Introduction to Natural Capital Accounting for the US

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Disclaimer

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Natural Capital and Ecosystem Services

- Natural Capital are tangible environmental assets, including land, water, minerals, and a number of natural resources such as timber and fish.
- Ecosystem services provide the flow of benefits that humans receive from these assets. These benefits from natural capital underpin almost every aspect of human well-being, including our food and water, security, health, and economy.

Natural Capital Accounting

- Natural capital accounts highlight the connections between the natural and economic systems, and can help governments to better:
  - Understand their economies' reliance upon natural systems,
  - Track changes in natural systems that may have implications for different industries, and
  - Manage natural resources and ecosystems to sustain their economic benefits into the future
- Natural capital accounting is a method of assessing contributions of natural ecosystems to the economy in a way that is consistent with the System of National Accounts used to measure economic activity (Guerry et al., 2015; WAVES, 2012).

System of National Accounts

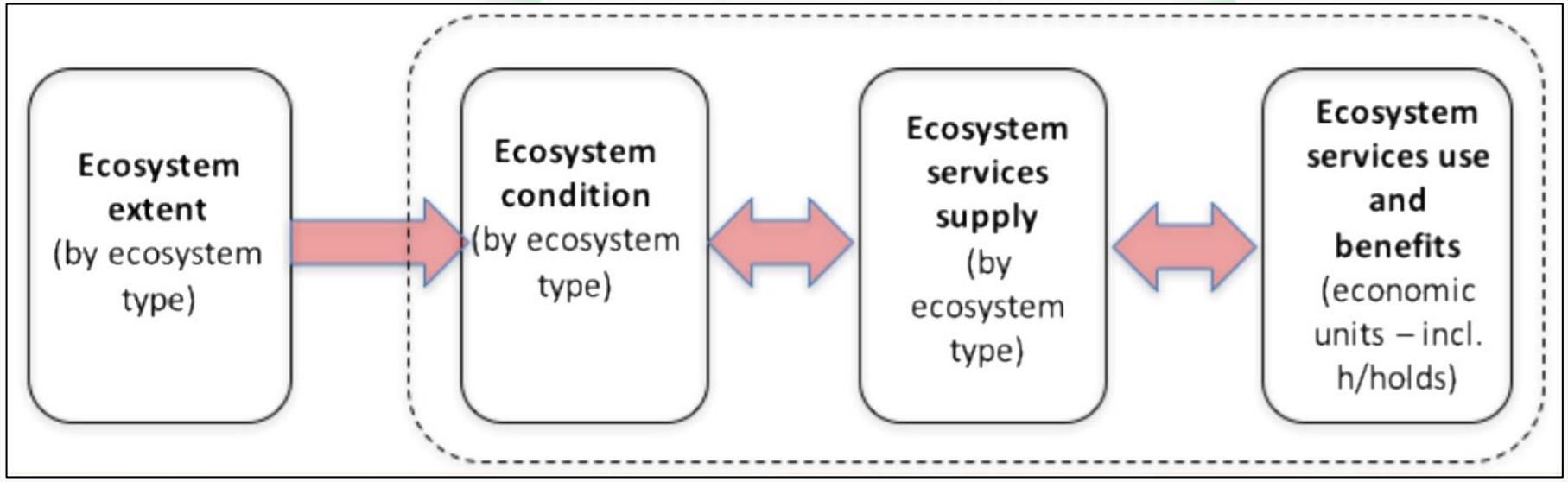
- The System of National Accounts is a measurement framework that has been evolving since the 1950s to embody the pre-eminent approach to the measurement of economic activity, economic wealth and the general structure of the economy.
- Over the past several decades, the United Nations and partner organizations have developed a standard framework for natural capital accounting called the System of Environmental-Economic Accounting or SEEA.

