

USAWC STRATEGY RESEARCH PROJECT

Invasive Species- A Threat to the Homeland?

by

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The views expressed in this academic research paper are those of the author and do not necessarily reflect the official policy or position of the U.S. Government, the Department of Defense, or any of its agencies.

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ABSTRACT

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This Strategic Research Project seeks to determine whether a potential adversary's introduction of an invasive species (Ebola, brown tree snake, zebra mussel etc.) into the United States poses a threat to our national security. This Strategic Research Project analyzes historical precedents to determine their effects and thus to predict the effects of a future attack. Several examples are used to depict this, to include a foot and mouth disease attack to destroy the livestock industry. The project examines reasons an adversary may choose this type of attack. It then assesses the Invasive Species Management Plan of the National Invasive Species Council. It concludes with recommendations for strengthening the nation's defense against an invasive species attack.

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PREFACE

I have been blessed to spend my life on a farm and to experience the wonders of nature first hand. However, over the course of years, I've noticed the unintentional introduction of new and more aggressive species of weeds, diseases and organisms on both my farm and the surrounding woodlands. Some of these species include soybean cyst nematode, soybean aphid, woolly cup grass, Canada thistle, poison hemlock, soybean sudden death syndrome, teasel, Japanese honeysuckle and wild garlic. Even now, the United States Department of Agriculture is issuing a warning of an impending introduction of a new soybean rust that can reduce yields up to 80%. These invasions have dramatically changed the techniques used to manage agriculture and the way I farm. In addition, they have created effects that are costly and difficult to mitigate. While trying to re-establish native prairie grass and forbs, it was very difficult to eradicate the non-native species and establish a pure native stand. One day while combating the encroachment of non-native species on the farm, the question came to mind "Could a terrorist or adversary use invasive species on a grand scale to wreak havoc on America both psychologically and financially?" This strategic research project will attempt to answer this perplexing question.

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INVASIVE SPECIES – A THREAT TO THE HOMELAND?

Defending our Nation against its enemies is the first and fundamental commitment of the Federal Government. Today, that task has changed dramatically. Enemies in the past needed great armies and great industrial capabilities to endanger America. Now, shadowy networks of individuals can bring great chaos and suffering to our shores for less than it costs to purchase a single tank.

—President George W. Bush
National Security Strategy of the United States, September 2002

Prior to Sept 11, 2001, when American leaders prepared for war they envisioned operations using bombs, tanks, guns, military force and other traditional armaments as weapons used to engage an enemy. The attacks on that fateful day forever changed the way the United States and the world would view the nature of war. Using four hijacked commercial jet liners, terrorists attacked the continental United States, killing over 3,000 men and women. This surprise attack was not a symmetric attack, but rather an asymmetric one. Furthermore, a non-state entity, such as the Al Qaeda terrorist organization conducted such an attack at a relatively low cost of under \$500,000.¹ However, this was just the beginning. The success of the attack, and the devastation inflicted on the nation at a relatively low cost will inspire our adversaries to continue their plans to employ asymmetric methods to threaten and weaken the United States. One of these methods could be the introduction of an invasive species. This paper will determine if invasive species are a threat to the United States and if the National Invasive Species Management Plan adequately prepares the United States for such an attack.

DEFINING TERMS

In order to determine whether an invasive species is a potential threat to the National Security of the United States, two terms must be clearly defined - invasive species, and asymmetric threats.

First, what is an invasive species? Presidential Executive Order 13112 defines invasive species “As a species that is 1) non-native (or alien) to the ecosystem under consideration **and** 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.”² An invasive species can be a microbe, plant, animal, or other organism. These invaders are typically moved from their natural habitat and introduced to a new environment both purposefully and by accident. The simple act of moving a non-indigenous species to a new habitat does not make it invasive. For centuries people have moved species around the world for agricultural and other purposes. Examples of non-invasive species are

numerous; they could be livestock and grain crops used for food or ornamental plants used in gardens. The majority of these species are non-threatening and benign, but some species can be threatening because of their impact on their new environment. Their introduction may threaten the natural balance in the ecosystem because of their competitive nature, may threaten human and agricultural plant and animal health, and may cause economic damage through the cost of controlling or managing the species. These threatening species are “invasive species.”

