NISC
NATIONAL INVASIVE SPECIES COUNCIL
SECRETARIAT

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before the

Senate Committee on Environment & Public Works

Regarding Innovations in Fighting Invasive Species and Conserving Wildlife[1]

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MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE, thank you for the opportunity to appear before you at this hearing on innovations in fighting invasive species and conserving wildlife. This is a particularly timely hearing for the National Invasive Species Council (NISC). We recently co-hosted the first annual Innovation Summit on invasive species, a major gathering of leading scientists, innovators, and entrepreneurs to solve seemingly intractable problems – problems that leave us vulnerable to the adverse impacts of invasive species.

NATIONAL INVASIVE SPECIES COUNCIL (NISC) LEADERSHIP

The Federal Government defines invasive species to mean, with regard to a particular ecosystem, a non-native organism whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human, animal, or plant health.

It is the policy of the United States to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established. Invasive species pose threats to prosperity, security, and quality of life. They have negative impacts on the environment and natural resources; agriculture and food production systems; water resources; human, animal, and plant health; infrastructure, the economy, energy, cultural resources, and military readiness. Every year, invasive species cost the United States an estimated $120 billion in economic losses and management expenditures.

Across the Federal government, agencies are focused on combatting invasive species. This includes efforts to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established. The NISC is an interdepartmental body charged with providing the vision and leadership necessary to coordinate, sustain, and expand federal efforts to safeguard the interests of the U.S. through the prevention, eradication, and control of invasive species, and through the restoration of ecosystems and other assets impacted

1 This document has been slightly modified to correct typographical errors. The original document is available here: http://bit.ly/204qyk4

by invasive species. NISC was established in 1999 under Executive Order 13112. At that time, NISC comprised the senior-most leaders of eight Federal Departments. In December 2016, NISC and its duties were expanded under Executive Order 13751.

NISC is co-chaired by the Secretaries of the Interior, Agriculture, and Commerce. Other Federal member agencies include the Secretaries of State, Treasury, Defense, Health and Human Services, Transportation, and Homeland Security; the Administrators of the National Aeronautics and Space Administration, Environmental Protection Agency, U.S. Agency for

International Development, the U.S. Trade Representative; and, in the Executive Office of the President, the Directors of the Office of Science and Technology Policy, Council on Environmental Quality, and the Office of Management and Budget.

A small staff of experts in science, technology, policy, program management, and interdepartmental coordination is responsible for carrying out the day-to-day duties of NISC, including coordinating the development and implementation of the NISC Management Plan. The Department of the Interior administers this Secretariat.

NISC provides high-level policy and planning on invasive species, from a whole of government perspective. This involves providing institutional leadership and priority setting, facilitating effective coordination and cost-efficiency within the Federal Government and with non-federal partners, raising awareness of the invasive species issue and motivating high-impact action, removing barriers to getting the job done effectively on the ground, assessing and strengthening federal capacities as needed to meet the Council's duties, and, most importantly for this hearing, fostering innovation.

The remainder of my comments will focus on NISC's work to foster innovation, with particular emphasis on initiatives to advance technological innovation.

TECHNOLOGY INNOVATION: AN INVASIVE SPECIES GAME CHANGER

The invasive species issue has been plagued by a misconception, a belief that the issue is too complex, too difficult, too costly to overcome. Frequently, the resulting attitude has been, "Why bother?" Investments in technology innovation can be game changing. They are demonstrating that seemingly insurmountable challenges can be overcome with substantial return on investment. They are helping us change the conversation from "can't" to "can" and "let's get it done, now!"

I would like to make five general points about technology innovation in the context of the invasive species issue and then focus on relevant NISC directives, priority actions, and outputs.

First, in order to be effective, advancements in technology innovation need not require substantial investments in time or money. There are numerous "low tech" innovations being made with relatively rapid, cost-efficient outputs. For example, intellectual advancements in risk analysis and horizon scanning approaches improves our capacities to target high risk invasive species and invasion pathways. Websites and smartphone applications are enabling invasive species managers and the public to access the information necessary for the early detection of and rapid response to invasive species (e.g. https://www.eddmaps.org). Detector ("sniffer") dogs are being trained to locate a wide range of invasive species – from zebra mussels to Burmese pythons – in order to facilitate eradication and control opportunities. Small modifications in gun design are enabling the broadcasting of herbicides and toxic baits into environments that are difficult to access.

