U. S. Geological Survey

Wildlife: Terrestrial and Endangered Resources Program

5-YEAR PROGRAM PLAN

Fiscal Years
2005-2009

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EXECUTIVE SUMMARY

Looking into the Future: The US Geological Survey (USGS) Wildlife: Terrestrial and Endangered Resources Program (WTER Program) is the largest USGS Program in the Biology Discipline and represents an annual effort of more than $40 million. The program supports investigations on scientific issues involving migratory wildlife, marine mammals[1], threatened and endangered species, wildlife disease, and others. It supports the development of tools and technologies for the conservation of wildlife on federally managed lands such as National Parks, National Wildlife Refuges, and Bureau of Land Management areas. To keep pace with these and other emerging wildlife issues will require a continued investment of resources.

This 5-Year Program Plan (Plan) was developed by scientists, managers, regulators, and policy-makers representing the USGS, U.S. Fish and Wildlife Service (USFWS), the National Park Service (NPS), State Fish and Wildlife Agencies, Native American Tribes, and non-governmental organizations (NGOs). ***Wildlife Advisory Teams*** were established based upon broad areas of program activities to develop the goals and objectives for this plan and to help guide the WTER Program in the future. Each team developed a set of goals and objectives in one of the following thematic areas:

- Migratory Birds and Habitat Linkages
- Marine and Freshwater Wildlife
- Imperiled Species and Conservation Genetics
- Wildlife Diseases and Zoonoses
- Science for International Conservation
- Large Mammals and Predators
- Human Dimensions and Traditional Knowledge
- Modeling and Emerging Technologies

The goals and objectives that these teams developed emphasize specific scientific results measured by both outputs (products such as predictive models, decision support systems, presentations, and publications) and outcomes (impacts of the science on wildlife resource management, regulations, or policy).

The ***Thematic Goals and Objectives*** developed by the Wildlife Advisory Teams have been synthesized into five larger, overarching ***Program Goals***. These Program Goals will be used for future reviews and audits, such as those encompassed by the Office of Management and Budget's Performance Assessment Rating Tool. However, the Thematic Goals and Objectives will likely resonate with USGS scientists and partners because most research and management is designed based on species, populations, or

[1] While the major emphasis of the WTER program is on terrestrial species, there are bodies of research under this program that also focus on marine and freshwater wildlife. Historically, groups such as marine mammals and sea ducks have fallen under the Wildlife Program, not under the Fisheries: Aquatic and Endangered Resources program.

specific ecological problems. This Plan was developed to (1) identify emerging wildlife research needs, (2) establish priorities for future program research, (3) describe present and future capabilities needed to meet these priorities, and (4) outline strategies to meet these future challenges.

WTER Program Vision

> …. ***to be the primary source of wildlife science needed to accomplish the stewardship mission of the Department of the Interior and its partners, including States and Tribes, both today and in the future.***

Program Goals

Over the next five years, research of the USGS Wildlife: Terrestrial and Endangered Resources program will focus on the following goals:

PROGRAM GOAL 1: Provide the Scientific Foundation for the Conservation of Terrestrial Plants, Wildlife, and Habitats by developing the basic *biological information* that partners need to formulate adaptive management strategies.

PROGRAM GOAL 2: Provide Tools and Techniques for *effective science-based management,* such as predictive models, decision support systems, and expert systems.

PROGRAM GOAL 3: Identify the factors that contribute to and/or limit the conservation and recovery efforts for terrestrial plant and wildlife *species-at-risk***.**

PROGRAM GOAL 4: *Institute an Adaptive Science[2] Approach* to Support the *Adaptive Management* of Terrestrial Plants and Wildlife and to Provide Technical Assistance to Natural Resource Managers. Engage USGS partners in defining high priority research needs for wildlife conservation and work closely with these partners to identify urgent wildlife issues, conduct effective research, and deliver timely results and technical assistance for natural resource management and decision making.

PROGRAM GOAL 5: Enhance USGS Wildlife Research to *Meet Emerging and Future Issues.* Build additional capabilities, expertise, and capacity in the WTER Program to meet the emerging needs of USGS partners as wildlife issues take on new importance in today's society.

Strategic Direction

The strategy for the USGS Wildlife: Terrestrial and Endangered Resources Program over the next five years will:

[2] Adaptive science requires the involvement of the end-user in the design, conduct, and application of the science in an iterative process as new studies are developed based on previous results.

- Use Wildlife Advisory Teams and other mechanisms to enhance dialogue among scientists, managers, and policy-makers.

- Focus research direction and funding to address priority wildlife research needs of the Department of the Interior (DOI), its partners, and the Nation.

- Provide leadership and advocacy for the continuing development of scientific and technological capabilities of USGS to address emerging wildlife management issues and challenges.

- Fully implement an *Adaptive Science* approach that is connected to *Adaptive Management* of natural resources.

Acknowledgements

This plan is the product of the hard work, dedication, and extensive knowledge of many USGS scientists, managers, and partners in other organizations and agencies. Those individuals who contributed to the development of this plan are listed in Appendix I and we wholeheartedly thank them all.

USGS WILDLIFE: TERRESTRIAL AND ENDANGERED RESOURCES PROGRAM

The research and technical assistance activities of the Wildlife: Terrestrial and Endangered Resources Program are conducted under the authorities that guide the DOI and USGS. A natural outgrowth of the USGS responsibility to deliver high-quality science information to DOI bureaus is the extension of services to other Federal agencies, the States, Tribes, and non-governmental organizations.

The Organizational Context and Role of the Program

Department of the Interior

The DOI has responsibilities to manage and protect the Nation's living resources. These responsibilities are conveyed by various legislative authorities, such as the Endangered Species Act and the Marine Mammal Protection Act. The DOI revised its Strategic Plan in 2003 to emphasize the information base, resource management, and technical assistance for decision making. The DOI Strategic Plan aims to unify scientific knowledge with applications of that knowledge in resource management through collaboration among scientists and Federal, State, Tribal and non-governmental natural resource managers. The DOI mission promotes informed resource protection, resource use, and recreation, with the goal of serving communities by advancing knowledge and informing decisions through the application of science. The USGS WTER Program supports the DOI Resource Protection Strategic Goals by providing scientific information

to sustain biological communities on DOI managed lands and waters.

U.S. Geological Survey

The USGS serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. As the science agency for DOI, the USGS is entrusted to provide unbiased, independent data and information on biology, hydrology, geology, and geography to the DOI and the Nation. The USGS has a primary responsibility to provide high-quality scientific data to DOI and its bureaus that manage lands and biological resources. A major institutional strength of USGS is the opportunity to conduct truly interdisciplinary science. The USGS actively seeks to promote scientific undertakings that integrate its capabilities on multiple spatial scales.

USGS Biological Resources Discipline and Mission

Part of the USGS mission is to ensure the continued availability of long-term environmental and natural resource information and to conduct systematic analyses and investigations for natural resource decision-making. The Biological Resources Discipline (BRD) serves this function though the activities of eight Programs:

- Wildlife: Terrestrial and Endangered Resources,
- Fisheries: Aquatic and Endangered Resources,
- Invasive Species,
- Status and Trends of Biological Resources,
- Contaminant Biology,
- Terrestrial, Freshwater and Marine Ecosystems,
- Biological Informatics, and
- Cooperative Research Units.

The Biology Discipline Mission

. . . . to work with others to provide the scientific understanding and technologies needed to support the sound management and conservation of our Nation's biological resources

WTER Program History

Federally funded wildlife research in the United States began in the late 1800s as part of the Bureau of Biological Survey within the U.S. Department of Agriculture (USDA). Research has changed during the last hundred years to reflect the changing attitudes and politics of the country. Most research early in the 1900s was related to the deleterious effects wildlife had on humans, especially with agriculture. Scientists conducted extensive food habits studies to determine losses to farming and commercial fishing caused by depredating wildlife. Extensive drainage of wetlands followed by the dust bowl era in the 1930s made the public aware of negative effects that humans were having on wildlife and resulted in increased research to help restore wildlife populations.

In 1940, all wildlife research conducted by USDA was transferred to DOI, reflecting the change in focus from impacts of wildlife on humans to impacts of humans on wildlife. Early wildlife research emphasized farm game, impoundment management, and avian eggshell thinning from pesticides. Research centers were created throughout the US to address wildlife issues in different geographic areas. Research on DDT and other potential wildlife contaminants began during the early 1940s continued following World War II and expanded during the 1960s at science centers as part of the environmental movement that was sweeping the country.

The environmental movement of the 1960s not only resulted in increased funding for contaminant research but also for new research thrusts with endangered species and urban wildlife. The first American bald eagle and whooping crane arrived at the Patuxent Wildlife Research Center in 1965 and 1966, respectively, as the beginning of a captive propagation program that attained international prominence. Extensive propagation of both species helped increase the wild populations throughout North America. Urban wildlife research conducted during the 1970s and 1980s focused on developing planning techniques used with large scale developments. The program also developed advice on backyard bird feeding used by millions of homeowners every year.

The creation of the National Biological Service in 1993, from the biological research entities of the DOI, including the US Fish and Wildlife Service, National Park Service, Minerals Management Service, Bureau of Land Management, and Bureau of Reclamation, and the subsequent merger into USGS as the Biological Resources Discipline, reflects major organizational change. However, the commitment of wildlife scientists in the organization remains steadfast and even more dedicated to meeting the needs of resource managers. Within the USGS organization, a more regional approach was taken and research also focused on broader environmental issues such as wetland restoration and effects of global warming. USGS, however, continues to address national wildlife concerns, especially with waterfowl and imperiled species, and maintains partnerships with State, Tribal, and municipal governments concerning local wildlife research issues.

