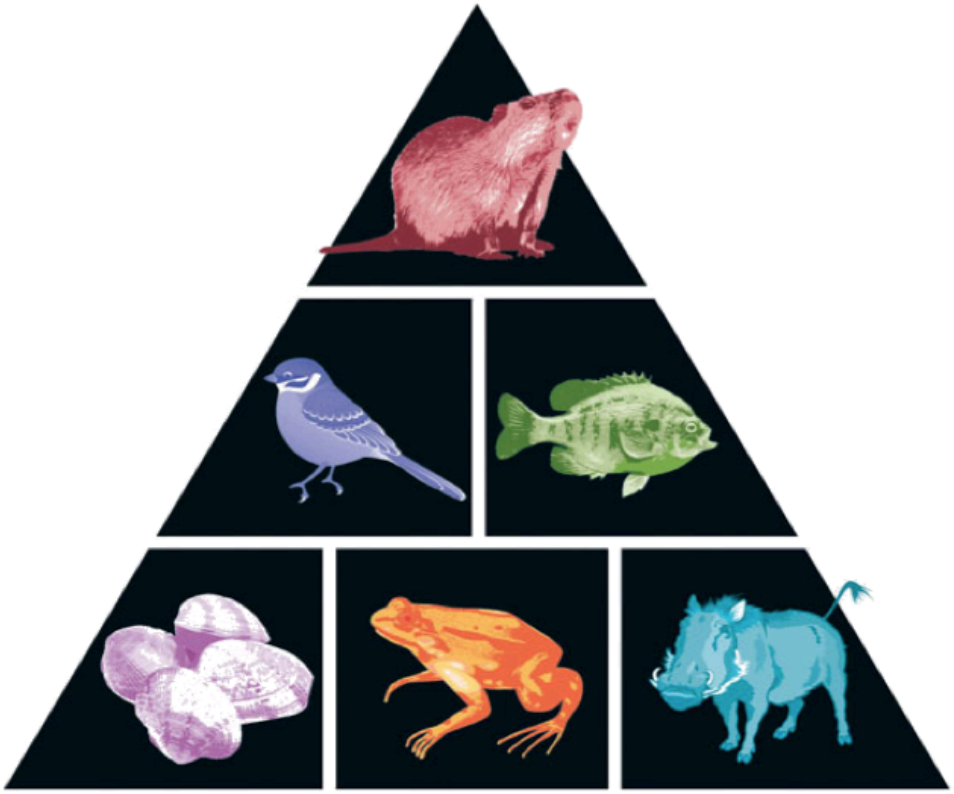
Invasive Fish and Wildlife Prevention Act



An Investigation of H.R. 996
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Executive Summary

Invasive species are a growing concern of the United States government as they pose substantial risks to the economy, the environment, and human health. This costs the United States $120 billion each year for prevention and management (Pimentel et al. 2005).

Pueraria lobata, commonly known as Japanese Kudzu, has been deemed "the vine that ate the South". Introduced to the United States in 1876 to combat soil erosion, Kudzu, with the help of humans, has grown and spread over the entire Southeastern U.S. The plant can grow as much as one foot per day, up to a total of sixty feet during the growing season. Given this high productivity and competitive edge, it is able to drastically impact the ecosystem by smothering other plants through rapid vertical and horizontal growth patterns, reducing plant biodiversity. Today, Kudzu costs the United States over 500 million dollars annually in agricultural losses, damage to ecosystems, and remediation. 7.4 million acres have been rendered useless because of this invasive species (Forseth, Jr. & Innis 2004).

Channa argus, or the Northern Snakehead, is an extremely aggressive predatory fish that has the ability to travel and survive out of water for up to four days. Native to Eastern Asia, it currently has no natural predators in America. The species was accidentally released from a fish market in the 1990s, and has since been outcompeting native species in several local water systems. Listed as an injurious wildlife under the Lacey Act, this invasive species has recently cost the Maryland government approximately $110,000 in damages (EEA 2005). The broader ecosystem effects of the Northern Snakehead have not been fully evaluated because it is a newly introduced species; however, due to its top predatory nature it should be controlled to prevent spread.

In March 2013, the Invasive Fish and Wildlife Prevention Act was proposed as a solution to the invasive species problem. In this report, H.R. 996 is analyzed using a variety of parameters to provide readers with a nuanced perspective of the bill and its potential to tackle the issue of invasives. We begin with a detailed examination of the science behind invasive species, then consider the different controversies and opposition. Next, the proposed solutions of the act are presented, along with the explanatory science. Finally, an assessment of the act's feasibility is discussed.