The Central Framework

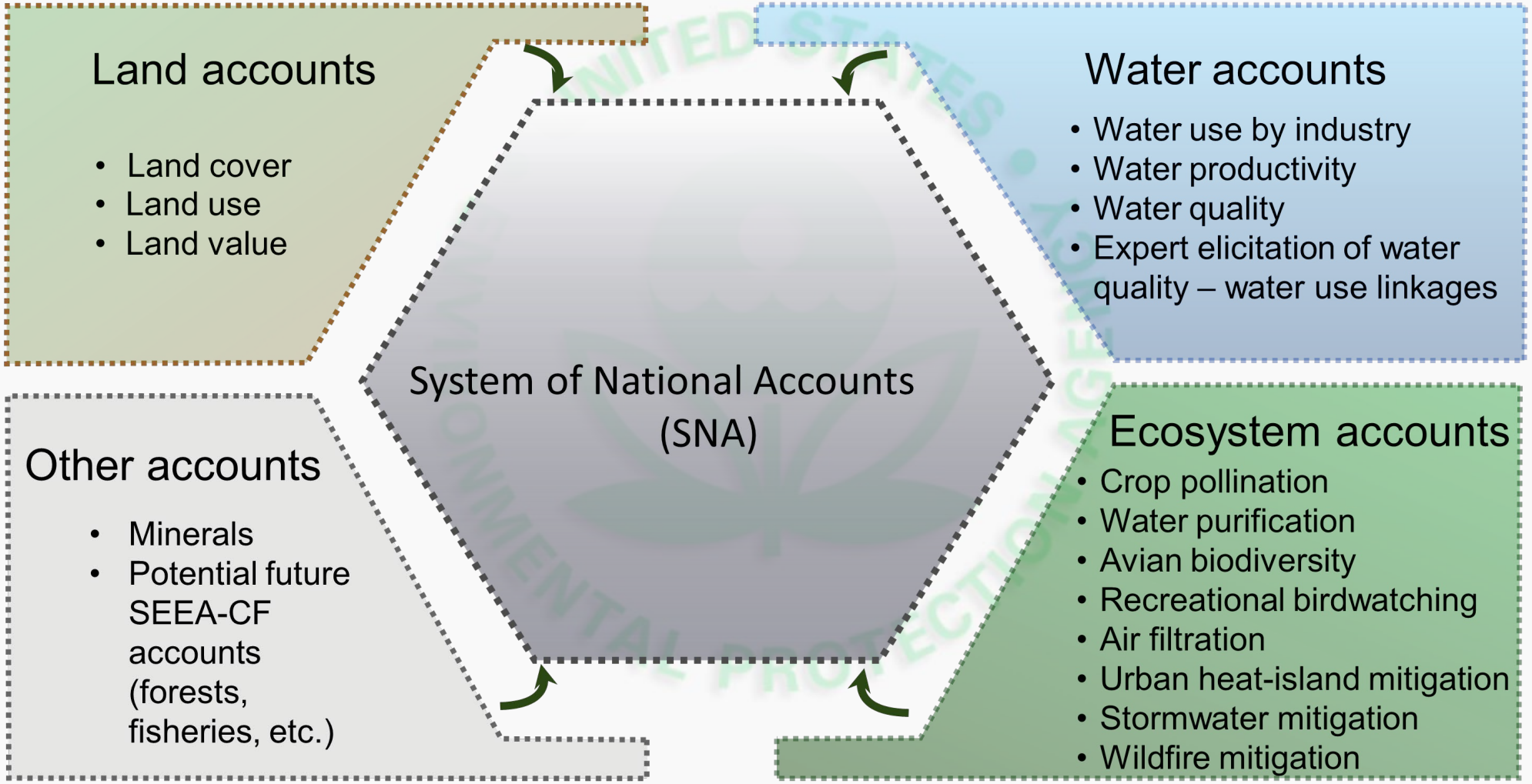
- The core of the System of Environmental-Economic Accounting is the Central Framework (United Nations et al., 2012).
- The Central Framework applies the accounting concepts, structures, rules and principles of the System of National Accounts to environmental information.
- The power of the Central Framework comes from its capacity to present information in both physical and monetary terms coherently (U.N. et al. 2014)