WTER Program Mission

. . . to provide the scientific information, tools, and technologies that DOI natural resource managers need to conduct sound management of our Nation's terrestrial plant and wildlife resources in response to ecological and societal needs

Program research activities provide critical scientific information that supports the DOI goal to protect and preserve the Nation's natural and cultural resources. Research results, technologies, and models are applied by natural resource managers and decision makers in designing and implementing conservation and restoration plans to manage natural resources for a healthy environment and strong economy. Terrestrial habitats are formed by, and subject to, constant change by natural geological, hydrologic, and climatic forces as well as ongoing human activities; therefore, interdisciplinary approaches are needed to ensure complete understanding of the interactions among terrestrial plants and animals

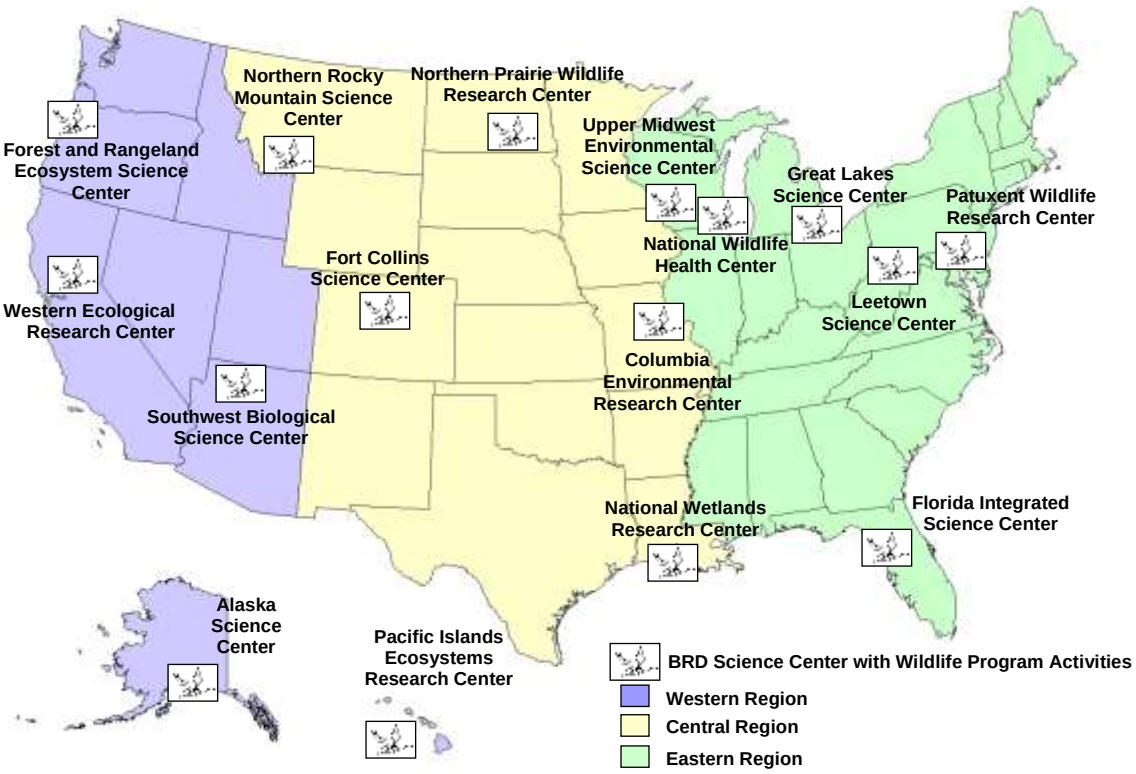
and their habitats. A primary focus of the WTER Program is the integration of biological information in the context of geologic, hydrologic, geographic, and climatologic change to obtain a more comprehensive understanding of the effects of change at local, regional, and landscape levels.

Program Capabilities

The WTER Program possesses unique capabilities needed to meet the Nation's wildlife challenges. The Program supports research in a wide variety of biological fields that extend from molecular levels to ecosystem ecology, each supported by cutting-edge technologies. Scientific expertise within the WTER Program includes organismal biology, ecology of terrestrial populations and habitats, wildlife health and diseases, genetics and molecular biology, animal behavior, statistical methodology, and developmental and reproductive biology. In each field, WTER scientists investigate the biological functions and interactions of wildlife species with their environment. Information from these studies is made available to managers for use in the conservation and restoration of biological resources.

Research activities of the Program are conducted at USGS Science Centers (Figure 1), field stations, Cooperative Research Units, and numerous academic institutions. Research often involves fieldwork that requires sophisticated technologies and other methods that have been adapted for wildlife, terrestrial plants, and terrestrial environments. Scientists of the WTER Program develop new applications of advanced scientific methods to provide natural resource managers with explicit information on the biology and ecology of terrestrial plants and wildlife to assist in the understanding, evaluation, and restoration of their populations and habitats.

Figure 1. USGS Science Centers Engaged in Wildlife Research



Examples of Program Accomplishments

Migratory Birds: USGS scientists have formed crucial adaptive management partnerships for sustaining wildlife populations of waterfowl, sandhill cranes, shorebirds, grassland birds, and multispecies groups in conjunction with USFWS scientists on National Wildlife Refuges. Waterfowl banding data are analyzed to assist the USFWS with the establishment of hunting regulations annually. USGS recently initiated a large international seaduck project with support of the Sea Duck Joint Venture that includes extensive satellite telemetry and the establishment of the first captive colony of seaducks for research purposes.

Recent research conducted under the Platte River Program has allowed scientists to obtain detailed insight into the distribution of subspecies and subpopulations of midcontinental sandhill cranes throughout the annual cycle. Federal and state crane managers in the Central Flyway are using these results as a key source of information as they develop a long-range management plan for the midcontinental population.

Large Predators: USGS has been a leader in research on the Eastern timber wolf and grizzly bears. More than 40 years of research have helped guide DOI policy related to wolves, including the management and recovery of this species; USGS science has produced central theory on predator-prey dynamics. USGS and other members of the

Interagency Grizzly Bear Study Team conduct research that provides information needed by various agencies for immediate and long-term management of grizzly bears inhabiting the Greater Yellowstone Ecosystem.

Wildlife Disease: USGS is working with the Centers for Disease Control and Prevention to determine the spatial and temporal dynamics of West Nile Virus and to understand how it moves among birds, mosquitoes, and humans. Models developed help to predict future movements of the virus, alert public health officials when human testing and diagnostic testing is advised, and to protect endangered birds from this disease. USGS scientists are also working closely with States, universities, and USDA to understand Chronic Wasting Disease (CWD) in deer and elk and to develop strategies for CWD management.

Marine and Freshwater Wildlife: Recent concerns and litigation related to the incidental take of manatees by watercraft-related activities prompted a cooperative effort between USFWS and USGS scientists to estimate the possible impacts of incidental take on manatee populations. USGS developed a state-of-the-art population model to address the question and provide USFWS with the information needed for policy guidance and legal interpretations.

Current Research Activities

Long-term investigations are developed by researchers in consultation with partners and other program stakeholders to address areas of biological uncertainty associated with natural resource management. Based on hypotheses developed from specific science needs, WTER scientists gain fundamental biological knowledge that allows natural resource managers and decision makers to develop informed plans for resource use. The WTER Program contributes data, assessments, evaluations, systematic analyses, models, and decision support tools for the management of natural, cultural, and historic resources important to human and ecological health. Incorporating the appropriate spatial and temporal scales to capture the life cycle, population, and ecological components of complex terrestrial communities and systems is a primary goal of long-term research.

Management of large areas such as National Parks, National Wildlife Refuges, and Bureau of Land Management public lands requires landscape scale risk assessments, predictive models, and decision support tools based on long-term ecological studies. The WTER Program provides syntheses of data from site-specific, place-based regional and national research and monitoring activities to support landscape-scaled understanding of biological processes that affect terrestrial species, populations, communities, and habitats.

Technical Assistance

Short-term, rapid response technical assistance provides immediate results to meet the science needs of natural resource managers. Examples include investigating wildlife mortality events, evaluating the abrupt degradation of terrestrial habitats through natural events, and reviewing management plans. Technical assistance activities may develop into long-term research if scientific uncertainty prohibits immediate action by natural resource managers or decision makers. Short-term targeted research and studies

complement long-term monitoring, research, and modeling activities to increase our understanding of complex issues such the ecology of wildlife disease, landscape-level habitat management, and wildlife-human conflicts.

CHALLENGES FOR THE FUTURE

National Perspectives

The major challenge is to provide relevant and comprehensive scientific information in a timely manner to managers and decision-makers dealing with immediate threats to species or habitats. Concurrently, a sustainable scientific enterprise must anticipate and plan for long-term and emerging needs. The advent of expanded international trade and movement of people has accelerated the spread of disease among terrestrial animals, and imperilment or displacement of native terrestrial species and habitats by invasive species. Potentially devastating pathogens and species are emerging with increased frequency. Moreover, continued expansion of human infrastructure fragments existing wildlife habitat threatening certain species, and in some instances, creating human-wildlife conflict. The management of wildlife and other terrestrial resources requires improved means to detect, control, or eradicate factors that negatively affect terrestrial plant and animal health, reproduction, and survival. The WTER Program has a critical mission to understand and predict how human activity and natural changes are affecting terrestrial plant and animal populations and to identify and prepare for future science information needs. The full impacts of international trade, global climate change, barriers in terrestrial systems, land-use practices, and other habitat changes on wildlife abundance and distribution are still poorly understood. New techniques, tools, approaches, and resources are needed to counteract those changes that threaten the future conditions and sustainability of terrestrial wildlife, plants, and systems.

Science Planning Strategies

The WTER Program applies five science planning strategies to identify natural resource science needs of its partners and stakeholders for setting future research priorities.

- Organize and facilitate workshops, meetings, and discussions with cooperating scientists, cooperating agencies, and stakeholders to define and prioritize scientific questions for systematic analysis.
- Formulate hypothesis-driven research plans with other USGS programs or with partner agencies to answer specific science information needs and develop implementation plans and funding approaches.
- Conduct systematic analyses in response to natural resource management needs, and characterize the biological attributes of terrestrial species and habitat interactions that regulate or respond to natural functions or human activities to build a scientific basis for adaptive management decisions.
- Develop, incorporate, test, or adapt new research techniques and technological tools into research designs, data collection, analyses, syntheses, and models to provide advanced scientific information to resource managers.

- Synthesize existing biological and physical information for terrestrial species and habitat interactions to develop conceptual and statistical models of population or habitat productivity and viability, risk assessment, and decision support tools for natural resource managers and decision makers.

Benefits to Partners

The WTER Program serves a large number of external stakeholders, and provides research support and technical assistance in several areas of expertise. Partners include a variety of Federal and State agencies, non-governmental organizations, private entities, and international governments that use the information frequently as important baseline information to assess individual or population status. Collaborations between and among USGS partner agencies and their stakeholders have ensured science support for critical issues related to adaptive management of terrestrial species and habitats to promote the health of the Nation's terrestrial natural resources.

Cooperative partnerships have been successful in designing and implementing large and complex research initiatives associated with WTER Program goals. Examples include the Amphibian Research and Monitoring Initiative, a partnership that involves numerous Federal, State, and non-governmental organizations, and the Chronic Wasting Disease Research Initiative to investigate this fatal disease of deer and elk. Partners and cooperating agencies rely on the continued involvement of USGS scientists to address issues of regional and national significance identified in adaptive management plans. Such cooperative efforts focus WTER Program expertise to solve natural resource management problems of national and international scope and significance.

USGS Programs combine the expertise and capabilities of the disciplines to provide integrated science capabilities to partners and stakeholders. The Program focus is on supporting DOI management of public lands, waters, DOI trust species, and habitats.

Societal Needs

The role of the WTER Program is to provide the scientific information necessary to manage and conserve wildlife resources for the future. One important dimension that wildlife science needs to address is the relationship to human behavior. Expansion of the human footprint on the landscape, cultural shifts from rural to urban lifestyles, and negative interactions between wildlife and humans all play a role in how society perceives wildlife and the ability for wildlife professionals to respond to societal needs. Wildlife science needs to adapt and expand in scope to meet these needs and this plan attempts to guide this effort within USGS for the future. Also, there is a real opportunity to enhance the role of Native American Tribal and Traditional Knowledge in wildlife research and management. The DOI is well positioned to integrate this approach into science planning and every effort should be made to develop mechanisms to address this opportunity.