Introduction of H.R. 996

The Invasive Fish and Wildlife Prevention Act was introduced into the House of Representatives on March 6, 2013 as H.R. 996. Representative Louise Slaughter has sponsored the bill and is backed by 30 cosponsors. H.R. 996 seeks to prevent the introduction and establishment of nonnative wildlife likely to cause harm in the United States. The U.S. Fish and Wildlife Service would serve as chief authority to monitor imported and existing species. The legislation proposes updated screening procedures with the option to designate harmful nonnative species as injurious. The simultaneous establishment of the Injurious Wildlife Prevention Fund would finance species management and would allow the legislation to be self-sustaining. The bill proposes monetary fines for violators, and an online database of the regulatory status for each nonnative species in the U.S. Enactment of H.R. 996 would reduce the economic costs, health impacts, and environmental losses that result from invasive species intrusions.

Louise Slaughter is a far left Democrat who has served as a Representative since 1987 in various New York state districts. She was originally motivated to advocate for natural resource protection from observing the Asian carp, an invasive fish known for altering food webs in the Great Lakes and Mississippi River. From her strategic work to combat Asian carp with the help of the Army Corp of Engineers, it is clear that Slaughter understands the importance of investing and protecting natural systems. Through introduction of invasive species legislation, Slaughter aims to protect United States ecosystems from the economic and environmental threats of invasive species (H.R. 996).

Twenty-eight organizations encouraged Louise Slaughter to improve regulation of wildlife trade and nonnative species invasions by sponsoring H.R. 996. They represented environmental, conservation, recreational, and religious organizations including: the Audubon Society, the National Wildlife Federation, the Nature Conservancy, and Alliance for the Great Lakes. Cosponsors support the effort to provide the U.S. Fish and Wildlife Service authority to make regulatory decisions to control the risks presented by nonnative wildlife (Brammeier et al 2012). In reference to the only existing invasive species legislation, the Lacey Act, Great Lakes United spokesperson, Jennifer Caddick, says, “This bill is a 21st century solution that improves oversight for the trade of live animals by updating a law enacted 113 years ago” (PRNewswire 2013).

The bill is currently sitting in the following four committees: Fisheries, Wildlife, Oceans and Insular Affairs; the House Budget Committee; Crime, Terrorism, Homeland Security and Investigations; and the House Committee of Ways and Means. On June 20-21, 2013, the National Environmental Coalition on Invasive Species (NECIS) and the Wildlife Society met with Congressional members in Washington, D.C. to further discuss the impacts of invasive species (Zupic 2013). NECIS believes that there is bipartisan support to identify and shut

pathways of “inadvertent introductions” of nonnative species through risk screening (NECIS 2013).

The bill currently remains immobile with a 5% chance of enactment.

Summary of Bill H.R. 996

The purpose of the Invasive Fish and Wildlife Prevention Act is to “establish an improved regulatory process for injurious wildlife to prevent the introduction and establishment in the United States of nonnative wildlife and wild animal pathogens and parasites that are likely to cause economic or environmental harm, or, harm to human or animal health” (H.R. 996).
A segmented overview of the bill text is outlined below:

Definitions (Section 3)

Roles played by the Director refer to the Director of the United States Fish and Wildlife Service and Secretary roles are played by the Secretary of the Interior. Importation of a nonnative species includes both attempts and actual introductions into any place subject to the jurisdiction of the United States. A native species is one that historically and/or currently occurs in the United States. This excludes species that were intentionally or unintentionally introduced by humans. Alternatively, nonnative wildlife taxon includes any family through subspecies of live animal, including reproductive material that is not native to the United States. Nonnative species born and/or raised in captivity also fall under this label. Approved wildlife sanctuaries are untaxed institutions that care for wild species as educational entities, but do not commercially trade or propagate animals.

Proposals for Regulations of Nonnative Wildlife Taxon (Section 4)

Any entity can submit a proposal for revised regulation of a taxon. Complete proposals will be published in the Federal Register for a 60-day public comment period and the Director will approve or disapprove in no more than 180 days. Approved species are designated as Injurious I or Injurious II.

Scientific Risk Assessment and Risk Determination Regulations (Section 5)

Injurious I taxa present a high degree of potential harm and cannot be successfully maintained in the United States. They may be injurious to humans, agriculture, horticulture, forestry, wildlife, or wildlife resources. Injurious II taxa have a degree of potential harm below that of Injurious I taxa. Permits are not required for Injurious II taxa maintained by qualified institutions. Determinations are made using Scientific Risk Assessment. Previously unregulated nonnative

wildlife taxa will be reviewed within three years of the act enactment date. The best available scientific screening will be used to make designation decisions.

