

Opportunities for and Implications of Including Ecosystem Services in Risk Assessments & Risk Management of Regulated Stressors



Wayne R. Munns, Jr.
US Environmental Protection Agency

Presentation Objectives

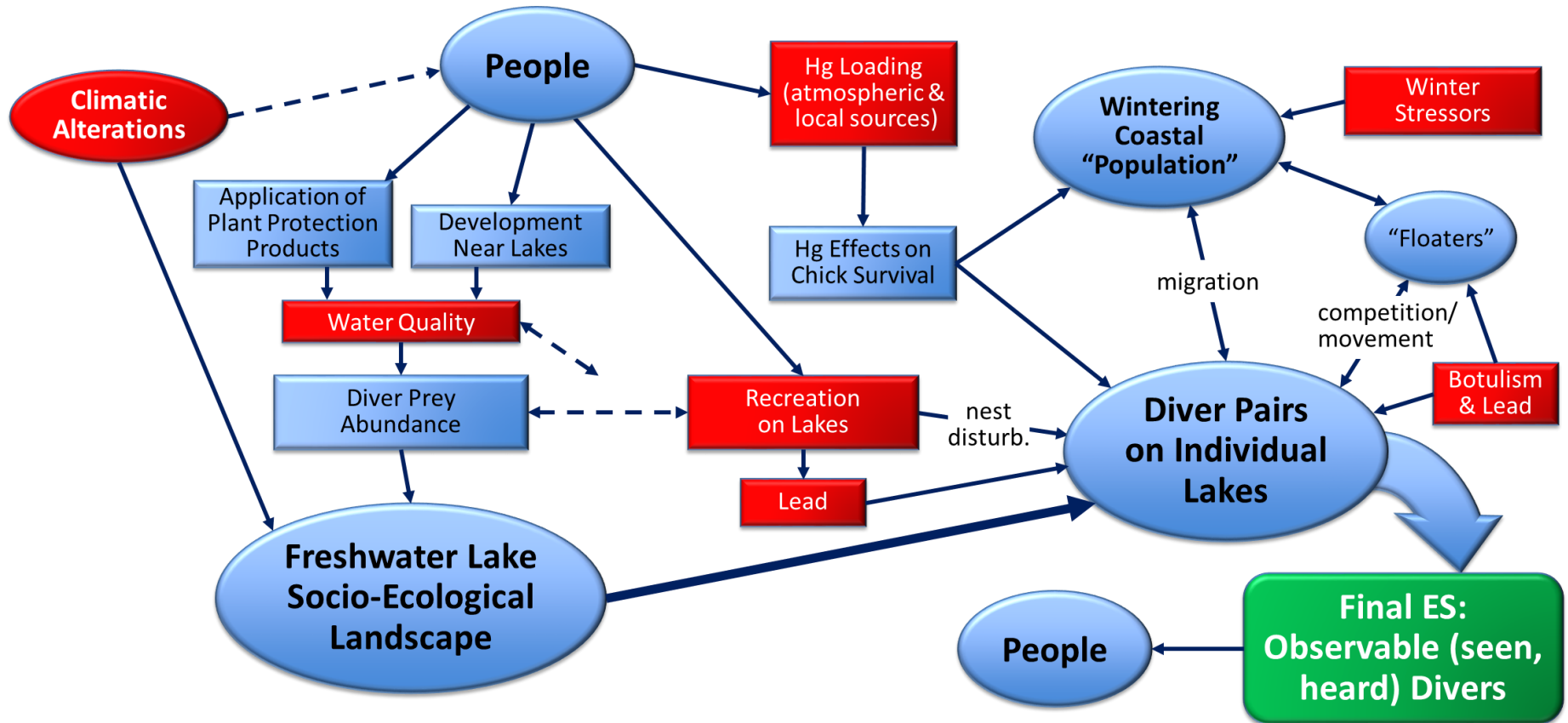
- Background
- Terminology
- A framework for ES in risk assessment & management
- Opportunities & implications
- Recommendations for risk assessment & management
- Actions needed to realize benefits



Some Terminology

- ***Ecological production function (EPF)*** – description of the types, quantities & interactions of natural features required to generate observable & measurable ecological outputs
- ***Ecological output*** – biophysical feature, quantity, or quality requiring little translation to make clear its relevance to human well-being (i.e., “public-friendly” or valued attribute of the ecosystem, such as food)
- ***Ecosystem goods and services (ES)*** – outputs of ecological processes that directly (final ES) or indirectly (intermediate ES) contribute to social welfare