Secondly, many of the technologies that could help us prevent, eradicate, or control invasive species already exist, but they were developed for other applications. The reapplication of existing

technologies is cost-effective and facilitates the emergence of new markets for the private sector. Technology innovation is a catalyst for public-private partnership. For example, Whooshh Innovations has been developing soft, flexible air-filled tubes that use gentle pressure variances to move objects – initially large volumes of fruit. With support from the Department of Energy, they are now using the system to cost-effectively photograph, sort, and move fish upstream. Although the

SELECTED SPECIES	EXAMPLES OF TECHNOLOGY APPLICATIONS
Asian carp	eDNA, barriers (e.g., underwater electroshock barriers, walls of carbon dioxide bubbles, fencing, locks), species-specific toxicants (carpicide), genetic engineering (e.g. to influence hybridization, sex determination, sterilization – research/conceptualization in progress), and overharvest
Cheatgrass	Remote sensing, video mapping linked to global positioning systems (GPS) and geographic information systems (GIS), biocontrol (options being explored), herbicides, genetic engineering (e.g. reducing herbicide resistance)
Chestnut blight	Genetic engineering (blight resistance), biocontrol (exploring introduction of a "helper virus")
Cogongrass	Mapping technologies, herbicides, biocontrol
Fire ant	Mapping technologies, baits, toxicants, large- scale hot water applications, biocontrol
Leafy spurge	Mapping technologies, herbicides, biocontrol
New Zealand mudsnail	Toxicants, temperature treatments, dessicants, biocontrol (predatory trematode), genetic engineering (theoretical)
Nutria	Snares, traps, attractants, "Judas nutria" (sterilization, radio tracking), artificial resting platforms, camera trapping, DNA sampling, detector dogs, genetic engineering (theoretical)
Purple loosestrife	Mapping technologies, herbicides, biocontrol (e.g. Galerucella spp.), site modification (e.g. dredging)
West Nile virus	Mapping technologies, predictive analytics and risk analyses tools, automated sampling, genetic engineering of mosquitoes (e.g. sex determination, inability to carry virus), vaccines
Zebra Mussel	eDNA, watercraft inspection/decontamination, antifouling products, screening, heat treatment, chemical oxidation, sealing contaminated infrastructure, pulse acoustics, magnetism, UV light, genetic engineering (theoretical)

Table 1. Examples of technologies being applied and/or considered for application to some of worst invasive species challenges in the United States.

initial target of the work was to transfer native fish (e.g. salmon or trout) over dams and other barriers, further adaptations to the system are being explored to enable the automated detection and extraction of invasive carp, lampreys, and other harmful aquatic species.

Third, opportunities are emerging to assemble a comprehensive toolbox to address some of the most imperative invasive species challenges. For example, satellites, drones, automated trapping systems, and DNA sampling techniques are being combined to develop predictive models to better understand the transmission of human disease via invasive mosquitoes.

Fourth, best practices for technology application are context specific, one approach will not fit all scenarios (Table 1). Considerations for developing "fit to purpose" approaches need to explore such variables as the biology of the target species, time of year/day for maximizing effectiveness, ecological and socio-cultural context, legal and institutional frameworks and, of course, budget constraints and timeliness.

Finally, in order for technologies to make a real difference on the ground, focus need not only be on scientific research, but also on the advancement of regulatory systems, social acceptance of technologies and international cooperation that create and maintain the enabling environment for technology application. This is particularly true with regard to some of the technologies that hold the greatest potential to make a significant impact on a large scale. For example, drones are in use for everything from surveillance to injecting toxins, the development and release of biocontrol agents, and the use of genetic-based tools to eradicate populations of invasive species.

The Federal Government has numerous roles to play in advancing technologies for the prevention, eradication, and control of invasive species. Examples include:

- communicating the need for technology innovation to address pressing invasive species challenges;
- catalyzing and incentivizing technology innovation and re-application;
- enabling innovators to reach proof of concept and put their ideas to work on meaningful scales, potentially producing new industries and jobs in the process;
- creating, advancing, and maintaining the intellectual property rights framework necessary for technology development and application; and
- applying technologies to prevent entry, detect and respond to potential invasive species before they have a chance to cause harm, and to eradicate and control those invasive species that are already established.

Technology application not only solves problems but also can provide a return on investment, creating an incentive for new investments and breakthroughs.

CURRENT PRIORITIES

The current priorities for NISC's work to advance technology innovation are set forth in Executive Order 13751 and the 2016-2018 NISC Management Plan. Section 3 of the Executive Order states:

e. *To the extent practicable, Federal agencies shall also expand the use of new and existing technologies and practices; develop, share, and utilize similar metrics and standards, methodologies, and databases and, where relevant, platforms for monitoring invasive species; and, facilitate the interoperability of*

information systems, open data, data analytics, predictive modeling, and data reporting necessary to inform timely, science-based decision making.

In Section 4, technology innovation is recognized as an emerging priority for the Council:

c. *Federal agencies shall…promoting open data and data analytics; harnessing technological advances in remote sensing technologies, molecular tools, cloud computing, and predictive analytics; and using tools such as challenge prizes, citizen science, and crowdsourcing.*

Section 6 states that the Council shall provide national leadership regarding invasive species and shall, among other things:

e. *support and encourage the development of new technologies and practices, and promote the use of existing technologies and practices, to prevent, eradicate, and control invasive species, including those that are vectors, reservoirs, and causative agents of disease.*

Section 7, which directs NISC to publish a National Invasive Species Council Management Plan every three years, states that the Management Plan shall include, among other things, recommendations to:

6. *foster scientific, technical, and programmatic innovation.*

The 2016–2018 NISC Management Plan, which pre-dated the revision of the original Executive Order by six months, includes a goal for the Council to:

Foster the scientific, technical, and programmatic innovation necessary to enable Federal agencies and their partners to prevent, eradicate, and/or control invasive species, as well as recover species and restore habitats and other assets in a timely and cost-effective manner with negligible impacts to human and environmental health.

