

US GEOLOGICAL SURVEY – FORT COLLINS SCIENCE CENTER

National Institute for Invasive Species Science

Business Plan

Version 4.0



Science for a Changing World

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its natural and living resources, natural hazards,
and the environment ...*



May 13, 2005

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EXECUTIVE SUMMARY

Non-indigenous invasive species may pose the single most formidable threat of natural disaster of the 21st century. The direct cost to the American economy alone is estimated at \$100-200 billion per year, greater than all other natural disasters combined. The spread of invasive species is growing as globalization increases the movements of pest and disease organisms. And, in only the past few years, this issue has developed into one of extraordinary interest to the American public, generating diverse stakeholder support ranging from land management agencies, states, tribes, the agricultural industry, conservation organizations, and private landowner groups. An historical confluence of science and technologies is making this a particularly opportune time to advance our understanding and ability to manage the invasive species threat.

The USGS National Institute for Invasive Species Science

The National Institute of Invasive Species Science is a USGS-led consortium of governmental and non-governmental partners whose aim is to provide reliable information and advanced decision support tools for documenting, understanding, predicting, assessing, and addressing the threat of invasive species in the United States. The Institute coordinates NASA's Invasive Species National Application activities for the Department of Interior and has a lead role in developing, testing, and deploying NASA-derived remote sensing and landscape-scale predictive modeling capabilities for the invasive species community.

The Institute was created in response to high priority needs for invasive species research and management identified by USGS and DOI clients, such as the National Park Service, US Fish and Wildlife Refuge System, Bureau of Land Management, Bureau of Reclamation, tribes, other land managers, and the general public.

Our vision is to provide national leadership in the area of invasive species science and work with others to disseminate and synthesize current and accurate data and research to detect, predict, and reduce the effects of harmful non-native plants, animals, and diseases in ecosystems and natural areas throughout the United States. Our mission is to develop cooperative approaches for invasive species science to meet the urgent needs of land managers and the public. Science is the primary driver for the Institute's programs and activities, and we are committed to nurturing the interdisciplinary cooperation and organizational collaborations necessary to meet the invasive species challenge from local to national scales.

Description

The Institute was founded in 2001. It is administratively based in the Department of Interior, US Geological Survey, Fort Collins Science Center. The Fort Collins Science Center is one of many laboratories in USGS's national network of science centers, field stations, and state co-op units and, as such, is in an excellent position to provide the physical and human resources needed for the Institute. The Center itself is located on the Natural Resources Research Center campus of Colorado State University in Fort Collins, Colorado. The Natural Resources Research Center, a partnership between six federal agencies and the university, was established to support and enhance cooperative research on natural resource issues.

Partnerships are the essential foundation upon which the National Institute for Invasive Species Science is based. NASA, Colorado State University's Natural Resource Ecology Laboratory (NREL), and the National Biological Information Infrastructure (NBII) are keystone partners who have played a crucial role in establishing the Institute and shaping its initial direction. Their broad expertise in core areas and long-term commitment contribute to the Institute's unique position within the scientific community. In addition, the Institute works with a broad array of research and data sharing operational partners, which now number in the dozens and includes private-sector and local, state, and national governmental agencies.

Business

Our core competencies are science research; applications and tool development; data and information discovery, access and integration; education; and public service. We are focusing our competencies along strategic paths of opportunity – what we refer to as “Lines of Business” – that have been important sources of funding during our start-up phase and are promising sources of future revenue. These include Science Research, Early Detection / Rapid Response, Education and Outreach, and Forecasting.

Science Research – The Institute focuses on the development and testing of cost-efficient field sampling methods and protocols and the integration and synthesis of existing information to quantify patterns of invasions, guide management activities, and identify gaps in information. This involves the development, enhancement, and testing of standardized protocols for invasive species surveys and monitoring, and improving the comparability of data across various sources. Our objectives are to make better use of existing data, identify habitats vulnerable to invasion, identify the highest priority invasive species, and better coordinate all aspects of invasive species science, such as prevention, early detection and rapid response, monitoring and research, and outreach.

Early Detection / Rapid Response – Early detection and rapid response is becoming a crucial aspect of our national approach to the invasive species threat. The Institute has a strong ED/RR foundation. Our work, in cooperation with NBII, focuses on the technological and social aspects of developing this network, by building key partnerships, designing “smart” surveys that can be used by a broad cross-section of the community, and creating web-based data-sharing and analysis technologies and new decision support tools.

Education and Outreach – The Institute’s participation in the National Biological Information Infrastructure’s Invasive Species Information Node is an important component of our public education and outreach service. The Institute is committed to making its scientific data and tools available to the extended community through this important portal.

Forecasting – High-performance modeling and use of space-based observations are essential elements of the nation’s emerging assault on invasive species. By working with NASA, the Institute is leading the way in developing the necessary technologies, algorithms, and science. We are developing a National Invasive Species Forecasting System for the management and control of invasive species on Department of Interior and adjacent lands. Early detection and monitoring protocols and predictive models developed at the Institute are being used to process NASA and commercial data to create on-demand, regional-scale assessments of invasive species patterns and vulnerable habitats. The System is becoming the basis for a unique information services line-of-business for the Institute and provides the means for delivering advanced decision support capabilities to a wide range of management applications.

Opportunities

With its unique blend of science and technology lines-of-business, the Institute is strategically positioned to lead USGS’s response to the invasive species problem and meet the information needs for a large and growing suite of customers. Effective solutions increasingly rely on multidisciplinary teaming and the ability to attack problems along several fronts. The Institute seeks to occupy a unique niche by being able to respond to the invasive species issue in a balanced, multifaceted way and thus appears to be well positioned to expand its leadership role in this area and acquire projects and contracts to sustain and grow.

Risks to success are those common to early-stage, information-intensive initiatives. These include “key person” vulnerabilities, market, competitive, technology, execution risks, and perhaps most significant, capitalization risk. We have identified specific strategies for reducing these risks, but clearly the Institute’s long-term success utterly depends on sustainable funding and commitment from USGS leadership.

Governance

The Institute is adopting a governance structure that will maximize its connection to the invasive species community while remaining light-weight and responsive in its day-to-day operations. It receives direction from a Board of Directors, Partnership Council, and Executive Advisory Council, the National Invasive Species Council, and USGS leadership. Dr. Thomas J. Stohlgren is the founding director of the Institute and the principal architect of its science and technology programs.

Finances

Over the years, USGS investments in ecological science at the Fort Collins Science Center have yielded important theoretical and applied results that provide the basis for the current opportunities. Since its creation in 2001, the annual budget for the National Institute for Invasive Species Science has nearly doubled to the current level in FY04 of approximately \$2.75M. The Institute is largely a “soft money” enterprise, with USGS currently covering operating costs of approximately \$675K per year. Upwards of 75% of our work is funded through competitive grants from non-USGS sources. Development of forecasting and predictive modeling capabilities dominates the current program with support for these activities coming from NASA through competitive grants that will run through FY08.

The financial and programmatic goals for the Institute over the next three years are to (1) increase USGS core funding to provide operational support for the Invasive Species Forecasting System, (2) develop new income streams using ISFS capabilities, and (3) increase Science Research and ED/RR activities to provide better program balance. Growth in USGS’s core funding will be needed to insure the Institute’s long-term viability and provide sufficient confidence within the partnership community to secure their commitments. Our goal is to grow USGS’s stable core from the current 25% to at least 50% by FY08.

Conclusion

The National Institute for Invasive Species Science presents a remarkable opportunity for USGS to increase its leadership role within the invasive species community. However, the Institute is at a crucial stage in its development. The following are the important next steps needed to assure success and transition from what is essentially an early-stage start-up to an operational organization:

Hire Deputy Director / Business Manager –The Institute has an urgent need for a full-time Deputy Director / Business Manager who can take on immediate responsibility for helping coordinate the activities of the Institute and adopting a formal approach to budget and business development.

Adopt Business Plan –USGS leadership must come to agreement on a business strategy for the Institute, including the proposed plan for operational transfer of NASA-derived capabilities to USGS.

Accelerate Core Funding Increase – To maximize the benefit of our work with NASA, there is an immediate need to secure a proposed \$750K/year increment in core funding through an emergency supplement, redirection, or other mechanism.

Instantiate Governance Plan – We must formally populate and convene the Board of Directors, Executive Advisory Council, and Partnership Council and launch the operational processes governing the Institute.

Clarify Relationships within USGS – We must maximize the value of the Institute to the broader USGS organization and make it a more general and effective resource for USGS’s invasive species efforts throughout the agency. We suggest that an internal USGS working group be established with the specific objective of coordinating the assimilation of this new Institute into mainstream, programmatic operations of the USGS. We want to actively involve many more USGS scientists, science centers, and disciplines.

1 STATEMENT OF PURPOSE

The National Institute of Invasive Species Science is a USGS-led consortium of governmental and non-governmental partners whose aim is to provide reliable information and advanced decision support tools for documenting, understanding, predicting, assessing, and addressing the threat of invasive species to the United States. The Institute coordinates NASA's Invasive Species National Application activities for the Department of Interior and has a lead role in developing, testing, and deploying NASA-derived remote sensing and landscape-scale predictive modeling capabilities for the invasive species community.

1.1 Vision and Mission

Our *vision* is to provide national leadership in the area of invasive species science and to work with others to disseminate and synthesize current and accurate data and research to detect, predict, and reduce the effects of harmful non-native plants, animals, and diseases in ecosystems throughout the United States, with particular emphasis on natural areas and public lands. Our *mission* is to develop cooperative approaches for invasive species science to meet the urgent needs of land managers and the public.

1.2 Principles and Values

Science is the primary driver for the Institute's programs and activities. We are committed to nurturing the interdisciplinary cooperation and organizational collaborations necessary to meet the invasive species challenge from local to national scales.

