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science for a changing world

USGS Ecosystems Mission Area

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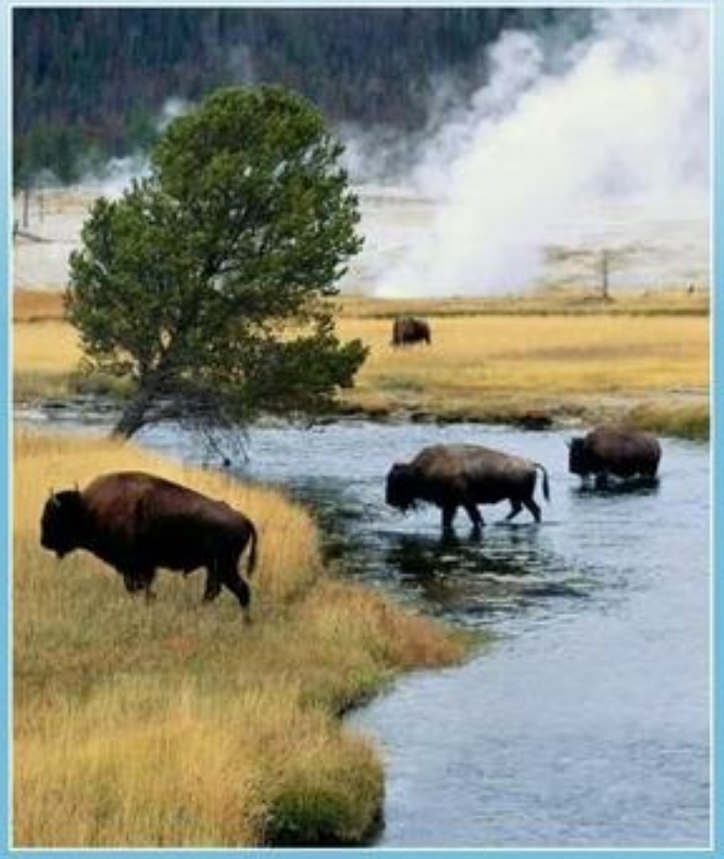
USGS Ecosystem Science Vision



The biological research arm of the U.S. Department of Interior and provides science to help America achieve sustainable management and conservation of biological resources in wild and urban spaces. Scientists examine consequences of climate and environmental change, effects of management actions on communities, lands and species, and risks and solutions to harmful invasive species, wildlife diseases, and contaminants in the environment.

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USGS Ecosystems Mission Area Research Centers

USGS Regions

- Northwest - Pacific Islands
- Southwest
- Alaska
- Rocky Mountain
- Midcontinent
- Southeast
- Northeast

DOI Unified Regions

1. North Atlantic-Appalachian
2. South Atlantic-Gulf
3. Great Lakes
4. Mississippi Basin
5. Missouri Basin
6. Arkansas-Rio Grande-Texas Gulf
7. Upper Colorado Basin
8. Lower Colorado Basin
9. Columbia-Pacific Northwest
10. California-Great Basin
11. Alaska
12. Pacific Islands

- Ecosystems Science Centers
- Ecosystems Science Center Field Stations
- Cooperative Research Units
- Climate Adaptation Science Centers

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Biological Threats & Invasive Species Research Program

- The Biological Threats and Invasive Species Research Program provides essential information, data, research, detection, management methods, and decision-support tools to help resource managers reduce the threat of invasive species and fish and wildlife disease. The need for enhanced biosurveillance of fish and wildlife disease and aquatic invasive species is among the USGS secretarial priorities and EMA is largely responsible for achieving this call to action through their current and future roles in
  - Risk prediction and forecasting
  - Early detection
  - Enhanced situational awareness
  - Decision support for biological threats

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Program Examples – Biological Threats Research

- Expanded the USGS Nonindigenous Aquatic Species Database Flood and Storm Tracker (NAS FAST)
- Registered CO_2 for AIS control
- Visual tools for early detection of noxious weeds
- Vaccination of little brown bats with specific fungal antigens

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Climate Adaptation Science Centers

Delivering science to help fish, wildlife, water, land, and people adapt to a changing climate