The purposeful introduction of invasive species poses an asymmetric threat. Although there is not a definition of an “asymmetric threat” in the Joint Manual for Terms and Definitions, the military refers to such threats in several places. Army Field Manual 3.0 states that “Asymmetry concerns dissimilarities in organization, equipment, doctrine, capabilities, and values between other armed forces...engagements are symmetric if forces, technologies and weapons are similar; they are asymmetric if forces, technologies, and weapons are different, or if a resort to terrorism and rejection of more conventional rules of engagement are the norm.”³ In addition, the Air Force has defined asymmetry a bit differently in its unclassified report on exercise STRATEGIC FORCE 96: “Symmetrical battles have classically pitted steel against steel in slow wars of attrition. Asymmetrical warfare departs from this thinking. Asymmetrical warfare avoids traditional force-on-force battles. Asymmetrical warfare favors pitting your strength against an enemy’s weakness in a non-traditional and sometimes unconventional manner.”⁴ Lastly, Joint Vision 2020 notes that such attacks pose a major threat to U.S. security: “The potential of such asymmetric approaches is perhaps the most serious danger the United States faces in the immediate future...the focus on the development of niche capabilities will increase. By developing and using approaches that avoid U.S. strengths and exploit potential vulnerabilities using significantly different methods of operation, adversaries will attempt to create conditions that effectively delay, deter, or counter the application of U.S. military capabilities.”⁵ Although all of these references to an asymmetric threat are applicable to define the purposeful introduction of an invasive species as a weapon, this paper will use the last definition.

According to this definition, the use of invasive species as a weapon would be an asymmetrical threat. An adversary could use an invasive species to attack the United States in an unconventional manner at a vulnerable seam or weak point to avoid the strength and military power of the United States.

BACKGROUND

Historically, the introduction of an invasive species has not been intentional, nor has it been the act of an adversary to weaken or attack the United States. Typically, invasive species were accidentally introduced when they were imported for ornamental purposes, escaped from captivity, or were carelessly released into the environment. Often invasive species arrived by means of ocean vessels' ballasts, or in pallets, produce, or plant nursery stock. Additionally, animals and other agricultural products have transported them to the United States.⁶

The new species flourish and rapidly expand as they typically have few or no natural enemies in their new environment. Parasites, pathogens, or predators that would inhibit or limit their spread are few or non-existent. In addition, the new environment often provides a better medium for growth and reproduction than its original surroundings.⁷ With these advantages, native species may find it difficult to compete and survive against a new more energetic and prolific neighbor.

A study by Cornell University estimated that approximately 50,000 foreign species have invaded the United States since the 1700's and the number in the last 30 years has increased at an alarming rate.⁸ Ten to fifteen percent of these foreign species are considered threatening or invasive. Their impact ranges from being a nuisance, to causing economic damage, health problems, and endangerment of native species; over forty-two percent of the "endangered" or "threatened" species are at risk because of invasive species.⁹ One hundred million acres of the entire United States are covered by invasive plants, and the rate of spread is 14 percent per year - an area twice the size of Delaware.¹⁰ Since 1985, The United States Department of Agricultural Animal and Plant Health Inspection Service (APHIS) has intercepted 7,400 species of plant pests at our country's borders.¹¹ The U.S. Department of Transportation estimates that every day 4600 acres of land are colonized by invasive species in the United States.¹² Every 60 seconds, oceangoing vessels release 40,000 gallons of foreign ballast water in American waters, releasing invasive species into U.S. waters.¹³

HISTORICAL EXAMPLES

History is full of examples of invasive species and their impact on their new parent environment. A few of these examples include the invasion of multiple species in San Francisco Bay, the hydrilla, the glassy winged sharp shooter, "foot and mouth" disease (Aphthovirus) and the brown tree snake.