1.3 Goals and Strategies

The Institute's overarching goal is to document, map, and predict invasive plants, animals, and diseases in the United States. The key steps along the way are as follows:

- Within two years, develop a comprehensive strategy for invasive species science that is responsive to the National Invasive Species Council's research agenda as identified in the National Invasive Species Management Plan;
- Within four years, create a national capability for invasive species forecasting, early detection, and rapid assessment of harmful invasive plants, animals, and wildlife diseases that can aid national efforts in prevention, containment (by linking to response authorities and capabilities, and restoration);
- Within six years, develop the economic and organizational basis for long-term sustainability of the Institute.

We will accomplish these goals by focusing on the following:

- National to local issues involving multi-agency and multi-sector interests, and the use of volunteer networks of "citizen scientists" to help document and map invasive species;
- Multi-scale analysis approaches that increase the use of field studies, remotely sensed data, high-performance computational modeling, landscape-scale data assimilation, and synthesis; and
- Information technologies and services to support invasive species research, management, data sharing, and policy decision-making.

Our partnership with NASA and the infusion of advanced technologies into invasive species research and management provides the Institute with a unique strategic advantage in attaining these goals.

2 DESCRIPTION OF THE INSTITUTE

The Institute is administratively based in the Department of Interior, US Geological Survey, Fort Collins Science Center. When fully established, it will receive guidance from a Board of Directors, Partnership Council, and Executive Advisory Council, the National Invasive Species Council, and USGS leadership. The Institute was created in response to high priority needs for invasive species research and management identified by USGS and DOI clients, such as the National Park Service, US Fish and Wildlife Refuge System, Bureau of Land Management, Bureau of Reclamation, tribes, other land managers, and the general public.

2.1 Name and Location

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2.2 USGS Mission

In the United States, the USGS has a lead role in delivering scientific information concerning invasive species in terrestrial and aquatic ecosystems in the US, with particular emphasis on natural areas and public lands. USGS technical and scientific capabilities directly support the management of Department of Interior lands and waters by documenting, monitoring, and predicting the establishment and spread of invasive species. USGS studies the ecology of invading species and vulnerable habitats to support prevention, early detection, assessment, containment, and, where possible, eradication of harmful invasive species. The USGS also investigates the physical properties, composition, and hydrology of geologic substrates to identify lands vulnerable to invasion. The USGS coordinates interagency activities through a network of science centers, co-operative research units, and the National Biological Information Infrastructure, whose extensive network of thematic and information service nodes plays a critical support role in delivering biological information of importance to invasive species.

2.3 NASA Partnership

A unique feature of the Institute is its strategic partnership with NASA. USGS and NASA are working together to create advanced, space-based decision support capabilities that will allow the Institute and its partners to address the national invasive species challenge. NASA's Science Mission Directorate currently provides measurements from Terra, QuickSCAT, Landsat 7, Jason, and other missions that map key ecosystem attributes needed to predict invasive species distributions. Several missions in the near- to mid-term will expand these measurements to include critical three-dimensional structure derived from synthetic aperture radar (SAR) and LIDAR technologies. Measurements are also supported through data purchase programs, including SeaWiFS ocean color imagery; high-resolution optical imagery from IKONOS, QuickBird, and other private-sector satellites; and land cover data from the Landsat Data Continuity Mission. In addition, NASA is providing the computational capabilities and expertise in large-scale, coupled Earth system modeling needed to ensure the successful transfer of the system into operational use by the Institute and its partners.

2.4 Leadership Structure

The core NIISS management and proposed leadership structure are as follows:

NIISS Senior Management

- Dr. Thomas J. Stohlgren
USGS Senior Scientist and NIISS Director
- Dr. Catherine Crosier
NIISS Deputy Director and Business Manager

NIISS Operations Staff

- USGS – Four USGS scientists, three ecologists/SCEP students, and eight graduate students / research assistants, and a web-master at Colorado State University.

NIISS Partnership Council (proposed)

- Co-Chair
USGS Partnership Coordinator
- Co-Chair
TBD (non-USGS)
TBD Representatives from: CSU Natural Resources Ecology Lab (NREL), Grand Staircase Escalante National Monument, Rocky Mountain National Park, Los Alamos National Labs / Cerro Grande Wildfire Site, The Tamarisk Coalition, National Park Service, Patuxent Wildlife Research Center, US Fish and Wildlife Service Wildlife Refuges, Biota of North America Program, US Forest Service, Forest Health Monitoring Program, Long-Term Ecological Research Program, Colorado Natural Heritage Program, Center for Environmental Management of Military Lands, Nature Conservancy, NatureServe, University of California at Davis, National Wildlife Health Center, Upper Midwest Environmental Science Center, State of Colorado.

Board of Directors (proposed)

- Co-Chair
USGS Invasive Species Program Director
- Co-Chair
- *TBD (non-USGS)*
- Members include: Director, USGS Fort Collins Science Center, Director, USGS/BRD, Director, USGS/NBII, others TBD (e.g., Assistant Chief, USGS Western Region), Director, CSU/NREL, Program Manager, NASA Invasive Species National Application) with other representatives from DOI, USGS/BRD, USGS/NBII, USGS/FORT, CSU/NREL, and the NIISS Partnership Council.

Executive Advisory Council (proposed)

- Co-Chair
Director, USGS
- Co-Chair
TBD (non-USGS)
- Members include: Chair, National Invasive Species Council and other TBD representatives from ESA, NSF, NASA, and TBD. Ex officio members include Co-Chairs of the NIISS Partnership Council.

Section 5 below provides a detailed description of roles, responsibilities, and governance structure.

2.5 Keystone Partnerships

Partnerships are the essential foundation upon which the National Institute for Invasive Species Science is based. The following keystone partners have played a crucial role in establishing the Institute and shaping its initial direction. Their broad expertise in core areas and long-term commitment contribute to the Institute's unique position within the scientific community.

NASA Goddard Space Flight Center – NASA Goddard Space Flight Center, located in a Maryland suburb outside of Washington, DC, is home to the nation's largest organization of combined scientists and engineers dedicated to learning and sharing their knowledge of the Earth, solar system, and Universe. NASA's Earth Science Applications theme benchmarks practical uses of NASA-sponsored observations from Earth observation systems and predictions from Earth science models. NASA implements projects that carry forth this mission through partnerships with public, private, and academic organizations. These partnerships focus on innovative approaches for using Earth science information to provide decision support that can be adapted in applications worldwide. The program focuses on applications of national priority to expand and accelerate the use of knowledge, science, and technologies resulting from NASA's goal of improving predictions in the areas of weather, climate, and natural hazards.

USGS and NASA are working together to develop, test, and deploy into practical use by the invasive species community NASA's remote sensing data and high-end computational modeling capabilities. A Memorandum of Understanding, scheduled to be adopted in 2005, will formalize this relationship.

National Biological Information Infrastructure – NBII is a broad, collaborative program to provide increased access to data and information on the Nation's biological resources. NBII links diverse, high-quality, non-proprietary biological databases, information products, and analytical tools maintained by NBII partners and other contributors in government agencies, academic institutions, non-government organizations, and private industry. NBII partners and collaborators also work on new standards, tools, and technologies that make it easier to find, integrate, and apply biological resources information. Resource managers, scientists, educators, and the general public use the NBII to answer a wide range of questions related to the management, use, or conservation of this Nation's biological resources.

The Institute plays a lead role in coordinating the activities in the NBII's Invasive Species Information Node which serves as a "data cooperative" to accelerate the sharing, standardization, completeness, and accessibility of data on the distribution and abundance of non-native plants, animals, and diseases in the United States.

Colorado State University Natural Resource Ecology Laboratory – Colorado State University's Natural Resource Ecology Laboratory (NREL) is an ecosystem research center whose activities span the globe and contributes to the scientific basis for understanding the interactions that sustain our environment, locally, regionally and globally. A unique feature of the Laboratory among ecosystem centers is its position as an interdisciplinary research institute in a university setting. NREL cuts across disciplinary and structural divisions. Some of its scientists are affiliated entirely with NREL. Others have joint appointments with university departments, and some are employees of federal or state agencies. They come together in an environment that minimizes disciplinary boundaries and enhances creative thought.

The USGS National Institute for Invasive Species Science works closely with NREL scientists, graduate students, and post doctoral fellows. USGS's long-standing and close relationship to the research and academic resources provided by Colorado State University significantly strengthens the Institute's ability to advance science and technology in the invasive species domain.

2.6 Operational Partnerships

In addition to our Keystone Partners, NIISS is forging relationships with important operational partners through a broad portfolio of research and data-sharing activities. Our goal is to facilitate interactions among our Keystone and Operational Partners and grow the network into a richly collaborative forum for sharing knowledge and resources.

Research Partnerships (selected examples)

- The US Fish and Wildlife Service National Refuge System has funded research programs to conduct a web-based survey of harmful invasive plants, animals, and diseases on the nation's 500+ wildlife refuges and initiate weed mapping programs in selected refuges using a mix of volunteers and research assistants.
- Scientists at several USGS Science Centers are contributing data on native and non-indigenous birds (Bruce Peterjohn, John Sauer, Patuxent National Wildlife Research Center), fish (Pam Fuller, South Florida Caribbean Science Center), Southwest Biological Science Center (Katherine Thomas) and wildlife diseases (Josh Dein, National Wildlife Disease Center), with non-government groups (e.g., NatureServe, Biota of North America Program) to consolidate and synthesize patterns of invasion in the US.
- Colorado State University (Agriculture Experiment Station) and the University of California at Davis (International Center for the Environment) are working with the Institute to develop state-wide mapping of invasive plants in Colorado and California.
- The National Interagency Fire Center (Boise, ID) has funded several research projects to survey, monitor, and model the effects of fire severity (and pre-fire treatments) on plant invasions, erosion, and fire effects in several western states.
- Department of Interior agencies (National Park Service, Bureau of Land Management) have funded landscape-scale survey projects for invasive plant species in Colorado and Utah.
- The International Atomic Energy Commission sponsored a NIISS-led assessment of the economic and ecological effects of cactoblastis in the southern US involving several agencies, states, and Mexico.