PROGRAM DIRECTION FOR THE FUTURE

WTER Program Vision

> …. ***to be the primary source of wildlife science needed to accomplish the conservation mission of the Department of the Interior and its partners, including States and Tribes, and to enhance capabilities at a rate sufficient to address emerging wildlife issues***

To accomplish this vision, the WTER Program is committed to providing accurate, comprehensive, timely, and unbiased scientific information to our DOI partners and natural resource management stakeholders. The Program will continue to build the scientific framework required by partners to answer pressing questions regarding terrestrial resource management.

National Framework

The WTER Program is closely linked to the other Biology Programs and provides research expertise for scientific questions regarding wildlife and habitats for other biology programs including Status and Trends; Terrestrial, Freshwater and Marine Ecosystems; Contaminant Biology; Invasive Species; Cooperative Research Units; and Biological Informatics. WTER Program goals are designed to produce scientific information with the other USGS Programs that can be applied to solving natural resource problems. Information transfer is vital, and the WTER Program cooperates with the Biological Informatics and Geographic Analysis and Monitoring Programs to capture and disseminate biological information about wildlife and habitat interactions in spatial and temporal contexts to DOI and other Federal, State, local, Tribal, and NGO natural resource agencies.

Science Quality

Quality scientific information is the primary product of the WTER Program. Under the DOI guidelines for government data and information, the Program is committed to objectivity, utility, and the integrity of the scientists, projects, products, and outcomes. USGS Science Quality Policy establishes an organizational framework and common procedures for scientific information to ensure uniform standards and unbiased, independent peer review of products.

Science Information Transfer

The WTER Program transmits scientific information to its partners through a wide range of products that include peer-reviewed articles and other publications, presentations, data and databases, decision support tools, risk assessment models, geographic information systems, and other advanced electronic information systems. The goal is to provide accurate and timely science-based information to our partners and the Nation. Accurate and timely science information is needed to provide the scientific basis for balanced

natural resource management to protect, conserve, and restore the Nation's wildlife resources.

5-YEAR PROGRAM GOALS, OBJECTIVES, AND STRATEGIES

The WTER Program Goals represent a synthesis of the Thematic Goals presented in Appendix II. Each Wildlife Advisory Team (WAT) developed goals, objectives, and measures that address the highest priority issues to be addressed by USGS wildlife research over the next five years. The Thematic Goals and Objectives will be useful for USGS scientists in their project planning and formulation process. For example, avian researchers will be able to reference the goals listed under the Migratory Birds and Habitat Linkages Theme to determine the future needs and direction for the next five years. The Program Goals address broad approaches to the science that are needed such as an increased involvement of partners in the science planning process and enhanced development of tools and techniques. The **WTER Program Goals, Objectives, and Strategies** are presented below.

Program Review

The WTER Program has not yet undergone an organizational Program Review, unlike the other BRD science Programs. This plan represents the first national effort to bring USGS wildlife scientists together with partners to chart the strategic direction of our science. The WTER Program review is scheduled to take place during FY2005. The review will build on this strategic plan and further articulate goals and objectives. Efforts will be made to incorporate the results and recommendations of this review into the next version of this plan.

WTER Program Goals, Objectives, and Strategies

Program Goal 1: Provide the Scientific Foundation for the Conservation of Terrestrial Plants, Wildlife, and Habitats by developing the basic *biological information* that partners need to formulate adaptive management strategies.

- **Program Objective 1.1:** Expand our understanding of terrestrial plant and wildlife populations and communities.
    - **Strategy:** Investigate the population ecology of terrestrial wildlife to inform conservation decision-makers.
    - **Strategy:** Investigate the effects of ecological processes at the individual, community, and ecosystem levels.
    - **Strategy:** Investigate the effects of habitat change on terrestrial plants and wildlife populations.
    - **Strategy:** Investigate the direct and indirect effects of human activity on terrestrial plants, wildlife, and their habitats.
- **Program Objective 1.2:** Integrate perspectives of human dimensions into scientific investigations.
    - **Strategy:** Investigate the role of human dimensions in terrestrial plant and wildlife conservation.
- **Program Objective 1.3:** Improve understanding of current and emerging wildlife disease issues and our ability to react to future occurrences.
    - **Strategy:** Expand the scope of wildlife disease research and extend studies to an ecosystem level.
- **Program Objective 1.4:** Conduct a national amphibian research and monitoring program (ARMI) to assess population trends at multiple spatial and temporal scales, evaluate the causes for declines and malformations, and provide scientific information for amphibian conservation.
    - **Strategy:** Establish a network designed to monitor the status and changes in the distributions and abundance of amphibian species and communities in the United States.
    - **Strategy:** Identify environmental conditions known to affect amphibians and document their differences across the Nation.
    - **Strategy:** Identify the underlying causes of amphibian population change and malformations.
    - **Strategy:** Disseminate information to managers, policy makers and the general public in support of amphibian conservation and conduct outreach to inform Natural Resource managers and decision makers on the results of amphibian research and to support amphibian conservation efforts.

Annual Funding: $24.2 million

Links to Other Programs: This goal will link to all other USGS biology Programs.

Partners and Customers: USFWS, NPS, BLM, USDA-FS, State, Tribal, and local wildlife management agencies, academic institutions, and scientific societies.

Products, Outcomes, and Measures: WTER scientists produce numerous articles that are published in peer-reviewed journals, presentations at professional science symposia, and recommendations for natural resource managers / decision makers. The measures for this goal are: 1) the number of formal workshops or training provided to customers and 2) the number of new or improved decision support systems.

Program Goal 2: Provide Tools and Techniques useful for *effective science-based management*, such as predictive models, decision support systems, and expert systems.

- **Program Objective 2.1:** Develop models and statistical methods for terrestrial plant and wildlife conservation.
    - **Strategy:** Integrate tools, technology, information, and expertise across multiple spatial, temporal, and thematic scales.
    - **Strategy:** Develop practical methods to identify the appropriate scales for plant and wildlife management.
- **Program Objective 2.2:** Develop genetic and molecular tools for terrestrial plant and wildlife conservation.
    - **Strategy:** Develop, assess, and apply conservation genetic tools and analyses at multiple levels of taxonomy.
    - **Strategy:** Develop and use molecular tools in combination with other biological and statistical methods and provide information for the management and conservation of terrestrial plant and wildlife species.
- **Program Objective 2.3:** Develop GIS-based tools and models for use in habitat conservation.
    - **Strategy:** Develop information and methods to assess and identify habitats for species of conservation interest.
- **Program Objective 2.4:** Develop techniques and strategies to identify, control, and prevent diseases in wildlife.
    - **Strategy:** Convene regular meetings with stakeholders and end-users of scientific information to ensure development of new research in appropriate areas of application and reduce duplication of efforts.
    - **Strategy:** Evaluate new techniques for the identification of disease agents.

Annual Funding: $3.3 million

Links to Other Programs: This goal will link to all other USGS biology Programs and the Geographic Analysis and Monitoring Program.

Partners and Customers: USFWS, NPS, BLM, USDA-APHIS/NRCS/FS, State, Tribal, and local wildlife management agencies, academic institutions, and scientific societies.

Products, Outcomes, and Measures: WTER scientists produce numerous articles that are published in peer-reviewed journals, presentations at professional science symposia, and recommendations for natural resource managers / decision makers. The measures for this goal are: 1) the number of formal workshops or training provided to customers and 2) the number of new or improved decision support systems.

Program Goal 3: Identify the factors that contribute to and/or limit the conservation and recovery efforts for terrestrial plant and wildlife *species-at-risk.*

- **Program Objective 3.1:** Identify factors limiting populations of plant and wildlife species at risk.
    - **Strategy:** Conduct genetic analyses to synthesize information on the evolutionary history, colonization patterns, species interactions, and genetic introgression in populations of plant and wildlife species at risk.
- **Program Objective 3.2:** Determine the underlying causes for long term declines in terrestrial plant and wildlife populations.
    - **Strategy:** Conduct interdisciplinary research on factors causing plant and wildlife species to undergo long term population declines throughout their geographic ranges.
- **Program Objective 3.3:** Characterize the threats to terrestrial plant and wildlife populations that are especially vulnerable due to their limited size and/or distribution.
    - **Strategy:** Investigate the role of ecological processes in the decline of terrestrial plant and wildlife populations at multiple scales.
    - **Strategy:** Investigate the individual and cumulative impacts of human activities on terrestrial plant and wildlife species at risk.
- **Program Objective 3.4:** Provide timely science information to natural resource managers and decision makers regarding species at risk and the effectiveness of alternative conservation strategies.
    - **Strategy:** Conduct population viability analyses for species at risk.
    - **Strategy:** Conduct research on the habitat requirements of species at risk.
    - **Strategy:** Conduct research on the social, political, and economic consequences of specific conservation strategies being considered for species at risk.
    - **Strategy:** Provide science support which assists DOI agencies establish population objectives.

Annual Funding: $10.2 million

Links to Other Programs: This goal will link to all other USGS biology programs.

Partners and Customers: USFWS, NPS, BLM, NOAA-NMFS, USDA-APHIS/NRCS/FS, State, Tribal, and local wildlife management agencies, academic institutions, and scientific societies.

Products, Outcomes, and Measures: WTER scientists produce numerous articles that are published in peer-reviewed journals, presentations at professional science symposia, and recommendations for natural resource managers and decision-makers. The measures for this goal are: 1) the number of systematic analyses and investigations delivered to customers and 2) the number of new or improved decision-support systems.

PROGRAM GOAL 4: *Institute an Adaptive Science Approach* to Support the *Adaptive Management* of Terrestrial Plants and Wildlife and to Provide Technical Assistance to Natural Resource Managers. Engage USGS partners in defining high priority research needs for wildlife conservation and work closely with these partners to identify urgent wildlife issues, conduct effective research, and deliver timely results and technical assistance for natural resource management and decision making.

- **Program Objective 4.1:** Enhance cooperative wildlife research, training, and information exchange that meets partner needs for science-based decision making.
    - **Strategy:** Conduct workshops involving USGS scientists and partners on important emerging wildlife conservation issues to facilitate information exchange and focus research direction.
    - **Strategy:** Develop new research based on partner needs that addresses environmental factors contributing to the understanding of wildlife ecology.
    - **Strategy:** Assess training needs across organizations and develop appropriate interagency training to meet those needs.
- **Program Objective 4.2:** Provide greater levels of science support for regulatory decision making.
    - **Strategy:** Enhance communication and interactions between researchers and resource managers to integrate science into the decision-making processes for terrestrial plant and wildlife management.
    - **Strategy:** Evaluate effectiveness of alternative management actions that consider cost, land use, and long-term objectives.
- **Program Objective 4.3:** Expand partner base to ensure that human dimensions and traditional knowledge are incorporated into USGS science planning as appropriate.
    - **Strategy:** Convene meetings and workshops with partners that can integrate human dimensions, traditional knowledge, and other cultural values into the development of new science projects.
    - **Strategy:** Develop mechanisms and processes that support communication and cooperation among USGS, Tribes, and other stakeholders to facilitate the application of relevant USGS science.
- **Program Objective 4.4:** Increase partner knowledge of USGS expertise, capabilities, and information systems.
    - **Strategy:** Develop and maintain searchable databases of scientific expertise within USGS.
- **Program Objective 4.5:** Assess wildlife response to ecological experiments and management actions to provide feedback for adaptive management.
    - **Strategy:** Engage natural resource managers in developing adaptive approaches in habitat management, population management, and other management situations.