Ecosystem Accounting

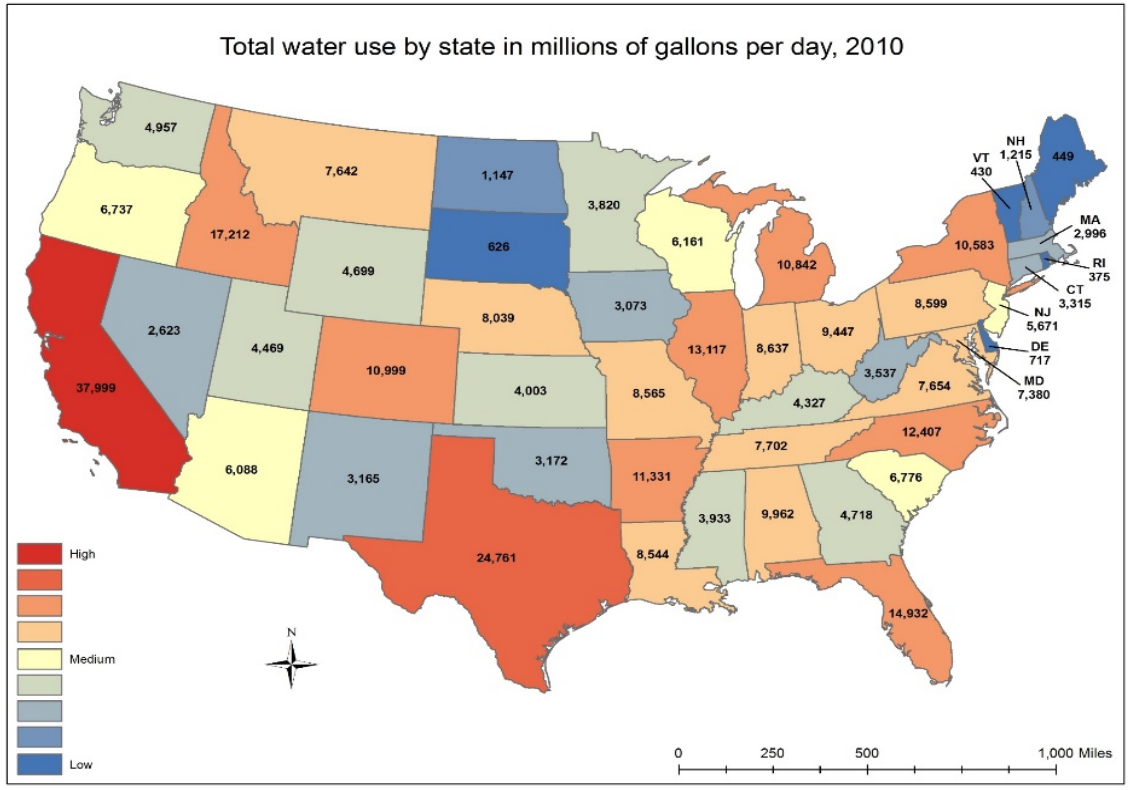
- The System of Environmental-Economic Accounting **Experimental Ecosystem Accounts**, which currently reside outside of the Central Framework, are being designed to track the extent and condition of ecosystem assets, beyond just timber and fish, and the flows of ecosystem services they provide to people and the economy (United Nations et al., 2013).

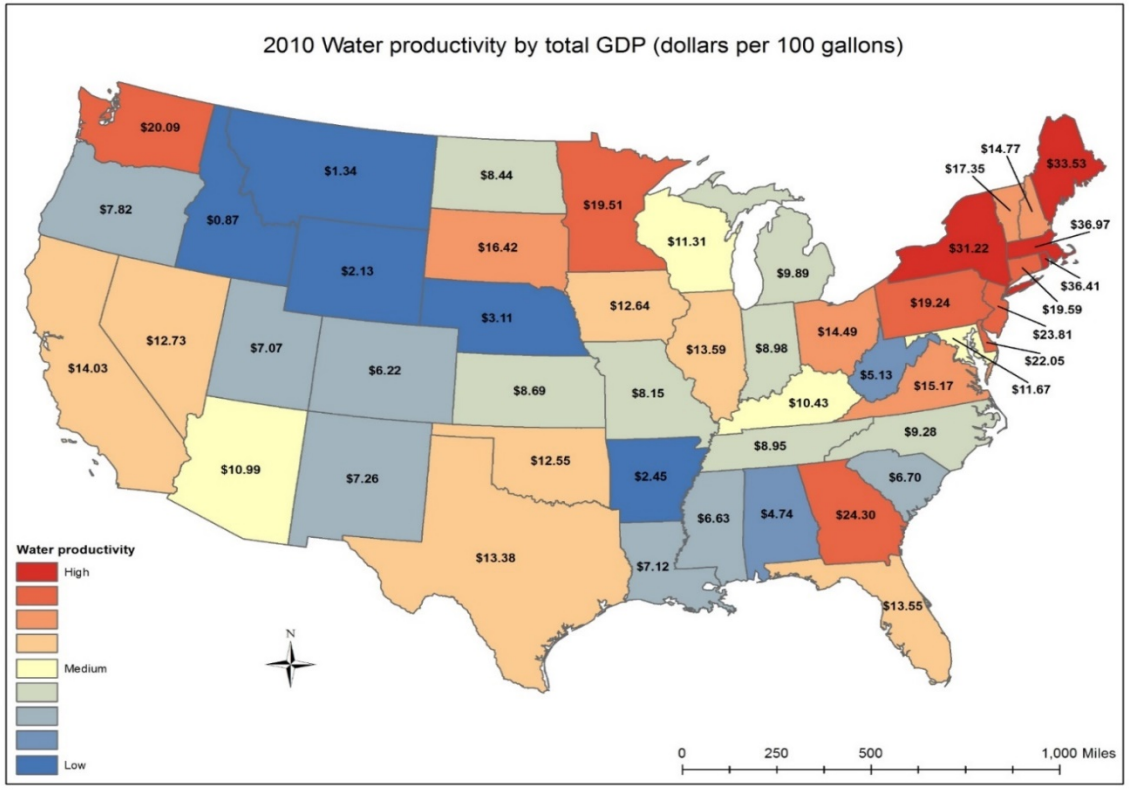


Integration into System of National Accounts



Water Account Examples for U.S.