Data Sharing Partnerships (selected examples)

- NASA Ames Research Center's "Develop Program" is working closely with NIISS staff to map and model tamarisk distributions in Nevada.
- Tribes – Piutes are sharing data on tamarisk locations in Nevada (with NASA above), while the Hopi are sharing tamarisk locations in New Mexico. We look to greatly expand these efforts.
- Several commercial interests (e.g., SRA International), volunteer groups (e.g., the Tamarisk Coalition), and school groups (University of Northern Colorado), and state and county weed coordinators have teamed up with NIISS to map tamarisk in many parts of Colorado. This work is being extended to at least eight western states.
- Through NBII, the Institute also benefits from the data sharing aspects of several of the research partnerships listed above including birds, fish, wildlife disease, and fire.

2.7 Core Competencies

Our core competencies, which are conveyed to and through the Institute by way of our Keystone and Operational Partners, include the following:

Research – The Institute conducts and coordinates basic and applied research on invasive species ecology. The program facilitates prevention, early detection, and rapid response by promoting consistent and comparable inventory and monitoring designs and methods, advancing control and restoration technologies, and developing predictive models (“ecological forecasting” capabilities) that integrate remote sensing and environmental mapping, state-of-the-art spatial and temporal modeling, and high-performance computing technologies. Key aspects of the research program focus on the design, development, and testing of a web-based Early Detection and Rapid Response System and the Invasive Species Forecasting System.

Applications – The Institute develops new operational capabilities by translating science results and technology developments into products for practical use by the scientific, resource management, and policy decision-making communities. Key aspects of the applications programs include the development of systematic protocols for early detection and rapid assessment, development of localized “watch lists” for land managers and the public, and “tool kits” for reporting and containing harmful invasive species.

Information – The Institute integrates data, information, and models as part of the National Biological Information Infrastructure (NBII) invasive species node which serves as a “data cooperative” to accelerate the sharing, standardization, completeness, and accessibility of data on the distribution and abundance of non-native plants, animals, and diseases in the United States. Preliminary emphasis was placed on plants, birds, and fishes, with near-term additions of aquatic organisms, plant pathogens, and wildlife diseases of concern.

Education – The Institute provides technical assistance and synthesis capabilities to states, tribes local government and non-government organizations, land and resource managers, scientists, and the public on all aspects of invasive species science, including control and restoration techniques. In addition, the Institute and its partners create and distribute fact sheets, species profiles, and online species identification tools and help train on-the-ground networks of volunteers in the identification and reporting of invasive species which greatly extends the use of volunteer networks and web-based reporting in the invasive species effort.

Public Service – The Institute’s outreach program proactively makes all information and science services available to stakeholders, policymakers, and the public as quickly as possible. We encourage a cost-efficient proactive approach to invasive species management based on watch lists, “alerts” to appropriate agencies and organizations involved in rapid response and containment, and increased public awareness.

2.8 Facilities

The Institute, through its Keystone Partners and by being a part of the USGS network of science centers, has ready access to an array of physical resources that are not only necessary for carrying out its work but contribute to the uniqueness of the Institute.

USGS Fort Collins Science Center – The National Institute for Invasive Species Science is based at the USGS Fort Collins Science Center (FORT). The FORT is one of 17 laboratories in USGS's national network of science centers and, as such, is in an excellent position to provide the physical and human resources needed for the Institute. FORT itself is located on the Natural Resources Research Center campus of Colorado State University in Fort Collins, Colorado. The Natural Resources Research Center, a partnership between six federal agencies and the university, was established to support and enhance cooperative research on natural resource issues.

FORT is home to a diverse team of USGS scientists who conduct research and develop technical applications to assist land managers and natural resource decision makers. FORT's staff includes 120 federal employees, a support services contract staff of more than 40 professionals, 40 university affiliates, and more than 100 seasonal staff and volunteers. The Institute is one of six focal areas of research at the FORT and has many cross-cutting projects with other FORT branches and USGS science centers. To further broaden the scope of cooperative opportunities, FORT also has scientists located at CSU's Natural Resource Ecology Laboratory, the Arid Lands Field Station at the University of New Mexico, the Jemez Mountains Field Station at Bandelier National Monument near Los Alamos, New Mexico, the Bureau of Reclamation's Technical Services Center in Denver, and the new Rocky Mountain Center for Conservation Genetics and Systematics at the University of Denver.

Colorado State University Natural Resource Ecology Laboratory – The Natural Resource Ecology Laboratory (NREL) is an interdisciplinary research program within the College of Natural Resources at Colorado State University Organized as a research unit within the College, NREL cuts across disciplinary and structural divisions. Some of the NREL scientists are affiliated entirely with the Laboratory. Others have joint appointments with university departments, and some are employees of federal or state agencies. The driving goal of NREL science is to increase the fundamental understanding of our environment, through collaborative application of ecology and ecosystem science principles which contribute to policy and management decisions promoting sustainability. More than 30 senior scientists are associated with the Natural Resource Ecology Laboratory. NREL staff members teach courses in various university Departments, supervise graduate and postgraduate research and share their knowledge with students at local schools and community organizations. About 15 scientists, post doctoral fellows, research assistants, and graduate students currently work on projects associated with the National Institute of Invasive Species Science.

2.9 IT Infrastructure

The Institute's uniqueness is in large part a result of the way we combine invasive species science with advanced information technology. IT infrastructure is thus crucial to our success. We have acquired our distinctive leadership position through a series of innovative partnerships that provide access to high-end communications and computational resources while reducing cost and risk to USGS.

NASA Goddard Space Flight Center – As the primary interface between USGS and NASA's Invasive Species National Applications activities, the Institute has access to an array of high-end computing resources that would be difficult to obtain elsewhere. NASA Goddard Space Flight Center is a world-class supercomputing facility providing the NASA-funded science community with the most powerful computing and mass storage resources available. Scientists use NASA computing resources to increase their understanding of the Earth, the solar system, and the universe through computational modeling and processing of space-borne observations. NASA supplies state-of-the-art high-performance computing targeted to the specialized needs of Earth and space scientists. Researchers benefit from the NASA's mass storage technologies that meet head-on the challenge of today's rapidly growing data storage needs. Highly skilled, dedicated support staff provide a complete range of computational science expertise.

Goddard delivers capabilities through an array of resources including a 1300-processor, 3.2 TeraFLOPS HP/Compaq AlphaServer with 8.5 TB of disk storage. As part of *Project Columbia*, NASA has integrated a cluster of 20 interconnected SGI® Altix® 512-processor systems, for a total of 10,240 Itanium 2 processors, to significantly increase the agency's capability and capacity through creation of "the Space Exploration Simulator." The new machine is based at NASA Ames Research Center in the heart of California's Silicon Valley and will provide an estimated 10-fold increase in NASA's current super-computing capacity.

USGS Fort Collins Science Center – Reflecting our early development stage, the Institute currently has basic IT capabilities. Most of our software and web development staff, and web and database hardware, are located at NREL. Engineering, programming, software development, testing, and quality assurance and control of hardware and software applications is primarily conducted at NASA Goddard Space Flight Center and NREL. As part of the USGS/NASA collaboration, two state-of-the-art Apple G5 cluster computers have been built to serve the needs of software and database development. One cluster resides at NASA, the other at the FORT, which provides systems administration support for the USGS machine.

As part of our long-term plan, the Institute seeks to greatly improve interactions, data sharing, and interoperability with other NBII nodes, Denver’s Center for Biological Informatics, other USGS science centers, the EROS Data Center, and the Natural Resources Research Center’s USDA “web farm.” Building in-house, contract, or long-term cooperative IT infrastructure is a major identified need for the Institute (see 6.4 Next Steps).

National Biological Information Infrastructure – NBII provides a standards-rich infrastructure for sharing invasive species data, information, and tools. Through NBII, which is the US link to the Global Biodiversity Information Facility, the Institute participates in worldwide efforts to combat the rapid spread of globally mobile invasive species.

2.10 Development Stage

The concept of a “National Center” for invasive species science was first proposed in an article in *Issues in Science and Technology* by Don Schmitz and Dan Simberloff in 1997:

Lacking at the federal level are leadership, coordination of management activities on public lands, public education, and a strong desire to prevent new invasions. A parallel may be seen in the Centers for Disease Control and Prevention, with its missions of preventing new invaders, monitoring outbreaks, conducting and coordinating research, developing and advocating management practices, recommending and implementing prevention strategies, dealing with state and local governments, and providing leadership and training. Perhaps the federal government could develop an analog for invasive plants and animals.

– Don Schmitz and Dan Simberloff, 1997

The concept and need for a federally backed Institute was further supported by early task force recommendations in the design of the National Invasive Species Management Plan and has been gathering interest from government and non-government organizations since 2001.

In response to these calls, USGS and the Fort Collins Science Center formed the Institute in 2001. The Institute is in the early start-up stage. The NASA collaboration began in late 2001 with funding of competitive research projects involving USGS, the Natural Resource Ecology Laboratory at Colorado State University and the Fort Collins Science Center. NBII activities started in 2002/2003 with additional funding in 2004. Building and office space were enhanced in 2003 with the construction of the new USGS Fort Collins Science Center at Natural Resource Research Center at Colorado State University. NASA scientists installed a high performance computer cluster at the Institute in August 2004. The next critical phase of development will focus on increased USGS core funding and support, additional core personnel, and increased partnerships and leveraging of expertise, data, and research funds within the network of USGS Science Centers, and among agencies, universities, and non-government organizations.

3 LINES OF BUSINESS

The National Institute for Invasive Species Science is focusing its core competencies along strategic paths of opportunity – referred to here as “Lines of Business” – that have been important sources of funding during our start-up phase and hold significant promise as future sources of revenue. These include Science Research, Early Detection / Rapid Response, Education and Outreach, and Forecasting. Development of these areas of opportunity will be crucial to the Institute’s long-term success. In the short-term (3 to 5 years) we will focus on: (1) moving the Invasive Species Forecasting *System* to an Invasive Species Forecasting *Service* for our clients and partners; (2) developing Early Detection and Rapid Assessment capabilities for invasive plants, animals, and diseases in the US; and (3) developing an integrated web-based “Global Organism Detection and Monitoring System for the US” (later global) to track the abundance and distributions of harmful organisms relative to habitats that are vulnerable to invasion.