Annual Funding: $2.3 million

Links to Other Programs: This goal will link to all other USGS biology Programs.

Partners and Customers: USFWS, NPS, BLM, USDA, NOAA, Non-governmental Organizations, State, Tribal, and local wildlife management agencies, academic institutions, and scientific societies.

Products, Outcomes, and Measures: WTER-funded scientists produce numerous articles that are published in peer-reviewed journals, presentations at professional science symposia, and recommendations for natural resource managers / decision makers. The measures for this goal are: 1) the number of systematic analyses and investigations delivered to customers, 2) the number of formal workshops or training provided to customers, and 3) the number of new or improved decision-support systems.

Program Goal 5: Enhance and Structure the USGS WTER to *Meet Emerging and Future Issues.* Build additional capabilities, expertise, and capacity in the WTER Program to meet the emerging needs of USGS partners as wildlife issues take on new importance in today's society.

- **Program Objective 5.1:** Improve cooperative approaches to meet current and emerging wildlife issues.
    - **Strategy:** Coordinate existing capabilities of USGS and its research partners
    - **Strategy:** Work with research partners to develop long range research plans that demonstrate why new resources are needed for addressing emerging and future issues.
- **Program Objective 5.2:** Enhance USGS wildlife science capabilities in core thematic areas.
- **Program Objective 5.2.1:** Increase human dimensions of wildlife management capabilities within the WTER Program that will integrate social, cultural, political, and economic research in addressing emerging human-wildlife issues.
    - **Strategy:** Formalize and develop techniques for conducting social science research to understand the impacts of human activities on all wildlife communities.
- **Program Objective 5.2.2:** Develop and use techniques and research methods that incorporate traditional knowledge and cultural values to support the management and conservation of wildlife and natural resources.
    - **Strategy:** Establish a process that formalizes communication and coordination between tribes and the USGS to develop approaches to integrate traditionally knowledge into the decision making process for wildlife and natural resource management.
- **Program Objective 5.2.3:** Develop a national wildlife disease program within USGS that integrates all partners in addressing wildlife disease issues.
    - **Strategy:** Take the lead role in establishing collaborations to study and monitor wildlife disease worldwide.
- **Program Objective 5.2.4:** Identify and describe the adverse effects of existing and potential exotics on Marine and Freshwater Wildlife populations.
    - **Strategy:** Understand and predict effects of established and potential exotics on Marine and Freshwater Wildlife via habitat degradation, community interaction, and disease.
- **Program Objective 5.2.5:** Conduct research that relates to species of common international concern, including migratory species, invasive species, and imperiled species.
    - **Strategy:** Develop international cooperative research on migratory birds, shared species, and imperiled species throughout their range.
- **Program Objective 5.2.6:** Assess (or quantify) consequences of ecological experiments.
    - **Strategy:** Develop methods (and adaptive processes) for assessing the consequences of ecological experiments.
- **Program Objective 5.2.7:** Take a multi-disciplinary approach in the assessment of imperiled plant and animal species.

    - **Strategy:** Integrate and develop our expertise in relevant fields necessary for imperiled plant and animal species assessments.
- **Program Objective 5.2.8:** Better understand the effects of human infrastructure and associated human activities on populations and behaviors of large mammals and predators.
    - **Strategy:** Construct and provide analytical tools for use by management oversight of human developments in order to minimize the impacts on populations and behaviors of large mammals and predators.
- **Program Objective 5.2.9:** Improve knowledge toward decision making for migratory birds and their habitats.
    - **Strategy:** Provide science support for regulatory decisions in migratory bird management.

Annual Funding: New Initiatives Required.

Links to Other Programs: This goal will link to all other USGS biology Programs.

Partners and Customers: USFWS, NPS, BLM, USDA-FS, USDA-APHIS, State, Tribal, and local wildlife management agencies are in need of enhanced scientific information for management, policy decisions, and regulation development related to rapidly emerging wildlife issues.

Products, Outcomes, and Measures: WTER-funded scientists produce numerous articles that are published in peer-reviewed journals, presentations at professional science symposia, and recommendations for natural resource managers / decision makers. The outcomes of these efforts: a) include assessments of the scope and severity of population declines nationwide, b) lead to a more complete understanding of the ecological factors that cause long term population declines, c) are included in science-based conservation plans for National Wildlife Refuges, National Parks, and BLM public lands. The measure for this goal is the number of systematic analyses and investigations delivered to customers.

APPENDIX I. Individuals Involved in the Planning Effort

Migratory Birds and Habitat Linkages

Graham Smith	USGS	Patuxent Wildlife Research Center
Robert Cox	USGS	Northern Prairie Wildlife Research Center
Adrian Farmer	USGS	Fort Collins Science Center
Dan McAuley	USGS	Patuxent Wildlife Research Center
Kevin Kenow	USGS	Upper Midwest Environmental Sciences Center
Barry Grand	USGS	Alabama Coop. Fish and Wildlife Research Unit
Brian Milsap	USFWS	Division of Migratory Bird Management

Large Mammals and Predators

David Mattson	USGS	Forest and Rangeland Ecosystems Science Center
Peter Gogan	USGS	Northern Rocky Mountain Science Center
Kurt Jenkins	USGS	Forest and Rangeland Ecosystems Science Center
Steven C. Amstrup	USGS	Alaska Science Center
Kathleen Longshore	USGS	Western Ecological Research Center
Jim de Vos	Arizona	Arizona Department of Game and Fish
Mike Coffey	NPS	Fort Collins, Colorado
Layne Hamilton	USFWS	Region 4, Florida Panther NWR

Imperiled Species and Conservation Genetics

Sue Haig	USGS	Forest and Rangeland Ecosystems Science Center
Monica Tomosy	USFWS	USGS Liaison, Imperiled Species Coordinator
Sandra L. Talbot	USGS	Alaska Science Center
Sara Oyler Mccance	USGS	Fort Collins Science Center
John French	USGS	Patuxent Wildlife Research Center
Esther Stroh	USGS	Northern Prairie Wildlife Research Center
Jerry Godbey	USGS	Fort Collins Science Center
Eban Paxtom	USGS	Southwest Biological Science Center
Steve Chambers	USFWS	Region 2, Environmental Contaminants
Lori Nordstrom	USFWS	Region 6, Ecological Services

Wildlife and Zoonotic Diseases

Charles van Riper	USGS	Southwest Biological Science Center
Michael Samuel	USGS/UW	Wisconsin Cooperative Wildlife Research Unit
Glenn Olsen	USGS	Patuxent Wildlife Research Center
Christopher Brand	USGS	National Wildlife Health Center
Tonie Rocke	USGS	National Wildlife Health Center
Bruce Morrison	Nebraska	Nebraska Parks, Fish, and Wildlife
Margaret Wild	NPS	Fort Collins, Colorado

Human Dimensions and Traditional Knowledge

Phadrea Ponds	USGS	Fort Collins Science Center
Scott D. Wright	USGS	National Wildlife Health Center
John Antonio	USFWS	Region 2 External Affairs
David Redhorse	USFWS	Region 6 External Affairs
David Fulton	USGS	Minnesota Coop. Fish and Wildlife Research Unit
Sue Marcus	USGS	USGS Director's Office
Edward Wemytewa	Zuni Tribe	Office of the Governor
John Goes-In-Center	Sioux Tribe	Pine Ridge, South Dakota

Modeling and Emerging Technologies

Doug Johnson	USGS	Northern Prairie Wildlife Research Center
Wes Newton	USGS	Northern Prairie Wildlife Research Center
Jeff Spooner	USGS	National Mapping Discipline
Dave Otis	USGS	Iowa Coop. Fish and Wildlife Research Unit
Alisa Gallant	USGS	EROS Data Center
Jewel Bennett	USFWS	National Conservation Training Center
Wayne Thogmartin	USGS	Upper Mississippi Environmental Science Center

Marine and Freshwater Wildlife

Pat Heglund	USGS	Upper Midwest Environmental Sciences Center
James Rogala	USGS	Upper Midwest Environmental Sciences Center
Margaret R. Petersen	USGS	Alaska Science Center
Mike Adams	USGS	Forest and Rangeland Ecosystems Science Center
Bob Bonde	USGS	Florida Integrated Science Center
Ken Rice	USGS	Florida Integrated Science Center
Diane Bowen	USFWS	Headquarters Fisheries and Habitat Conservation

Science for International Conservation

Richard Johnson	USGS	Fort Collins Science Center
Qinfeng Guo	USGS	Northern Prairie Wildlife Research Center
Don MacLaughlin	IAFWA	International Assoc of Fish & Wildlife Agencies
Roddy Gabel	USFWS	Headquarters, International Affairs
Tom Franklin	TWS	The Wildlife Society

Planning and Writing

Mark Sogge	USGS	Southwest Biological Science Center
Matt Perry	USGS	Patuxent Wildlife Research Center
Rick Kearney	USGS	Wildlife: Terrestrial and Endangered Resources
Steve Hilburger	USGS	Wildlife: Terrestrial and Endangered Resources
Greg Smith	USGS	Wildlife: Terrestrial and Endangered Resources

APPENDIX II. Thematic Goals, Objectives, Strategies, and Measures

Human Dimensions and Traditional Knowledge Advisory Team

HDT Goal 1. To fully integrate all aspects of human dimensions research into the WTER program.		
HDT Objective 1A: Integrate and develop social science expertise in relevant fields (e.g., wildlife disease, large mammals and predators, marine and fresh water wildlife, etc,) necessary to identify and understand human-wildlife interactions.		
Strategy	**Outcome**	**Measure**
Understand the socio demographic and economic factors that affect wildlife management practices and policies	Improve our understanding of how demographic shifts in the U.S. affect regional or national public preferences for wildlife and wildlife management.	Data that will contribute to a framework providing regional and national perspectives on changes human-wildlife interactions
Develop a risk analysis tool that will combine biological factors with existing societal and ecological factors to assess disease risk.	An integrated risk analysis tool that can be used by managers to aid in risk assessment emerging zoonotic diseases.	The use of this data analysis approach to delineate linkages and causalities of biological and societal factors in disease risk
Identify significant information gaps with respect to human-wildlife interaction	Training for resource managers focusing on the strategic application of technical and social science data.	Number of requests for short term, rapid response technical assistance for immediate management needs.
Develop models and decision support systems to evaluate the effects of management alternatives on wildlife species communities	Provision of this information in usable formats—including training when appropriate—so that managers can match social science findings to management questions.	Agencies make scientifically sound and legally defensible decisions (decreased litigation) Number of times models are used in a decision-making process.
Develop an institutional and economic framework that incorporates the institutional complexities, social and economic constraints, and predicts stakeholders' influence and preferences in the resource management decision-making process.	Identify the obstacles and opportunities for collaborate planning at the human-wildland interface	Agencies use data to make scientifically sound and legally defensible decisions (decreased litigation)
Develop indicators and understanding of human impacts on wildlife communities	This information will help resource managers understand and respond how to the many socio demographic changes related to human-wildlife interaction	Number of requests for short term, rapid response technical assistance for immediate management needs.
Anticipate future sociological and human-wildlife related issues	Workshops, symposia, and working group meetings	Initiation of new projects with stakeholder involvement
HDT Goal 2: Develop and use techniques and research methods that incorporate traditional knowledge and cultural values to support the management and conservation of wildlife and natural resources.		
HDT Objective 2A: Enhance research capabilities to include research support and technical assistance from Tribes for application in natural resource management problem solving and decision making.		
Strategy	**Outcome**	**Measure**
Incorporate native and other cultural values, traditions, needs, and world views into USGS scientific studies so that USGS science is improved, more comprehensive, and more relevant to native and other stakeholders.	Statements of relationship.	Number of working relationships with tribes and stakeholders
Apply/use oral histories and other traditional knowledge as a	A curriculum for USGS employees on traditional knowledge and learning styles of	Increased data collection and sharing between USGS and tribes