The four priority actions to support implementation of this goal in the context of technology innovation are to:

1. *create a mechanism for fostering the development, adoption, and sharing of the decision support tools that will enable NISC member Department/Agencies to more effectively implement the duties set forth in E.O. 13112, NISC Management Plans, and other guidance documents;*
2. *work with scientific and technical institutions, organize and co-host an Innovation Summit to*
   a. *promote scientific, technical, and technological advances that can facilitate invasive species prevention, eradication, and control, and*
   b. *identify priority needs for further advances in science and technology that can provide solutions to some of the worst invasive species challenges in the U.S. and elsewhere;*
3. *conduct an assessment of the potential ecological, socio-economic, and political benefits and costs of gene editing technology in the context of invasive species prevention, eradication, and control; and*
4. *based on the outputs of the previous action, develop guidance for the potential ecological,*

socio-economic, and political benefits and costs of gene editing technology in the context of invasive species prevention, eradication, and control

THE INNOVATION SUMMIT: A BREAK THROUGH

I want to highlight the work that has already been accomplished in the implementation of the third action – organizing an Innovation Summit to advance the prevention, eradication, and control of invasive species. The Innovation Summit was held on December 5, 2016 at the Smithsonian Institution with funding provided by the Laura and John Arnold Foundation. The partner organizations that co-hosted the event included the NISC Secretariat, Smithsonian Institution, Arnold Foundation, Island Conservation, Conservation X Labs and the ANSTF. More than 300 people participated in person or via webcast. Participants included invasive species scientists and managers, technology innovators, experts in technology regulation, and technology grantmakers.

The Innovation Summit was the first ever event to explicitly focus on technology innovation for invasive species from scientific, regulatory, and social perspectives. Through presentations and panel discussions, experts representing a wide range of disciplines reviewed grand challenges in invasive species management (e.g. from invasive grasses that impact rangelands to nutria that threaten infrastructure), new approaches and applied technologies to address these invasive species challenges, mechanisms for incentivizing innovation, the need to create the enabling environment for the technology application (including regulatory, legal, and social barriers), how to best attract technology innovators, and recommendations for moving forward.

The Summit agenda, speaker bios, abstracts, and presentation recordings are available on the NISC website at http://www.doi.gov/invasivespecies/innovation. A report of the Summit is in progress. We anticipate that it will be released by the end of the month, at which time it will also become available on the NISC website.

The presentations and discussions at the Summit did highlight a variety of opportunities for advancing federal leadership in technology innovation for invasive species. Examples include:

- communicating the "grand challenges" in invasive species prevention, eradication, and control to the entrepreneurial community across a wide range of sectors. Those with problems need to become far more visible to those who are highly motivated to innovate solutions;
- incentivizing technology development by the private sector through competitions, prizes, or other initiatives that inspire entrepreneurs to tackle the most pressing invasive species challenges;
- promoting the availability of federal technology grant programs to invasive species scientists and managers. Summit participants included representatives of the Small Business Administration's Small Business Innovation Research program, the Defense Department's Defense Advanced Research Projects Agency, the National Science Foundation's I-Core Program, and the Office of the Director of National Intelligence's Intelligence Advanced Research Projects Activity for the rapid development and commercialization of frontier science and technologies;
- exploring mechanisms to advance regulatory frameworks in a timely manner. Technological advancements – particularly those related to automation and gene-based technologies – are now outpacing the ability of regulatory systems to effectively regulate these technologies;
- fostering public education/outreach initiatives in order to address social concerns about technology development and application in the invasive species context; and
- cultivating an "innovation culture" within and outside the federal government. A wide range of

opportunities and options exist to facilitate highly productive and inspirational interactions that result in innovating thinking and outputs. These could include and be built into future Innovation Summits.

CONCLUSION

Transformative solutions drawing on advances in technological innovation exist and can be game changers in addressing invasive species. Federal agencies play a key leveraging role in working with partners to identify challenges and opportunities, expand investment, and reduce barriers to the development and application of possible solutions. These technology innovations and their application can represent a long-term cost-savings compared to existing expensive practices. Prioritizing technology innovation can have substantial payoffs – potentially saving millions of dollars in costs posed by a single invasive species.

Mr. Chairman, thank you for the opportunity to testify. I am happy to address the Committee's questions regarding NISC's role in advancing the innovation culture necessary to change the conversation from "We can't" to "We can do this . . . ."