

Science for the Changing Great Basin

The U.S. Geological Survey (USGS), with its multidisciplinary structure and role as a federal science organization, is well suited to provide integrated science in the Great Basin of the western United States. A research strategy developed by the USGS and collaborating partners addresses critical management issues in the basin, including invasive species, status and trends of wildlife populations and communities, wildfire, global climate change, and riparian and wetland habitats. Information obtained through implementation of this strategy will be important for decision-making by natural-resource managers.



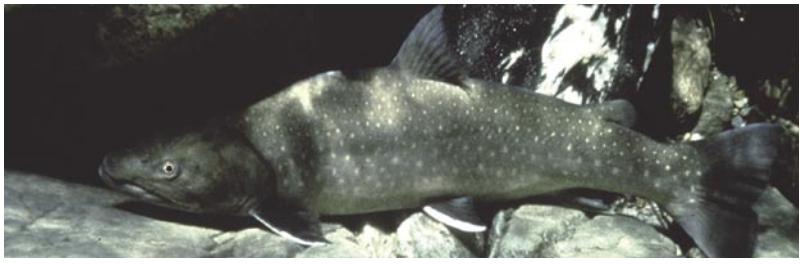
The Great Basin is an expanse of over 2.6 million square kilometers (1 million square miles) of semi-arid lands punctuated by numerous mountain ranges in the western United States (Figure 1). Because of the large amount and contiguity of public lands in the basin, the region offers a compelling opportunity to conduct landscape-level, applied science in a relatively understudied region.

In the Great Basin, public land uses are diverse and ever-increasing: water development, road networks, mining, grazing of domestic livestock, motorized recreation, urban expansion, hunting, and timber harvest, among others. These uses can affect the structure, composition, and function of Great Basin ecosystems, often resulting in altered hydrologic regimes, spread of exotic species, uncharacteristic wildfires, and degraded soils. Adaptive management of areas that encompass entire watersheds is needed to address these changing conditions, and such adaptive management requires reliable scientific information.

USGS scientists and collaborators have developed a long-term research strategy designed to address current and future research needs for management of the Intermountain West's semi-arid ecosystems administered by the Department of the Interior. The research questions are relevant to four major western basins –the Interior Columbia, Snake River, Klamath, and Great basins. In addition to synthesizing highest-priority stated information needs of natural-resource managers into a few integrated research questions, the strategy draws from recent scientific literature to create applied research questions that support the strategy's ultimate goals. Also, the strategy recognizes the dynamic and unpredictable nature of ecosystems, and explicitly allows for a range of outcomes rather than an unvarying endpoint.



Figure 1. The Great Basin





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7 Guiding Principles

- Transition from single-species to habitat- or guild-based management
- Recognition of disturbance regimes and events as triggers to system change
- Testing the existence of thresholds, alternative states, multiple pathways, and trends
- Treatment of management actions as opportunities for experimentation
- Testing of assumptions (e.g., indicators, cause-effect relationships), so that management can adapt to new information
- Implementation of monitoring and analysis at scales ranging from watersheds to management units to regions
- Use of control sites to separate natural variability from change induced by management

5 Research Themes

Five research themes were chosen jointly by managers and scientists from cooperating agencies across the Great Basin. Sample issues for each theme include:

Rangeland health

- invasive plants
- biological diversity
- fire as a disturbance process
- soil chemistry
- biological soil crusts

Landscape restoration

- habitat fragmentation and edge effects
- wildlife habitat
- invasive species
- soils

Aquatic-terrestrial interface

- riparian, wetland, and upland communities
- multiple-scale perspective
- springs

Monitoring for adaptive management

- vegetation
- wildlife
- fishes
- soils

Species and habitats at risk

- sagebrush-steppe habitats and sagebrush-obligate species
- expansion of junipers and pinyon pines
- salmonids
- threatened, endangered, and rare species
- ephemeral wetlands
- endemic fishes



The ultimate goal of the research strategy is to provide ideas for integrating emerging scientific understanding into future management in order to:

- **Restore and maintain long-term ecosystem health and ecological integrity.**
- **Emphasize adaptive management over the long term**
- **Provide consistent management direction over broad spatial and temporal scales**
- **Restore and maintain habitats for plant and animal species**
- **Support economic and social needs of people, without compromising the above goals**

Guiding Principles

Seven principles guide the proposed research, and the research is organized in five themes. The strategy melds the use of observational studies with experimental manipulation, treating management actions as experiments whenever feasible. For each research issue, the strategy provides a broad framework of questions within which specific questions and hypotheses can be designed. Information justifying the importance of and need for research also accompanies each issue. Research questions in the strategy possess designations to guide prioritization of implementation. Designations reflect the magnitude and immediacy of the research need, as well as the relative risk associated with not undertaking the research.

Examples of Research Questions

Aquatic-Terrestrial Interface Theme: What are the composition, abundance, and trend of spring-dwelling biotas? How do soils and nearby communities (e.g., invertebrates, plants, large mammals, birds, granivorous mammals) respond to changes in spring management?

Landscape Restoration Theme: Within sagebrush ecosystems, how do soil characteristics, nutrient and water flows, vertebrate and invertebrate assemblages, and sagebrush-obligate species vary across the landscape in areas of different patch size, habitat quality (i.e., composition and cover of exotic forbs, native grasses, native forbs), grazing history, current grazing system, and distance from sagebrush "mainland"? In a mosaic of varying land uses and vegetation types, how does rate of habitat change and conversion compare with historic rates of change and conversion? Do size and geometry of fragments and their interspersion across the landscape predict the spread of exotics, nutrient flow into and from ecosystem fragments, or abundance of species with large or specialized habitat requirements?

Rangeland Health Theme: Are there plant or animal species that a) represent a particular use, ecosystem, or management concern; b) exert disproportionate effects on ecosystem composition and function; or c) are important functional components of more than one food web, plant-animal association, or ecosystem (i.e., link species)? If such species do exist, what factors limit the ability of trends in one species to predict dynamics of other species?

Collaborators

Management agencies and other cooperators were involved in the development of the strategy from beginning to end. Several groups collectively agreed on the five goals and research themes, and each management agency contributed their list of research needs. Their research questions were reviewed, sorted, combined, and edited based on current knowledge and methods of applied scientists. This filtering occurred through personal contacts with scientists and managers in meetings and workshops and through reviews of current scientific literature. As the strategy neared completion, cooperators again conducted a final review. Key cooperators in development of the plan included Oregon State University, Eastern Oregon Agricultural Research Station, The Nature Conservancy, USDI-Bureau of Land Management, USDI-Fish and Wildlife Service, USDI-National Park Service, USDI-Bureau of Reclamation, USDA-Agricultural Research Service, and USDA-Forest Service.

Map of Great Basin produced by Robert G. Elston, Jr. MS, Biological Resources Research Center. Basin boundary follows Brussard et al. 1998. Great Basin-Mojave Desert Region in M.J. Mac et al. Status and Trends of the Nation's Biological Resources. 2 vols. U.S. Department of Interior, U.S. Geological Survey, Reston, Virg. Image credits: Sage-grouse, ©Terry Steele; bull trout, Russ Thurow, Rocky Mountain Research Station; others public domain. Authors: Erik Beever and David Pyke. Designed by Sandra Arbogast

The plan is available on the web at: http://fresc.usgs.gov/res_strat.pdf

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