complementary source of information for stewardship of nature	indigenous people. Ecological history of indigenous people.	
Educate USGS leadership and employees understanding of unique relationships, treaties, and agreement between tribes and US government. Improve proactive addressing federal Trust responsibilities	Improved knowledge and understanding of USGS leadership and employees about the external and internal resources available concerning HD and traditional knowledge	Case studies concerning agency tribal relationship.
Identify institutional barriers in agency decision-making processes concerning research conducted on/in tribal areas.	Educate USGS leadership, employees, and scientists about the unique diplomatic/traditional protocols and relationships between tribes and US government. Improve tribal understanding of the decision making processes used by USGS.	Number of identified models and cases studies of federal agency decision-processes related to priority setting for research needs related to tribal and other stakeholders.
Enhance collaboration and cooperation between USGS and tribes, stakeholders, and other human communities to further issues of mutual interest	Realignment of USGS regions to accommodate a “different America”	Enhanced working relationships with tribes and stakeholders
Develop working agreements—MOUs, SORs, Cooperative agreements	Grant programs to develop cooperative research with tribes and tribal colleges.	Number of working relationships with tribes and stakeholders

Imperiled Species and Genetics Advisory Team

ISG Goal 1: Take a multi-disciplinary approach to imperiled plant and animal species assessments		
ISG Objective 1A: Integrate and develop our expertise in relevant fields (e.g., taxonomy, genetics, morphology, behavior, ecology, life history, multi-spatial and temporal factors, etc.) necessary for imperiled plant and animal species assessments.		
Strategy	**Outcome**	**Measure**
Conduct multi-disciplinary training and workshops	USGS scientists and partners develop a better understanding of imperiled plant and animal species assessments Improve our understanding of multi-spatial and temporal factors affecting imperiled species conservation and recovery.	Number of participants and their evaluations
Develop communication networks among specialists in fields of concern both within USGS and external sources	Improved cooperation among stakeholders	Initiation of new projects with stakeholder involvement
ISG Objective 1B: Assist partners in making complex decisions.		
Strategy	**Outcome**	**Measure**
Formalize, develop, and quantify techniques for making decisions in imperiled plant and animal conservation and recovery strategies Coordinate workshops, symposia, and working group meetings	USGS provides technical expertise in risk analysis, PVA, uncertainty analyses, and structured decision theory/making	Agencies make scientifically sound and legally defensible decisions (decreased litigation)
Providing technical assistance by participating on recovery teams, working groups, implementation groups, structured decision making panels	Partners actions on regulations, management decisions, and policy are better informed	Agencies make scientifically sound and legally defensible decisions (decreased litigation)
ISG Objective 1C: Conduct research to assist the conservation and recovery of imperiled plant and animal species.		
Strategy	**Outcome**	**Measure**
Conduct research in cooperation with other agencies and working groups to define and prioritize research needs.	Quality information available for priority decisions	Agencies and organizations adopt/adapt management for conservation and recovery of imperiled plants and animals
Strategy: Examine surrogate species of imperiled plant and animal species for insight into life histories, threats, and possible recovery strategies. A. Evaluate species in other countries or in other parts of a species range. B. Evaluate factors affecting captive and wild populations and how they relate to each other: husbandry, reintroductions, etc.	More robust information for species and a better foundation for management decisions	Agencies and organizations adopt/adapt management for conservation and recovery of imperiled plants and animals
Conduct basic research into life histories, possible threats, and/or recovery strategies	Quality information available	Information available for conservation and recovery of imperiled plants and animals
Explore, develop and implement new theories, techniques and technology for imperiled plant and animal species recovery	Reports, publications, and technical advice based on the Outcome of research	Agencies and organizations adopt/adapt management for conservation and recovery of imperiled plants and animals

ISG Goal 2: Evaluate current and future anthropogenic impacts and issues on the viability of imperiled plant and animal species and habitats		
ISG Objective 2A: Identify and measure anthropogenic impacts on imperiled plant and animals species habitats such as invasive species impact, climate changes, or overall degradation and loss of available habitat.		
Strategy	**Outcome**	**Measure**
Set priority among species to be studied, possibly: 1. Those tied closely to habitat; 2. Those with active species restoration underway; and/or 3. Those with habitat restoration identified as a task in current recovery plans.	A clear agreement on the species and habitats of highest priority is achieved between USGS and management agencies	Agencies and organizations confirm the priority of the results delivered by USGS in their reports and recommendations
ISG Objective 2B: Identify and measure exposure and impacts of chemical contaminants to imperiled plant and animal species.		
Strategy	**Outcome**	**Measure**
Develop a database on the overlap of imperiled plant and animal species ranges and the geographic extent of chemical contamination. Refine this database by: habitat type, trophic level of species, taxon, chemical type, etc.	Database developed	Number of requests/ queries of the database by USGS stakeholders
Toxicological study of individual imperiled plant or animal species	New research is initiated	Number of studies initiated
Develop mitigation or avoidance strategies for imperiled plant and animal species recovery or restorations	Strategies are incorporated into recovery plans and other key documents	Key documents cite USGS contributions to the foundation of their recommendations
ISG Objective 2C: Identify species or local populations of concern to traditional societies especially those of high spiritual value or importance to subsistence hunting and gathering. These may be imperiled plant or animal species, as USGS has defined them.		
Strategy	**Outcome**	**Measure**
Convene meetings and workshops with Native American partners and develop partnerships with Tribes and organization where lacking	Information is developed and disseminated and stimulates new research and better management decisions	Products are developed and traditional societies are fully engaged in the process
ISG Objective 2D: Evaluate health status of wild and captive imperiled plant and animal species and potential for disease, including novel routes of infection.		
Strategy	**Outcome**	**Measure**
Develop vaccines for captive and released animals against problem pathogens	Protection of priority species from select pathogens	Number of species protected from pathogens
Develop strategy for monitoring health and disease in imperiled plant and animal species, especially release animals	Health monitoring plan for priority species	Number of species protected by plan implementation
Make available on the web or otherwise publish information of disease prevalence and incidence for emerging or other disease	Web or published reports of available information, with updates as new information is received	Numbers of reports of species and pathogens from cooperating agencies and the public that can be incorporated into the accessible web sites or publications
ISG Goal 3: Develop, assess, and apply conservation genetic tools and analyses from the individual level through higher level taxonomy		
ISG Objective 3A: Investigate the applicability of new molecular and analytical tools for imperiled plant and animal species conservation and recovery.		
Strategy	**Outcome**	**Measure**
Partner with theoreticians (informal) to build and maintain connections with	Enhanced sophistication in hypothesis generation and testing	Recognition of scientists and USGS products by the scientific

the academic world		community (awards, board memberships, stature in professional societies)
Provide and update training for BRD scientists in molecular techniques and analytical tools	Annual workshop concerning different aspects of molecular techniques and analytical tools to be held in multiple regions	Assessment of research through RGEP and reviews (Program, Regional, Center) reflects state-of-the-art approaches by USGS scientists
ISG Objective 3B: Research the relationship between molecular tools and genetic concepts with policy issues such as ESU, MU, DPS, hybrids, subspecies, and other taxonomic issues.		
Strategy	**Outcome**	**Measure**
Develop a colloquium to discuss policy issues such as ESU, MU, DPS, and definitions of a population (include taxonomists and FWS personnel)	Proceedings released from meetings concerning this topic	Number of meetings or workshops held
Provide a consensus within USGS for conceptual issues (ESU, DPS, etc.) future research, and problems (involve NRC)	Peer-reviewed publication with consensus information specific to ESA	Recognition of scientists and USGS products by the scientific community (awards, board memberships, stature in professional societies)
ISG Objective 3C: Training and information transfer to understand and interpret genetic research.		
Strategy	**Outcome**	**Measure**
Provide training opportunities to bridge the gap between USGS scientists and partner agencies, institutions, and organizations	More effective science is conducted and better utilization of the information generated is achieved	Number of cooperative meetings and workshops held with partners
Provide opportunities to collaborate with DOI genetic labs	Enhanced cooperation	Number of cooperative projects initiated
Provide opportunities for visitors (from other agencies and international) to come into research labs to learn techniques and facilitate comparative research across international boundaries	Broad, worldwide cooperative projects are initiated	Numbers of scientific exchanges and new partnerships developed
ISG Objective 3D: Utilize molecular genetic tools to address management issues for imperiled species or species of concern within a team framework.		
Strategy	**Outcome**	**Measure**
Assess genetic characteristics of imperiled species or species of concern using cutting edge techniques and analysis.	Species specific or taxon specific genetic data and interpretations (reports or publications)	Number of reports
Provide technical assistance to partners	Service on recovery teams, working groups, implementation groups	Number of USGS scientists serving on teams/groups
Investigate the applicability of new molecular tools to imperiled plant and animal species conservation and recovery	New tools are validated and applied to conservation problems	Number of reports or technical assistance projects
Research relationship between molecular tools and genetic concepts with (e.g., ESA) policy issues such as DPS, hybrids, subspecies, and other taxonomic issues	New directions in wildlife science that inform management decisions	Number of reports or technical assistance projects