Focusing on impacts & adaptation

- Helping managers protect our public land & natural resources
- Collaborating with tribes & indigenous communities to prepare for climate risks
- Educating & training the next generation of scientists

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Examples of Recent Climate Adaption Science Center Project Results

Using drones to study glacial outburst flooding in Alaska

Prescribed Fire Before Drought May Lessen Tree Loss

Climate Effects on Small Biodiversity "Hot Spots"

Gulf of Maine Seasonal Timing Shifts

Climate Scenario Planning for Badlands National Park

Climate Change Effects on Deer and Moose in the Midwest

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Climate Research & Development Program

Provide foundational research and data needed to understand and anticipate how the physical, chemical, and biological components of the Earth system are affected by changing environment, land use, climate, and management strategies

Builds upon long-standing USGS expertise in past climate, geology, hydrology, geography, and biology to document changes over daily to millennial timescale and to assess and model impacts of change on local, regional, and national spatial scales

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Program Examples - Climate Research & Development

- Documented mangrove/marsh response to multiple factors (changing sea level, fresh water availability, sediment supply, geomorphology) over various time scales
- Completed reanalysis of USGS Benchmark Glaciers to improve methods to calibrate glacier measurements and document impact of climate change
- Combined geologic evidence and modeling to better understand environmental and climatic factors controlling permafrost formation and thaw in northern high latitudes
- Continued to evaluate correlations between die-back of sequoia and other western trees, canopy water content, and drought
- Using land-change models, developed land-use and conservation scenarios to evaluate how different soil management practices affect water availability in the western US

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Cooperative Research Units

- The Cooperative Research Unit (CRU) program meets the science and technical assistance needs of Federal, State, and local natural resource managers. Each of the 40 CRUs, located in 38 States, is a partnership of the USGS, other Interior bureaus, other Federal agencies, a State fish and wildlife agency, a host university, and the Wildlife Management Institute. The program positions USGS scientists at universities to help identify and respond to field level natural resource information needs, coordinate pooling of resources among agencies, trains and mentors graduate students; and facilitates Federal and other natural resource managers' access to university expertise and facilities.

- The CRU program has a 3-part mission that has been consistent throughout the history of the program:
  - Actionable research to meet cooperator science needs,
  - Graduate education to develop the fish and wildlife science and management workforce of the future, and
  - Technical assistance to cooperators on application and integration of new science.
- Program direction for the CRU comes at two levels that interact fluidly:
  1. Headquarters provides direction based on DOI/USGS/EMA priorities and national cooperators needs; and
  2. Each Unit has a coordinating committee comprised of USGS, other DOI partners, State, and university cooperators that formulate the ongoing research, education, and technical assistance duties of the individual Units.
- This combination of a centralized and grass roots direction yields a diverse portfolio without duplication where the impact is greater than the sum of its parts.

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Program Examples – Cooperative Research Units

- Corridor Mapping Team for SO 3362
- Training on Species Distribution Models (SDM) for management & conservation
- Moose Population Declines in the Northeast
- Species Status Assessments

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Environmental Health Program

The Toxic Substances Hydrology and Contaminant Biology Programs work collaboratively to assess and differentiate the environmental contaminant and pathogen exposures that cause actual health risks versus those that are only perceived. Specialized teams of hydrologists, geologists, chemists, biologists, ecologists, toxicologists and geographers work together in the field and laboratories across the United States.

