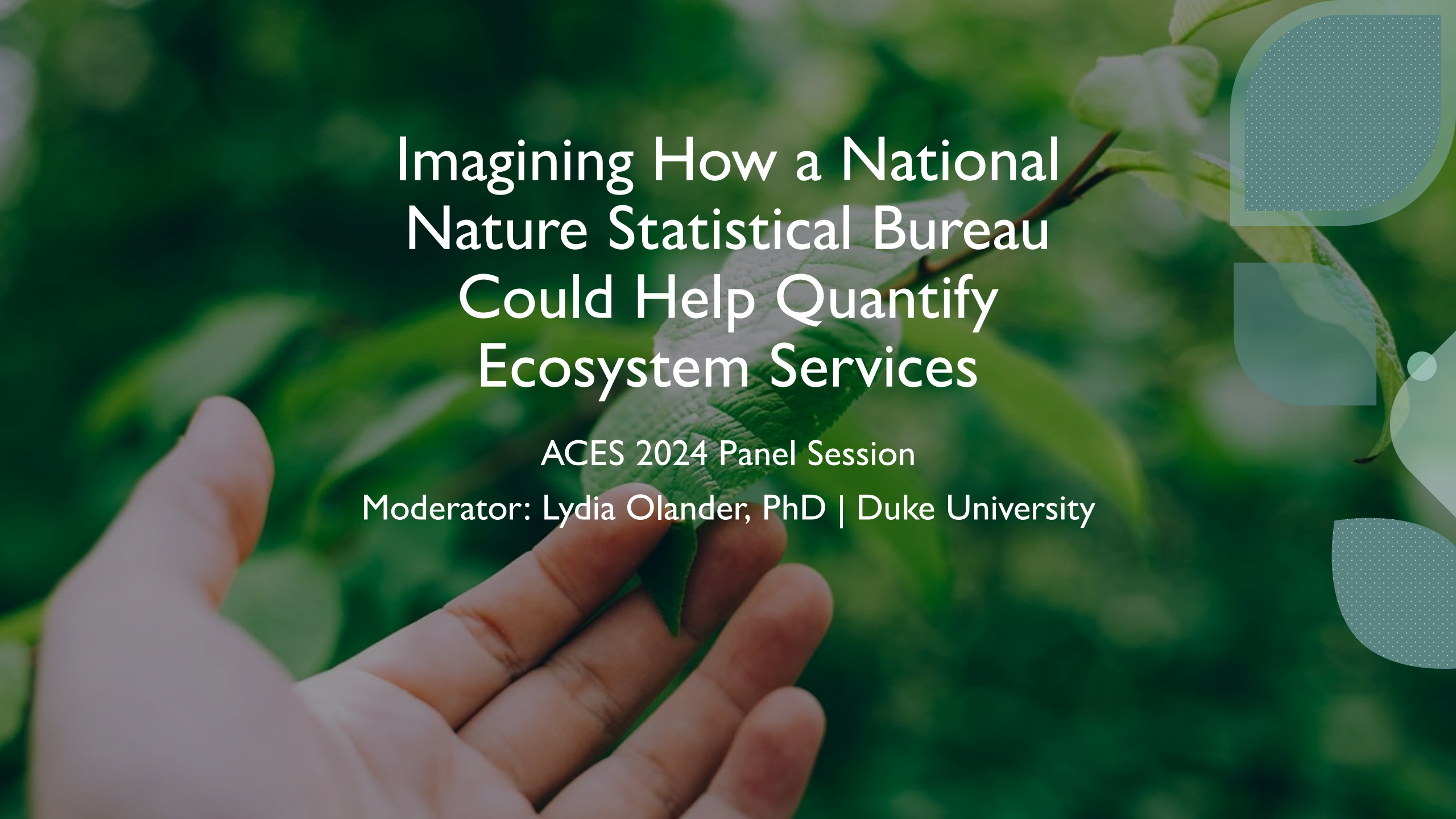


Imagining How a National Nature Statistical Bureau Could Help Quantify Ecosystem Services

ACES 2024 Panel Session

Moderator: Lydia Olander, PhD | Duke University

Challenges

- Nature data is collected and managed by multiple federal agencies to support different programmatic and regulatory functions.
- Inconsistent data quality
- Inconsistent metrics
- Limited capacity to evaluate and incorporate new data
- High latency leading to outdated data and tools
- Data set incompatibility

End Uses

Spatially explicit national, state, county status and trends for nature and ES & Economic implications of changes in nature through natural capital accounting (statistical) can inform:

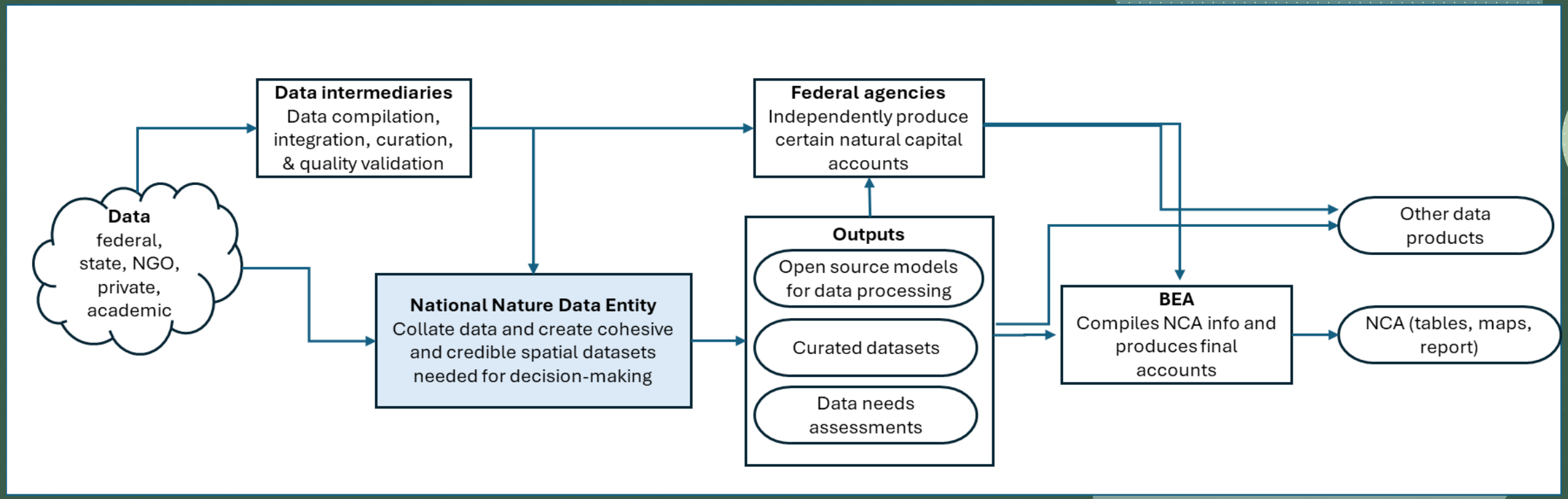
- Federal (state and local) policy and investments in nature resources and conservation (e.g., fire, drought, flood, food/timber production, conservation, compensatory mitigation)
- Private sector investments
  - Quality of farm and timber lands
  - Quality of hunting leases
  - NEPA compliance and nature disclosure
- Tracking progress toward goals (e.g., 30x30)
  - National nature assessment

Activities to collate nature data across agencies into cohesive and credible spatially explicit data sets that can feed into critical products necessary for public and private sector decision making related to nature, including natural capital economic accounts and indicators.

- Established data pipeline, integration, and quality framework to facilitate aggregation of nature data across federal agencies and incorporate external data sources
- Standardized, credible, interoperable nature data
- Reduced data latency
- Automated creation of key data sets
- Streamlined data sharing (with protections for private/ sensitive/ confidential data) within and outside of the federal system
- Cohesive identification and elevation of nature data needs

Possible Mission

The _____ is dedicated to collating data across agencies into cohesive and credible spatially explicit data sets that underlie critical data products necessary for public and private sector decision making related to nature, including national environmental-economic accounts and indicators.