3.1 Science Research

The Institute focuses on two key areas of scientific research: (1) the development and testing of cost-efficient field sampling methods and protocols; and (2) the integration and synthesis of existing information to quantify patterns of invasions, guide management activities, and fill gaps in information.

Embedded in these seemingly simple tasks are issues of data availability, the willingness of scientists to share data, combining disparate datasets with incomplete data and uncertainties, new multivariate statistical approaches, and understanding the limits to data extrapolation. Large-scale data integration is essential to identify gaps in information, and to strategically guide the collection of new information in under-represented areas, for high priority species, and for specific times to create long-term, defensible databases.

This research ultimately involves the development, enhancement, and testing of standardized protocols for invasive species surveys and monitoring, while improving the comparability of data across agencies, tribes, non-government organizations, volunteer groups, and the public. The objectives of this research are to make better use of existing data, identify habitats vulnerable to invasion, identify the highest priority invasive species, and better coordinate all aspects of invasive species science, such as prevention, early detection and rapid response, monitoring and research, and outreach.

| | |
|-----------------------------|---|
| Keystone Partners: | NREL, NASA |
| Operational Partners: | USGS, National Park Service, Bureau of Land Management, USDA Forest Service, NatureServe, Biota of North America Program |
| Current/Recent Clients: | Rocky Mountain National Park, Grand Staircase-Escalante National Monument, Bandelier National Monument Cerro Grande Wildfire Site Synthesis customers include the USFWS Refuge System, International Atomic Energy Commission, and the State of Colorado. |
| Financial/Resource Profile: | Funding for field studies typically range from \$250K to \$400K/year. Growth potential is enormous as clients demand a mix of local-scale research and cumulative-effects research to set priorities for early detection, containment, and restoration activities from national to local scales. Demands for data synthesis are growing more quickly. Three top scientific journals have invited us to contribute keystone papers on patterns of invasion in the US, and more national and international organizations are requisitioning our services for synthesis projects. Being recognized leaders in this area should significantly aid fund raising for this focus area. |
| For more information, see: | http://kiowa.colostate.edu/cwis438/niiss/index.html |

3.2 Early Detection / Rapid Response

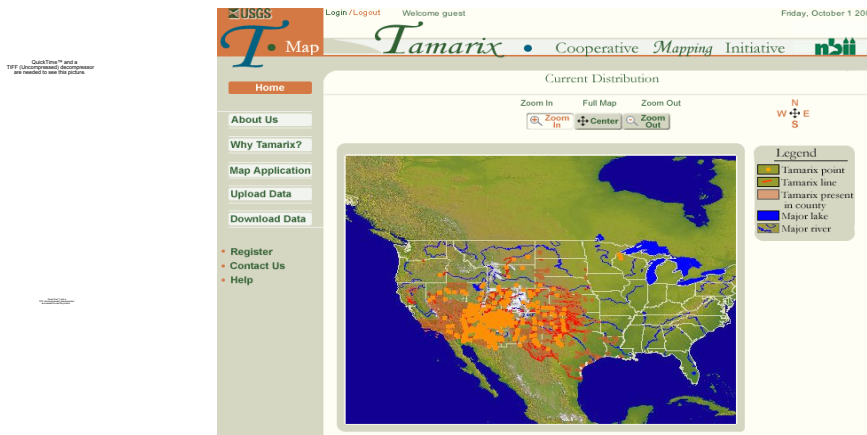
Ideally, harmful invasive species should be prevented from establishing in new ecosystems. Where prevention fails, species must be detected early to allow for cost-efficient control or containment. Early detection and rapid response (ED/RR) is thus becoming a crucial aspect of our national approach to the invasive species threat.

The Institute has a strong ED/RR foundation starting with our first major initiative, *One If By Land, Two If by Sea*. We have learned that early detection requires help from agencies, tribes, non-government organizations, and volunteers – perhaps millions of “citizen scientists” – who can work together across geographic distances in a coordinated and effective way to document emerging events. Our work has focused on the technological and social aspects of developing this network, by building key partnerships, by designing “smart” surveys that can be used by a broad cross-section of the community, and by creating web-based data-sharing and analysis technologies and new decision support tools.

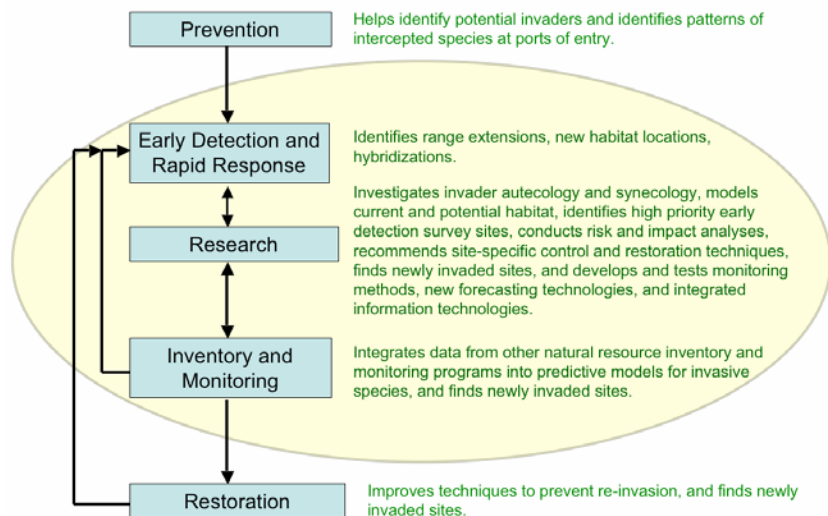
- Keystone Partners: NREL, NBII, NASA
- Operational Partners: US Fish and Wildlife Service Refuge System, State of Colorado
- Current/Recent Clients: We have developed a web-based reporting system for mapping tamarisk in the western US, with tools to submit occurrence and cover data to a centralized, spatially-explicit database. We have worked with the USFWS Refuge System (440+ refuges) to develop a similar capability for “watch lists” and will soon do the same for weeds for the State of Colorado. We are helping develop specifications for an ED/RR system for the country in an activity sponsored by the USGS, National Geographics, and SeaStudios. Similarly, we are participating with a variety of partners in the ongoing development of online tools to assist scientists and volunteers in identifying and pinpointing the location of invasive species.

Financial/Resource Profile: IT proof-of-concept studies typically range from \$25K to \$200K/year. There appears to be significant growth potential for ED/RR technology- and science-based products and services. Demands for standardized data reporting and predictive modeling are increasing; several workshops and calls for proposals have identified ED/RR as a major theme; and national and international organizations are requisitioning help in this area.

<http://kiowa.colostate.edu/cwis438/niiss/index.html>



Interactions Among NIISS Research and Forecasting Activities and Early Detection / Rapid Response Program Elements



3.3 Education and Outreach

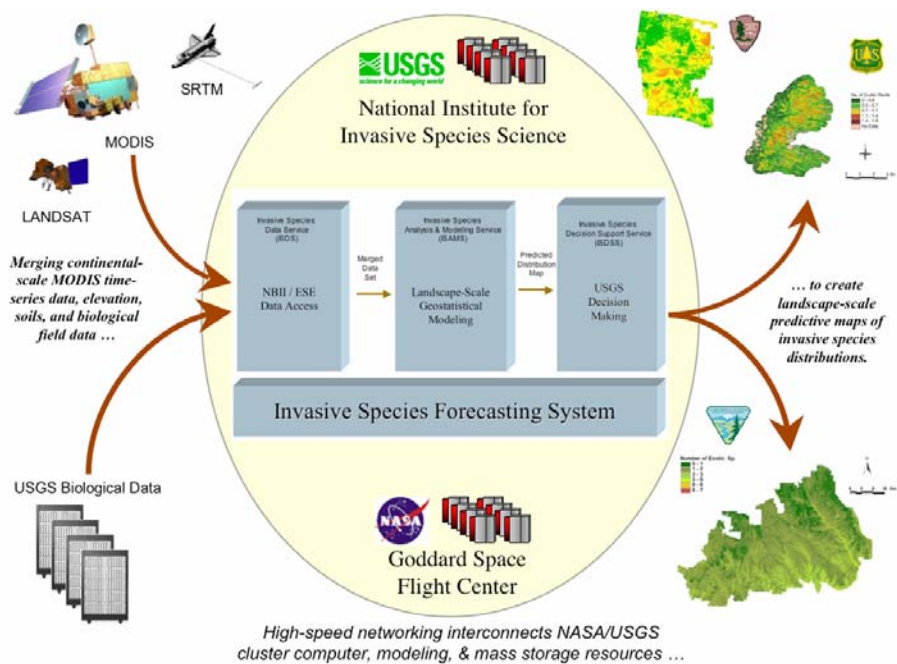
The Institute’s participation in the National Biological Information Infrastructure’s (NBII) Invasive Species Information Node (ISIN) is an important component of our public education and outreach service. The Institute is committed to making its scientific data and tools available to the extended community through this important portal. We expect node development and support to become a more prominent aspect of our communications strategy as databases and software applications mature over the next few years.

- Keystone Partners: CSU/NREL, USGS FORT colleagues, several other NBII Nodes and science collaborators, and the H.J. Heinz III Center.
- Operational Partners: Several USGS Scientists (Bruce Peterjohn, Pam Fuller, John Sauer), other scientists (e.g., John Kartesz, Biota of North America Program; Larry Master, NatureServe; Jim Quinn, University of California, Davis), and many others.
- Current/Recent Clients: State of Colorado, Heinz Center, Ecological Society of America, the scientific community (including three recent synthesis papers on patterns of invasions of plants, birds, and fishes in the United States).
- Financial/Resource Profile: Since 2002, the Institute has received \$300K to lay the groundwork and launch the ISIN. There is good potential for expanded support as the ISIN matures into a fully operational service.
- For more information, see: <http://www.InvasiveSpecies.nbi.gov>

3.4 Forecasting

High-performance modeling and use of space-based observations are essential elements of the nation’s emerging assault on invasive species, and the Institute is leading the way in the developing the necessary technologies, algorithms, and science. We are working with NASA’s Applied Sciences Program to develop a National Invasive Species Forecasting System (ISFS) for the management and control of invasive species on Department of Interior and adjacent lands. Early detection and monitoring protocols and predictive models developed at the Institute are being used to process NASA and commercial data to create on-demand, regional-scale assessments of invasive species patterns and vulnerable habitats. When finished, the system will be made broadly available to the natural resource management community through the Institute’s website and the NBII program. Most important, the ISFS will be the basis for a unique information services line-of-business for the Institute and provide the means for delivering advanced decision support capabilities, such as those required by Early Detection / Rapid Response.