Environmental Health Teams

- **Toxins and HABs Science Team** works to quantify toxin exposure and effects, identify hazards and vulnerabilities, develop tools to quantify and forecast toxin occurrence and exposure, and estimate socioeconomic impacts. Knowledge gained is being used to identify actual versus perceived health risks posed by harmful algal toxins.
- **Energy Science Team** uses a watershed- and aquifer-based interdisciplinary science approach, that helps show where exposure to environmental contaminants from energy development activities might cause adverse health impacts on biota, as well as where they are not causing impacts.
- **Water and Wastewater Infrastructure Team** works in collaboration with National Institutes of Health, U.S. Environmental Protection Agency, public drinking water utilities, and academia, is providing new data on the microbial and chemical content of drinking water at dozens of selected sites across the Nation. Several hundreds of potential contaminants are being monitored in raw (untreated) water entering public water supplies, treated water entering distribution infrastructure, and at taps after premise plumbing in order to characterize factors that effect exposure to contaminants through our drinking water. Exposure models are being developed in collaboration with epidemiologists and other public health experts.
- A variety of chemical tools such as synthetic nutrients, pesticides, and veterinary pharmaceuticals are used in modern agriculture to increase yields and combat pests and disease. The **Food Resources Team** works to determine the actual vs the perceived threats to fish, wildlife, and beneficial insects such as pollinators
- For existing mining or mineral processing sites that are shown to have adverse health impacts, our **Mineral Science Team** informs land managers and other decision makers to identify where limited cleanup funding can be applied in order to achieve the greatest benefits and to measure cleanup success from a health perspective.
- **Fishing and Hunting Team** with other federal, state and university collaborators, conduct scientific research that informs resource managers how to economically and effectively minimize risk to sport fish and wildlife by understanding the environmental transport, fate, exposure pathways, and potential biological effects of contaminants and pathogens.

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Land Management Research Program

- The Land Management Research Program (LMRP) provides science to understand natural and human influences on lands, waters, and ecosystems under management responsibility of Interior bureaus and other Federal, State, and tribal partners. LMRP conducts place-based, issue-driven interdisciplinary research to inform land and water management and restoration efforts. LMRP provides science to
  - Understand how land and water management activities influence habitats needed to maintain species of conservation concern to provide for fishing, hunting, and non-consumptive recreation opportunities,
  - Implement land and water management efforts to preclude species from being listed under the Endangered Species Act, and
  - Delist or downlist imperiled species in terrestrial, aquatic, coastal, and estuarine systems.

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Program Examples – Land Management Research

- Conservation and Restoration Strategy Tool
- Disturbance Automated Reference Tool (DART)
- An integrated assessment of wastewater reuse, exposure risk, and fish Endocrine disruption
- Maps and related spatial data depicting longterm vegetation between 1984-2018 in the WLCI
- USGS BBL - new version of the REPORTBAND

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Species Management Research Program

- The Species Management Research Program provides science to protect, conserve and enhance species of fish and wildlife that are important to the U.S. public by conducting applied science to inform resource management decisions by Interior bureaus and other Federal, State, and tribal partners.

- Species Management Research Program studies provide information for
  - best-informed decisions on whether species require listing under the Endangered Species Act,
  - management to recover species and keep species from needing to be listed,
  - informed management activities needed to support sustainable management of fish and wildlife populations, including commercially and recreationally important species
  - cost-effective and multi-functional uses of public lands in concert with sustainable fish and wildlife populations, and
  - management to reduce or eliminate stressors to populations.
- Integrated predictive science capacity of the USGS provides science to
  - enable managers to forecast changes in the abundance of fish and wildlife populations and
  - develop tools for resource managers to use to predict the response by fish and wildlife populations to different management alternatives.

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Program Examples – Species Management Research

- Historical and future distribution of listed species
- Species status assessments for decisions about at-risk species
- Genetic studies to measure community biodiversity
- Design and testing of innovative fish passageways
- Chesapeake Bay watershed and deep ocean coral habitats
- Remote sensing and citizen science

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FY21-22 Budget

Ecosystems Budget Activities (000)			
	FY 2021 Enacted	FY 2022 President's Request	FY 2022 House Mark
Biological Threats and Invasive Species Research Program	38,249	43,951[1]	43,951[1]
Climate Adaptation Science Center and Land Change Science Program	60,488	120,800	116,300
Cooperative Research Units Program	25,000	25,506	27,506
Environmental Health Program	24,745	25,739	26,739
Land Management Research Program	56,681	75,303	71,303
Species Management Research Program	53,914	66,918	69,418
Total Ecosystems Program	259,077	358,217	355,217

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Climate Related Planned Increases

- Decision Support Science for Clean Energy - $4M
- Species Management Conservation and Adaptation - $10M
- Land Management Conservation and Adaptation - $5.2M
- Ecosystem Services - $8M
- Biological Threats & Invasive Species Climate-Driven Threats - $4M
- Biological Carbon Sequestration - $2M
- Greenhouse Gas Monitoring - $5M
- Climate Impacts on Physical and Biological Systems - $8M
- Expanded Climate Adaptation Science Center Support - $25M
- Tribal Climate Adaptation - $10M
- Synthesis of Regional Findings to National Level - $2.5M
- Biodiversity - $2.5M