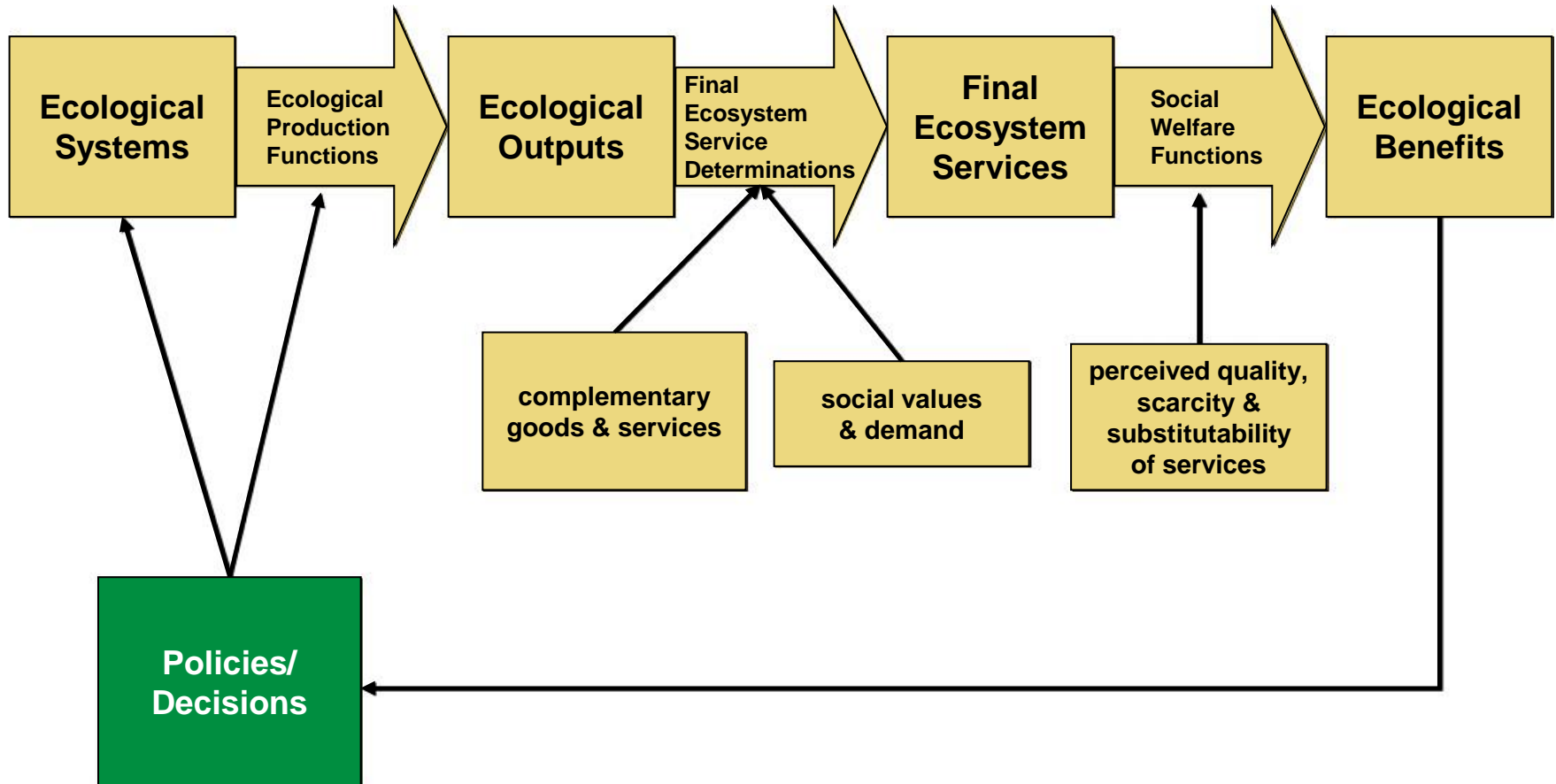
Multi-Stressor EPFs



Some Terminology

- **Human well-being** – broadly, the condition of humans & society, defined in terms of the basic material & other natural resource needs for a good life, freedom of choice, health, wealth, social relations, and personal security
- **Social welfare** – human well-being measured at some aggregate level
- **Ecological benefits** – contributions to social welfare of ES