The San Francisco Bay plays an important role in American commerce. Many ocean-going vessels bring in foreign goods through the Bay's ports to trade with the United States. In

addition to bringing in foreign goods, these transports also inadvertently bring in foreign invasive species; the Bay is invaded by a new species on an average of once every 12 weeks.¹⁴ The San Francisco Bay alone is now home to over 240 non-indigenous species¹⁵ (See figure1). In some areas of the Bay it is difficult to find a native organism.¹⁶ In October 1986, three small clams were collected from the bay by a college biology class and later identified as a foreign species from Asia, the Asian species *Potamocorbula amurinsis*. In 1996, this species reached densities of 50,000 clams per square meter, a density that filters the entire water in the bay at least once and up to two times a day. These prolific clams virtually eliminated phytoplankton, the base of the food chain in the Bay. Although the final effects have yet to be determined, this disruption in the food chain can only be detrimental.¹⁷ Figure 1 graphically depicts the invasion of species into the bay by period. In the period between 1940 to 1969 the Bay saw a doubling of the number of entering invasive species. In the period 1970 to 1995 the increase jumped to almost a five fold increase.

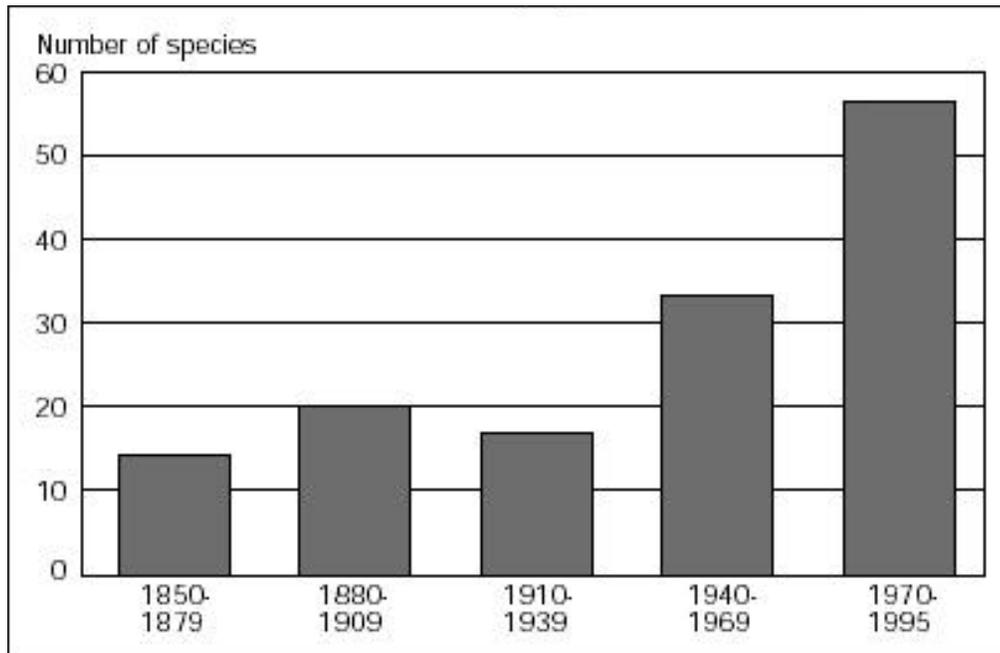


FIGURE 1 INVASION INTO THE SAN FRANCISCO BAY BY PERIOD¹⁸

A second example of an invasive species posing challenges to the environment is the spread of hydrilla in Florida and other states. Hydrilla is an extremely prolific aquatic weed native to Asia. It interferes with water usage, displaces native species, disrupts water

ecosystems, impedes water flow in canals, and plugs water pumps. The weed was first discovered in the United States in Florida in 1960, but early detection and extermination did not occur before the weed became established. Hydrilla spread rapidly from its first appearance in Florida; we still do not know how far north it may spread. Total eradication of the species is no longer feasible at this point of its spread and establishment. Government agencies, landowners and others are using aquatic herbicides to control its spread but the cost has been high. The economic cost to control hydrilla is 14.5 million dollars annually in Florida alone. An economic study of Lake Orange in Florida indicated the loss of tourism and declining real estate values around the infested lake will cost almost 11 million dollars annually if hydrilla are allowed to grow uncontrolled.¹⁹