Previous efforts to create federal nature data coordination

- National Biological Survey/Service (created in 1993, transferred to USGS in 1996, reorganized under Ecosystems Mission Area in 2010)
- National Biological Information Infrastructure (created 1994, terminated 2012)
- Bureau of Environmental Statistics (within EPA, proposed 1990s)
- State of the Nation's Ecosystems report (Heinz Center, released in 2002 and 2008; Center closed in 2013)
- Report on the Environment (EPA began this initiative in 2001; indicators continue to be updated as new data are available)

Possible interagency structures

- Federal statistical agency
- Federal interagency forum
- Federally funded R&D center
- Congressionally established independent nonprofit organization
- Data trust

Panel

- Dr. Ken Bagstad – USGS
- Dr. Emily Silverman – DOI
- Dr. Chris Hartley – USDA
- Dr. Regan Smyth – NatureServe

Considerations for a National nature statistical data infrastructure

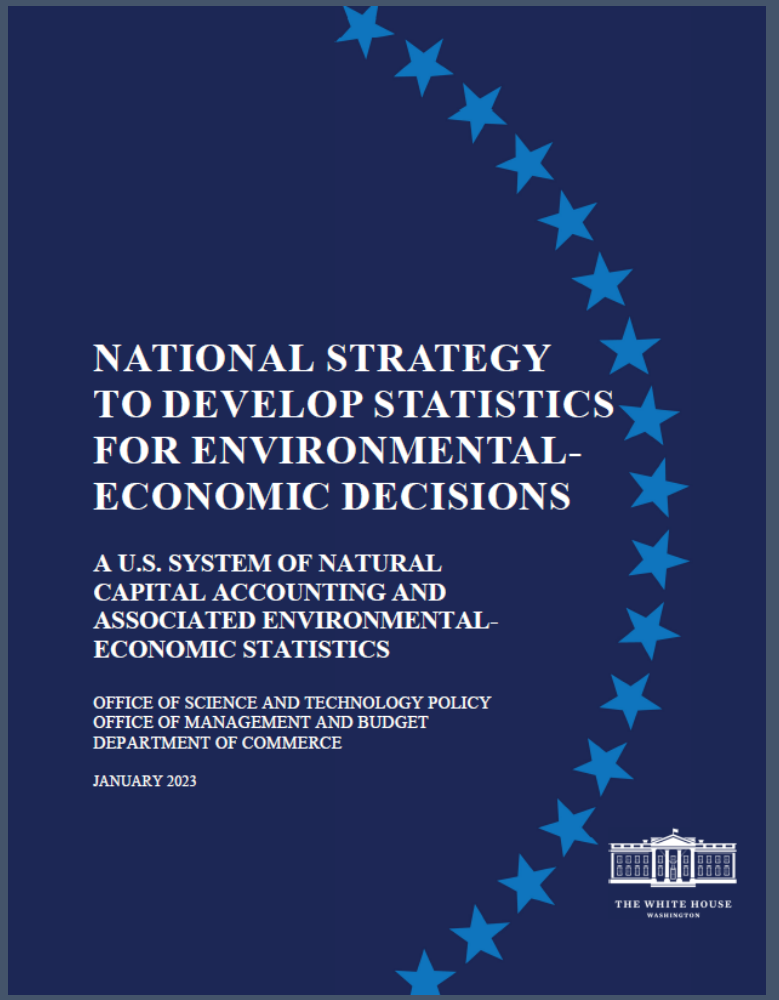
December 2024

Ken Bagstad

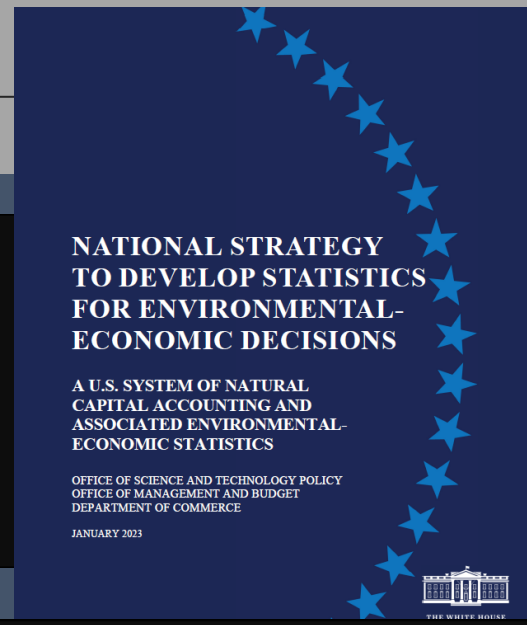
Nature data, circa 2035

"**Supporting recommendation:** The Federal Government should produce annual assessments of Change in Natural Asset Wealth. The metric ideally would be reported with fourth quarter GDP in early April… The choice of annual reporting… should be revisited if more frequent information becomes necessary… some of the data used for the updates will be collected, and possibly reported, more frequently—particularly when intra-annual variation matters."

(U.S. Natural Capital Accounting Strategy, Pg. 34)



		Co-Lead Departments/ Agencies	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Headline Summaries	Changes in natural capital wealth	BEA, NOAA, DOI, USDA														
	Net domestic product inclusive of natural assets	BEA			*											
cts	Hazards, extreme weather and climate events, and resilience	NOAA, DOI, USDA, Census, USFS														
	• • •															
Phase I Environmental Sectors	Air emissions	BEA, EPA														
	Water	USGS, EPA, BEA, USDA, NOAA														
	Land	BEA, USDA, DOI, EPA, USFS														
	Environmental activities & jobs	BEA, BLS, EPA, Census														
	Marine natural capital (I)	NOAA, BEA														
	• • •															
Supporting Activities	Classification systems	CSOTUS, BEA, EPA, BLS, Census, DOI														
	Data sharing protocols	CSOTUS, NASA, DOI, NOAA, Census														
	Valuation standards for national accounting	OMB, BLS, BEA, EPA, NOAA, DOI, USDA														
	Guidance for using the system in Federal benefit-cost analysis	OMB														
	International engagement	CSOTUS, Treasury, State								Ongoing						
	Website and data serving system	BEA or other														



Pilot Prototype Production-grade

Enabling conditions for nature data

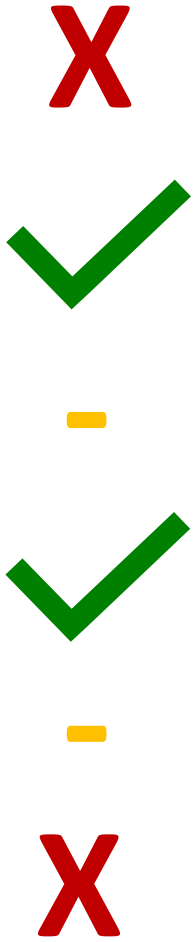


Table 1
Factors that enable business use of natural capital data.

Relevance/materiality:
- Data must be available for aspects of natural capital that are material to a company, which may include how nature impacts a company and its operations, and also how the operations of a company impact nature.

Accessibility:
- Provided in a format that can be readily used by non-specialists
- Licensed suitably for commercial use
- Affordability

Quality:
- Accuracy of data
- Completeness of data with respect to appropriate spatial and temporal scales consistent with business decisions

Credibility:
- Sourced from credible data providers
- Quality assured and backed up by a credible standard and/or methodology with clearly stated limitations

Capacity:
- The ability to collect, clean, organize, publish, and use data for decision making

Infrastructure:
- Governance and management of data
- Standards and guidance on data use
- Technology and training to be able to use high volumes of potentially complex data

Adapted and modified from NCC, 2019

Today's NCA data aren't timely, complete, or yet production-grade

Ingram et al. 2022

Data & model integration: 2018

Pollination, water purification, carbon storage

Avian biodiversity

Air pollutant removal

“Kindness of strangers” approach: acceptable for pilots, completely unsuitable for production-grade data

Ecosystem Services 43 (2020) 101099

Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser

Testing ecosystem accounting in the United States: A case study for the Southeast

Katherine J.D. Warnell[a], Marc Russell[b], Charles Rhodes[c], Kenneth J. Bagstad[d,*], Lydia P. Olander[a], David J. Nowak[e], Rajendra Poudel[f], Pierre D. Glynn[g], Julie L. Hass[h], Satoshi Hirabayashi[i], Jane Carter Ingram[j], John Matuszak[k], Kirsten L.L. Oleson[l], Stephen M. Posner[m], Ferdinando Villa[n]