ISG Goal 4: Develop and use molecular tools in combination with other biological and statistical methods to support the management and conservation of wildlife and plant species and natural resources		
ISG Objective 4A: Fully integrate the collection of molecular tools in population and higher-level assessments.		
Strategy	**Outcome**	**Measure**
Use molecular markers and stable isotope analyses to assess population structure, status, distribution, and connectivity in species that are difficult to monitor directly, including genetic-tagging in mark-recapture studies, studies to assess effective population size, and admixture analyses	USGS science is used in new technologies	Number of projects using new technologies
Use genetic characters as the basis for population identification, especially during the non-breeding phase for migratory invertebrate and vertebrate species or the assessment of interbreeding and hybridization between species	Higher quality decisions based on population characteristics	Success gauged by partner feedback
Use molecular markers, including genetics and stable isotope analyses to define population structure and status for use in population viability analyses to help set national and international recovery goals for imperiled plant and animal species	Higher quality decisions based on population characteristics	Success gauged by partner feedback
ISG Objective 4B: Facilitate a thorough integration of genetic information into models used to design and evaluate population restoration programs.		
Strategy	**Outcome**	**Measure**
Use molecular markers to evaluate the contribution of wild and captive/reintroduced individuals to natural reproduction	Better delineation of population characteristics needed for population management	Success gauged by partner / end-user feedback
Use molecular markers and pedigree analyses to design restoration of imperiled plant and animal species populations in the wild and in captivity	Better delineation of population characteristics needed for population management	Success gauged by partner / end-user feedback
Integrate use of molecular markers, pedigree analyses, and population viability analyses for translocation and restoration efforts. These adaptive management protocols provide information that is complementary to other biological characteristics and can sometimes provide additional insight into the importance of ecological phenomena	Better delineation of population characteristics needed for population management	Success gauged by partner / end-user feedback
ISG Objective 4C: Apply genetic and molecular tools in ecosystem research planning efforts.		
Strategy	**Outcome**	**Measure**
Use molecular markers to assess the impacts of habitat fragmentation among multiple taxa occurring in the same ecosystem	Better understanding of habitat fragmentation impacts	Resource managers use this information in the acquisition of new lands and management of existing lands
Use molecular tools to explore the role of microbes and pathogenic organisms in maintenance of ecosystem balance	Better understanding of ecosystem function and ecological services	Resource managers are able to apply this information

Investigate comparative phylogeography and community genetics where appropriate	Better understanding of population attributes, isolation, fragmentation, and resulting impacts	Researchers use this information for hypothesis generation and/or resource managers are able to apply this information
ISG Objective 4D: Gain a deeper understanding of disease agents and processes; facilitate the design of more effective control strategies that minimize the effects of disease in wild and cultured host populations; maintain the expertise and flexibility to respond to new and emerging diseases as they occur.		
Strategy	**Outcome**	**Measure**
Develop new diagnostic molecular tools for plant and wildlife diseases	Enhanced diagnostic capabilities	More rapid detection of disease
Use molecular tools to initiate studies of disease hosts and parasite diversity	Enhanced understanding of disease ecology	Better disease management
Use molecular epidemiology to examine virus traffic patterns throughout large geographic regions	Enhanced understanding of disease transmission pathways	Ability to develop control strategies for disease
Develop effective DNA vaccines to prevent viral disease transmission	More effective protection of wildlife	Enhanced conservation and restoration outcomes
Use molecular markers to investigate the potential threat of animal diseases to human health	Enhanced diagnostic capabilities	Enhanced conservation and restoration outcomes
ISG Objective 4E: Develop cost-effective contaminant screening tools.		
Strategy	**Outcome**	**Measure**
Use molecular tools to examine the relationship between DNA damage and concentration of contaminants	Managers have new tools to assess contaminant impacts	Use of USGS information in ecological damage assessments
Use molecular tools to examine fine-scale physiological effects of contaminants. The effects of environmental contamination may be covert in one generation if the effect is occurring at the level of germ cell formation or gamete development. Thus, molecular tools can be used to prevent catastrophic impacts on imperiled plant and animal species populations	Managers have new tools to assess contaminant impacts	Use of USGS information in ecological damage assessments
Use molecular markers in indicator species to track bioaccumulation and movement of heavy metals and other contaminants	Managers have new tools to assess contaminant impacts	Use of USGS information in ecological damage assessments
ISG Objective 4F: Take advantage of the sensitivity of genetic and molecular tools for evaluation and remediation of invasive species, and for the protection of native species by utilizing the ability to predict genetic effects of environmental and demographic changes caused by non-indigenous species.		
Strategy	**Outcome**	**Measure**
Use genetic characters to trace an invasive species or population to a point of origin.	Better definition of potential impacts of invaders in the new environment based on its ecology/origin	Remediation and control measures are developed
Use molecular tools for development and evaluation of biocontrol and physiological control measures for invasives	Enhanced control measures for invasives	Success gauged by partner / end-user feedback
Use molecular tools to identify cryptic invasive species and assess prevalence of hybridization between invasive and native species	Better understanding of the population and sub-population-level impacts of invasives	Success gauged by partner / end-user feedback

ISG Goal 5: Develop and maintain searchable databases to facilitate information access and transfer.		
ISG Objective 5A: Develop and maintain searchable database of expertise regarding imperiled plant and animal species and genetics within USGS.		
Strategy	**Outcome**	**Measure**
Design and maintain a database populated with information on individual USGS scientists' areas of expertise including species studied, field of inquiry (e.g., taxonomy, demography, population viability, molecular markers, etc.), reports and publications, etc.	USFWS, NPS, BLM, other partners will use this database as a first stop when looking for assistance on a particular species, issue, approach, etc.	Number of cases (e.g., during listing recommendation, recovery planning, etc.) in which database is used to identify individuals with appropriate expertise, or for technical assistance on similar issues/species
ISG Objective 5B: Develop and maintain searchable metadata database for population-level genetic information as an NBII node for GBIF.		
Strategy	**Outcome**	**Measure**
Design and maintain (NBII maintains) a database populated with information on population-level genetic information generated by USGS studies. (Note: The fields need to be carefully thought out, but will include such fields as species, # of pops, # of individuals in each pop, spatial extent/arrangement of pops, molecular tool applied, #loci, etc.)	USFWS, NPS, BLM, other partners will use this database to assess available population-level genetics data for a given species, or for particular applications of a specific molecular tool	Number of cases (e.g., during listing recommendation, recovery planning, etc.) in which database is used to identify existing or similar studies on specific or similar taxa
ISG Objective 5C: Promote long-term archiving of samples and/or voucher specimens used in USGS studies.		
Strategy	**Outcome**	**Measure**
Include plans and protocols for maintaining long-term storage of samples and specimens in study plans	Documented procedures and practices for maintaining viability and provenance of samples and specimens	Percent of study plans with documented protocols/plans for archiving samples/specimens
Provide funding for archival equipment and supplies	Cost savings by eliminating need to recollect and/or reanalyze samples/specimens	Number of researchers requesting use of archives

Large Mammals and Predators Advisory Team

LMP Goal 1: Establish practical methods that estimate trends, status, and projections for large mammal and predator populations with rigor sufficient for management purposes		
LMP Objective 1A: Evaluate existing field and analytical methods		
Strategy	**Outcome**	**Measure**
Convene experts to appraise existing techniques	Comparisons and evaluations of the effectiveness of existing methods of population assessment	Rejection/retention of existing methods, Recommendation of new methods
LMP Objective 1B: Develop and improve field methods.		
Strategy	**Outcome**	**Measure**
Implement field studies to develop and test new field methods	Demographic estimate with explicit treatment of bias and with reported CIs.	Use by managing agencies
LMP Objective 1C: Develop and improve analytical methods.		
Strategy	**Outcome**	**Measure**
Develop and test new [analytical and predictive] models	Effects of management actions on habitat structure/composition/function as they relate to large mammals and predators.	Number of models developed
LMP Goal 2: Understand the effects management actions that change habitat structure and composition have on large mammal populations.		
LMP Objective 2A: Provide analytical tools to predict effects of habitat management on large mammal/predator populations and behavior.		
Strategy	**Outcome**	**Measure**
Implement field studies based upon adaptive management	Incorporation of information from the adaptive management program/models into management decision-making processes.	Number of new studies initiated
LMP Goal 3: Better understand the effects (direct, indirect, and cumulative) of human infrastructure and associated human activities on populations and behaviors of large mammals and predators.		
LMP Objective 3A: Provide analytical tools to inform management oversight of human developments in order to minimize the impacts on populations and behaviors of large mammals and predators.		
Strategy	**Outcome**	**Measure**
Develop new tools in cooperation with the resource management end-user community	New tools and techniques are used by resource managers	Number of new tools and techniques developed and validated
LMP Objective 3B: Construct analytical tools which inform decision-makers regarding the effects of development practices on predator populations and behavior.		
Strategy	**Outcome**	**Measure**
Collect and compile data on the effects of human infrastructure and associated activities on the structure and function of habitat as it relates to LMPs	Databases and associated decision support tools are regularly used by land managers and urban planners to aid decision making processes regarding placement and use of human infrastructure	Success gauged by partner / end-user feedback
Relate LMP demography and behavior to human facilities	Better understanding of human impact on LMPs	Recognition of scientists and USGS products by the scientific community (awards, board memberships, stature in professional societies)
Collect and compile data on the direct effects of human infrastructure and associated activities on large mammals and predator behaviors and population dynamics	Better understanding of human impact on LMPs	Success gauged by partner / end-user feedback
Relate LMP demography and behavior to direct effects of human infrastructure and associated activities	Better understanding of human impact on LMPs	Success gauged by partner / end-user feedback

LMP Goal 4: Understand the interactions of predation and large mammal herbivory in ecosystems		
LMP Objective 4A: Understand the role of cyclical habitat changes and other processes on population levels of predators and prey and how they influence effects on each other.		
Strategy	**Outcome**	**Measure**
Conduct long-term, broad-scale, multi-species, studies in a variety of ecosystems	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center reviews as well as mechanisms such as citation index
Conduct shorter-term tactical studies of particular interaction components	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center reviews as well as mechanisms such as citation index
Manipulate predator and or prey densities to test specific hypotheses regarding predators/prey interactions	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center reviews as well as mechanisms such as citation index
LMP Objective 4B: Understand/predict effects of global climate change on LMPs.		
Strategy	**Outcome**	**Measure**
Conduct long-term, broad-scale, multi-species, studies in a variety of ecosystems	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center reviews as well as mechanisms such as citation index
Conduct shorter-term tactical studies of particular interaction components	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center reviews as well as mechanisms such as citation index
LMP Objective 4C: Identify information gaps that are currently precluding an understanding of environmental and population factors affecting predation and the impacts of herbivory.		
Strategy	**Outcome**	**Measure**
Conduct long-term, broad-scale, multi-species, studies in a variety of ecosystems	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center reviews as well as mechanisms such as citation index
Conduct shorter-term tactical studies of particular interaction components	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center

		reviews as well as mechanisms such as citation index
LMP Objective 4D: Institute studies to remedy gaps in identified understanding.		
Strategy	**Outcome**	**Measure**
Conduct long-term, broad-scale, multi-species, studies in a variety of ecosystems	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center reviews as well as mechanisms such as citation index
Conduct shorter-term tactical studies of particular interaction components	Results are regularly used in management of large herbivores and their predators, and in making forage allocations	Success can be gauged by the response of USGS partners to the delivery of new information and comments provided during Program, Regional, and Center reviews as well as mechanisms such as citation index
LMP Goal 5: Understand the consequences of fragmentation and other isolation processes and their importance to the conservation of LMPs		
LMP Objective 5A: Determine the roles of genetics, epidemiology, movement corridors, and population ecology in population function.		
Strategy	**Outcome**	**Measure**
Initiate new research	New knowledge is applied by partners	Number of applications of new information by partners
LMP Objective 5B: Develop analytical and simulation tools to assess habitat suitability for at-risk populations.		
Strategy	**Outcome**	**Measure**
Work with partners to develop appropriate tools	New tools are available	Number of applications of new tools by partners.
LMP Objective 5C: Determine function and structure of movement corridors providing effective connectivity for small isolated populations.		
Strategy	**Outcome**	**Measure**
Initiate new research	New knowledge is applied by partners	Number of applications of new information by partners
LMP Objective 5D: Determine roles of genetic structure and variability in maintenance of viable populations.		
Strategy	**Outcome**	**Measure**
Convene a scientific workshop on state-of-the-art approaches LMP population ecology	New research incorporate approaches identified as new and emerging technologies	Number of new studies that apply new approaches identified