The third example is the glassy winged sharpshooter, an invasive insect that hosts the bacterium *Xylella Fastidiosa*. The insect was first detected in California in 1990. Although it is uncertain how it arrived in California, it is believed to have arrived on plants imported from an infected area. The bacterium *Xylella Fastidiosa* causes Pierce's Disease in grapes, which infects and kills the grape vine. The glassy winged sharpshooter transmits and spreads the disease when it feeds on the plant. Severe outbreaks of the disease necessitated destruction of diseased plants and a major replanting of grape vines, resulting in a reduction in grape production.²⁰ Tourism and grape-related industries are collectively worth 35 billion dollars in California. The bacteria-carrying insect has cost a 40 million dollar overall loss in the grape, wine and raisin industry and an undisclosed amount in the tourism industry.²¹

A fourth example is foot and mouth disease (aphthovirus), a highly infectious disease that infects cloven-hoofed animals. The disease struck Britain in 2001 with a vengeance, killing over a thousand livestock,²² with millions more voluntarily killed or destroyed to prevent the spread of the disease²³. Furthermore, to prevent the disease from spreading from Great Britain the European Union placed an embargo on British meat. In turn, the United States placed a temporary ban on meat imports from the entire European Union and Chile. To control the spread of the disease in Britain, limits were placed on movement of people and equipment throughout the area. Overall, foot and mouth disease cost British companies 30 billion dollars, with a 300,000 dollar average loss to large businesses and a 75,000 dollar loss to small businesses.²⁴

A last and very serious example of the impact of invasive species is the accidental introduction of the brown tree snake into Guam. The brown tree snake was probably introduced into Guam during World War II by military ships arriving from the South Pacific. Its introduction resulted in 1200 incidents of power outages and the extinction of several native species

including 10 of the 13 native bird species, 2 of the 3 bat native species, and 6 of the 12 native lizard species.²⁵ The snake is indeed a public nuisance; it has spread across the island at a rapid rate and achieved densities of 12,000 snakes per square mile.²⁶ The snakes are very aggressive and have been reported to attack small children while they sleep. One in every thousand visits to the emergency room is the result of snakebite from the slightly venomous snake. As a result, Guam, which was once a popular tourist site has lost the majority of its tourism. Prior to the brown tree snakes' invasion, tourism ranked third as a revenue source, surpassed only by Federal government and military expenditures. Transportation and shipping have slowed to ensure no further spread of the snake. Healthcare costs on the island have risen due to snakebites. The snake has deeply affected agriculture, where production and revenues have steadily declined since the snake was introduced in 1945. The snakes' predation pressure on both live animals and eggs makes it almost impossible to raise poultry. Insect species that were formerly controlled by species eliminated by the brown tree snake are now damaging fruits and vegetables. Increased insect populations demand more pesticides, which increases costs of agricultural production. Direct damages in losses of overall productivity in the country are estimated at between one to four million dollars per year, with estimated research and control costs of the brown tree snake at four million dollars.²⁷ In all, the introduction of the brown tree snake had a more negative ecological impact on the island of Guam than all of the heavy fighting and naval bombardment that leveled the island's forests in World War II. The island ecology recovered from World War II with time, but time offers no chance for recovery of the extinct species lost to the brown tree snake.²⁸

There are many more examples of invasive species. Citing all the examples of invasive species and the damage they cause is beyond the scope of this paper. Our country's history and the world are full of these examples. Consider the Bubonic plague, an invasive highly infectious disease that struck the European continent in the 14th century and killed a large portion of the European population or the current problem with leafy spurge, an invasive plant that causes an estimated 100 million dollars damage in the Great Plains states.²⁹ The economic, psychological, environmental, agricultural, and human health costs have been high. These are just a very few examples of the destructive potential of invasive species accidentally introduced to a new environment; it is just the tip of the iceberg of what could happen if destructive invasive species were purposefully introduced.