- Keystone Partners: NASA, NREL
- Operational Partners: National Park Service, Bureau of Land Management, USDA Forest Service
- Current/Recent Clients: Rocky Mountain National Park, Grand Staircase-Escalante National Monument, Bandelier National Monument Cerro Grande Wildfire Site
- Financial/Resource Profile: Approximately \$6.5 M of NASA funding invested in this effort through competitive grants scheduled to run through FY08. Increasing USGS investment ramping up to provide operational support for ISFS by FY08. Significant income potential in the application of ISFS capabilities.
- For more information, see: <http://InvasiveSpecies.gsfc.nasa.gov>



4 OPPORTUNITY ANALYSIS

The National Institute for Invasive Species Science, with its unique blend of science and technology lines-of-business, is strategically positioned to lead USGS's response to the invasive species problem and meet the information needs for a large and growing suite of customers.

4.1 Needs Analysis

Non-indigenous invasive species may pose the 21st century's single most formidable threat of natural disaster. During the past hundred years, non-indigenous plants, animals, and pathogens have been introduced at increasing rates into all US ecosystems. A growing number of these species are becoming invasive, and they contribute to declines in native species and to changes in ecosystem function. The direct cost to the American economy alone is estimated at \$100-200 billion per year, greater than all other natural disasters combined. More species are invading every year due to increased trade and travel: every harbor, airport, train station, truck stop, and mail box is a potential source of entry.

Most land management agencies and the public clearly understand that early detection and rapid response is the only cost-efficient way to contain major epidemics. However, with tens of thousands of species occurring in many ecosystems, it is often difficult to detect the early establishment of newly arriving harmful invaders. In addition, broad-scale systematic inventory and monitoring programs by government agencies are limited, poorly funded, and typical survey techniques often miss many species. In addition, data from past and current field campaigns are widely dispersed in various formats, and generally incomplete geographically taxonomically, and temporally. Information is spatially spotty, some biological groups have been studied far more than others, and even the best data are mixes of old museum records and newer casual observations.

This constellation of science, technology, information, and policy challenges makes dealing with invasive species particularly complex. Effective solutions increasingly rely on multidisciplinary teaming and the ability to attack problems along several fronts. The Institute seeks to occupy a unique niche by being able to respond to the invasive species issue in a balanced, multifaceted way.

4.2 Target Customers

The Institute can benefit many groups. Our primary customers are land managers in the Department of the Interior, including the US Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Reclamation, and the Tribes. Because invasive species disregard agency boundaries, our customers also include adjacent land owners such as land managers in national forests and rangelands, Department of Defense lands, state forests, county weed coordinators, lands managed by The Nature Conservancy, and other private lands.

States also are primary customers as many have developed close working relationships between county weed coordinators, federal land managers, and local communities adjacent to public lands. States are also responsible for wildlife and wildlife diseases, and invasive animals. Often the data we collect and synthesize from many federal land management sites and other natural areas within a state can be immediately useful for invasive species management at the state level. Other important customers include non-government organizations, policy makers, educators, science organizations, and the public who all benefit from the sharing of information on harmful non-indigenous species. Likewise, educators, scientists, and the public must be kept informed about recent invasions in their area.

While hard numbers are difficult to obtain, we estimate the combined annual expenditures of the customer base described here is in the millions of dollars each year. Redundancies and inefficiencies abound across this network of activities. The demand for increased effectiveness of these programs, under constraints of

time and money, will undoubtedly create market opportunities for the Institute for the foreseeable future.

4.3 Strategic Position

The USGS has been at the forefront in the development and implementation of the National Invasive Species Management Plan. The Institute's Director, Tom Stohlgren, helped synthesize recommendations for the final draft of the Plan, and continues to serve on National Invasive Species Council task groups. Along with the USGS Invasive Species Program Coordinator, Stohlgren and many others in the USGS have played significant roles in cross-cut budget initiatives for invasive species research and management, and have helped coordinate Early Detection/Rapid Response plans for the Federal Interagency Committee on the Management of Noxious Exotic Weeds (FICMNEW). The USGS, with over 30 science centers across the US and coop-stations in almost every state, and NASA with research centers, satellite systems, and computer capabilities have an unusually strong foundation for the integrated science and management of invasive species. Existing partnerships with states, tribes, universities, and non-government groups are testimony to proven cooperative research across the county.

In addition, recent policy directives clearly recognize our unique strategic position. The Executive Order on interagency cooperation provides a mandate to integrate activities across Departments and Bureaus and to leverage information and expertise. Current and planned inter-Departmental cross-cut budget initiatives and the USGS Five Year Plan for the Invasive Species Program specifically identify the National Institute of Invasive Species Science as the cornerstone of data sharing, information technologies, and ecological forecasting of invasive species. Department of the Interior guidelines recognize the leadership role of the USGS in coordinating science activities and improving the comparability of data across agencies. NASA, likewise, elevated "Invasive Species" to one of twelve National Application areas in their Science Mission Program largely due to the programmatic focus growing within USGS through the Institute.

Over the next five years, the Institute will consolidate its leadership role by focusing its lines-of-business and core competencies to create a collection of product and activity classes badly needed by the invasive species community. These include:

- Develop and test cost-efficient field sampling methods and protocols;
- Consolidate, reformat, and synthesize existing information to quantify the patterns of invasions, guide management activities, and identify gaps in information;
- Create and maintain a more standardized information management system for documenting, mapping, and predicting the distribution and abundance of harmful invasive species;
- Develop or enhance invasive species surveys and reporting tools that effectively use citizens, government and non-government organizations, and educators;
- Integrate remote sensing, high performance computing, ecological research, and economics to develop statistically sound risk maps, "probable and "potential and future" distribution maps, and potential impact maps for priority species; and
- Provide real-time, quality data, decision support tools, and technical assistance to land managers, policy makers, educators, and the public.

These products and activities further define a unique market position for the Institute.

4.4 Risk Assessment

Success of the Institute depends on a number of factors. The following are among the major risks that place the Institute's success in jeopardy and the approaches we propose for dealing with those risks.

Risk: Key Person Vulnerability

No TJS, no NIISS ...

Mitigation: The founding director, Tom Stohlgren, is providing crucial leadership to the Institute in its formative stages. In order to provide a stable and continuing leadership context, the Institute is actively training the next generation of scientists and managers. Key staff members are being cross-trained in order to make the organization more adaptable. The partnership network we are developing will also provide resiliency that helps reduce this vulnerability.

Risk: Market Risk

The market may not respond to NIISS products or services either because there is no real market need or the market isn't yet ready ...

Mitigation: There has been strongly positive response from partner and client communities to the concept and early products of the Institute. The Institute will work closely and continuously with its customers and partners to "market test" its activities and stay aligned with the expectations and needs of those with whom it works.

Risk: Competitive Risk

New competitors for NIISS could enter the market ...

Mitigation: Currently there exist no known direct competitors seeking to perform the Institute's science and services. Related and similar activities on a smaller scale are occurring for specific taxa or for specific geographic regions, but no national-scale system is in place to facilitate networking among these activities. Risk here can be reduced by working closely with the extended community, promoting collaboration over competition, and building integrative technological frameworks for the overall domain.

Risk: Technology Risk

The technology or product design and engineering won't work or won't work as well as envisioned. Ineffective operational transition from NASA to USGS ...

Mitigation: We will work closely with experienced technology partners who bring formal engineering methodologies and best practices to bear on the Institute's information system and product development activities. Our work with NBII and NASA colleagues are prime examples of how we are working to reduce this risk factor. Operational transitions will be carefully planned and carried out with the full knowledge and support of senior management.

Risk: Execution Risk

Won't be able to effectively manage the roll-out and growth of NIISS due to lack of political or operational support or general agency discomfort with novelty ...

Mitigation: We will make open communication a key goal and work closely with management and staff to build trust and confidence and a shared desire to succeed in a mission of national importance.

Risk: Capitalization Risk

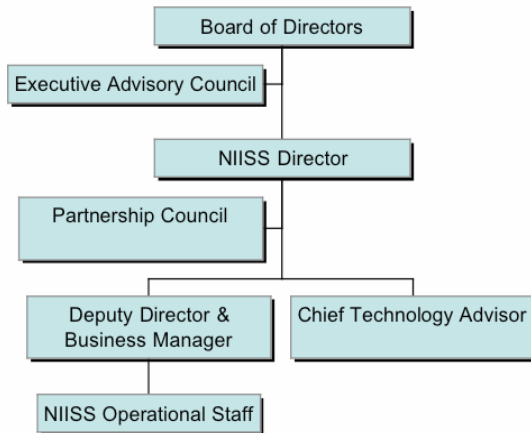
Underestimated costs, over-estimated income, agency support doesn't materialize ...

Mitigation: Success of the Institute utterly depends on a sustainable funding core and commitment from USGS leadership. Business development and the full realization of the political and financial opportunities resulting from the NASA collaboration requires the immediate addition of a senior software engineer / project manager to the NIISS staff.

5 MANAGEMENT AND OPERATIONS

The Institute is adopting a governance structure that will maximize its connection to the invasive species community while remaining light-weight and responsive in its day-to-day operations. Elements of this governance structure have been adapted from successful related models, including the *North American Waterfowl Management Plan*, the *Joint Fire Science Program*, *NBII*, and others.