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WATER, LAND, AND SPECIES RELATED CLIMATE INCREASES

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Decision Support Science for Clean Energy

- USGS fish and wildlife biologists and ecologists will work with regulatory agencies and the clean energy industry to produce science-based tools and strategies that will help decision-makers determine optimal placement of clean energy infrastructure on lands and in waters where risks and harmful impacts to protected species and habitats can be minimized or mitigated, helping to streamline siting and permitting of clean energy projects
- Expected products include
  - Maps of desert tortoise connectivity for guiding solar energy development in the southwest
  - Novel high resolution models and GIS tools identifying high and low risk areas for protected species, developed in collaboration with Federal research laboratories such as the Department of Energy labs (e.g. National Renewable Energy Laboratory and others)

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Species Management - Conservation and Adaptation

- Expand work on threats to fish and wildlife like climate change, drought, extreme storm events, and invasive species and disease
- Develop new tools and technologies to help managers consider species responses to alternative management scenarios and incorporate uncertainty about outcomes into decision-making at broad scales
- Species and their habitats are interdependent and complex in their relationships; will work in tandem with the Land Management Research Program to direct resources to participatory science supporting the full spectrum of management information needs for species and their habitats, including, climate change, climate change adaptation, and species and ecosystem response to land use, land change and resource management

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Land Management - Conservation and Adaptation

- Build capacity to expand work with decision makers within the DOI land management bureaus and create targeted adaptation planning frameworks linked to explicit conservation goals and outcomes
- Work with scientists and decision-makers to study the efficacy of management and restoration actions
- Employ advanced predictive modeling to compare alternative management scenarios for managers to understand policy, trade-offs, and management implications, saving time and resources on actions
- Use targeted monitoring as a critical adaptive management approach to land and waters with complex, interacting, and dynamic challenges.
- Develop a guiding framework to incorporate species refugia into natural resource management to inform land and species conservation, invasive species management, recreation management, and other decisions

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Ecosystem Services

- Build a stronger understanding of the benefits that ecosystems offer and what ecosystem services are most beneficial to communities, with quantitative analysis of benefits and trade-offs across the range of land management alternatives
- Better measure the value of green infrastructure - using nature as part of our infrastructure system (e.g., natural wetlands for purifying water), which can be incorporated into a portfolio of solutions to increase water storage capacity, flood risk mitigation, coastal storm protection, carbon sequestration, and climate change adaptation
- Provide better information to land managers and decision makers achieve conservation and restoration goals, such as the America the Beautiful initiative
- Support NEPA planning and empower all stakeholders with the unbiased information to prioritize and achieve multiple conservation outcomes and integrate land and species conservation research into adaptive management
- Inform the development of public-private partnerships and investment in green infrastructure to enhance ecosystem services

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Biological Threats & Invasive Species Climate Driven Threats

- Focus on three regions that are expected to be disproportionately affected by climate change (Alaska, Hawaii and U.S. insular territories in the Pacific, and the Northeast) and that support critical habitat and species of conservation concern
  - Connect biosurveillance, risk reduction, and mitigation tools with key stakeholders in Tribal Nations and other underserved communities in addition to traditional Federal and State partners
  - Engage stakeholders to identify information gaps and research needs
  - With stakeholder consensus on prioritized science needs, the USGS will implement research and surveillance activities to support an adaptive management approach to changing climates in the prioritized regions

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Biodiversity

- Underlying support for nature's contributions to people, providing, for example, food and water security, hazard protection, and serves as an important component of cultural identity
- Understanding the key linkages between climate and biodiversity, and how climate may impact future contributions to people will be critical to help mitigate or adapt to climate driven change
- Develop science to allow us to understand the key linkages between climate change and biodiversity
  - focus on understanding the linkages between biodiversity and climate change
  - development of scientific approaches to help reverse the decline of biodiversity
  - perform the first National Assessment of Biodiversity and Ecosystems

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END