Emergency Temporary Designation (Section 6)

The Director may temporarily designate a non-native taxon as Injurious I under emergency circumstances in which individuals, the economy or the environment are threatened.

Information on Imported Animals (Section 7)

The Director will create an electronic database outlining quantities and regulatory status of nonnative taxon, as well as annual, cumulative reports.

Prevention of Wildlife Pathogens and Parasites (Section 10)

The Secretary is to prevent the importation of wildlife pathogens and harmful parasites through necessary import restrictions (i.e. quarantine). Consultations regarding prevention are conducted with appropriate federal agencies, wildlife agencies, and veterinary authorities.

Prohibitions (Section 11)

Importation, interstate commerce, permit violation, and release of Injurious I and Injurious II species will be unlawful for all persons under the jurisdiction of the United States. Taxa owned prior to designation as Injurious II may be transported between states for non-commercial purposes. These prohibitions will not apply to importation and transportation by federal agencies.

Permits and Exemptions for Qualified Institutions and Live Animal Transporters (Section 12)

The Director may issue permits to qualified institutions. Such institutions must maintain records of their activity with Injurious taxa such as possession, breeding, and transportation. The Director must keep a published list of qualified institutions.

User Fees (Section 13)

User fees will be imposed on imported wildlife shipments to cover a portion of the cost to monitor, conduct assessments, maintain records, and prevent entry of wildlife pathogens and parasites. Annual total fee revenue shall not exceed the costs of inspection and overseeing importation of live wildlife.

Relationship to State Law (Section 14)

Lawfully obtained injurious wildlife taxa are a possession under State law. However, this act does not preempt state law which occasionally has more stringent requirements for non-native wildlife taxa.

Penalties and Sanctions (Section 15)

Persons found committing prohibited acts will be subject to a civil penalty of $10,000 or less per offense. Permit and provision violators will be charged a maximum of $500 per offense. Persons knowingly violating provisions of this act will be charged with a Class A misdemeanor and are responsible for all costs associated with their fault including forfeiture of property.

Injurious Wildlife Prevention Fund (Section 16)

The fund will consist of user fees and judicial penalties received after one fiscal year (75% to carry out the Act and 25% to provide aid for state wildlife risk assessment). An annual report will detail revenue, expenditures, recommendations, and balance at the end of each fiscal year.

Environmental Problem and Science Behind the Problem

From a biological point of view, invasive species exhibit fast growth and rapid reproduction, effective methods of dispersal, genetic adaptability, and ability to alter their natural conditions to promote their own survival. They are generally opportunists that take advantage of a wide variety of environmental conditions, as well as generalists that are able to live off of a wide range of food types and more capable of occupying unexploited niches of the destination habitat. These invasive species are successful where there is a void of controlling mechanisms, such as natural predators (Kolar and Lodge 2001), and areas with repeated opportunities for establishment. From an ecological point of view, when determining if a species can be classified as invasive, we have to examine whether the habitat may enable the proliferation of the species. At low population densities, it can be difficult for the introduced species to reproduce and persist in a new location. Therefore, a species may re-visit a location multiple times before becoming established (Verling et al. 2005). Introduced species have superior competitive ability for resources (i.e. light, space, water or food, etc.) and are easily able to adapt to ecosystem changes. For example, a wildfire or unexpected dry or wet season can wipe out a portion of local species, leaving space for more competitive and dominant introduced species. They deteriorate the ambient habitat's quality and cause harm to other species.

Case Study

Cryphonectria parasitica, a fungus commonly known for causing Chestnut Blight, was first introduced to the United States around the 1900s through ornamental Japanese and Chinese chestnuts. It was first described and accounted for in 1905 (Murrill 1906). However, within forty years of being discovered in the U.S., the Chestnut Blight had completely decimated the American Chestnut tree population, which was estimated to be over 4 billion. The American Chestnut had significant biological and economic importance. For humans, the chestnut tree was very popular for its role in the timber industry. It is a rot-resistant, fast-growing, and very lucrative tree species. These trees produce chestnuts which were, and still are, popular in urban areas as a form of food for both humans, as well as a resource for small woodland creatures (Murrill 1906).