			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	TOTAL
Wild pollination*	Area of pollinator habitat in flight range of pollinator-dependent crops (sq km)	2001									5,471	2,516	1,336	1,290	165			7,061	172	18,011
		2006									4,152	2,125	1,459	2,191	423			11,539	371	22,259
		2011									53,679	30,441	6,670	18,388	9,314			43,104	3,354	164,951
	Area of pollinator-dependent crops in flight range of pollinator habitat (sq km)	2001															11,182			11,182
		2006															21,581			21,581
		2011															65,818			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	92,966
		2006									31,453	19,780	6,678		5,997			25,427	3,504	92,840
		2011									31,005	19,330	6,353		6,192			25,151	3,789	91,820
	% of flowpath between NPS sources and waterways in purifying land cover types	2001			30.6%															
		2006			30.4%															
		2011			29.9%															
Bird biodiversity	Mean bird species richness (out of 160 species modeled)	2001	142.1		141.6	145.0	149.0				147.5	148.3				147.5	148.0	145.5	127.9	
		2006	142.5		142.0	146.0	150.0				147.6	148.3		145.0		147.5	148.3	145.8	129.0	
		2011	142.4		142.5	144.5	150.0				147.5	148.3		144.0		148.0	147.6	145.9	129.4	
	Wind Speed (m/s)	2010	2.42																	
		2015	2.54																	
	Temperature (°C)	2010	17.06																	
		2015	17.38																	
	Precipitation (mm/yr)	2010	962																	
		2015	1344																	
	Canopy cover (%)	2010	58%																	

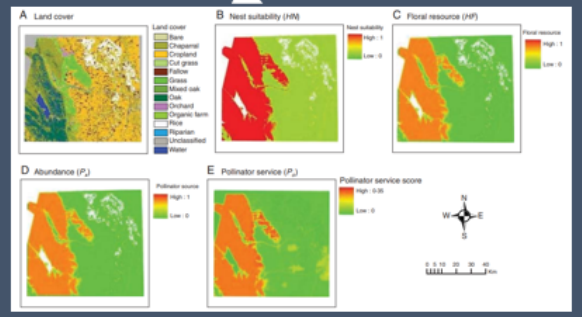
Data & model integration: Today

NLCD

USDA Cropland Data Layer

USDA-NASS crop yield & price data

Ecological data on pollinators (model parameterization)



https://code.usgs.gov/

ScienceBase

bea Bureau of Economic Analysis U.S. DEPARTMENT OF COMMERCE

Year	Ecosystem Types (Land cover)												
	Developed - Low	Developed - Medium	Developed - High	Barren	Deciduous Forest	Evergreen Forest	Mixed Forest	Scrub/Shrub	Grassland/Herbaceous	Agriculture	Woody Wetlands	Emergent Herbaceous Wetlands	TOTAL
2008	$140.4	$17.7	$1.2	$4.1	$243.7	$44.0	$50.7	$136.9	$552.1	$5,909.1	$101.2	$71.8	$7,273.0
2011	$160.7	$21.2	$1.5	$7.0	$286.8	$61.7	$61.2	$227.1	$531.3	$7,435.5	$119.8	$98.8	$9,012.7
2014	$223.9	$34.9	$2.7	$12.0	$399.7	$60.0	$74.5	$183.9	$791.9	$9,591.9	$145.6	$138.2	$11,659.1
2017	$210.5	$34.3	$2.7	$8.9	$431.9	$61.3	$77.8	$189.4	$506.1	$9,352.3	$149.1	$141.3	$11,165.6
2020	$171.9	$32.7	$2.7	$8.2	$432.2	$60.8	$90.6	$167.4	$381.5	$7,624.0	$121.6	$121.2	$9,215.0

Year	Economic Units													
	111110 Soybean farming	111120 Oilseed (except soybean) farming[1]	111219 Other vegetable (except potato) and melon farming[2]	111310 Orange groves	111320 Citrus (except orange)	111331 Apple orchards	111332 Grape vineyards	111333 Strawberry farming	111334 Berry (except strawberry) farming[3]	111335 Tree nut farming[4]	111339 Other noncitrus fruit farming[5]	111920 Cotton farming	111992 Peanut farming	TOTAL
2008	$4,311.2	$66.2	$66.7	$563.7	$57.5	$347.5	$506.5	$93.9	$45.1	$246.9	$264.7	$556.6	$146.3	$7,273.0
2011	$4,791.3	$64.2	$41.2	$576.5	$59.9	$342.7	$433.9	$107.9	$40.8	$364.7	$225.5	$1,798.4	$165.7	$9,012.7
2014	$7,415.7	$63.8	$47.4	$547.2	$86.3	$362.7	$868.0	$295.3	$81.2	$710.0	$220.4	$794.4	$166.9	$11,659.1
2017	$7,232.1	$65.6	$80.3	$368.4	$45.5	$328.5	$879.9	$137.8	$70.1	$528.5	$250.4	$998.6	$179.9	$11,165.6
2020	$5,848.8	$85.5	$43.3	$152.0	$94.3	$363.8	$654.2	$33.1	$94.1	$570.8	$351.8	$764.3	$159.1	$9,215.0

FAIR Principles: A 21st-century science solution

FAIR Principles

Findability

Resource and its metadata are easy to find by both, humans and computer systems. Basic machine readable descriptive metadata allows the discovery of interesting data sets and services.

Accessibility

Resource and metadata are stored for the long term such that they can be easily accessed and downloaded or locally used by humans and ideally also machines using standard communication protocols.

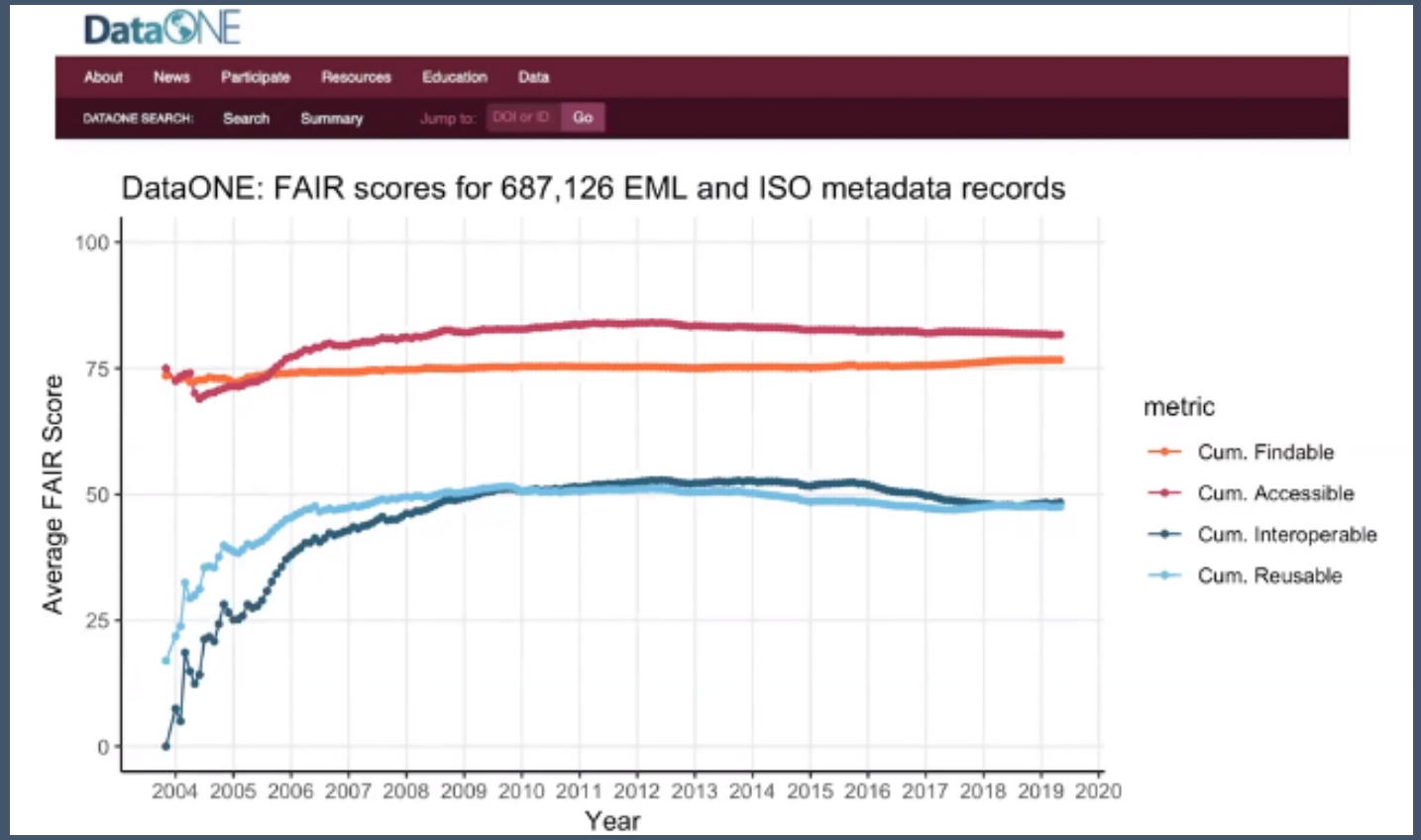
Interoperability

Metadata should be ready to be exchanged, interpreted and combined in a (semi)automated way with other data sets by humans as well as computer systems.