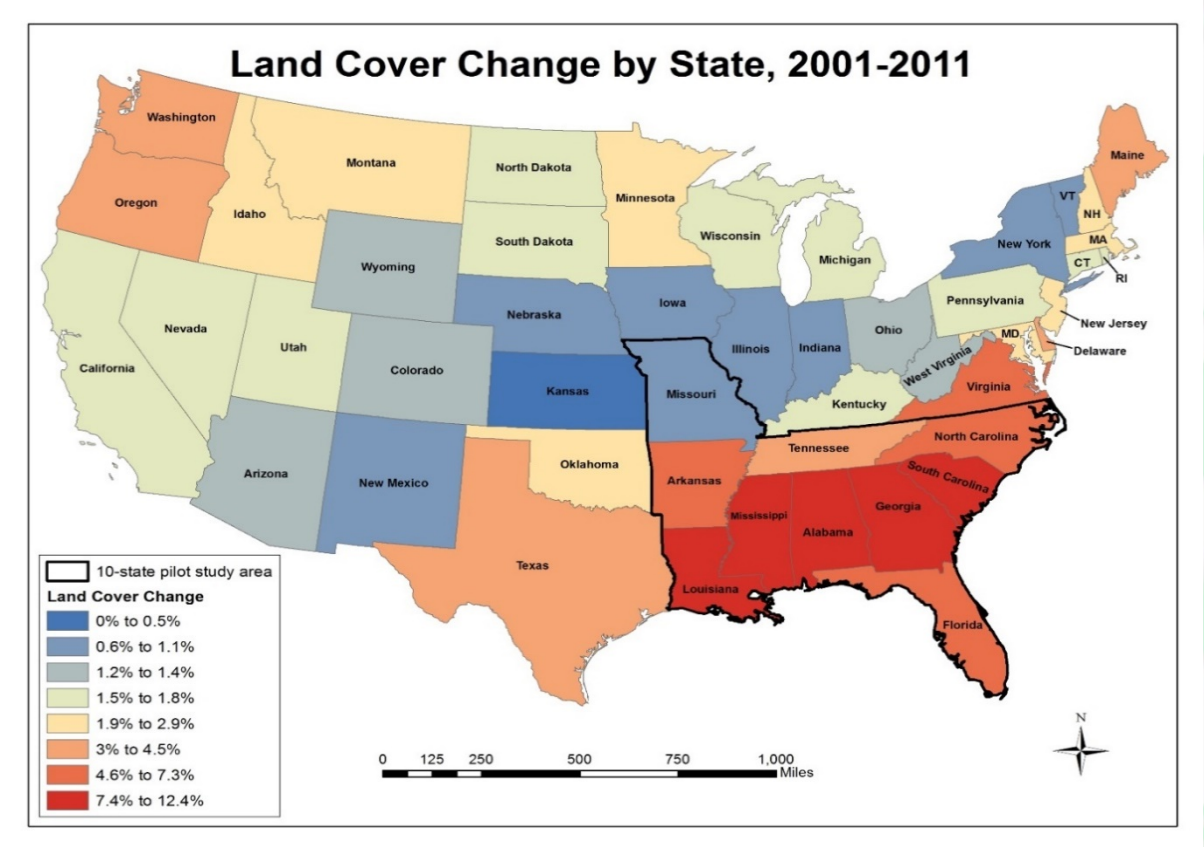


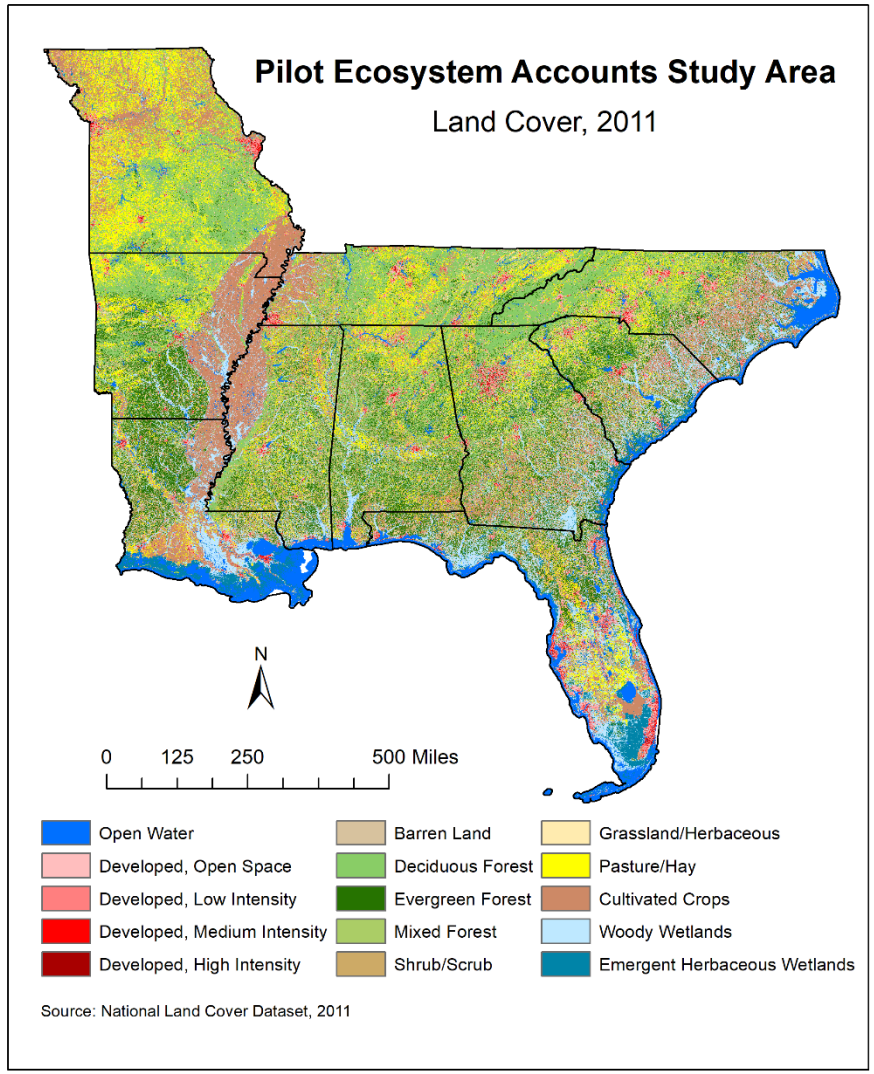


Natural Capital Accounting and Ecosystem Services

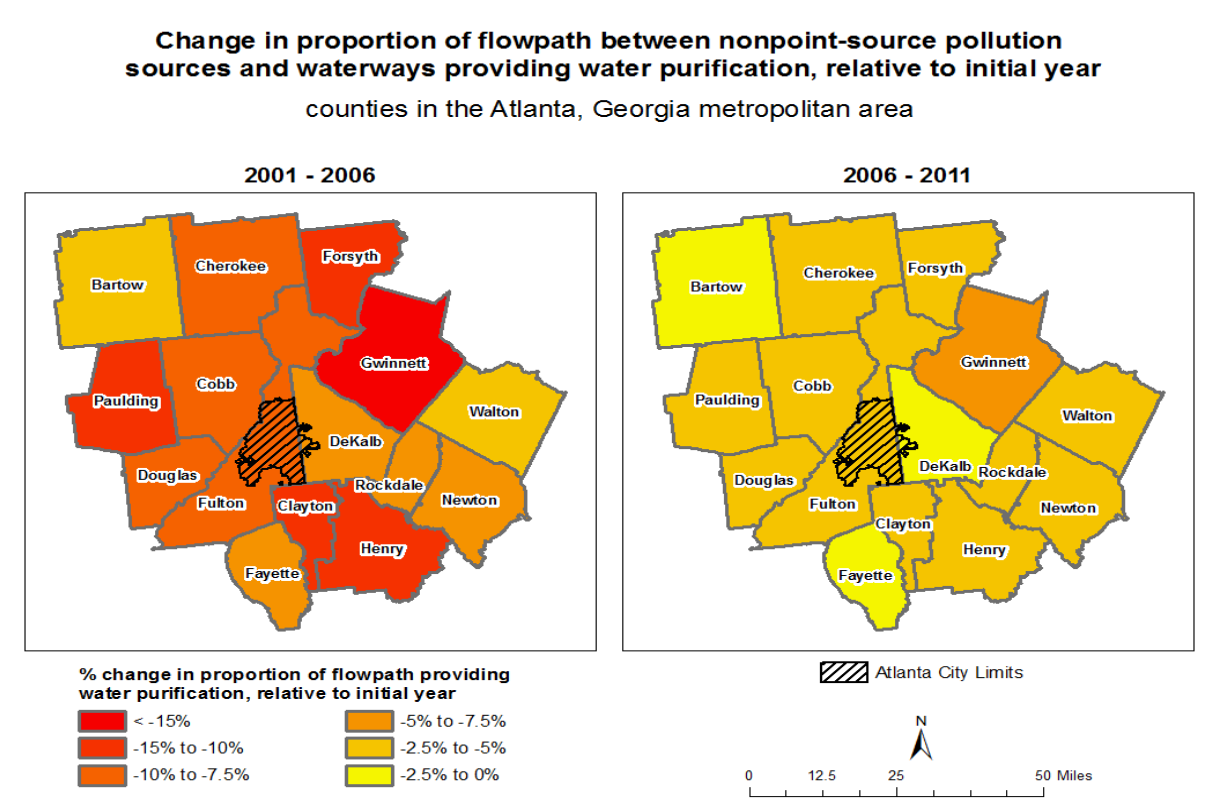
- Common principles include:
  - An emphasis on spatial definition of ecosystems;
  - The use of ecosystem type (often approximated by land cover type) as the main descriptor of complex portfolios of environmental function; and
  - Assessments that are largely static in nature (i.e. focused on structural features and not functional rates), but repeatable over time.
- Accounting principles, when applied to ES science, focus attention directly onto ecological products at their entry points into the economic realm where they then can be associated with benefits to humans.