Modes of Invasive Species Introduction

In recent decades, the world has entered what is known as the "Era of Globalization." Improvements in shipping, technology and logistics have "accelerated the ease with which commodities are transported across the globe," greatly increasing the magnitude of biological invasions (Hulme 2009). Therefore, invasive species enter ecosystems through a variety of different sources, both intentionally (e.g. pest control) and unintentionally (e.g. contaminated materials). To successfully establish themselves in a new environment, invasive species must overcome a variety of challenges that include: the ability to enter and survive in the pathways through which they are transported; successful reproduction and population increase in new locations; spread beyond original point of establishment; and expansion to high densities that impact ecosystems (Reed et al. 2012).

Commercial transportation via ships, airplanes and vehicles plays a significant role in the spread of species from one region to another. The introduction of over 70% of aquatic invasive species, such as the zebra mussel (*Dreissena polymorpha*), has been related to ballast water discharge and attachment to vessels (Beyer et al. 2011). On airplanes, organisms can become lodged in landing gear and thus travel as stowaways to other parts of the world. Both ships and trucks use a variety of cargo-packing materials, such as wood or granite, which can serve as a host for these organisms where they can survive undetected for long periods of time. Wood packing material has been found to have infection rates ranging from 22-24%, while granite has been found to harbor live insects 32% of the time (Batabyal 2006). A second mode of spread is through human activities, such as the global trade for exotic pets or plants for ornamentation (van Wilgen et al. 2009). Some of these nonnative plants, mammals, and reptiles are released or escape into the wild, where they then become established in new ecosystems and pose risks to the native biodiversity. For example, the Burmese python (*Pythonmolurus bivittatus)* was introduced to the Florida Everglades through the animal trade when over 30,000 individuals were imported into the U.S. between 1979 and 2009 from southern Asia (Reed et al. 2012). A third mode of spread

is by the natural process of migrating wildlife. As birds migrate, they often carry seeds, plants, or organisms, such as parasites within their digestive tracts or attached their feathers. When released, these species have the potential to invade new areas (Raissa 2006).

Effects on Humans, Ecosystems and Other Species

Invasive species can have huge effects on ecosystems such as changing environmental geomorphology, shifting community structure, or impacting the human economy. The effects are varied, so in order to make the most informed policy actions, scientific research is particularly crucial (Pimentel 2005).

Effects on humans: Impacts are typically measured via the economic and environmental costs incurred from introduction of an invasive species. Upon examining United States finances, there were approximately $97 billion in damages from 1906 to 1991, mostly in agriculture and forestry. A few costly invasive species include:

- the zebra mussel, a mollusk that made its way into the Great Lakes causing $1 billion in damage in control costs
- hydrilla, an aquatic weed that cost Florida $14.5 million a year to control
- the common pigeon, which costs approximately $9 per bird for control in major cities (Pimentel 2005)

Effects on ecosystems: Additionally, invasive species affect geological, chemical and physical processes of the environment. Animals that are ecosystem engineers, like beavers, significantly alter physical aspects of an environment (Clive et al. 1994, Dukes et al. 2004). Other animals with less obvious impact, such as feral sheep and goats, can cause increased levels of erosion due to overgrazing and compacting of ground soils. One species of particular interest particularly is the feral pig. These animals suppress the regeneration of woody species (e.g. native oak) which reduces herbaceous cover and accelerates erosion. Other impacts include soil disturbance in grasslands and increases in siltation of streams due to pigs turning up soil along stream banks. (Dukes et al. 2004). When such drastic changes occur to the geomorphology of an ecosystem, species composition and species richness of the area are affected as well. When aspects of an ecosystem change, biodiversity can decrease which increases the environment's susceptibility to future invasions from invasive species (Dukes et al. 2004, Hampton et al. 2004).

Effects on other species: The effects on other species are much more difficult to quantify, but still pose a problem as research has shown that 42% of the current endangered species in the U.S. are directly threatened by invasive species. This number can reach 80% in more vulnerable ecosystems around the world. Additionally, there are species not yet listed as endangered but that are being significantly affected by invasive species (Pimentel 2005). One example of invasive species impacts on the existing species of an ecosystem is the introduction of feral pigs to the Channel Islands off the coast of California. With no natural predator, feral pig populations

increased, causing a trophic cascade of the ecosystem. Golden eagles colonized the islands to prey on pigs and the native fox species, which caused fox populations to decrease dramatically. This led to less resource competition with the island skunk causing populations to increase dramatically, throwing off the natural ecosystem balance. This example clearly presents the potential detrimental impacts that an invasive species can have on the existing predator-prey interactions (Dukes et al. 2004). The layers of the community structure shift and can ultimately cause the collapse of an ecosystem (Roemer et al. 2002).