Reusability

Data and metadata are sufficiently well-described to allow data to be reused in future research, allowing for integration with other compatible data sources. Proper citation must be facilitated, and the conditions under which the data can be used should be clear to machines

https://go-fair.org/



https://old.dataone.org/webinars/quantifying-fair-metadata-improvement-and-guidance-dataone-repository-network

Interoperability:

The ability of independently developed data or tools to integrate or work together with minimal effort*

A core challenge to the global scientific community

*for use in computational pipelines – models & workflows should support interoperability too

Types of interoperability

Syntactic interoperability:
Use of compatible data formats and communication protocols.
Low bar, more limited advantages

<

Semantic interoperability:
Data transfers where a receiving system can understand the meaning of exchanged data, reusing it appropriately.
Higher bar, greater potential for automation & data/model reuse.

Heiler 1995

Semantic interoperability requires shared semantics

- Community involvement; clear goals; limited scope; simple, intuitive structure; continuous evolution; active curation; and early use (Bada et al. 2004)
- *A semantics community of practice for the field of ecosystem services*

```
model chemistry:Organic chemistry:Carbon im:Mass
        observing
             ecology:Vegetation chemistry:Carbon im:Mass [...]
        set to [vegetation_carbon_storage + soil_carbon_storage];
```

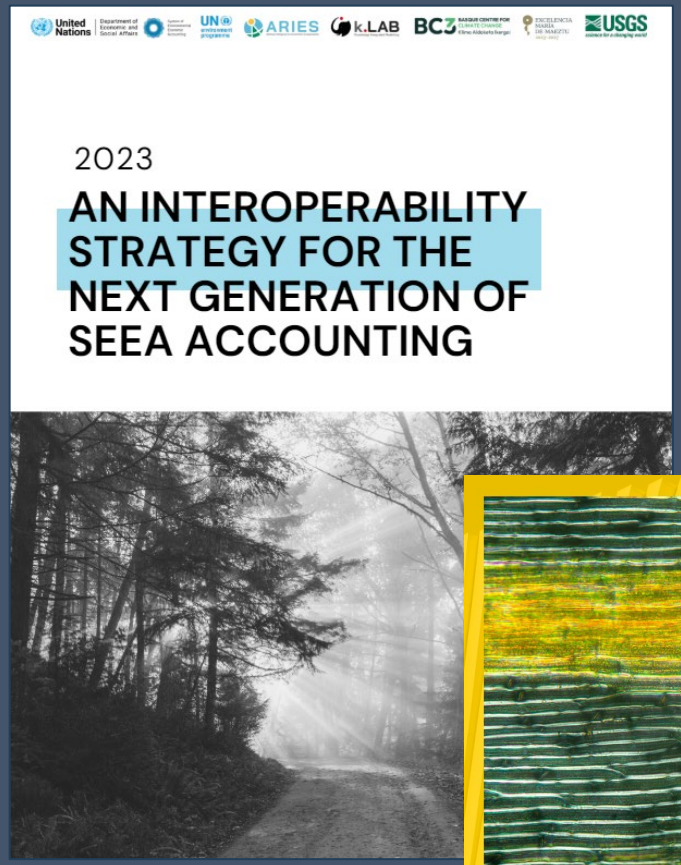
Interoperability for ecosystem service assessments: Why, how, who, and for whom?

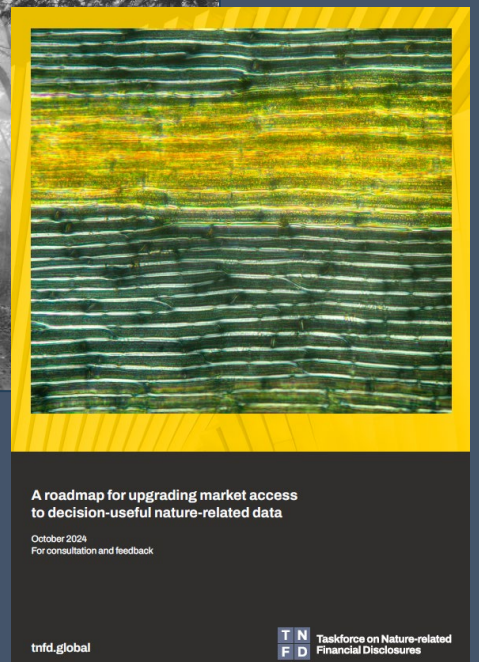
Kenneth J. Bagstad[1*], Stefano Balbi[2,3], Greta Adamo[2], Ioannis N. Athanasiadis[4], Flavio Affinito[5], Simon Willcock[6,7], Ainhoa Magrach[2,3], Kiichiro Hayashi[8], Zuzana V. Harmáčková[9], Aidin Niamir[10], Bruno Smets[11], Marcel Buchhorn[11], Evangelina G. Drakou[12], Alessandra Alfieri[13], Bram Edens[14], Luis Gonzalez Morales[15], Agnes Vári[5,16], María-José Sanz[2,3], Ferdinando Villa[2,3]

Abstract. Despite continued, rapid growth in the literature, the fragmentation of information is a major barrier to more timely and credible ecosystem services (ES) assessments. A major reason for this

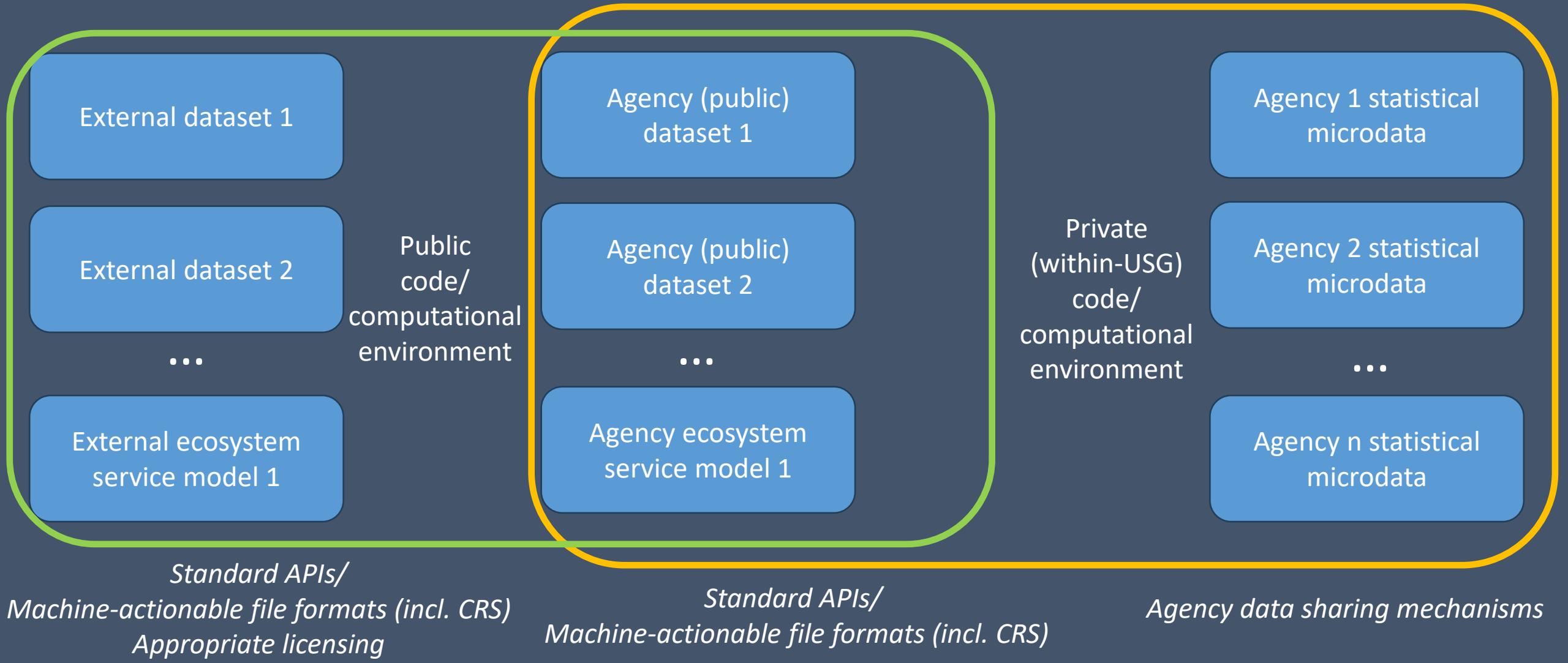
Bagstad et al. (in revision), resubmitted to *Ecosystem Services*

Technical & institutional/cultural dimensions





Nature data & code ecosystem



Thanks!