Pilot Ecosystem Account

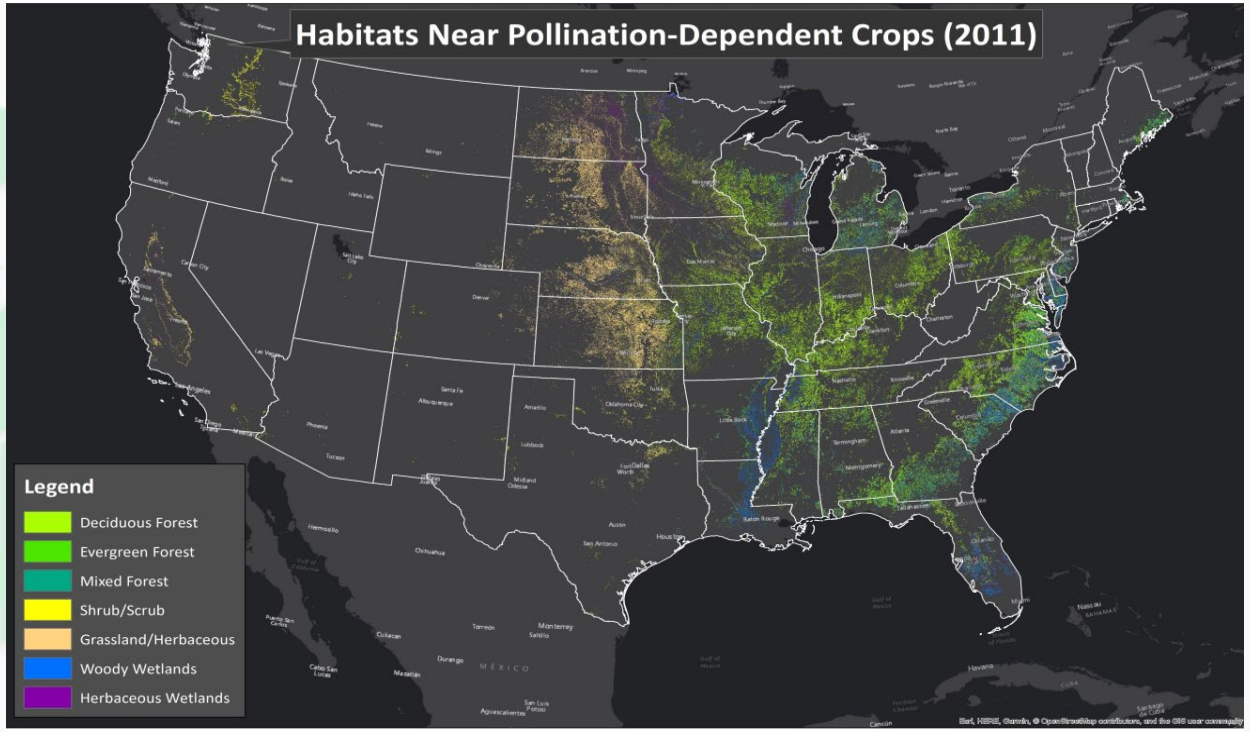




Condition Metrics – Part of Production Functions



Condition metric related to the supply of clean water



Condition metric related to the supply of wild pollination