The Role of Biodiversity in Invasive Species Introductions

With ecosystems being as dynamic and multifaceted as they are, it is difficult to pinpoint what aspects make an ecosystem more or less susceptible to the effects of invasive species. When looking at the Channel Islands case study, there are specific aspects that made the establishment of feral pigs so successful. Pigs had a much higher and constant annual reproduction rate in contrast to the foxes, making it easier to maintain large populations. Skunk populations were not affected by the establishment of golden eagles: skunks are nocturnal while eagles hunt during the day. With foxes having lower fecundity, crepuscular behavior, and smaller size in general, the trophic cascade brought on by the introduction of the feral pig quickly impacted their population (Roemer et al 2002).

In *The Ecology of Invasions by Animals and Plants*, the author, Charles S. Elton, claims that ecosystems with higher species diversity are less subject to invasive species. Since ecosystems tend to be more stable with higher species diversity, fewer available niches reduce the possibilities for invasive species to penetrate: these theories are consistent with trends of invasive species. However, the presence of highly diverse but heavily invaded ecosystems has led to the argument by some ecologists that ecosystems with high species diversity are more susceptible to invasion. It is noteworthy that small-scale studies tend to show a negative relationship between diversity and invasion, while large-scale studies, tend to show the reverse (Stohlgren et al. 1999). The latter may be a side effect of invasive species' abilities to capitalize on increased resource availability and the fact that larger samples often result in weaker species interactions (Byers and Noonburg 2003).

Cases For and Against Governmental Intervention

From the examples provided on different wildlife, it is evident that most introduced species are capable of yielding disastrous ecological consequences to native environments. They have created public health concerns such as clogging and fouling waterways, spreading of diseases, and reducing quality of public parks and spaces (Livingston et al. 2008). If these issues are not addressed early and effectively, the negative consequences will quickly exacerbate to points beyond remediation. Government interventions are much needed as invasive species cost the U.S. billions of dollars in economic and environmental losses. A top-down prevention approach,

as well as close monitoring of introduced species effects on ecological systems, would be most effective in addressing these issues. This would largely require strong leadership by political entities as well as the community and individual interest. Education is crucial in raising awareness and promoting better management and protection of our environmental resources.

While the proponents of H.R. 996 agree with its purposes, the opponents argue that invasive species should not be regarded as "culprits" simply because they are nonnative. Instead, they believe they should only be addressed when the damages to ecological systems are properly surveyed (Kareiva 2011). Those opposing the bill also suggest that removal of certain invasive species could potentially harm ecosystems. For example, the Tamarisk tree in the southwestern United States provides nesting habitat for the endangered willow flycatcher (CBS 2010); removing this supposedly invasive species could alter the ecosystem and negatively impact the already vulnerable bird. It could be too general to create a "one size fits all" approach to invasive wildlife because they have both positive and negative effects on ecosystems (Davis 2011). A final argument against H.R.996 is it will adversely affect the pet industry, since most exotic reptiles, amphibians, birds, and fish would be deemed invasive and consequently banned or eliminated.

Proposed Solution

Previously established solutions to the problem of invasive species in the US were addressed by the Lacey Act of 1900. Before H.R. 996, it was the only existing legislation that acknowledged invasive species. Due to the slow listing protocol and its original development as a poaching law for game preservation, it no longer suits all needs of our now globalized country (Wisch 2003). The Invasive Fish and Wildlife Act creates a risk assessment program for imported species and improves the reporting requirements for all nonnative species in the United States, allowing for tighter inspection and quarantine procedures, screenings, and management protocols for existing species (Congress 2013).

Proposed Methods and Determinations

Upon enactment, this bill would "establish a process for assessing and analyzing the risk of a non-native taxa" that has been, or could be found, existing in the United States. Live wildlife imports would be subject to pre-import risk screening, strict customs regulations, and diligent tracking if granted entry. Pre-approval of imports would be coupled with preventing importation, or attempts at importation, of harmful wildlife species. The Secretary may require health certificates, set quarantine requirements or make specifications for conveyances to carry out this duty. The act also establishes protocol for management of nonnative species currently residing in the United States (Kroeger 2007). These decisions will be based on a Scientific Risk

Assessment (SRA). This appraisal organizes relevant facts at the species and subspecies level which is then used to develop a risk determination that addresses the potential for "reduction, mitigation, control and management" of identified risks. Species are then deemed Injurious I or Injurious II based on their degree and range of potential harm and success in captivity.