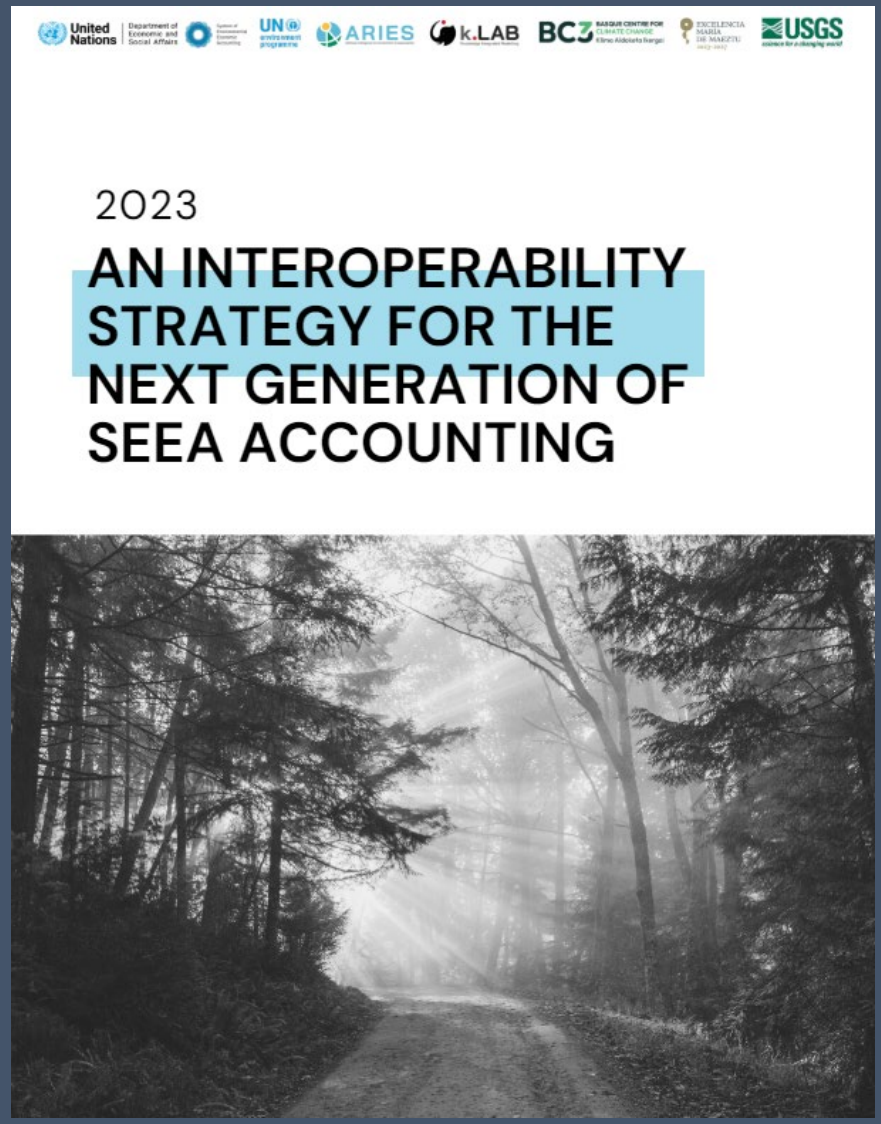
kjbagstad@usgs.gov

A shared vision?

SEEA accounts & related indicators will be:

1. rapidly recompilable as new science emerges,
2. quickly produced to show the most recent trends as new annual data become available, with
3. robust international comparisons possible, while country-specific customization is still easily done.

This vision moves high-quality, meaningful information from scientists into the hands of decision makers, the public, and the media as quickly as possible.



