
  - Habitat loss/destruction
  - Water availability/flow alterations
  - Wildfires
  - Invasive Species
  - Disease
  - Unseasonal temperatures
  - Excessive erosion, siltation
  - Over exploitation
- **Causes**
  - Development
  - Agriculture
  - Deforestation
  - Runoff from industry, cities
  - Untreated sewage, effluent
  - Dams, levees, impoundments
  - Energy development
  - Alteration of energy base
  - Climate Change
  - Human population growth

Common Management Goals

- Maintain and restore:
  - "Ecological Integrity" (condition, health) of rivers, streams, wetlands
  - Functional Value (e.g., ecosystem services of water quality, groundwater recharge, flood reduction)
  - Social Values (e.g., tourism, aesthetics, recreation, education)



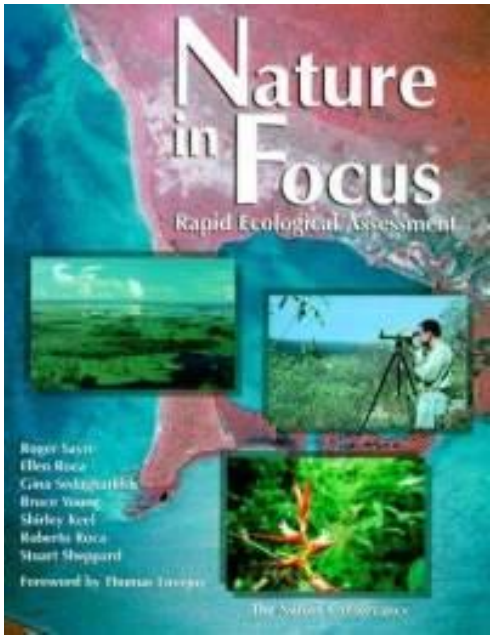
Reduced Ecosystems = Reduced Ecosystem Services


Source: Wikipedia (user:NEON_ja)

- To improve “ecological integrity” or “functional value” of wetlands, we need to know what the current status is, and whether our efforts are helping.
- To reduce the rate of biodiversity loss, we need to know better what biodiversity is there.
- Poor knowledge of aquatic biodiversity is often a fundamental constraint to conservation.

REAs: General Principles

- Accelerated, targeted, flexible biodiversity survey
- Often focused on species associated with particular vegetation types or topographical features
- Implemented by teams with disciplinary specializations
- Produce baseline biophysical data, maps, recommendations, and increased institutional capabilities for effective conservation work



(Sayre et al. 2000, TNC)

Typical Steps of an REA Process

Planning

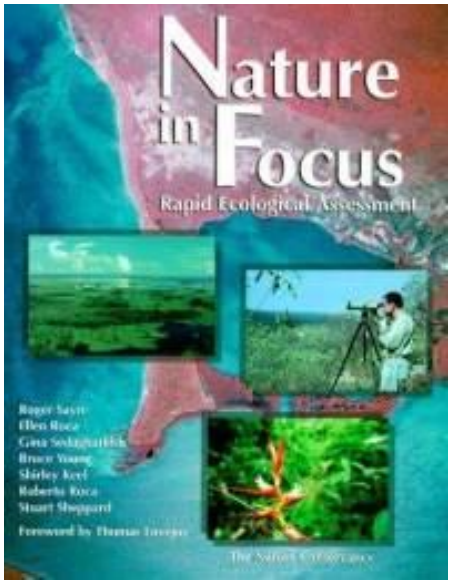
1. Conceptual Development
2. Initial Planning
3. Initial Landscape Characterization
   > Compilation of existing data
4. Planning Workshop – Work Plan
5. Training Workshop

Field

6. Field Implementation

Post-Processing

7. Report Generation by Discipline
8. Information Integration and Synthesis
9. Preparation of Final Report and Maps
10. Publication and Dissemination of Products



(Sayre et al. 2000, TNC)

Range of REAs

- Level of rigor and comprehensiveness vary
- REAs are conducted on different scales:
  - Small Park → Entire Global Region
  - Few Taxa → Extensive Taxa Representation
- The type of REA depends on….
  - Goals/Objectives
  - Time/Money
  - Resources/Expertise

Graphic source: http://savingsblogger.com/2011/06/money-vs-family-life/time-vs-money

Common REA Goals

Example Goals

- Produce baseline biophysical data
- Determine presence/absence of indicator species
- Define biological diversity of site
- Measure population change over time
- Support regulatory compliance
- Support adaptive management
- Verify vegetation community classification/map
- Conduct a threats analysis
- Train local scientists in REA methodology

Goals are Key:

Goals of an REA shape the methods, design, and approach of the REA.

Consider:

How will data be used?

What are ultimate management questions?

REA Common Features

- Speed
- Careful planning and training
- Clearly defined goals and objectives
- Mapping technology (GIS/GPS, Remote Sensing)
- Two levels of assessments

Landscape Level	Species Level
▪ Satellite imagery, aerials	▪ Field sampling
▪ Vegetation mapping	▪ Refine species lists
▪ GIS	▪ GPS

- Careful scientific documentation
- Dissemination of results
- Capacity Building and Partnerships

(Sayre et al. 2000, TNC)

An REA is Not…

Limitations

- Sometimes REA yields preliminary data with low levels of confidence.
- Doesn't take into account temporal changes (un-less REA is repeated).
- REAs can be expensive.