The act addresses all factions of wildlife taxa, as determinations are considered at family through subspecies levels and include germplasms (i.e. eggs, sperm). It prohibits importation, interstate transport, and release of listed species within both the continental United States and associated territories overseen by the federal government. Prohibitions do not apply to qualified institutions (e.g. zoos, aquariums) nor federal, state, or local law enforcement personnel so long as close records of transport, breeding and possession are kept. Anyone may propose a species for listing and suggestions go the Federal Register for a 60-day public comment period, after which 180 days are allotted for determination by the Director. The Director is required to consult with six bodies, five of which are consistent such as NOAA and the CDC (Congress 2013).

Finances and Record-Keeping

The act is self-sustaining by way of the Injurious Wildlife Prevention Fund, which is financed by Secretary-imposed fees on all imported wildlife shipments as well as fines from criminal and civil violations of the act. Legislative intent seeks to use this fund for recovery of 75% of costs afforded for species monitoring and SRAs. Civil administrative penalties are fined at a maximum of $10,000 per violation. Criminal offenders are those who knowingly violate act provisions and have been found guilty of Class A misdemeanors. In both instances, quantifiable damages are borne by the violator and forfeiture of wildlife and related property is required. H.R. 996 mandates that a public electronic database be kept on a federal internet website for prompt access to records of listed injurious species, regulatory statuses and import quantities. Injurious Wildlife Prevention Fund transactions are to be kept in an up-to-date, record keeping system including yearly reports of the electronic database (FWS 2012).

Advantages and Disadvantages of the Proposed Solutions

H.R. 996 outlines a process for active screening of suitable candidates for listing as injurious (Jenkins 2007). With only about 13% of imported species having risk annotations, the proposed methods would not be too labor intensive and could help close the gap in disease and destruction prevention (NAS 2005). The mandatory pre-import screening process is more efficient and systematic than past approaches and provides the Fish and Wildlife Service the needed authority to outright prohibit importations (Eder 2013). International animal imports are the easiest nonnative species to regulate and existing problem species would be listed within the three-year buffer to fully enact all provisions of the bill. A strict invasive species bill would save money in terms of conservation efforts to rebound ecosystem services, surveillance, containment, eradication, and preserving scenic amenities (Kroeger 2007). Even with such high species

numbers, preventing the invasion of just a single species will impede subsequent invasions. However, we have limited knowledge regarding the reproduction, habitat preferences, competitive ability, and the economical or environmental destructive capacity of invasive species. This could lead to an overly broad, blanket listing of species as invasive that could behave neutrally in the United States (USARK 2013). Over-criminalization of a large number of taxa would impose great loss to the exotic pet industry: in 2004, retail value was estimated at $330 million for the United States, which does not include monetary losses to the pet industry through sales, jobs, supplies and services (Kroeger 2007, Reuters 2007). H.R. 996 hopes to reduce the probability of future damages by putting a time limit on the species listing process, including measures for emergency situations, as well as constantly implementing the aforementioned solutions (Fowler 2007).

Science Behind the Solution

Understanding the impact potential of any given non-native species should be achieved through scientific risk assessments and harm potential categorizations. Monitoring and regulating the importation, establishment, and spread of such species should be achieved through rapid determination procedures: this requires understanding the nature of the invasive species problem, the risk analytics theory behind the proposed solution, and the technology involved in monitoring and controlling the process.

Ecology of the Solution

A successful invasive species is known to exhibit at least one or more of the following traits: high growth and reproductive rates, high dispersal potential, genetic adaptability, lack of natural controlling mechanisms, opportunist traits (highly adaptable to changing environments), or generalist traits (can live off of a wide range of resources, occupying multiple niches). There are three stages invasive species undergo when introduced to a new environment. First is opportunity, which can occur through human-aided introduction or accidental or undetected introduction. This includes global commerce for food, familiar species, fisheries enhancement, or ecosystem manipulation, as well as seed contaminants, ballast water discharge, and interstate packing/shipping materials. Second is establishment in the environment. An invasive species can become established when there is a lack of natural predators or parasites, and through human disturbances that can aid in their success (Verling et al. 2005). The third phase is successful proliferation. Once the species is successfully established in the destination habitat, the repeated introduction and attempts of establishment to nearby similar-structured or functioning habitats will give rise to the species' spread (USDA 2005). The act aims to establish more proactive controls on the opportunity stage to prevent potential invasive species from entering the United

States, as well as implement reactive control on the spread stage to prevent greater harm caused by existing invasive species. The act is less focused on mitigating during the establishment stage due to its high dependence on successful introduction of the species.