U.S. DEPARTMENT OF THE INTERIOR

DOI Perspectives on a National Nature Statistical Bureau

A Community on Ecosystem Services 2024
Austin, TX
December 11, 2024

Emily Silverman, Advisor on Statistical Policy, Office of Policy Analysis

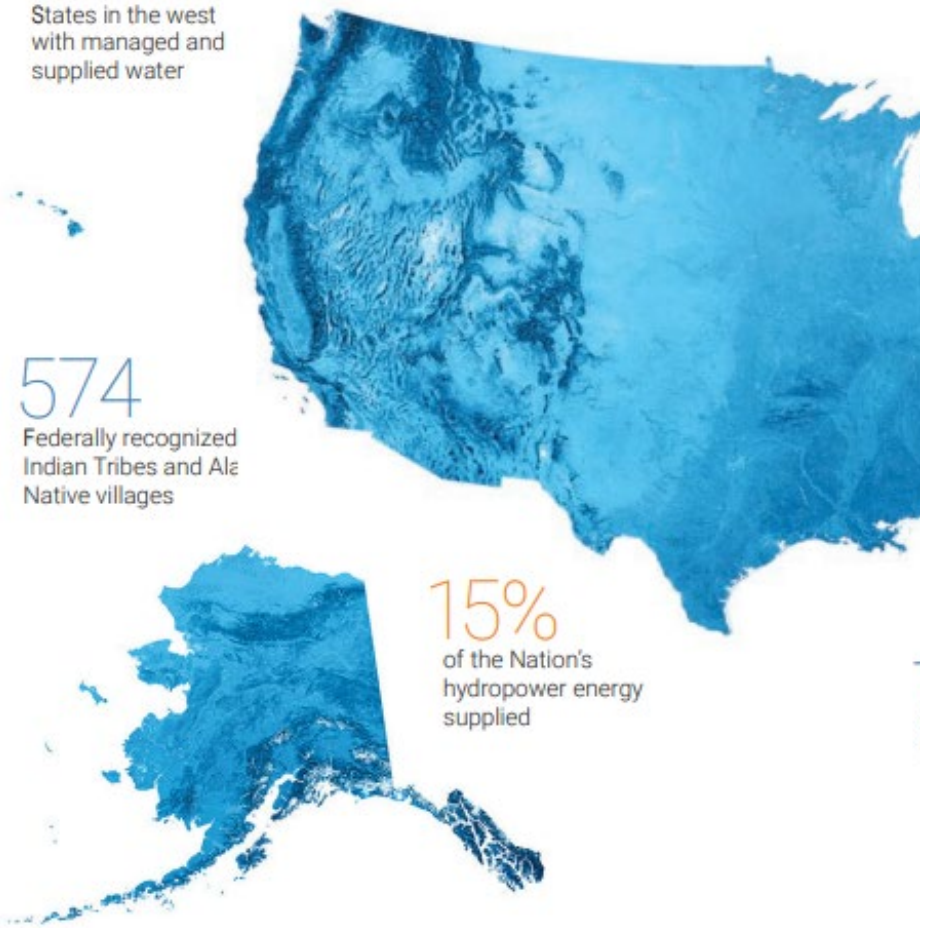
DOI at-a-Glance

480 million
acres of public lands for access

532 million
visitors to DOI lands and waters in 2021

20%
of the Nation's land stewarded

17
States in the west with managed and supplied water



574
Federally recognized Indian Tribes and Ala Native villages

15%
of the Nation's hydropower energy supplied

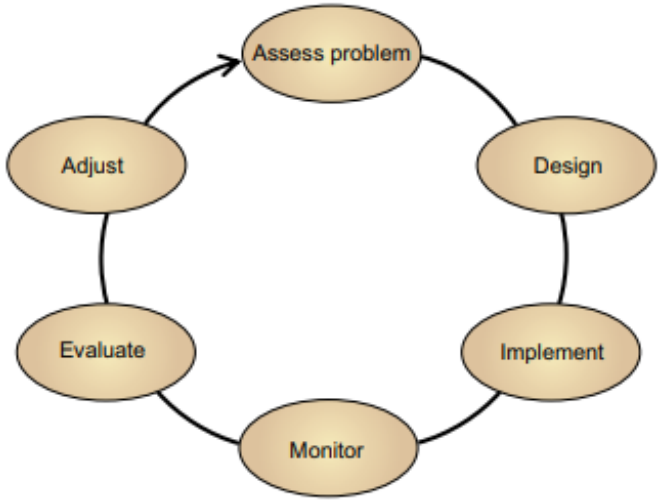
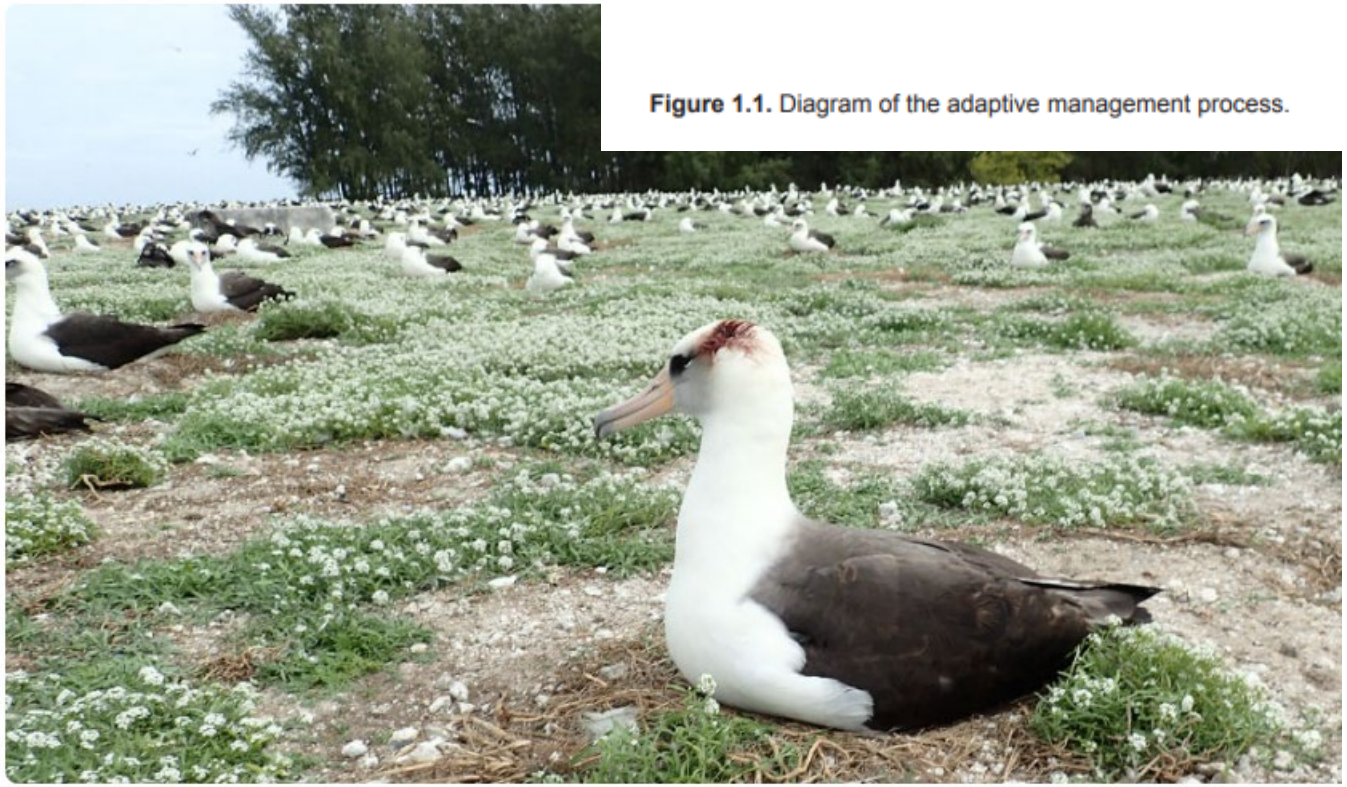


Figure 1.1. Diagram of the adaptive management process.

Invasive Rodents



Invasive house mice cause injury to nesting birds like this injured Laysan albatross at Midway Atoll National Wildlife Refuge. F

Department of the Interior

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides...

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Permafrost and... - 16

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37,506 datasets found

Order by: Relevance

Water Quality Data 847 recent views

Water quality data for the Refuge collected by volunteers collected once every two weeks: Turbidity, pH, Dissolved oxygen (DO), Salinity & Temperature. Sampling will occur...

CSV

1 meter Digital Elevation Models (DEMs) - USGS National Map 3DEP Downloadable Data Collection NGDA 287 recent views

This is a tiled collection of the 3D Elevation Program (3DEP) and is one meter resolution. The 3DEP data holdings serve as the elevation layer of The National Map, and provide...

XML XML

USGS Water-Quality Data for the Nation - National Water Information System (NWIS) 253 recent views

The USGS compiles online access to water-resources data collected at approximately 1.5 million sites in all 50 States, the District of Columbia, Puerto Rico, the Virgin Islands,...

XML XML

Harmonized continuous water quality data in support of modeling harmful algal blooms in the United States, 2005 - 2022 173 recent views

Harmful algal blooms (HABs) are overgrowths of algae or cyanobacteria in water and can be harmful to humans and animals directly via toxin exposure or indirectly via changes in...

XML XML

What is DOI currently missing?

Enterprise priorities for clearly defined statistical products.

Capacity to integrate nature data across DOI.

Capacity to update ongoing monitoring programs.

Independence of statistical production from policy and mission.

Statistical policies and standard practices.

What could a nature statistics agency do for DOI?

Provide relevant, unified statistics to advance our mission.

Protect critical, high priority data streams.

Help professionalize statistical work and practices.

Improve data quality and efficiency via standards and review.

Provide resources for enterprise and external data products.

What would some challenges be?

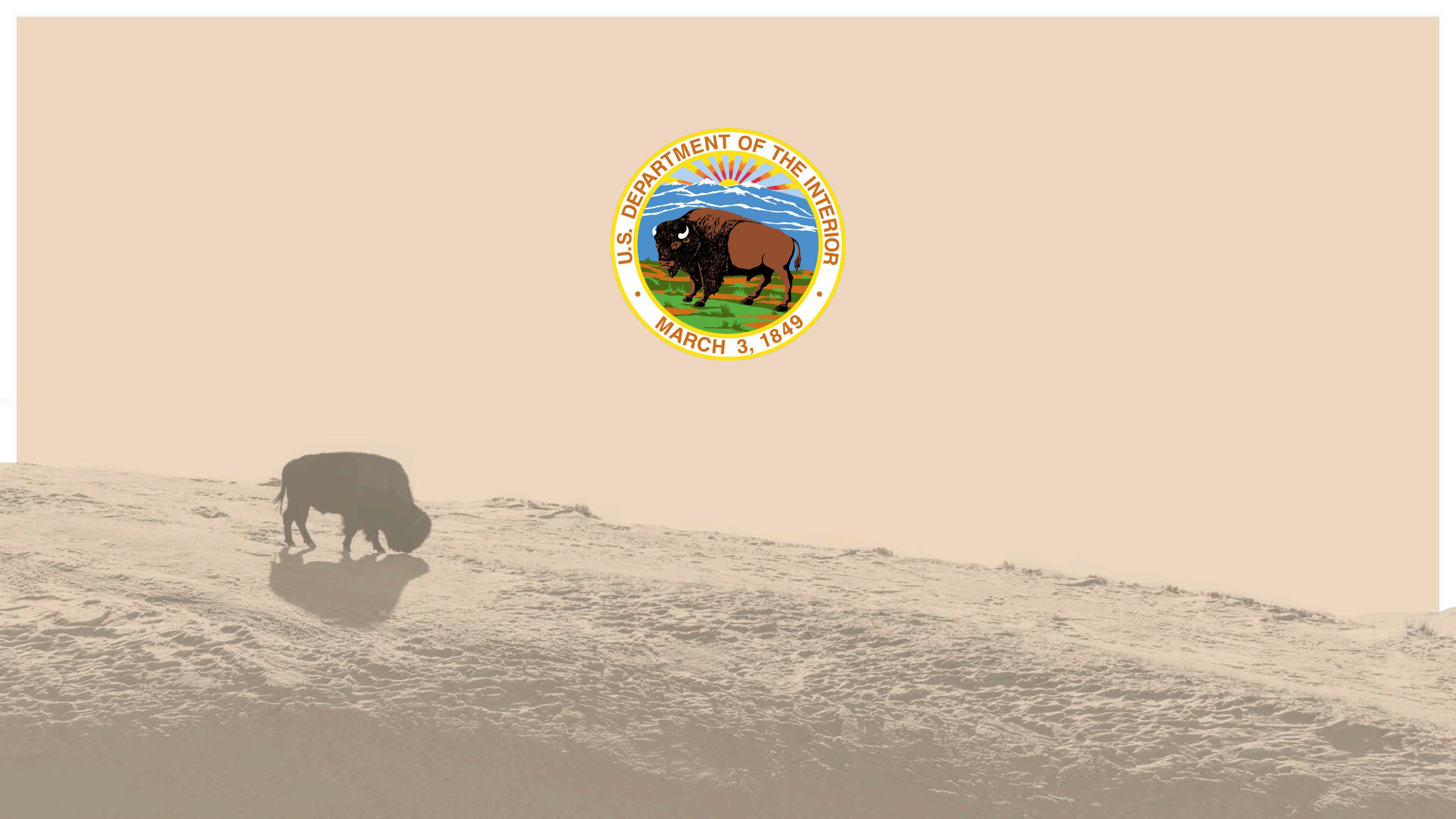
Bridging the ‘national roll up’ and ‘project-scale’ divide.