- Exhaustive inventory
- A management plan
- Rigorous assessment of ecological relationships
- Basic research to understand ecological processes
- Comprehensive environmental impact assessment
- Biodiversity monitoring or change-detection analysis (unless systematically repeated)
- Predictive or descriptive model for explaining distribution of biodiversity

What REAs do…

- Provide information/tools for land managers and stakeholders for resource planning, decision making
- Evaluate landscapes across ecoregions to more fully understand:
  - Ecological conditions and trends
  - Potential natural and human influences
  - Opportunities for conservation, development
- Seek to identify & document important resource values and spatial patterns
- Systematically repeated REAs can be used to assess trends and temporal changes
- Identify data gaps and future research needs

Our Focus: REAs of Wetland Resources

Assessments of rivers, streams, and wetlands have received a lot of interest globally in the last 40 years (e.g., Ramsar Convention) due to accelerated impacts and increasing demands on these vital resources.

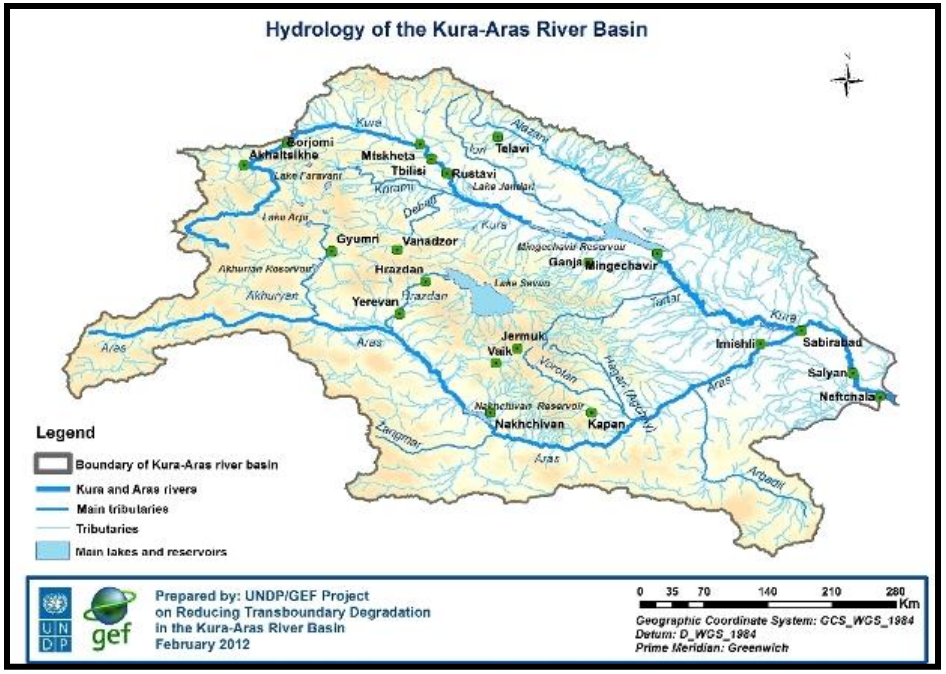



Photo by Dr. Mary M. Matthews

5 Rapid Assessment Types (Uses) for Wetlands

(Ramsar Convention, 2005)

1. Baseline Inventory
2. Species-Specific Assessment
3. Change Assessment
4. Indicator Assessment
5. Resource Assessment

(Inventory, Monitoring, and/or Assessment)

REA types/uses are not mutually exclusive...

REA for Wetlands:
(1) Baseline Inventory

- Baseline inventories are valuable when little information is known about an area
- Can help with conservation prioritization
- Goal is to sample as many sites and list as many species per site as possible in short time
- Aerial/remote imagery is especially useful
- Taxonomic data will likely include: fish, plankton, epiphytic and benthic invertebrates, aquatic and terrestrial plants, and algae

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REA for Wetlands:
(2) Species Specific Assessment

- Species specific assessments provide rapid appraisal of the status of a particular wetland species or taxonomic group (e.g., endangered species, species at risk, exotic species)

- Can provide more detailed biological information about a focus species of economic or ecological importance (e.g., keystone species, indicator species, umbrella species, flagship)

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REA for Wetlands:
(3) Change Assessment

- To determine effects of human activities or natural disturbances (storms, exceptional drought, etc) on ecological integrity.
- Information is:
  - "Retrospective" – using pre-disturbance (baseline) data for comparison or "reference sites" and environmental quality standards.
  - "Predictive" -- potential consequences of a future project; establishes a baseline inventory for future surveys.
- Challenge to detect "effect" above "noise" of natural variation.

REA for Wetlands:
(3) Change Assessment, cont.

- Monitoring implies more than one REA/ sampling event over time
- Facilitated by quantitative/metric-based protocols
- Repeated REAs at intervals do not automatically constitute monitoring
- Monitoring facilitates adaptive management
  - Trend analysis
  - Impact assessments, effects analyses
  - Potential causal effects
  - Early detection of problems

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REA for Wetlands:
(4) Indicator Assessment

- Provides data on health or condition of inland water systems
- **Biological Indicators** = biological diversity as "indicators" of water quality, hydrology, and overall "health" of ecosystem
- Taxonomic groups, individual species, groups of species, or entire communities can be indicators
- Typically benthic macroinvertebrates, fish, and algae are used as indicators

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REA for Wetlands:
(5) Resource Assessment

- Focus is on potential for sustainable use of biological resource, usually an economically important species.
- Findings can facilitate ecologically sustainable development.
- Important element is involvement of local communities and governments.
- Findings can also be used to monitor health of fisheries and other resources.