Risk Assessment

Assessment requires the establishment of risk analyzing processes on species using the Scientific Risk Assessment tool, which involves the following steps (USEPA 1998, Anderson 2004):

1. Frame the question – *What is the overall risk of introducing a species into the United States?*
2. Identify hazards – *What are the economic, environmental and human health consequences?*
3. Outline the risk pathways – *What impacts the chances for species X to transport into the United States, establish itself in the habitat, and spread successfully to ambient environment?*
4. Identify data needs – *What specific data do we need to quantify the above listed pathways?*
5. Collect data – *What is the most appropriate mode of data collection (i.e. sampling, modeling)?*
6. Compute overall risk – *How can we construct the risk profile for a species given the data at hand?*

Technological Feasibility and Concerns

Although the sciences and the proposals for invasive species are based on sound research, properly integrating risk assessment practices, an accurate invasive species database, and rapid determination procedures into the solutions is challenging. This brings to attention several concerns regarding technological feasibility and the ambiguity of the solutions as proposed in the act.

There are technical constraints to include quantitative data for invasive species. Besides recording the scientific name and regulatory status of the invasive species, the act requires the database to include all quantities of imports of all live wildlife. In order to give a close estimate of quantities of importation would require a detailed measurement of all the pathways for the species to be imported into the United States (e.g. cargo, air, land, and/or accidental introduction), possibilities and frequency of importation associated with each of the pathways, and what proportion of the amount transported actually achieves its original purpose (Wilcove et al. 1998). This is difficult to quantify since the inherited adaptability and survival rate vary greatly among different species, but even among the same species that might have different habitats, conditions and resources available. The reliability of rapid determination procedures is another area of concern. According to the Federal Interagency Committee for the Management of

Noxious and Exotic Weeds, the underlying assumptions for rapid assessment of invasive species' classification involve both pre-determined protocols and methods in place, but also information regarding the species' capability of invasion, the probability of spread, the types of control options, and probability of eradication (FICMNEW 2005).

The science of invasive ecology and biology is sound and scientists have crafted reliable and valid scientific risk assessment tools to evaluate the overall risk profile for any given species invasion incident. However, the technical constraints such as the inclusion of quantity data for invasive species in database and the data reliability concerns during the rapid determination procedures need to be addressed if the Act is to be successful.

Controversies

Regulatory actions manage two types of risk regarding invasive species. The first is the introduction of invasive species, and the second is the species' likelihood of establishment, spread, and cause of harm to society after introduction. However, there has generally been a gap in these two areas of evaluation as most focus is on the introduction, and less attention is paid to full evaluation of the impact (Andersen et al. 2004). Scientists and pet shop owners both argue that there is too much emphasis placed on the prescreening process where species can be improperly categorized as harmful. In addition, the Act does not identify the precise methods for sound science to identify risk with scientific procedures. Current early detection techniques are often seen as incomplete because they mostly look at imported invasive species, while ignoring existing problem taxa. Methods that only look at imports and border protection are missing a large subset of invasive species.

There is a concern that species overlooked in identification could either be non-hazardous or beneficial. If species are misidentified in the screening process, the government may pay for services already provided by supportive nonnative species. Conversely, some scientists find early detection beneficial because it corrects the lag time between introductions and identification of negative impacts. Currently, species are often undetected and establish themselves for years before they are recognized as harmful which results in larger costs for control and eradication (Keller et al. 2007). When there is a lack of consensus in the scientific evidence, for example choosing scientific models to assess how the invasive species currently or potentially interacts with an ecosystem, it can lead to a disregard of the evidence altogether. Policy makers may be forced to believe that there are insufficient data to support the data and instead rely instead exclusively on subjective judgment (Addison *et al.* 2012). This subjectivity in judgment could apply to the process of designating Injurious Type I and Type II species, as well as the emergency designation of invasive species. This may lead to arbitrary and biased

decisions that adversely impact conservation outcomes (Burgman *et al*., 2011). Valid scientific recommendations disregarded due to unstructured judgments can lead to unintended outcomes with negative consequences for the environment, the economy, and human health.