5.1 Organizational Structure



compatibility of hardware and software design and engineering, and integrates NASA activities related to remote sensing, information technologies, and cooperative research studies. The Deputy Director and Business Manager is responsible for integrating USGS research related to invasive species science and supporting interdisciplinary research by serving as liaison to USGS officials, science centers, and scientists at all levels in the organization. Together, the NIISS Senior Management: (1) supervise or direct the NIISS Operations Staff; (2) report accomplishments, performance measures, and expenditures to the Board of Directors, the scientific community, and the public; (3) provide scientific and technical leadership in ongoing studies and education and outreach activities; and (4) propose new integrated science activities in consultation with partners and customers. NIISS Senior Management also actively participate in professional societies, NISC task groups, interagency committees, science center activities, and community and land management focal groups to better understand and respond to customer

NIISS Operations Staff – NIISS Operational Staff currently includes four USGS scientists, three ecologists/SCEP students, eight graduate students/research assistants, and a webmaster at Colorado State University. Indirectly, several USGS scientists and university scientists contribute time, data, and expertise to the Institute. NIISS Operational Staff (1) plan and conduct approved research projects; (2) integrate activities in the field and laboratory/science center level; (3) report accomplishments, performance measures, and expenditures to NIISS Senior Management and post peer-reviewed data, publish peer-reviewed products; and (4) and help develop new integrated science activities in consultation with partners and customers.

5.2 Governance Plan

Functionally, elements of the Institute’s organizational structure interact as follows:

NIISS Senior Management – NIISS Senior Management consists of Dr. Thomas J. Stohlgren (USGS Scientist and NIISS Director) and Dr. Catherine Crosier (NIISS Deputy Director and Business Manager). Dr. John L. Schnase (NASA Senior Scientist and ISFS Project Principal Investigator) assists as an external technology advisor to the Institute.

The NIISS Director provides leadership, oversees daily operations, integrates all aspects and cooperative invasive species science, and coordinates management and research activities with the technology advisor and Deputy Director. The Technology Advisor helps develop proposals for new technologies, assures the

NIISS Partnership Council – The role of the NIISS Partnership Council is to advise NIISS Senior Management about partnership opportunities, upcoming budget initiatives and science opportunities, ways to increase the comparability and utility of data across all levels of government and the public, and ways to improve education and outreach. The NIISS Partnership Council has rotating co-chairs with a staggered two-year volunteer terms. One co-chair is a USGS official (Regional Director, Regional Deputy Director, or Program Coordinator), while the other co-chair is from outside the USGS from a cooperating agency, Tribe, state, or non-government organization). Four or more members of the Partnership Council are nominated and serve one-year volunteer terms from cooperating agencies, Tribes, states, or non-government organizations. The NIISS Partnership Council is supplied with quarterly reports by the NIISS Deputy Director, who also conducts monthly telephone conferences for information exchange and updates. The Partnership Council also plays a key role in documenting short-term and long-term priority needs for research and information technologies, and provides a ranking of local, regional, and national science needs to the Board of Directors and NIISS Senior Management.

Board of Directors – The Board of Directors provides programmatic and budgetary direction to NIISS Senior Management, especially regarding inter-departmental cross-cut budget initiatives, future science directions within cooperating agencies, and strategic planning between NBII and the Invasive Species Science Program. The Board of Directors is co-chaired by the USGS Invasive Species Program Coordinator and a co-chair from outside the USGS. Other permanent members include: the Chief Biologist for Information, Director of the Fort Collins Science, the USGS Chief Scientist for Biology, and NASA Invasive Species National Application Program Director. Rotating and staggered 3-year members may include the Director of the Natural Resource Ecology Laboratory, the Assistant Director of the NBII, or with other representatives from DOI, USGS, NBII, NASA, and the NIISS Partnership Council. The Board of Directors is kept informed through routine conversations with NIISS Senior Management and with monthly reports (minutes of NIISS Partner Council teleconferences), quarterly reports (accomplishments, performance measures, expenditures), and annual reports.

The Board of Directors plays a key role in coordinating the allocation of funds from NBIII, the USGS Invasive Species Program, and other USGS sources and sets general priorities for research and information technologies common to USGS invasive species activities. They also oversee the development of a mutual and coordinated “request for proposal” (RFP) process conducted jointly by NIISS Senior Management and the NBII Invasive Species Node Coordinator. The RFP process includes a pre-proposal process open to USGS and non-USGS staff, anonymous peer reviews for technical merit, and program-priority reviews and suggested rankings by NIISS Senior Management Staff and the NBII Invasive Species Node Coordinator. The suggested rankings are forwarded to the Board of Directors for approval. This process insures that the highest local, regional, and national priorities are addressed in a consistent and unbiased manner, and provides for a coordinated and accountable process based on scientific peer-review.

Executive Advisory Council – The Executive Advisory Council serves as an advisory resource to the Board of Directors. It seeks to ensure long-term support for the Institute, provides advice on administration and policy matters, and monitors progress relative to annual guidance and performance measures. The Executive Advisory Council is co-chaired by the Director of the USGS and a co-chair from outside the USGS. Members may include: the Director of the USGS/BRD, Chair of National Invasive Species Council, and Director of NASA Applications Program. *Ex officio* members include Co-Chairs of the NIISS Partnership. They meet annually with the Board of Directors, receive quarterly and annual reports, and also seek guidance as needed on future science directions and needs from an informal “blue ribbon panel” of experts on invasion ecology, remote sensing, information science or others (e.g., Dan Simberloff, Lori Williams, Bill Brown, Hal Mooney, Don Schmitz, David Lodge, Lloyd Loope).

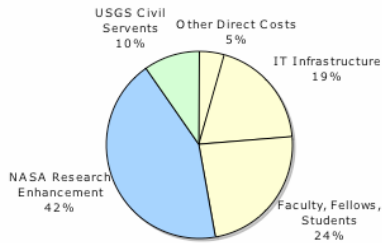
6 FINANCIAL AND OPERATIONAL DEVELOPMENT

Over the years, USGS investments in ecological science at the Fort Collins Science Center have yielded a wide range of theoretical and applied results that provide the basis for the opportunities presented in this business plan. In this section, we show the current financial state of the Institute and outline patterns of financial growth that will be required in the coming years to make the Institute a sustainable and effective organization not only to USGS but to the Department of Interior and the extended scientific and management communities concerned with invasive species.

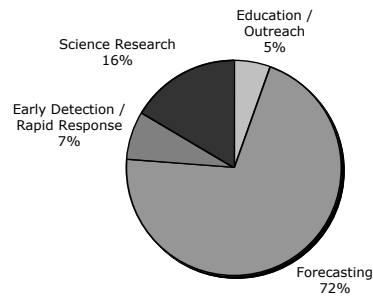
6.1 Current Budget and Funding Sources

Since its creation in 2001, the annual budget for the National Institute for Invasive Species Science has nearly doubled to the current level in FY04 of approximately \$2.75M (Appendix A). The Institute is largely a “soft money” operation, with USGS covering operating costs of approximately \$675K per year. As shown in the charts below, almost 75% of our work is funded through competitive grants from non-USGS sources. Development of forecasting and predictive modeling capabilities dominates the current program with support for these activities coming from NASA through competitive grants that will run through FY08.

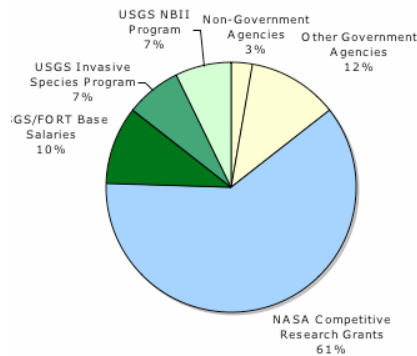
FY '04 NIISS Budget
(Total = \$2,750 K)



FY '04 Program Distribution



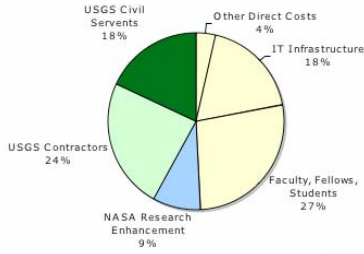
FY '04 Funding Sources
(FY04 = \$2,750 K)



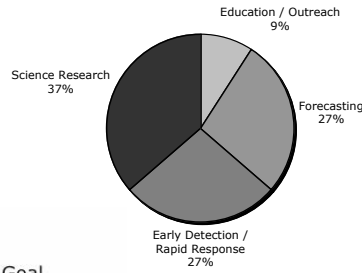
6.2 Three-Year Budget Projections

The financial and programmatic goals for the Institute over the next three years are to (1) increase USGS core funding to provide operational support for the Invasive Species Forecasting System, (2) develop new income streams using ISFS capabilities, and (3) increase Science Research and ED/RR activities to provide better program balance. Growth in USGS’s core funding will be needed to insure the Institute’s long-term viability and provide sufficient confidence within the partnership community to secure their commitments. Our goal is to grow USGS’s stable core from the current 25% to at least 50% by FY08. This translates into a total augmentation of approximately \$750K per year over current rates. The figures below illustrate the Institute’s FY08 financial and programmatic goals and the “expected case” incremental budgetary milestones required to meet these goals (Appendix A).