Implementing changes to protocols.

Avoiding significant added work.

Ensuring flexibility for changing needs across levels.

Ensuring sufficient subject-matter expertise within the new agency, or connections to SMEs.


U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

USDA

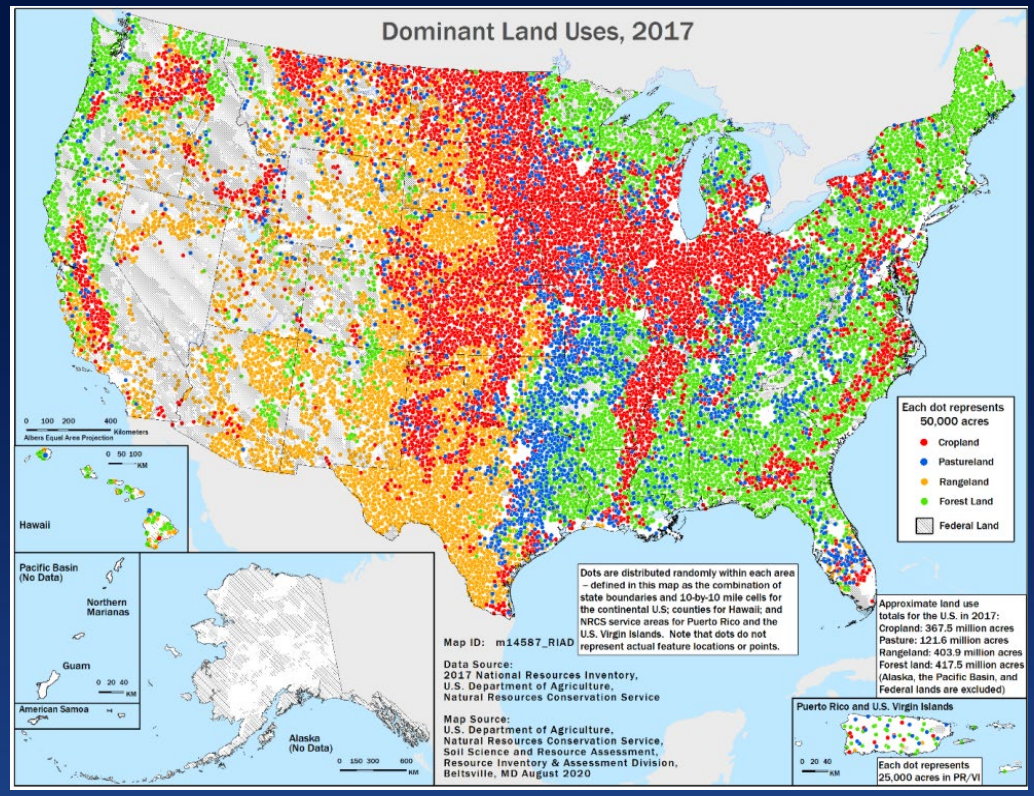
United States Department of Agriculture

USDA: *The People's Department*

The **United States Department of Agriculture (USDA)** is an executive department of the United States federal government. It aims to meet the needs of commercial farming and livestock food production, promote agricultural trade and production, assure food safety, protect natural resources, promote conservation, foster investments in infrastructure and clean energy rural communities, and works to end hunger in the United States and internationally.

What does USDA Know about *Nature Data*?

- Sixty percent of lands in the U.S. are privately owned, including about one billion acres of working forests, ranches, and farms
- Working lands provide substantial benefits to nature and ecosystem services which are critical to human health, food supplies, and biodiversity



USDA Structure and Statistics

- Twenty-nine agencies and offices with about 100,000 employees and more than 4,500 locations in the U.S. and abroad
- Two principal statistical agencies:
  - **National Agricultural Statistics Service** - timely, accurate, and useful statistics in service to U.S. agriculture
  - **Economic Research Service** - high-quality, objective economic research to inform and enhance public and private decision making

Examples of USDA Data Resources

- **National Resources Inventory (NRI)** program collects and produces consistent and comprehensive information on the status, condition, and trends of land, soil, water, and related resources on the Nation's non-federal lands
- **Forest Inventory and Analysis (FIA)** program reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership for both public and private lands in the U.S.
- **Resources Planning Act Assessment (RPA)** provides trends and projections of the availability and condition of renewable resources across the U.S.
- **Conservation Effects Assessment Project (CEAP)** is a multi-agency effort to quantify the environmental effects of conservation practices and programs and develop the scientific base for managing the agricultural landscape for environmental quality
- **Agricultural Resource Management Survey (ARMS)** is the USDA's primary source of information on production practices, resource use, and economic well-being of America's farms and ranches
- **Census of Agriculture** provides land use and ownership data, operator characteristics, production practices, income and expenditures for U.S. farms and ranches and the people who operate them
- **Soil Survey Geographic Database (SSURGO)** contains information about soil as collected by the National Cooperative Soil Survey over the course of a century

What's missing?

(Better) Coordination

Challenges and Opportunities

Scientific

- Develop standardized data frameworks and collection protocols
  - Timely
  - Accurate
  - Objective
  - Useful

Administrative

- Specific authority
- Durable funding
- Identify who is responsible for the data and where it is housed
- Safeguard data confidentiality and security

60+

NETWORK PROGRAMS
IN THE UNITED STATES
AND CANADA

OVER

1,000

CONSERVATION PROFESSIONALS

NatureServe

The Power of the Network

The network collects, analyzes, and distributes detailed scientific data about plants, animals, and ecosystems in their jurisdictions

100,000

Species Assessed

7,000

Ecosystem Types Classified

Synthesizing nature data from a vast network…

In-the-field Observations

Specimens

Earth Observations

NatureServe Network

DATA EXCHANGE

NatureServe Biotics

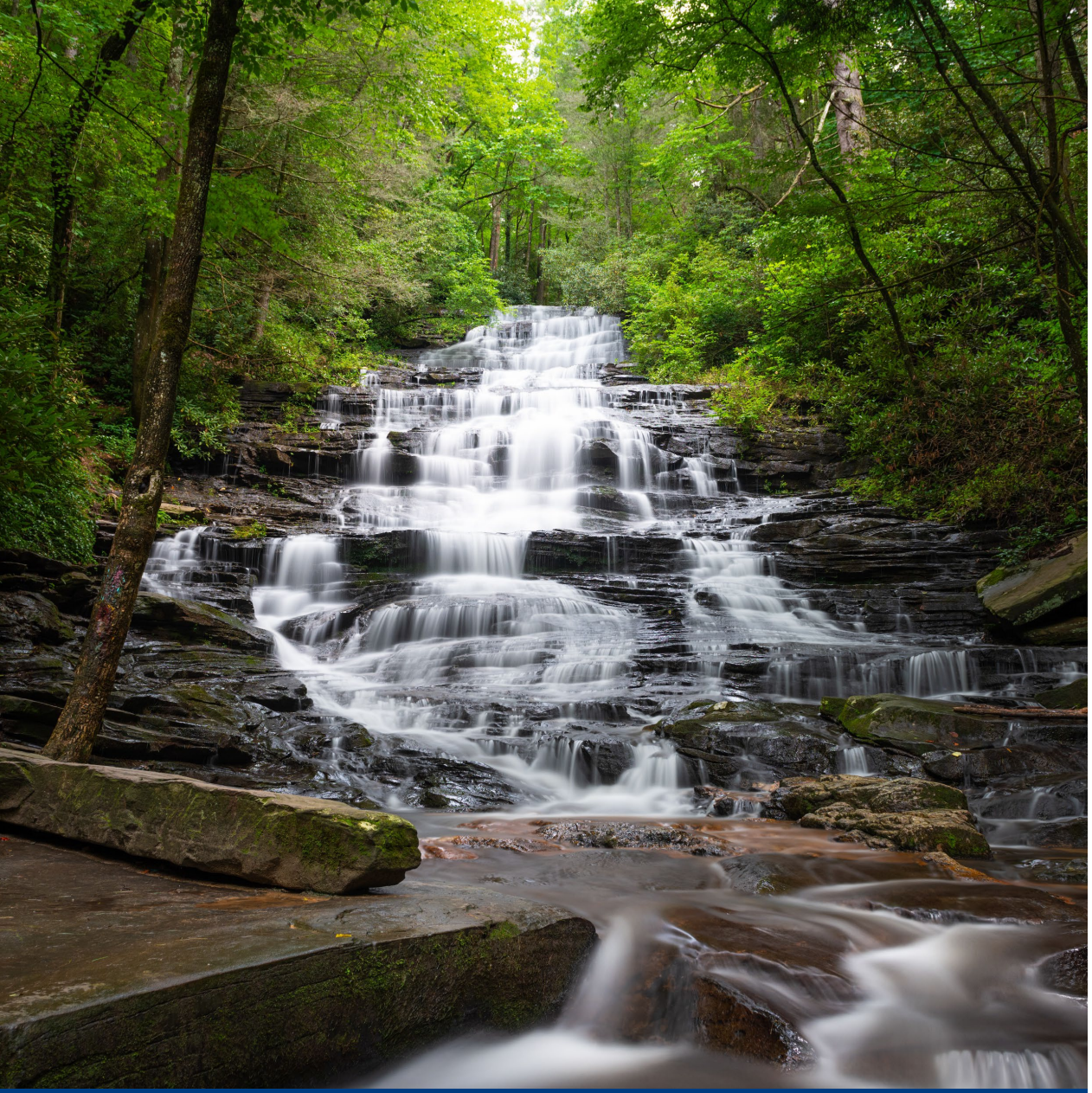
Government Assessments & Land Management Decisions