Not all studies of invasive species seemed to have undergone the appropriate rigorous assessment of how dangerous they may be to human health and economy. In a case study done by Hager and McCoy (1998) regarding the effects of purple loosestrife, previous data on its negative effects on ecosystem health was sought out: they discovered that most data used by scientists to claim that purple loosestrife would be a very detrimental invasive species was inconclusive or sometimes nonexistent. With the purple loosestrife, there was only one biological factor out of three that made it a potential invasive species. When later experiments were performed, it was found that it did not significantly outcompete other organisms when introduced to a new environment. Furthermore, purple loosestrife was actually being used productively by 29 out of 39 species. This is one example of many potential species that were hastily identified as invasive, most likely in an attempt to prevent environmental damages by this aggressive plant. However, it is important to conduct significant scientific research, and analyze the data with enough rigor and attention to detail to make scientifically valid arguments with respect to the results of these sorts of studies. This can lead to discontinuity between scientists and policy makers and ultimately to negative environmental, economic, and human health effects (Addison et al. 2012, Burgman et al. 2011).

The act requires the proposed species to be listed within 180 days, the new process is much faster than the multiyear process previously used. The National Wildlife Federation endorses this timeline and deems it as efficient since species would be identified and controlled more rapidly (WSJ 2013). However, this raises the possibility that hasty decisions will be made regarding a species based on insufficient data.

Measuring Success

When measuring the success and failures of invasive species, indicator species and genetic monitoring are two of the best tools to determine regional biodiversity. Indicator species are environmentally sensitive species that can represent the environmental conditions of an area based on abundance and health. Therefore, response to an invasive species by an indicator species may indicate further degradation or potential for a domino effect on an ecosystem (National Geographic 2013). Using genetic monitoring, scientists can use molecular markers or distinguishable fragments of DNA to identify invasive species as well as their origin. Fewer positively identified invasive species would indicate a successful policy. This is useful to take a closer look at invasive species impact instead of just presence. For example, molecular markers

can be identified in animal stomach DNA to determine food web structure and the relationships between predators and prey of native or invasive species (USGS 2012). Environmental changes can also be identified via analysis of loci of certain genetic traits: presence of traits on certain can indicate a stressed environment, and presence in large numbers may indicate a significant negative impact from invasive species (Schwartz et al 2007).

Economic indicators can also accurately track the presence and success of invasive species policy (Pimentel 2005). This is currently a functional system as states regularly track the amount of money spent on damage, management, and eradication incurred from invasive species. Similar to economic indicators, public health indicators are an efficient way to track the success of the policy.

The current techniques available to study these indicators are mostly based on sound, regular, and systematic surveys of wildlife areas. These surveys can help gather genetic, economic, and health data, and would need to be state implemented to provide baseline and secondary data to demonstrate changes and trends of invasive species (FSW 2009).

Conclusion

The issue of invasive species is an undeniable and current threat to the economy, ecosystems, and human health of the United States, and thus requires a policy that is as complex and multi-faceted as the problem itself. By reviewing the issue on a larger, more-integrated scale with a focus on potential outcomes of the introduction and establishment of invasive species, the United States will be able to create appropriate legislation that is effective, efficient, and successful in evading the invasive species problem. The introduction and establishment of invasive species can impact ecosystems in a multitude of ways and it is imperative that further research is done to establish a more nuanced perspective of their effects.

The need for more research cannot be stressed enough – it needs to be reflected in the risk assessment process, and ultimately in the policy recommendations set out to address the situation that will help policymakers understand the science behind these solutions. Although it is likely that invasives will need to be treated on a case-by-case basis, proper assessments conducted on each potential species to establish its individual impact on an ecosystem will contribute to an overall database of invasive life history traits. This will help narrow the gap between scientists and policymakers, enabling them to work together to create models to predict impacts of potential future invasions. Furthermore, this will determine effective management strategies for specific species and landscapes, trace the program's effects through quantitative measures, and provide feedback to future policy making processes.

There is a need to work with state governments to ensure that assessment surveys are adequately conducted so as to ensure that outlined management procedures are effective. The risk assessment process is based on sound science yet efforts need to be made to convey the reasoning behind these assessments to various stakeholders, such as the pet industry, to provide clarity on which species will fall under its purview and how they will be handled as they come into the United States.

The Act has a strong focus on self-financing and feasibility through the creation of the Injurious Wildlife Prevention Fund and places emphasis on the need to involve local citizens in its implementation. Allowing individuals to report and provide updated information on potential invasive species represents the advantageous blend of science, robust policy, and social outreach that is encapsulated in H.R. 996.

While the Act does have shortcomings that need to be addressed, with appropriate modifications regarding the aforementioned controversies, it could provide a much-needed impetus to action on invasive species. The passage of H.R. 996 would be a very progressive step for the United States government in addressing the issue of invasive species.

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