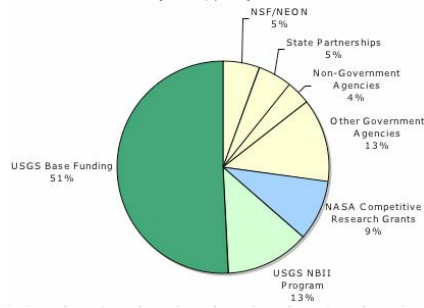
FY '08 Budget Goal
(Total = \$2,750 K)



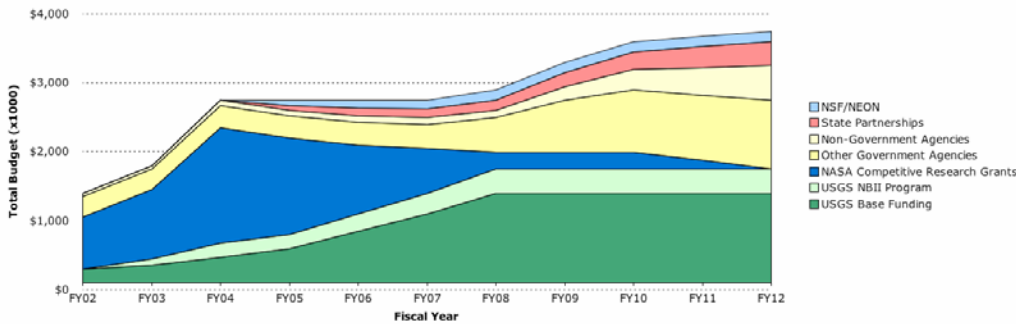
FY '08 Program Distribution Goal



FY '08 Funding Sources Goal
(FY04 = \$2,750 K)



Budget Trend Estimate

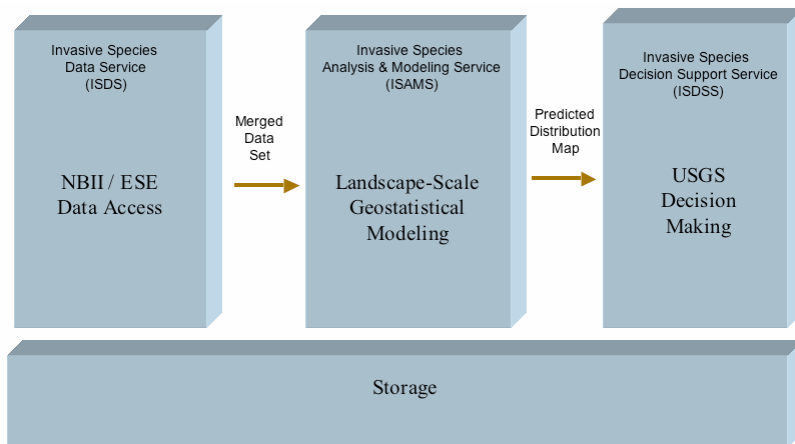


6.3 ISFS Operational Transfer

As describe above, the Institute has been working with NASA’s Applied Sciences Program to develop an Invasive Species Forecasting System (ISFS). The goal is to enable USGS to make better use of NASA’s satellite data for invasive species work. Our strategy calls for NASA to work closely with USGS to extract requirements, then provide remote sensing, software engineering, and high-end computing expertise to build, test, and deploy the ISFS. NASA’s participation will diminish over the next three years as the ISFS matures from developmental prototype into an operational system. Since advanced modeling and forecasting are key program elements of the Institute, the successful transfer and effective use of ISFS capabilities are crucial to our viability and long-term success.

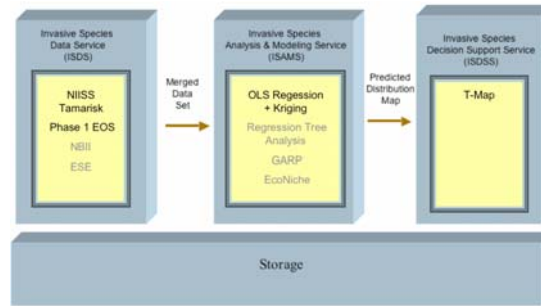
USGS Director, Chip Groat, and NASA’s former Associate Administrator for Earth Science, Ghassem Asrar, have provided general guidance for the USGS/NASA collaboration. The partnership’s implementation strategy has been coordinated by Sue Haseltine (USGS Associate Director for Biology), Gladys Cotter (USGS Associate Chief Biologist for Information), Doug Posson ((Former) Director, USGS Fort Collins Science Center), Bill Gregg (USGS Invasive Species Program Manager), Mike Frame (USGS NBII Technology Director), Ron Birk (NASA Director of Applied Sciences), and Ed Sheffner (NASA Program Manager for Invasive Species). This team has essentially functioned as an *ad hoc* steering committee for the effort, which will increasingly look to the business plan, the maturing organizational structure of the Institute, and our NASA/USGS technology transition strategy as a roadmap for the Institute’s long-term development.

Invasive Species Forecasting System – The ISFS is a web-based decision support framework comprising three functional elements. The Invasive Species Data Service (ISDS) enables field sample data on invasive species to be combined with remotely sensed data to create the type of merged data required for regional scale predictive modeling of potential distributions and vulnerable habitats. The Invasive Species Analysis and Modeling Service (ISAMS) allows different types of predictive models to be run against merged datasets. Landscape-scale modeling using large datasets is computationally demanding, and NASA has helped the Institute develop the required high-end computing capabilities to do this work. Finally, predictive distribution maps produced by the Modeling Service can be brought into the Invasive Species Decision Support Service (ISDSS), which allows predictive distribution maps to be used in a variety of decision support tools used by the Institute.



Development Stage – We are approximately three years into ISFS development. We have designed the overall architecture for the system, and Version 1.0 with associated documentation, installation guides, and user manuals has been released. A schedule is in place for continuing version updates as enhancements are added and system use increases. An initial collection of field and satellite data have been integrated into the ISDS data service and initial validated geostatistical algorithms have been integrated into the ISAMS modeling service. The NIISS *T-Map* mapping tool is currently being integrated into the ISDSS decision support component of the system. Cluster computers were installed at NIISS and NASA this year. In FY04, ISFS began its transition from engineering prototype to operational system.

Transfer Strategy – Over the next three years, the engineering effort will focus on maturing and stabilizing the ISFS framework, completing development of the ISDS data service, continuing expansion of the client base, and building the network infrastructure to allow the distributed resources of the ISFS to be easily accessed as a seamless, web-service capability. The transition to operational control by USGS will essentially re-map resource allocations from those needed for engineering to a configuration appropriate for an operational service. Since much is still unknown about the ultimate scope of such a service, our strategy is to define a level of capability consistent with what is currently being supported by the NASA grants, assume this cost into NIISS core funding, then make any future ISFS expansion a part of the unfolding business development activities of the Institute. This strategy is reflected in Section 6.2’s budget projections for FY08.



Milestones – ISFS project management currently focuses on the engineering effort. Over the next two years, resources in this area will shift to accommodate our need for business management and development of the Institute’s forecasting activities, for which ISFS provides the technological base. Customer service will become an increasingly important aspect of this transition thread. Over the same period, software and hardware engineering activities will decline significantly, and a portion of these resources will be applied to ISFS systems administration. As we finish developing the Invasive Species Data Service, resources will be allocated to the ongoing tasks of integrating new datasets. During this transition, we also hope to take advantage of some of the remarkable advances being made in networking and communications by integrating our online capabilities into the broadening array of high-performance web services for the communities we serve.

This plan will be formalized in the next few months by adoption of the Institute’s business plan and the USGS/NASA MOU. By FY08, ISFS will be under full operational control of USGS and the Institute. Transition plan details are being incorporated into the project’s master schedule as they develop and are available for review through the Institute’s website.

| | | | |
|---------|--|---|--|
| Q2 FY05 | Business Plan & MOU Adopted | ⇒ | Systems Administration |
| Q4 FY05 | ISFS Software/Hardware Engineering | ⇒ | Ongoing Data Acquisition & Integration |
| Q4 FY06 | ISDS Database Development & Initiation | ⇒ | Business Management & Customer Service |
| Q4 FY07 | ISFS Engineering Project Management | ⇒ | |
| Q1 FY08 | NASA/USGS Transfer Complete | | |

| | | | |
|------|------|------|------|
| NASA | | | USGS |
| FY05 | FY06 | FY07 | FY08 |

6.4 Next Steps

The Institute is at a crucial stage in its development. The transition from what is essentially an early-stage start-up to an operational organization will require significant maturation along all the major trajectories identified in this business plan. The following are crucial next steps:

- 1) Hire Deputy Director / Business Manager – The Institute’s science program has developed at an extraordinary pace over the past three years, and with the nation’s increasing awareness of the invasive species issue, opportunities and expectations continue to grow. The Institute is now in the process of bringing on a full-time Deputy Director / Business Manager (Dr. Catherine Crosier) who can take on immediate responsibility for tracking and coordinating the various science and technology activities of the Institute. It is also essential that we adopt a more formal approach to budget development and business growth and develop a timeline and detailed implementation plan, which will be major responsibilities for the new Deputy Director.
- 2) Adopt Business Plan – Business plans inevitably evolve, and what we present here is essentially a strategy document for how to proceed. Additional work will be needed as the new Deputy Director takes on the task of formal business development for the Institute. Developing a detailed business model for ISFS products and services will be particularly important. It is also important that USGS leadership and key voices involved in this effort come to agreement on basic elements of this approach as soon as possible, including the strategy proposed for operational transfer of the ISFS from NASA to USGS and the MOU between NASA and USGS.
- 3) Accelerate Core Funding Increase – The financial profile outlined in Section 6 points to the need to expand core funding for the Institute by approximately \$750K per year to assure success of the Institute. To maximize the benefit of our work with NASA, we have an urgent need to hire a full-time senior software engineer / project manager who can coordinate the Institute’s software development activities, facilitate interactions with the NASA software engineering team, coordinate the security and access protocols relating to our new high-end cluster computer, and start us down the path of assuming operational control of ISFS capabilities. When coupled with the growing cost of computer support and facilities and indirect costs, there is an immediate need to secure the \$750K increment in core funding, starting in FY05, through an emergency supplement, redirection, or other mechanism.
- 4) Instantiate Governance Plan – As soon as possible after adoption of the business plan, we must formally populate and convene the Board of Directors, Executive Advisory Council, and Partnership Council. Once formed, an early product of the Board of Directors should be by-laws that provide a more detailed map of the operational processes governing the Institute. Likewise, an early task for the newly formed Partnership Council should be protocols for formally engaging Institute partners.
- 5) Clarify Relationships within USGS – We must maximize the value of the Institute to the broader USGS organization and make it a more general and effective resource for USGS’s invasive species efforts throughout the agency. It is important – both for the USGS and the external communities we serve – that the activities of the Institute and the related invasive species activities of NBII and USGS Science Centers be coherent and present a uniform and rationally integrated face to the public, and that the human and technology resources of NBII, FORT, and other USGS Science Centers work together in an integrated way. We suggest that an internal USGS working group be established with the specific objective of coordinating the assimilation of this new Institute into mainstream, programmatic operations of the USGS.