MFW Goal 1: To identify adverse effects of existing and potential exotics on MFW populations		
MFW Objective 1A: Understand effects of *established* exotics on MFW via habitat degradation, community interaction, and disease.		
Strategy	**Outcome**	**Measure**
Predictive modeling, comparative studies, manipulative experiments	Results regularly used in management plans for prevention and control of invasive species	Reduction in the rate of establishment of exotic species and reduction in the spatial extent of currently established exotics
MFW Objective 1B: Predict effects of *potential* exotics on habitat degradation, community interaction, and disease as related to MFW.		
Strategy	**Outcome**	**Measure**
Predictive modeling, gathering information	1. Priority listing of potential invasive species and their life history characteristics. 2. Results regularly used in management plans and legislative actions for the prevention and monitoring of invasive species	Reduction in the introduction and establishment of invasive species
MFW Objective 1C: Determine the potential rate of spread of *established* and *potential* exotics, and what impacts the spread will have on MFW.		
Strategy	**Outcome**	**Measure**
Develop risk assessment models	Priority listing for management of potential invasives based on adverse effects to MFW.	Reduction in the introduction and establishment of invasive species.
MFW Goal 2: Assess health and fitness of MFW (populations, communities, individuals)		
MFW Objective 2A: Determine the effects of contaminants, diseases, and other stressors (nutrition, parasites, generics) on the health and fitness of MFW.		
Strategy	**Outcome**	**Measure**
Conduct manipulation experiments to determine effects of stressors, both individually and in combination (synergistic)	Use of results and relationships to improve MFW health, Use of results to decrease response or detection time, Use of results to modify use of potential contaminants	Significant improvement in health and fitness of MFW
Facilitate the development of forensics tools to better determine baseline condition (physiological and population norms) and impact of the stressors	Use of results and relationships to improve MFW health, Use of results to decrease response or detection time, Use of results to modify use of potential contaminants	Significant improvement in health and fitness of MFW
Conduct monitoring and correlative field research to determine effects on wildlife populations and predict outbreaks	Use of results and relationships to improve MFW health, Use of results to decrease response or detection time, Use of results to modify use of potential contaminants	Significant improvement in health and fitness of MFW
MFW Goal 3: To understand status/trends and sustainability of populations of focal marine and freshwater wildlife species impacted by human use/impacts, such as harvest, incidental take, by-catch, and commercial fishing		
MFW Objective 3A: Identify population drivers for focal marine and freshwater wildlife.		
Strategy	**Outcome**	**Measure**
Construct a database for life history data and the association of those data with drivers	Databases used to develop models	Number of times databases are used in models
Use and develop new technologies and new quantitative methods to explore relationships between drivers and life history parameters	Technological advances, research and monitoring tools. Use of results to improve the status and trends of declining species	Publication in the peer-reviewed literature. Significant improvement in the status and trends of declining populations of marine and freshwater wildlife
MFW Objective 3B: Measure change in populations of focal marine and freshwater wildlife.		
Strategy	**Outcome**	**Measure**
Design and implement a monitoring program to provide unbiased	Reported trends via a functional monitoring program	Number of species with trend information

population parameter estimates with variance estimates (including emerging technology marking and quantitative techniques).		
MFW Objective 3C: Use models to predict sustainability of populations of focal MFW.		
Strategy	**Outcome**	**Measure**
Develop predictive models for focal marine and freshwater wildlife species.	Validation of mitigation	Number of times model used for each
Develop a framework for adaptive management.	Tools used in management decision	Number of times used
MFW Goal 4: To understand the impacts of habitat and environmental change on marine and freshwater wildlife communities		
MFW Objective 4A: Investigate the effects of hydrology on marine and freshwater wildlife communities		
Strategy	**Outcome**	**Measure**
Collect empirical data on hydrologic gradient and marine and freshwater communities	Apply information to guide management decisions	Better understanding of the effects of hydrological shifts on marine and freshwater wildlife communities and their associated habitats
Conduct manipulative experiments to understand how hydrology influences community and species diversity	Use of information to conserve and better manage habitats and to make regulatory decisions	Better understanding of the effects of habitat changes and reversal of habitat loss
MFW Objective 4B: Investigate effects of global climate change on MFW communities.		
Strategy	**Outcome**	**Measure**
Monitor and assess impacts of GCC on marine and freshwater populations and communities	Guidelines for monitoring.	Improved monitoring capabilities, improved extent of monitoring.
Develop predictive models of GCC effects that incorporate local to global scale	validated models and information to guide policy	Significant changes in policies
MFW Objective 4C: Investigate effects of natural hazards (hurricanes, floods, red tide, volcanoes, fire, el nino) on MFW communities.		
Strategy	**Outcome**	**Measure**
Monitor and assess damage to MFW associated with hazards	Quantitative measures of natural hazards effects on marine and freshwater communities.	Better understanding of the long term effects of natural hazards on MFW populations.
Develop predictive models that incorporate short to long temporal scales	Use of information to lessen impact and shorten population recovery times	Recovery or significant improvement of affected habitats and populations
MFW Objective 4D: Determine effects of habitat destruction effects and restoration measures on MFW communities.		
Strategy	**Outcome**	**Measure**
Investigate effects (including cumulative effects) of large-scale disturbance, such as fragmentation, meta-population effects, genetic distribution and movement, on MFW.	Use of information to conserve habitats, to make regulatory decisions, determine mitigation on measures	Improvement in the conservation of habitats, better conservation partnerships with private land owners, and appropriate and responsible mitigation efforts

MBH Goal 1: Improving knowledge toward decision making for migratory birds and their habitats		
MBH Objective 1A: Provide science support for regulatory decisions in migratory bird management (in this case regulatory decisions encompass both hunting and permitting)		
Strategy	**Outcome**	**Measure**
Develop decision theoretic tools to inform regulatory decision makers	The implementation of ARM, or others, actually put in place by management agencies	The number of populations, species, management situations for which ARM, or others, are actually applied
MBH Objective 1B: Provide science support for habitat acquisition and management.		
Strategy	**Outcome**	**Measure**
Develop information and methods to assess and identify suitable habitat	The use by management agencies	The number of specific cases implemented by the management agencies
Develop methods to improve habitat suitability	The use of the methods by management agencies for actual improvement of habitat	The number of specific cases where the management agencies utilizes the methods.
Identify and evaluate cost effective management actions (consider land-use and long-term context)	The use by the management actions by management agencies	The number of specific cases where the management agencies use this approach
Assessing the impact of human disturbance on habitat quality	The use of these assessments by management agencies	The use of these assessments by management agencies
MBH Objective 1C: Provide science support for identifying limiting factors on the birds annual basis for focusing management		
Strategy	**Outcome**	**Measure**
Develop models and techniques (including field) to help identify key factors affecting population levels for species of management concern or interest. Anticipate future issues/species of special concern.	Implementation of models and techniques by management agencies	The number of times the management agencies utilize this approach
MBH Objective 1D: Provide science support to identify sub-populations.		
Strategy	**Outcome**	**Measure**
Develop methods to identify sub-populations, for example, use genetics to determine subpopulations and use stable isotopes to identify habitat linkages.	The utilization of these methods in a management context (by or for a management agency)	Number of species population questions resolved
Develop approaches to identify the appropriate scale at which to manage; there is a need to match grain/scale of population subdivision resolution with grain/scale of management. Assess feasibility of managing at smallest identifiable level	Use by management agencies to refine management plans	Number of species population questions resolved
MBH Objective 1E: Provide science support which assists DOI agencies establish population objectives		
Strategy	**Outcome**	**Measure**
Develop minimum viable population models	The use of the models by management agencies to make decisions	Number of instances where guidance was provided in setting population objectives
Develop science support and technical assistance to determine carrying capacity at various scales	The use of the assistance by management agencies to make decisions	The number of instances where guidance was provided in setting population objectives
Develop models and methods to measure progress toward meeting population goals	The use of the models by management agencies to make decisions	The number of instances where these methods are adopted

Develop survey methods	The use of the survey methods by management agencies to assess populations	The number of instances where these methods are adopted
Develop science support to establish meaningful population objective for a particular management goal	Utilization of this science support by management agencies to establish meaningful population objectives	Number of instances where guidance was provided in setting population objectives
MBH Overarching Goal: Ensure that there is adequate collaboration between USGS and partner agencies to ensure that research needs are identified, prioritized and addressed		
Strategy	**Outcome**	**Measure**
Develop a mechanism, a series of mechanisms, such as meetings or workshops, to ensure collaboration; Design guidelines to ensure collaboration	Enhanced use of USGS science by partners	USGS partners report great utility of the science
Utilize a ranking process to identify and prioritize what research and collaboration efforts are undertaken	Workshops with partners are held	Number of different agencies and organizations that participate in the process

Modeling and Emerging Technologies Advisory Team

MET Goal 1: Assess (or quantify) consequences of ecological experiments		
MET Objective 1A: Develop methodologies (and adaptive processes) (integrating predictive modeling, monitoring, evaluation, and feedback) for assessing consequences of ecological experiments		
Strategy	**Outcome**	**Measure**
To evaluate situations in which models have been used in decision-making	Assessment supports change in policies and practices or management has increased confidence in current policies and practices	The number of specific cases in which models are applied and evaluated in an adaptive management context
MET Goal 2: Seek serendipity		
MET Objective 2A: Senior scientists should not be discouraged from field work, where ideas may be organically derived		
Strategy	**Outcome**	**Measure**
Encourage mentoring and team approaches that are led by senior scientists.	Innovation and discovery	International recognition of USGS as a world leader in biological science.
MET Goal 3: Integrate tools, technology, information, and expertise across multiple spatial, temporal, and thematic scales		
MET Objective 3A: Increase awareness of benefits and capabilities of multi-scale thinking		
Strategy	**Outcome**	**Measure**
Derive broad-scaled inferences from the integrated analyses of fine-scaled information, and derive fine-scaled inferences from a broad-scaled context	Tools, technology, information, and expertise applied at a multiple spatial scale provide a coherent framework for research	The number of specific instances in which tools, technology, information, and expertise are developed across multiple scales
MET Objective 3B: Increase awareness of tools and technologies accommodating multi-scaled thinking		
Strategy	**Outcome**	**Measure**
Increase communications regarding capabilities of new technology	Tools, technology, information, and expertise applied at a multiple spatial scale provide a coherent framework for research	The number of specific instances in which tools, technology, information, and expertise are developed across multiple scales
MET Goal 4: Develop National Indicators of Biological Integrity, similar to GNP/GDP		
MET Objective 4A: Develop indicators relevant to the WTER Program.		
Strategy	**Outcome**	**Measure**
Convene a series of workshops	Indicators are developed	Indicators are use to measure wildlife integrity
MET Goal 5: Predict urban and exurban development to assess the risk of human population growth to the conservation of wildlife habitat		
MET Objective 5A: Develop risk assessment models for wildlife habitat		
Strategy	**Outcome**	**Measure**
Identify multidisciplinary projects needed to assess risks	Risk assessment models developed	Models are used by urban planners and managers
MET Goal 6: Provide leadership in the development and application of quantitative methods in the science and management of natural resources		
Objective 6A: Develop methods		
Strategy	**Outcome**	**Measure**
Identify needs and opportunities for new methods	New methods are developed and tested	New methods are used
MET Objective 6B: Guide application of quantitative methods		
Strategy	**Outcome**	**Measure**
Identify needs and opportunities to apply existing methods	Enhanced communication with partners for application of existing methods	Number of applications used
Cadre of experts to provide training and advice to users or managers	Users and managers develop appreciation for quantitative methods	Number of new users and managers engaged in application
MET Objective 6C: Training and information transfer		