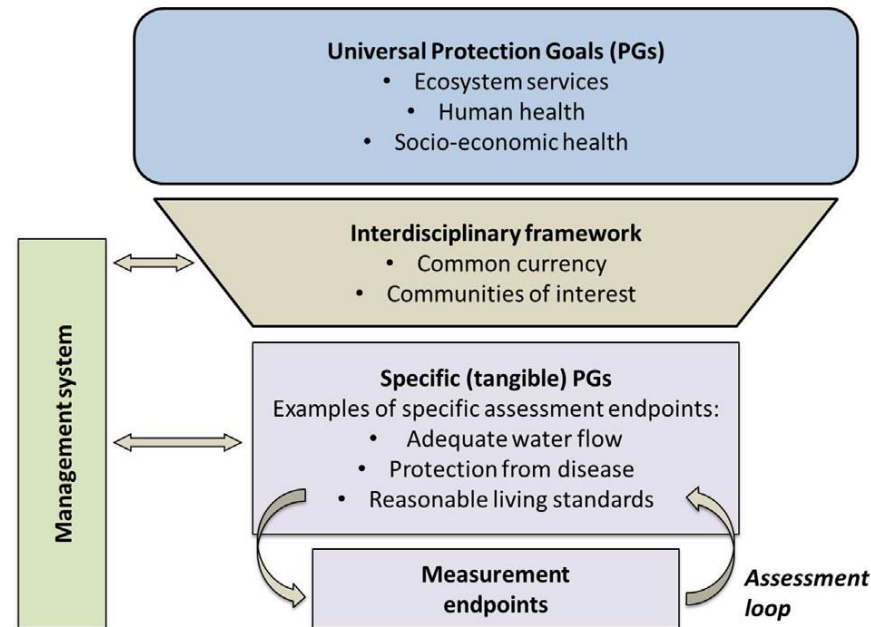




1. More comprehensive & consistent environmental protection
 - management decisions will consider larger parts of, or even entire, ecosystems
 - emphasis on final ES directs assessments to evaluate effects on complement of species & processes as components of EPFs
 - when combined with conventional assessment endpoints, decisions can consider more comprehensive set of objectives
 - decisions will be more fully informed, and scientifically & societally defensible
- Articulate benefits, costs & trade-offs involved in environmental decisions/policies/actions
 - decision alternatives can be compared using economic principals (monetized or nonmonetized)
 - ES losses & gains can form a basis for communicating decision rationale

Opportunities & Implications

3. Inform derivation of operational & tractable protection goals & environmental quality standards
- more actionable by making context-specific
 - linking standards to valued ES increases understanding & transparency



4. Enable integration of human health & environmental risk assessment
 - ES can be a “common currency” linking ecological & public health concerns
 - promotes holistic decision making
5. Facilitate horizontal integration of policies, regulations & programs
 - ES can be a “common currency” enabling transfer of information
 - encourages alignment & synergies
 - avoids unanticipated consequences

6. Enhance transparency of assessment results & decisions
 - people’s values are reflected directly
 - enables closer integration of ecological & societal objectives
 - incremental benefits of decision alternatives articulated in ways that policy makers & the public can understand and will care about



Recommendations for Risk Assessment & Management

- Problem Formulation

- select ES assessment endpoints following either EFSA¹ or Generic Ecological Assessment Endpoints² approach
- ensure assessment endpoints have documentable linkages to human health & well-being
- actively engage stakeholders in ES assessment endpoint selection to reflect values
- utilize standardized classification systems when possible
- base conceptual models on EPFs³
- use EPFs to select measurement endpoints critical to ecological production



¹Devos et al. 2015. *EMBO Reports* 16:1060-1063.

²Munns et al. 2015b. *Integr Environ Assess Manag* 12:522-528.

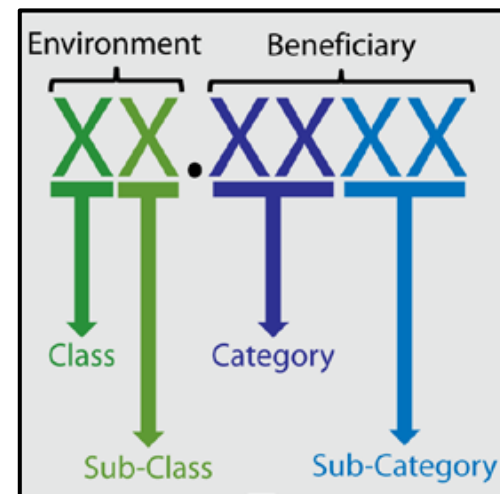
³Olander et al. 2018. NESP Conceptual Model Series No. 1.
Munns et al. 2017a. *Integr Environ Assess Manag* 13:62-73.