Corporate Biodiversity Reporting & Accounting

Academic Research

Ecosystem Service Evaluation

…to meet the needs of many



Panther Falls, Georgia.
Photo by Sean Pavone Photography.

What Holds Us Back?

Lack of Access

Data *does* exist to meet many shared needs but is often difficult to locate and vet. Pay to play access hampers impact and creates a lack of transparency.

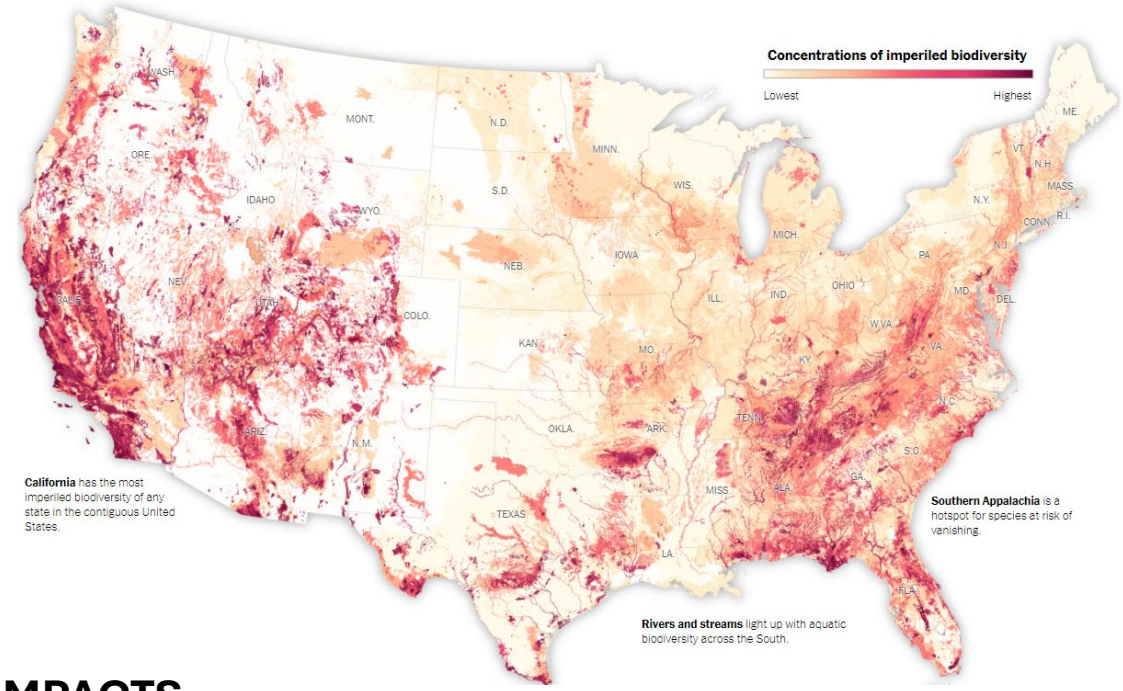
Duplication of Effort

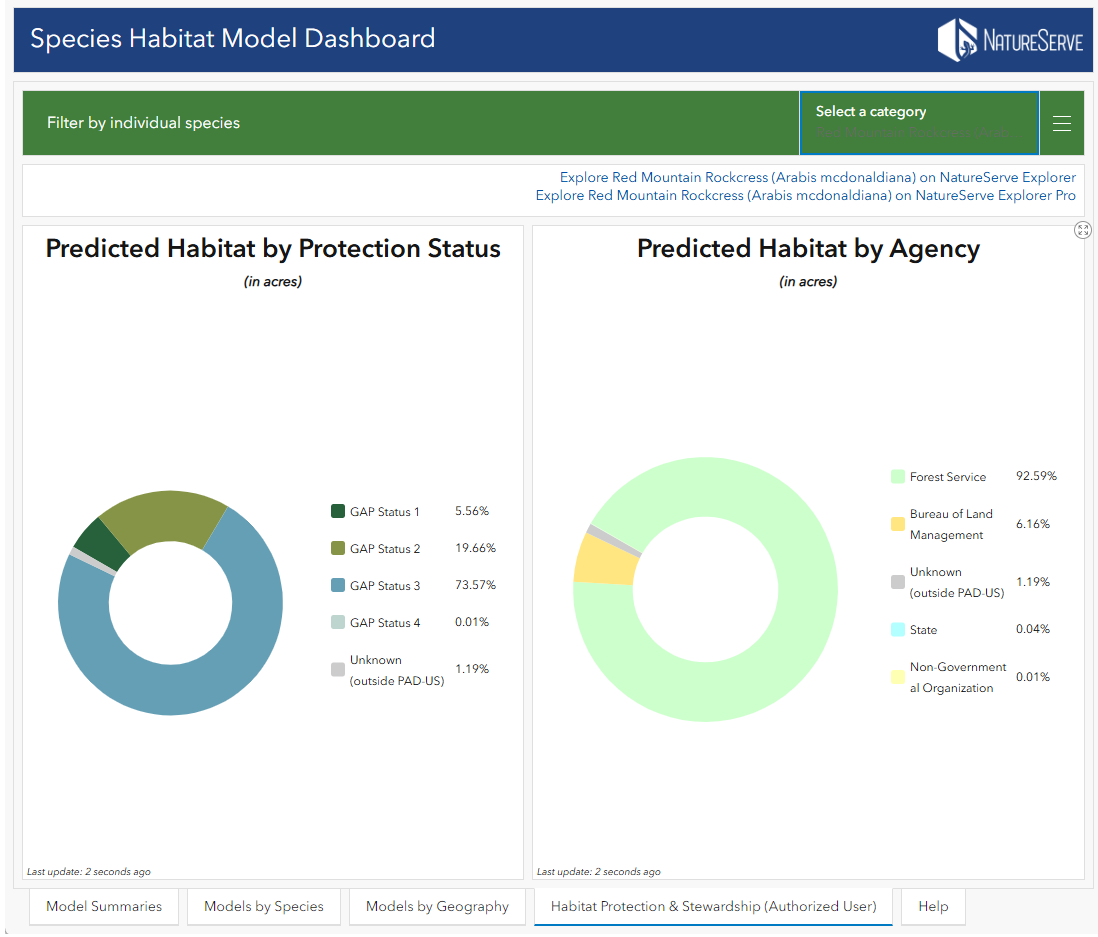
Different federal agencies, of different parts of the same agency, are funding similar work.

Misdirected Investment

Resources are being spent on *bespoke* analyses for few instead on *maintenance and provision of core data* to serve many.

What Happens When We Get This Right?





IMPACTS

- NEPA compliance: refined ranges, streamlined environmental review
- State Wildlife Action Plans
- Federal land management
- Corporate accounting, conservation investment

NatureServe