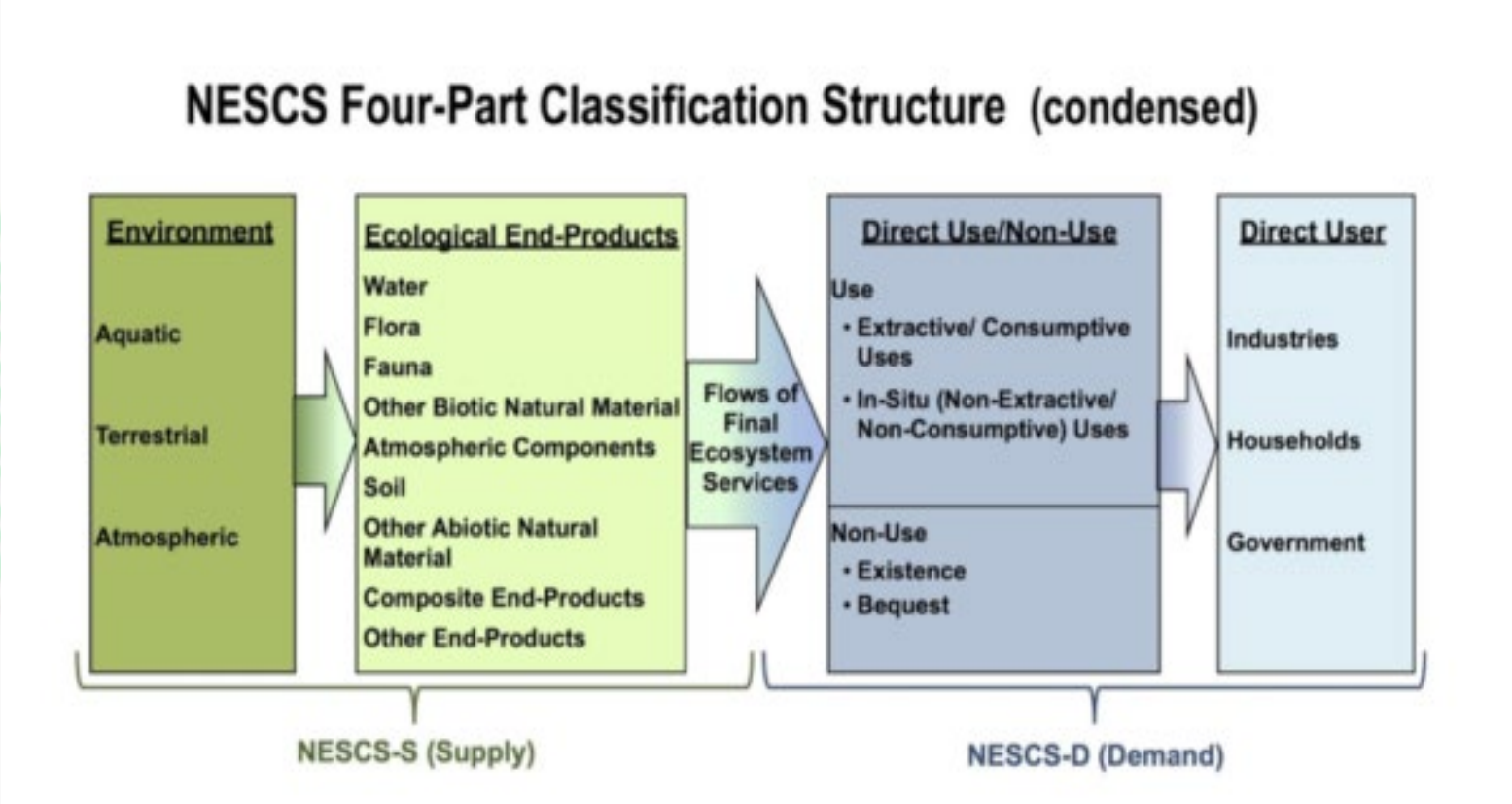
Condition Table

- Focus on structural and functional aspects of the ecosystem that support the supply of ecological end-products
- Not directly used
- Metrics from EPA's ESML