Standardizing ES Classification

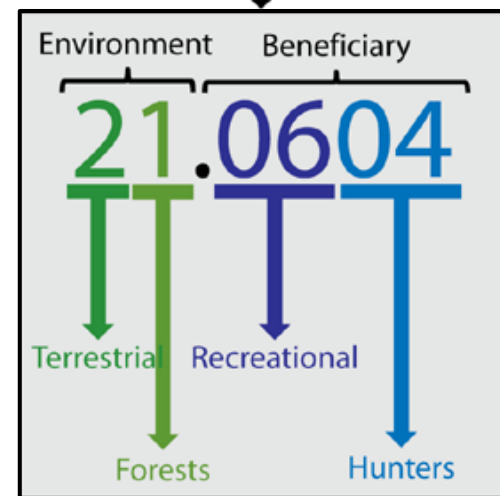
- Several typologies exist (e.g., de Groot et al. 2002, MEA 2005, Common International Classification for Ecosystem Services (Haines-Young and Potschin 2010a,b, 2013)), yet few provide standardized accounting schemes
- National Ecosystem Services Classification System (NESCS)
 - based on existing hierarchical classification & accounting systems for economic goods & services
 - incorporates supply-side & demand-side
 - provides consistency & clarity in defining final ES
 - avoids double counting
 - flexible & comprehensive
 - supports different types of policy impact analyses (e.g., cost-benefit analysis of environmental regulations)

	NESCS-S		NESCS-D	
Group	Environment	End-Product	Direct Use/Non-Use	Direct User
Definition	Spatial units with similar biophysical characteristics that are located on or near the Earth's surface and that contain or produce "end-products"	Biophysical components of nature that are directly used or appreciated by humans	Different ways in which end-products are used or appreciated by humans	Entities that directly use or appreciate the end-products
Hierarchy and Coding System				
NESCS Code for FFES [±] : <i>WW.XX.YYYY.ZZZZZZ</i>				
Class	<i>W</i>	<i>WW.X</i>	<i>WW.XX.Y</i>	<i>WW.XX.YYYY.Z</i>
Subclass	<i>WW</i>	<i>WW.XX</i>	<i>WW.XX.YY</i>	<i>WW.XX.YYYY.ZZZ</i>
Detail			<i>WW.XX.YYYY</i>	<i>WW.XX.YYYY.ZZZZZZ</i>
Example 1: Water in the ocean being used as a medium for freight transportation				
NESCS Code for FFES: 15.12.1202.1483111				
Class	Aquatic: 1	Water: 1	Direct Use: 1	Industry: 1
Subclass	Open Ocean and Seas: 15	Liquid Water: 12	In-Situ Use: 12	Transportation and Warehousing: 148
Detail			Transportation medium: 1202	Deep Sea Freight Transportation: 1483111
Example 2: Water in rivers being extracted for household gardening purposes				
NESCS Code for FFES: 11.12.1105.201				
Class	Aquatic: 1	Water: 1	Direct Use: 1	Households: 2
Subclass	Rivers and Streams: 11	Liquid Water: 12	Extractive Use: 11	Households: 201
Detail			Support of plant or animal cultivation: 1105	

- Final Ecosystem Goods and Services Classification System” (FEGS-CS)
 - many attributes similar to NESCS
 - based on independent components of ecosystems (supply) & beneficiaries (demand)
 - focuses on final ES to avoid double counting



FEGS Classification Structure	
X	Environmental Class
XX.	Environmental Sub-Class
XX.XX	Beneficiary Category
XX.XXXX	Beneficiary Sub-Category



Recommendations for Risk Assessment & Management

- Analysis
 - evaluate EPFs to understand effects of alternative decision options on ES assessment endpoints
 - use EPFs to identify indirect ecological benefits
- Risk Characterization
 - ensure risk quantification & interpretation are performed using ES assessment endpoints in conjunction with conventional endpoints
 - communicate nature & magnitude of risks in terms & units amenable to valuation
- Risk Management/Communication
 - use conceptualizations of EPFs as key messaging devices when communicating risk & decision rationale
 - employ targeted monitoring to evaluate efficacy of assessment results & to inform adaptive management actions

Actions to Realize Benefits

- Adopting ES in policies & protection goals
- Developing procedural constructs & guidance
- Developing methods for identifying & quantifying ES responsive to decision making
- Documenting EPFs tied to tractable protection goals
 - conceptual, empirical & mechanistic
 - “menu” catalogs for specific decision contexts
- Educating
 - risk assessors
 - risk managers
 - key stakeholders & public

