FORT COLLINS SCIENCE CENTER
Trust Species and Habitats Branch
Using the Innovative Approaches of Today to Conserve Biodiversity for Tomorrow

Capabilities

Some of the biggest challenges facing wildlife today are changes to their environment from both natural and anthropogenic causes. Natural resource managers, planners, policy makers, industry and private landowners must make informed decisions and policies regarding management, conservation, and restoration of species, habitats, and ecosystem function in response to these changes. Specific needs include (1) a better understanding of population status and trends; (2) understanding of species' habitat needs and roles in supporting ecosystem functions; (3) the ability to assess species' responses to environmental changes and predict future responses; and (4) the development of innovative techniques and tools to better understand, minimize or prevent any unintended consequences of environmental change.

The Trust Species and Habitats (TSH) Branch of the Fort Collins Science Center (FORT) includes a diverse group of scientists encompassing both traditional and specialized expertise in wildlife biology, ecosystem ecology, quantitative ecology, disease ecology, molecular genetics, and stable isotope geochemistry. Using our expertise and collaborating with others around the world, our goal is to provide the information, tools, and technologies that our partners need to support conservation, management, and restoration of terrestrial vertebrate populations, habitats, and ecosystem function in a changing world.

Photograph by Kenneth Ingham.

Species Conservation

Large scale changes are occurring to our natural landscapes, often resulting in changes to the distribution and abundance of species living within these landscapes. Populations of many species affected by these natural or anthropogenic changes require focused management to ensure their conservation and sometimes recovery from the brink of extinction. For many of these species, limited information exists about their life history, status, and distribution, or how changes in their abundance or distribution alter ecosystem processes, productivity, or structure. TSH scientists develop innovative tools, techniques, and research to understand species' distribution, interactions, condition, and conservation requirements. U.S. Department of the Interior, State agencies and others use the results of our work to better understand species' response to environmental change, inform conservation and management needs, and conserve biodiversity and ecosystem function across our landscapes.

Photograph by Dean Biggins, USGS.

Molecular Genetics

The use of molecular genetics tools has become increasingly important in addressing wildlife conservation issues. TSH geneticists use genetic information to augment studies of population dynamics and population viability, investigate population structure and gene flow, estimate population size and survival rates, and document genetic diversity. Newer and more comprehensive genomic methods are increasingly being used to: study the structure, function, and expression of genes and their response to environmental stressors; elucidate how geographical and environmental features structure genetic processes such as gene flow, genetic drift, and selection; identify, track, and make predictions regarding emerging infectious diseases; and monitor and predict the impacts of invasive species and contaminants on wildlife and ecosystems.

Ecology of Wildlife Disease

The United States is undergoing ecological change that is increasing the interface between wildlife, humans, and disease. Such changes are resulting in unpredictable shifts in the balances of disease cycles in natural hosts and humans, with consequences to many imperiled species. In addition to population declines, the loss of wildlife from disease contributes to a corresponding decline in ecosystem services that benefit human health and economies. TSH scientists collaborate with researchers and resource managers around the world to gain better scientific understanding of the ecological factors involved in the transmission and epidemiology of infectious diseases in wildlife, as well as contributing to the development of tools and techniques to help understand and manage disease in wildlife populations.

Photograph by U.S. Fish and Wildlife Service.

Photograph by Marcy Marot, USGS.

Ecological Applications of Stable Isotopes

Stable isotope geochemistry represents a powerful tool for better understanding biogeochemical cycles, species' distributions, contaminant cycling, food webs, and ecosystem structure. Using stable isotopes, TSH scientists are able to capitalize on two essential attributes. First, isotopic ratios in an organism's tissue reflect the isotopic ratios of what it eats or grows in, and second, local isotopic ratios vary spatially across the face of the earth. Combining this knowledge, our scientists can make inferences into the dietary habits and migration pathways of birds, mammals and fish, as well as contaminant cycling and accumulation in species and their habitats. There is a growing need for such information and stable isotopes offer a new approach to integrate earth and life sciences in the context of conservation and environmental change.

Biometrics

Mathematical and statistical methods used to analyze biological data are powerful research tools that play several important roles in conceptualizing and understanding the structure and dynamics of ecological systems. Through the development of specialized and sophisticated quantitative tools and models, the complex nature of data arising from studies of ecological systems can be understood. Scientists in the TSH branch conduct research to develop and evaluate mathematical and statistical tools and models that abstract and accommodate the unique characteristics of ecological systems and data, while also allowing for maximum extraction of information about those systems. This research is critical for improving the information gained from time-consuming, logistically difficult, and resource-intense field studies.

Photograph by Paul Cryan, USGS.

Selected Projects

Bat Fatalities at Wind Turbines—Investigating the Causes and Consequences

Wind energy is one of the fastest-growing industries in the world and represents an important step toward reducing dependence on nonrenewable sources of power. However, unprecedented numbers of tree-roosting bats are dying at wind turbines on multiple continents, raising concerns about the well-being of these animals. While causes of bat fatalities at wind turbines remain unknown, potential clues can be found in the patterns of fatalities. TSH scientists, in collaboration with other U.S. Geological Survey (USGS) science centers as well as partners from Federal, State, and non-governmental organizations, are using these clues to focus research efforts. Investigations are underway to (1) better identify the seasonal distributions, habitat needs, and migration patterns of species showing greatest susceptibility, (2) assess the potential roles of mating and feeding behaviors in turbine collisions, (3) develop new video-based methods for studying and monitoring bats flying around wind turbines at night, and (4) test whether bats are attracted to turbines. Findings from these studies are leading us toward new ways of monitoring and possibly avoiding bat fatalities at wind turbines.