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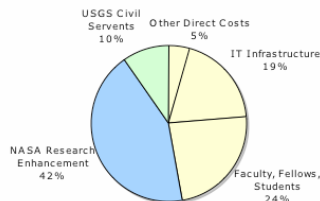
APPENDICES

APPENDIX A – DETAILED FINANCIALS

FY '04 NIISS Budget / Program Distribution Detail

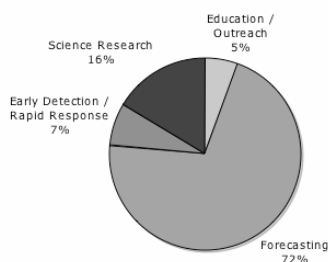
| Category | Costs (\$ x1000 / year) | | |
|----------------------------|-------------------------|------|------|
| | TOTAL | NASA | USGS |
| Other Direct Costs | \$ 125 | 50 | 75 |
| IT Infrastructure | \$ 525 | 100 | 425 |
| Faculty, Fellows, Students | \$ 650 | | 650 |
| NASA Research Enhancement | \$ 1,180 | 850 | |
| USGS Civil Servants | \$ 270 | | 270 |
| | \$ 2,750 | | |

FY '04 NIISS Budget
(Total = \$2,750 K)



| Category | Costs (\$ x1000 / year) | | |
|----------------------------------|-------------------------|-------|------|
| | TOTAL | NASA | USGS |
| Education / Outreach | \$ 150 | | 150 |
| Forecasting | \$ 1,950 | 1,330 | 620 |
| Early Detection / Rapid Response | \$ 200 | | 200 |
| Science Research | \$ 450 | | 450 |
| | \$ 2,750 | | |

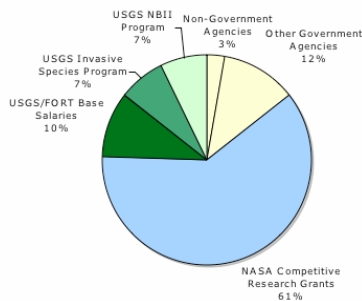
FY '04 Program Distribution



FY '04 Funding Sources Detail

| Category | Costs (\$ x1000 / year) | | |
|----------------------------------|-------------------------|------|-------|
| | TOTAL | NASA | USGS |
| Non-Government Agencies | \$ 75 | 200 | |
| Other Government Agencies | \$ 325 | 325 | |
| NASA Competitive Research Grants | \$ 1,680 | 350 | 1,330 |
| USGS/FORT Base Salaries | \$ 270 | | 270 |
| USGS Invasive Species Program | \$ 200 | | 200 |
| USGS NBII Program | \$ 200 | | 200 |
| | \$ 2,750 | | |

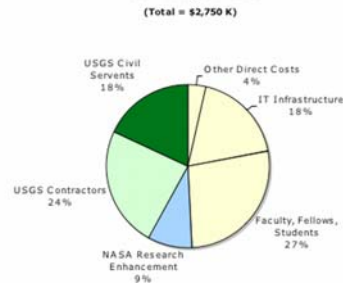
FY '04 Funding Sources
(FY04 = \$2,750 K)



FY '08 NIISS Budget / Program Distribution Detail

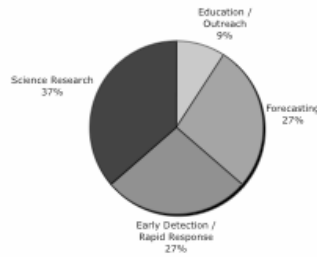
| Category | Costs (\$ x1000 / year) | | |
|----------------------------|-------------------------|------|------|
| | TOTAL | NASA | USGS |
| Other Direct Costs | \$ 100 | | 100 |
| IT Infrastructure | \$ 500 | | 500 |
| Faculty, Fellows, Students | \$ 750 | | 750 |
| NASA Research Enhancement | \$ 250 | | 250 |
| USGS Contractors | \$ 650 | | 650 |
| USGS Civil Servents | \$ 500 | | 500 |
| | \$ 2,750 | | |

FY '08 Budget Goal



| Category | Costs (\$ x1000 / year) | | |
|----------------------------------|-------------------------|------|-------|
| | TOTAL | NASA | USGS |
| Education / Outreach | \$ 250 | | 250 |
| Forecasting | \$ 750 | | 750 |
| Early Detection / Rapid Response | \$ 750 | | 750 |
| Science Research | \$ 1,000 | | 1,000 |
| | \$ 2,750 | | |

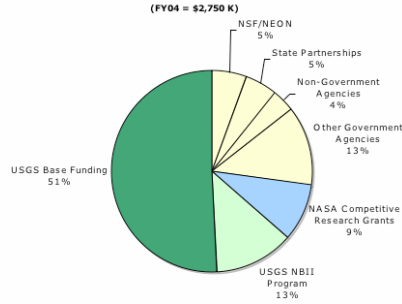
FY '08 Program Distribution Goal



FY '08 Funding Sources Detail

| Category | Costs (\$ x1000 / year) | | |
|----------------------------------|-------------------------|------|-------|
| | TOTAL | NASA | USGS |
| NSF/NEON | \$ 150 | | 150 |
| State Partnerships | \$ 150 | | 150 |
| Non-Government Agencies | \$ 100 | | 100 |
| Other Government Agencies | \$ 350 | | 35 |
| NASA Competitive Research Grants | \$ 250 | 250 | |
| USGS NBII Program | \$ 350 | | 350 |
| USGS Base Funding | \$ 1,400 | | 1,400 |
| | \$ 2,750 | | |

FY '08 Funding Sources Goal

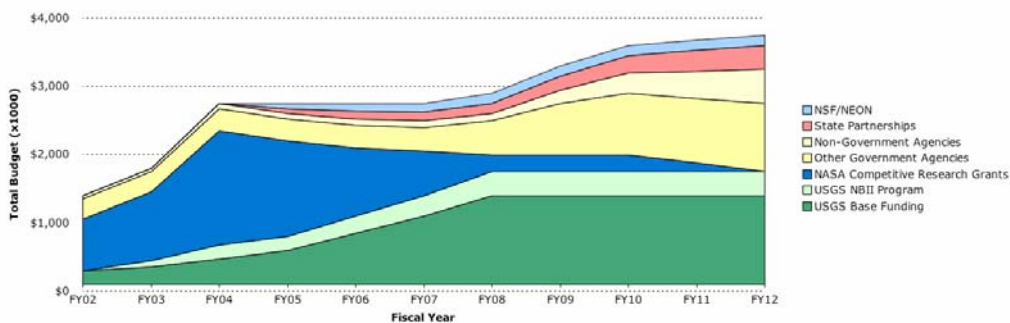


Flat budget with USGS increasing its base from 25% to at minimum of 65% ...

*

Ten-Year Budget Trend Estimate

| Funding Sources | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | FY10 | FY11 | FY12 |
|----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| USGS Base Funding | \$ 300 | \$ 350 | \$ 475 | \$ 600 | \$ 850 | \$ 1,100 | \$ 1,400 | \$ 1,400 | \$ 1,400 | \$ 1,400 | \$ 1,400 |
| USGS NBII Program | \$ - | \$ 100 | \$ 200 | \$ 200 | \$ 250 | \$ 300 | \$ 350 | \$ 350 | \$ 350 | \$ 350 | \$ 350 |
| NASA Competitive Research Grants | \$ 750 | \$ 1,000 | \$ 1,075 | \$ 1,400 | \$ 1,000 | \$ 650 | \$ 250 | \$ 250 | \$ 250 | \$ 125 | \$ 0 |
| Other Government Agencies | \$ 300 | \$ 300 | \$ 325 | \$ 325 | \$ 325 | \$ 350 | \$ 500 | \$ 750 | \$ 900 | \$ 950 | \$ 1,000 |
| Non-Government Agencies | \$ 30 | \$ 50 | \$ 75 | \$ 75 | \$ 95 | \$ 100 | \$ 100 | \$ 200 | \$ 300 | \$ 400 | \$ 500 |
| State Partnerships | \$ - | \$ - | \$ - | \$ 75 | \$ 115 | \$ 125 | \$ 150 | \$ 200 | \$ 250 | \$ 300 | \$ 350 |
| NSF/NEON | \$ - | \$ - | \$ - | \$ 75 | \$ 115 | \$ 125 | \$ 150 | \$ 150 | \$ 150 | \$ 150 | \$ 150 |
| | \$ 1,400 | \$ 1,800 | \$ 2,750 | \$ 2,750 | \$ 2,750 | \$ 2,750 | \$ 2,900 | \$ 3,300 | \$ 3,600 | \$ 3,675 | \$ 3,750 |



* We anticipate a continuing need for NASA data products. Beyond FY08, USGS will essentially become a NASA customer. Details about this future relationship are subject to further discussions.

APPENDIX B – REFERENCES

Publications

Schnase, J.L., Stohlgren, T.J., & Smith, J.A. 2002. The National Invasive Species Forecasting System: A strategic NASA/USGS partnership to manage biological invasions. NASA Earth Science Enterprise Applications Division Special Issue. *Earth Observing Magazine*, August, pp. 46-49.

Schnase, J.L., Smith, J.A., Stohlgren, T.J., Graves, S., & Trees, C. 2002. Biological Invasions: A challenge in ecological forecasting. In: *Proceedings of the International Geoscience and Remote Sensing Symposium, 2002* (IGARSS '02, Toronto, June), IEEE 2—2 International Vol. 1, pp. 122-124.

Websites

For Information about the National Institute for Invasive Species Science, see:

<http://www.niiss.org>

Field Code Changed

For information about the USGS Fort Collins Science Center, see:

<http://fort.usgs.gov>

For information about the USGS Biological Resources Division, see:

<http://biology.usgs.gov/>

For information about the National Biological Information Infrastructure, see:

<http://www.nbi.gov>

For information about the Invasive Species Forecasting System, see:

<http://InvasiveSpecis.gsfc.nasa.gov>

For information about NASA Goddard Space Flight Center, see:

<http://www.gsfc.nasa.gov>

For information about NASA's Applied Sciences Program, see:

<http://www.earth.nasa.gov/eseapps/>