			Ecosystem Types (Land Cover)																
			Offshore	Open Water - non-freshwater	Open Water - freshwater	Developed - Open	Developed - Low	Developed - Medium	Developed - High	Barren	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/Scrub	Grassland/Herbaceous	Pasture/Hay	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands
Pollination	Area of pollinator habitat near pollinator-dependent crops (sq km)*	2001									5,471	2,516	1,336	1,290	165			7,061	172
		2006									4,152	2,125	1,459	2,191	423			11,539	371
		2011									53,679	30,441	6,670	18,388	9,314			43,104	3,354
	Area of pollinator-dependent crops in range of pollinator habitat (sq km)*	2001															11,182		
		2006															21,581		
		2011															65,818		
	Ratio of pollinator habitat to pollinator-dependent crops*	2001															1.66		
		2006															1.05		
		2011															2.55		
Water purification	Area of purifying land cover types between NPS sources and waterways (sq km)	2001									31,542	20,238	6,959		5,385			25,463	3,379
		2006									31,453	19,780	6,678		5,997			25,427	3,504
		2011									31,005	19,330	6,353		6,192			25,151	3,789
	% of flowpath between NPS sources and waterways in purifying land cover types	2001			30.6%														
		2006			30.4%														
		2011			29.9%														
Bird biodiversity	Bird species richness (160 species modeled)	2001	158		157	156	149				160	160				160	160	158	148
		2006	158		157	156	150				160	160		145		160	160	159	150
		2011	158		157	156	150				160	160		144		160	160	159	147

EPA's Classification System

- Useful Foundation
- Provides terms and classes for elements of Supply and Use tables:
  - Environment and Users
  - Ecological End-Products and Uses
  - Ecosystem Services



Ecosystem Account Supply Table

- Focus on *where* ecological end-products are when directly *used* in ecosystem services

			Ecosystem Types (Land Cover)															
			Offshore	Open Water	Developed - Open	Developed - Low	Developed - Medium	Developed - High	Barren	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/Scrub	Grassland/Herbaceous	Pasture/Hay	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Total
Recreational birding (thousands of birding days)		2001	2,015	8,471	6,935	5,897	1,850	978	416	6,586	3,441	365	1,075	1,498	2,285	4,614	7,106	3,343	56,874
		2006	518	4,418	8,552	9,451	4,368	1,129	780	6,273	3,433	531	2,208	2,808	2,833	3,658	6,196	2,204	59,360
		2011	1,236	5,207	10,022	7,420	3,553	1,046	1,408	7,173	3,816	692	1,966	1,833	4,050	2,634	4,964	3,695	60,715
Air pollutant concentrations (annual mean, ppb or µg/m^3)	CO	2010			323.66														323.66
		2015			290.10														290.10
	NO2	2010			7.43														7.43
		2015			7.01														7.01
	O3	2010			30.29														30.29
		2015			27.88														27.88
	PM10*	2010			9.41														9.41
		2015			9.54														9.54
	PM2.5	2010			10.89														10.89
		2015			10.35														10.35
	SO2	2010			2.00														2.00
		2015			1.04														1.04

Ecological End-Products

- Water
- Flora
- Fauna
- Other Biotic Natural Material
- Atmospheric Components
- Soil
- Other Abiotic Natural Material
- Composite End-Products
- Other End-Products

Ecosystem Types (Land Cover)

Metrics from FEGS Champions

Ecosystem Account Use Table

- Focus on *who* uses *ecological end-products* when they are used in ecosystem services
- Ties directly to North American Industrial Classification System (plus Households and Govt)
- Use = Supply

Ecological End-Products

- Water
- Flora
- Fauna
- Other Biotic Natural Material
- Atmospheric Components
- Soil
- Other Abiotic Natural Material
- Composite End-Products
- Other End-Products

Economic Units (Direct User)

		Economic units (NAICS codes)			
		Ho	In	Go	To
	2001	56,874	0	0	56,874
	2006	59,360	0	0	59,360
	2011	60,715	0	0	60,715
CO	2010				323.66
	2015				290.10
NO2	2010				7.43
	2015				7.01
O3	2010				30.29
	2015				27.88
PM10*	2010				9.41
	2015				9.54
PM2.5	2010				10.89
	2015				10.35
SO2	2010				2.00
	2015				1.04

How EPA research supports Natural Capital Accounting

- Final Ecosystem Service Approach provides much support in the form of frameworks, classification systems, definitions, and metrics.
- Enviro-Atlas provides a wide range of useful spatial data layers for generating tables.
- Ecosystem Services Model Library provides many production functions for relating condition table metrics to supply and use table metrics.
- FEGS champions are generating metrics for many ecosystem specific Final Ecosystem Services.
- Community based work serves as a testing ground for pilot accounts.

Questions

- For further information contact: Marc Russell (russell.marc@epa.gov)
- Co-leading Ecosystem Accounts manuscript for special issue of Ecosystem Services journal for next year
- Working group final meeting next Spring at SYSYNC, University of Maryland