Photograph by Paul Cryan, USGS.

Landscape Genetics of Sage Grouse

Greater and Gunnison sage-grouse populations are species considered for listing under the Endangered Species Act of 1973. Loss and fragmentation of sagebrush habitats are among the primary causes of decline in these species. A fundamental need for species conservation is to identify and subsequently maintain a set of connected populations. Landscape genetics combines the fields of population genetics and landscape ecology to investigate how landscape and environmental features affect connectivity, gene flow, population structure, and local adaptation. TSH geneticists, in collaboration with other USGS scientists, Federal, State, and local agencies, and academia, are using genetic data in conjunction with landscape data (for example, habitat, roads, energy development, and elevation) to identify landscape features that function as barriers to movement for both Greater and Gunnison sage-grouse. These studies will help define biologically meaningful populations, provide information on levels of connectivity among populations, and define characteristics of barriers (including geographic distance, topographic features, and anthropogenic land uses) that affect dispersal and genetic exchange. Managers will be able to apply this understanding to focus conservation efforts in areas that will maximize benefits to sage-grouse populations.

Photograph by Gerrit Vyn.

Ecology of Plague

In North America, the flea transmitted plague bacterium (*Yersinia pestis*) has colonized and altered native animal communities and ecosystems since its invasion a little more than a century ago. Many species have suffered adverse consequences from plague, perhaps none more than the endangered black-footed ferret. Plague has established within the ranges of all North American prairie dog species, which collectively serve as the sole habitat and predominant prey base for the endangered black-footed ferret. This disease causes periodic and sometimes dramatic die-offs of both prairie dogs and ferrets. Plague also threatens the recovery of the threatened Utah prairie dog and is suspected of contributing to declines in other species of conservation concern. TSH scientists are conducting research on various aspects of plague ecology and management including: (1) treatment-control studies using vaccines and insecticides to examine effects of enzootic plague on survival rates and other population parameters in various animal communities, (2) field testing the efficacy of a bait-delivered vaccine for prairie dogs, (3) investigating factors involved in plague persistence in the environment, and (4) evaluating potential development of insecticide resistance in fleas. Findings from this research will provide resource managers a better understanding of plague and new tools for managing this disease in wildlife.

Photograph by Tonie Rocke, USGS.

Photograph by U.S. Fish and Wildlife Service.

Foraging Ecology Using Stable Isotopes

Understanding species habitat requirements is incomplete without insight into nutrition, including various aspects of foraging ecology. Traditional diet studies can be challenging because of logistics, issues related to resource availability, and observations are often short-term in nature based on gut contents or scat. Additionally, perturbations such as species introductions, habitat degradation, pollution, and climate change can drastically alter the availability and quality of dietary resources. Stable isotope techniques offer a useful tool for gaining longer-term insight into the dietary habits for a variety of wildlife species. In collaboration with other USGS scientists, Federal and State agencies, and university researchers, TSH scientists are using stable isotopes to: (1) understand the foraging habits of polar bears, providing context from which future changes because of habitat loss can be inferred; (2) investigate nutritional stress as the cause of population decline in Stellar sea lions; (3) assess the effects of a gillnet ban on bottlenose dolphin, (4) reconstruct aquatic food web pathways before and after exotic species invasions; (5) determine the arrival time on arctic breeding grounds of a long-distance migratory shorebird based on a shift in diet; and (6) clarify the role of marine-derived nutrients to juvenile salmon. Findings from this work are providing valuable insight into the foraging ecology of species of management or conservation concern.

Using Quantile Regression to Investigate Ecological Limiting Factors

Photograph by Alan Franklin, U.S. Department of Agriculture.

Unexplained heterogeneity in statistical models of animal responses to their physical environment is reasonable to expect because the measured habitat resources are a constraint on—but not the sole determinant of—abundance, survival, fecundity, or fitness. The ecological understanding and reliability of management predictions based on animal habitat models can be improved by shifting focus from estimating expected values (means) of responses to estimating intervals of responses associated with multiple percentiles of a distribution. TSH scientists have refined quantile regression to provide novel insights on trout densities in stream habitat, allometric growth of fish to assess body condition, monitoring habitat management objectives at National Wildlife Refuges, and evaluating changes in stream-water quality over 40 years. Additional refinements include modifying quantile regression for small counts to evaluate effects of climate, demographic characteristics of parents, and landscape habitat on California spotted owl fledglings produced on territories over 20 years on the Lassen National Forest. Quantile regression can provide managers with modeled relationships that more realistically reflect the variation in animal responses observed in their physical environments.

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And a continuing team of short- and long-term contractors, work-study students, student contractors, and a large cadre of volunteers, all of whom are essential to the accomplishments and productivity of our branch.

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