Targets of Protection and Related Endpoints:
Structures and Functions of Organisms, Populations, and Ecosystems

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Assessment Endpoint: Definition

An assessment endpoint is the formal expression of an actual environmental value of concern that can be evaluated objectively either through direct measurement/observation or through a logical relationship with a surrogate measurement or observation.

Presents policy and technical foundation for adopting a wide range of assessment endpoints (US EPA 2003).

An updated version due out soon from the US EPA will include Ecosystem Service Endpoints.
Assessment Endpoints

- An Assessment Endpoint, at minimum, includes an entity and an attribute - but a location and time period are useful though optional in many cases
  - An entity (e.g., a species or population of interest)
  - An attribute (e.g., number, size, rate, condition)
  - A location (e.g., a specific reach of a stream)
  - A time period (e.g., 2015 through 2020)

Examples – Ecological Receptors: {entity} {attribute} {location} {time}

- The growth of trout in Fish Creek over the next five years
  An organism attribute associated with the individuals in an assessment population
- The productivity of the trout population in Fish Creek over the next five years
  A population attribute associated with an individual assessment population
- The average productivity of trout populations in Region Y over the next five years
  A population attribute associated with a set of populations
Organism-based Focus

**Advantages**

- Direct and read-across correspondence to toxicity tests
- Often includes multiple effects endpoints (growth, survival, fecundity)
- Effects endpoints mostly amenable to acute and chronic exposures
- Dose (internal) can be measured directly or through use of -omics

**Limitations**

- Indirect or secondary effects not observable in most standard tests
- Dynamics of population effects not captured
- Effects of multiple, concurrent stressors seldom considered
- Test organisms usually in near optimal conditions unlike in real world settings
Multiple Stressors

- Arguably no organism resides at the optimum position for all of its niche parameters (i.e., “stress” is a constant).
- Acclimation is an important survival mechanism for organisms - a means of finessing the effects of specific stressors.
- Adaptation is an important evolutionary mechanism that adjusts population fitness to changing environments.
- Cumulative effects of stressors confound predictive capacity regarding particular stressor effects.

Death Spiral

Niche Parameters

x, y, z
Population-based Focus

**Advantages**
- Addresses the most commonly claimed regulatory target (i.e., protect population)
- Indirect or secondary effects assessed (e.g., effects on food source, prey; effects on predators)
- Considers multiple, concurrent stressor effects.

**Limitations**
- Little or no ecotoxicity data available
- Level of effort and costs to obtain experimental data much greater than organism-based studies
- Phenology restricts the times that studies can be done
Ecosystem-based Focus

Advantages

- Inherently addresses complexity (interactions among abiotic and biotic components)
- Addresses temporal and spatial dynamics
- Field studies and models can be more explanatory in terms of system trajectories
- Can be simulated using cosms

Limitations

- Each setting is unique - lessons from one place or time to another may not be transferable
- Costs can be considerable
- Systems responses may take years, even multiple decades before they are observable
Ecosystem Services Focus

- Explicitly considers the delivery of goods and services that people care about.
- Ecosystem services endpoints can be used in the existing ecological risk framework.
- May be especially important for ionizing radiation settings especially in areas with
  - little demonstrable adverse effects to plants or wildlife
  - but subject to exclusion of humans as a safeguard for human health (and thus constituting a loss in terms of many ecosystem services, particularly provisioning services).
Importance of Habitat in EcoRA

- Wildlife respond to differences in landscape features (attraction, avoidance)
- Spatial relationships between stressors and foraging activities influence exposure
  - Co-located distributions increase exposure
  - Disjoint distributions decrease exposure
Ecosystem Services – sustainability

PROVISIONING SERVICES
- Water, food
- Minerals, energy
- Pharmaceuticals

REGULATING SERVICES
- Carbon sequestration and climate regulation
- Decomposition, detoxification and purification
- Pest and disease control
- Pollination

SUPPORTING SERVICES
- Nutrient dispersal and cycling
- Seed dispersal
- Primary production

CULTURAL SERVICES
- Cultural, intellectual and spiritual inspiration
- Recreational and ecotourism experiences
- Scientific discovery

ECOLOGY
SOCiETY
ECONOMY


[McCormick et al. 2012.]
• ...EPFs translate ecological changes into outcomes that people use or value.” [Wainger and Mazzotta 2011]

• “a description of the type, quantity, and interactions of natural features required to generate measurable ecological outputs” having “clear ... relevance to human wellbeing.” [Munns et al. in review]

EPFs are usable expressions (i.e., models) of the processes by which ecosystems produce ecosystem services, often including external influences on those processes.

encompasses cardinal (fully quantitative), ordinal (rating, ranking), and qualitative (yes-no, plus-minus) expressions
A sample conceptual model that considers multiple ES, including some requiring consideration of trade-offs.
Closing Comments

- **Organism-based Efforts**
  - Provide high quality data that are relatively easy to corroborate through repeated experiments
  - Have the least relevance to the different regulatory entities - endpoints at population and higher levels of ecological organization

- **Population-based Efforts**
  - Quality data acquisition more difficult and costly than organism-based efforts
  - Higher relevance to stated protection goals

- **Ecosystem-based Efforts**
  - Generally, one-off studies due to the uniqueness of any ecosystem
  - Highest relevance to protection goals, including consideration of ecosystem services
Selected Literature