Strategy	Outcome	Measure
Prepare manuals, training classes, workshops, web-based, repositories	Enhanced use of newly developed technologies by partners	Number of new technologies applied

Wildlife Disease and Zoonoses Advisory Team

WDZ Goal 1: Develop a national wildlife disease program within USGS that integrates all partners in addressing wildlife disease issues		
WDZ Objective 1A: Elevate present wildlife disease and zoonoses (WDZ) programs within USGS to a national level.		
Strategy	**Outcome**	**Measure**
Remove USGS regional boundary challenges for all wildlife disease research, surveillance, monitoring, etc.	USGS elevates wildlife disease to the national program level	Number of studies that cross regional boundaries
Conduct an EXTERNAL review of USGS wildlife disease programs	Following review, changes are made commensurate with recommendations of the panel	Review document developed with recommendations
WDZ Objective 1B: Take the lead role in establishing international collaborations to study and monitor wildlife disease throughout the world		
Strategy	**Outcome**	**Measure**
Establish a process for building international communication and coordination on wildlife disease issues	Increased collaboration with international science community	How many international interactions the specialist facilitates
Determine opportunities and issues of mutual WDZ international interests	Increased collaboration with international science community	Number of international partners that sign up to collaborate on WDZ issues
Coordinate and collaborate international WDZ research of mutual interest to US	Increased collaboration with international science community	Number of issues identified
Identify and advertise for a wildlife disease specialist within USGS to act as a point of contact for international WDZ issues	Specialist is appointed	How many international interactions the specialist facilitates
WDZ Objective 1C: Take the lead in developing a coordinated system for identifying and responding to priority WDZ issues that is built on partner needs, consultation and collaboration.		
Strategy	**Outcome**	**Measure**
Develop a priority list of wildlife diseases of concern	List is developed and published	How many partners utilize and cite list
Develop national plans for reporting, rapid response, and investigation of specific diseases	Generic plan protocol is developed	How many partners adopt the plan and how often it is used? How many partners contribute to plan?
Attract, recruit, train, and retain recognized experts in the WDZ field (apprenticeships, post-doctoral fellowships, etc.)	Consistent level of high quality scientists employed	Number and quality of people brought into the USGS through the program
Network research and laboratory facilities that work on wildlife disease	Comprehensive list composed of WDZ facilities that could be networked	Number of facilities that agree to join the network
WDZ Goal 2: Enhance collaborative wildlife and zoonotic disease research that meets partner needs for science-based decision making.		
WDZ Objective 2A: Create a needs identification process		
Strategy	**Outcome**	**Measure**
Develop a functional collaborative process for identifying partner needs for wildlife disease issues (partner information needs = PIN)	State input from wildlife association committees and number of state, tribal and other partners participating	Comprehensive database of needs and USGS response to needs is developed
WDZ Objective 2B: Support collaborative wildlife disease research that addresses partner management needs		
Strategy	**Outcome**	**Measure**
Develop joint funding and research	Integrate POBS, NRPP, SSP, and QR to focus	Number of joint partner research

strategies with partner agencies	on section dealing with WDZ issues	needs addressed
Foster an adaptive management approach to evaluate and enhance strategies for disease management.	Provide technical assistance to partners in developing adaptive management strategies for WDZ	Number of adaptive management program developed
WDZ Goal 3: Expand the scope of wildlife disease research and extend studies to an ecosystem level		
WDZ Objective 3A: Expand wildlife disease research studies to improve the scientific basis for WDZ management and control		
Strategy	**Outcome**	**Measure**
Assess population impacts of wildlife diseases and management actions	Quantitative and qualitative assessments conducted	Number of studies and conclusions implemented into partner management actions
Develop function-based and predictive models that improve our understanding of the ecology, epidemiology, and management of wildlife disease	Models to understand and control disease	Number of models started, completed, and published
Support the use and development of technological tools, such as molecular genetics, isotopes, and epidemiological studies, to address wildlife disease issues.	New technologies developed	Number of technological tools utilized by USGS scientists and partners
WDZ Objective 3B: Integrate wildlife disease and ecological studies to better understand disease issues in an ecosystem context.		
Strategy	**Outcome**	**Measure**
Investigate interrelationships among host, agents, and environment	Enhanced understanding of the complexity of relationships	Number of studies and conclusions implemented into partner management actions.
Support collaborative research to understand and model multi-host, multi-agent disease systems across landscape, regional and multi-seasonal scales	Enhanced understanding of the complexity of relationships	Number of studies and conclusions implemented into partner management actions.
Study the effects of ecosystem and anthropogenic changes on wildlife disease processes	Understanding and models that aid in disease management	Numbers of studies utilized (as cited in science citation index) and incorporated by partners
WDZ Goal 4: Enhance wildlife disease training and information exchange		
WDZ Objective 4A: Coordinate appropriate WDZ technical training for states, tribes, DOI partners, USGS, and others requiring assistance.		
Strategy	**Outcome**	**Measure**
Identify apprenticeship programs and training workshops	Comprehensive list of programs developed	Number of apprenticeships and workshops taken
WDZ Objective 4B: Coordinate WDZ professional training		
Strategy	**Outcome**	**Measure**
Identify professional programs and workshops that are appropriate for partner professional training	Comprehensive list of training needs and opportunities	Number of professional training programs offered and number of partners that assist in teaching and taking the trainings
Coordinate our training efforts with NCTC.	Cooperative agreement between USGS and NCTC	Number of people taking WDZ courses at NCTC
WDZ Objective 4C: Establish and enhance transfer/exchange of information capabilities		
Strategy	**Outcome**	**Measure**
Design and produce electronic clearing house for national and international wildlife disease issues	Increased availability of information between agencies	Number of visits to web site, number of partners linked to web site
Provide information, education to general public	Fact sheets, joint products, etc.	Number produced and distributed or requested by public
Provide user-friendly capabilities for partners to provide wildlife disease	Capabilities established	Amount of information disseminated through this

information.		capability
Provide IACUC training and assistance to support partners	Workshops organized and conducted	Number of training sessions conducted
WDZ Goal 5: Maintain and enhance USGS facilities for wildlife disease capabilities		
WDZ Objective 5A: Acquire large animal wildlife disease research facilities.		
Strategy	**Outcome**	**Measure**
Identify the needs within USGS and by partners for large animal research facilities and what is available elsewhere	Recommendation for large animal research facilities that will meet USGS needs in the future	Strategic document for development produced
Acquire new facilities as identified above	Proposal developed to acquire new facilities	New facilities built
WDZ Objective 5B: Upgrade current USGS WDZ facilities with state-of-the-art technology.		
Strategy	**Outcome**	**Measure**
Conduct a survey to identify what needs to be upgraded	Listing of what facilities need to be upgraded	Number of facilities upgraded
WDZ Objective 5C: Acquire state-of-the-art wildlife toxicology/contaminant research facility		
Strategy	**Outcome**	**Measure**
Identify possible facility location, design, and support	Strategic plan for these specialized facilities	Number of facilities constructed

Science for International Conservation Advisory Team

SIC Goal 1: Conduct research that relates to species of common concern, including migratory species, invasive species, and imperiled species		
SIC Objective 1A: Develop international cooperative research on migratory birds and shared species throughout their range		
Strategy	**Outcome**	**Measure**
Meet at the Program, Regional, and local levels with counterparts in other countries that share a portion of a species' range	USGS managers and scientists develop new opportunities for research and information exchange	Number of new scientist-to-scientist partnerships and Institutional partnerships created
SIC Objective 1B: Conduct research to determine the potential origin and radiation of species in other parts of the world prior to their introduction into the US as invasive species		
Strategy	**Outcome**	**Measure**
Develop international partnerships to determine species with a high potential for introduction into the US	Ecological risk assessments produced for various species and geographic regions of the world	Information of the potential for invasions is given to USDA-APHIS, USFWS Law Enforcement, and US Customs
SIC Objective 1C: Conduct research on imperiled species, with an emphasis on CITES species		
Strategy		
Develop international cooperative research on species of concern that are subject to international trade, exploitation, or harvest	New information and models to assess threats to species and populations	Information of the potential for invasions is given to USDA-APHIS, USFWS Law Enforcement, and US Customs
SIC Goal 2: Conserve biological and cultural diversity with sustainable development		
SIC Objective 2A: Investigate biodiversity of world's plants and animals		
Strategy	**Outcome**	**Measure**
Work with foreign natural resources agencies and organizations to assess hot spots of biodiversity	Publish biodiversity information using a variety of outlets	Enhanced understanding of the need for conservation in key areas
SIC Objective 2B: Investigate the human value of the world's plants and animals		
Strategy	**Outcome**	**Measure**
Work with international organizations and foreign governments to understand the value of biological resources	Publications identify biological value at the local, regional, national, and international scales	Enhanced efforts by conservation organizations on those species identified
SIC Goal 3: Develop cooperative projects on emerging technologies and tools with global applications		
SIC Objective 4A:		
Strategy	**Outcome**	**Measure**
Work with foreign natural resources agencies and organizations to exchange information, technologies, and scientists	New scientific exchanges are made and new technologies adapted from other countries	Number of exchanges that take place

APPENDIX III. Acronyms and Abbreviations

BIA	Bureau of Indian Affairs
CRU	Cooperative Research Unit
DOI	Department of the Interior
ESA	Endangered Species Act
HDT	Human Dimensions and Traditional Knowledge (Advisory Team)
ISG	Imperiled Species and Genetics (Advisory Team)
LMP	Large Mammals and Predators (Advisory Team)
MBH	Migratory Birds and Habitat Linkages (Advisory Team)
MET	Modeling and Emerging Technologies (Advisory Team)
MFW	Marine and Freshwater Wildlife (Advisory Team)
MMS	Minerals Management Service
NBII	National Biological Information Infrastructure
NPS	US National Park Service
SIC	Science for International Conservation (Advisory Team)
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WDZ	Wildlife Disease and Zoonoses (Advisory Team)
WTER	Wildlife: Terrestrial and Endangered Resources Program