REASON FOR AN ATTACK

Since the United States has been colonized and continues to be colonized by invasive species, why would an adversary - state, non-state, or terrorist - use an invasive species or combination thereof as an option to threaten the national security of the United States?

The answer lies in the overwhelming impact an invasive species would have on the United States. An adversary would use invasive species as an asymmetric method of attack to weaken the country through inflicting tremendous economic and psychological damage. Such an attack could ultimately weaken the will of the people and affect national policy by straining the economy, tainting America's food supply, or endangering the health of the populace. In addition, adversaries could strike a strong blow while avoiding a symmetric retaliation and weaken the United States while achieving a more long-term equitable political, economic, and military balance of power. The United States is the world's only true superpower. In fact the United States is so dominating that it is often referred to as a "Hyper-power" by Europeans.³⁰ To attack the United States directly in a symmetric manner would defy logic and result in rapid destruction of a weaker adversary.

Currently, the United States military is going through a revolution in military affairs. It is striving to expand its current superior capabilities through state-of-the-art technology and advanced information systems. If this is successful and the trend continues, only a few adversaries will be willing to commit the resources necessary to build a force that is a symmetric peer competitor of the United States. Yet an adversary's attack could delay the United States' revolution of military affairs, transformation of military forces, and build up of military and national power. This could allow an adversary the opportunity for a build up of its own, to allow a direct, symmetric confrontation over time when force correlation and balance of military strength would be more favorable. A successful attack would also provide a more favorable condition or position for an adversary to negotiate for given desired goals.

Therefore, to compete with or challenge the United States as the world's "hyper power," it is only logical to employ asymmetric methods. An asymmetric adversary would attack at the weak point or a seam in the United States' defense in an unanticipated way. A frontal symmetric attack against the United States would only be met with overwhelming American military power and ultimate defeat.

TERRORIST PURPOSE

Terrorists have other reasons for using invasive species. Traditionally, terrorists have used violence and fear as a means of political coercion to "undermine the legitimacy of the

targeted government and garner support among a disaffected populace.” Other non-political objectives include millennial or anarchical objectives, such as using “indiscriminate violence to create a general environment of fear and chaos prior to a general overthrow of Western political order or. . . even simply seek anarchy as a goal.” An example of this is the subway sarin attack by the Aum Shinrikyo group in Japan, who took no credit for the attack.³¹ Yet a new reason for terrorists’ use of an invasive species includes the new “war paradigm.”³² Paradigmatic theorists assert that since terrorist groups typically lack the ability to confront their adversary directly, they will take a more indirect, less confrontational approach to conducting terrorist acts. This long-term approach does not advance specific demands but intends to inflict damage to wear down an adversary over time. Consider the strategy of Osama Bin Laden and the Al Qaeda organization. The bombings in the 1990’s of the World Trade Center, of the embassies in Nairobi and Dar-es-Salaam, and of U.S. military forces at the Khobar Towers exemplify this protracted war paradigm.³³ They are not isolated events. Rather, they are a coordinated series of attacks designed to confuse, disrupt, and demoralize the U. S. government and its citizens over time.

Invasive species could be used to support all three of these terrorist motives. Fast-spreading invasive species such as small pox and other microbes that threaten human health or food safety directly support the terrorist motive of violence and fear to undermine the legitimacy of government or to support anarchical objectives. However, most other invasive species support the latter “protracted war” paradigm. Most are slower in their effects and require some time to cause damage. However, such a slower, covert attack might go undetected for years until the species are well implanted and impossible to counter. As such, long term economic, health, and psychological effects of using invasive species could serve to strike a tremendous blow at the United States by exhausting resources and national will over time.

POTENTIAL EFFECTS

One of the primary effects of the introduction of an invasive species by an adversary would be economic. Cornell University estimated the cost of invasive species to be 138 billion dollars annually in their effects and control in the United States.³⁴ This is over one-third of the funding allocated to the total military budget in the 2003 National Defense Authorization Act. As depicted in the charts below from the Congressional Budget Office, the discretionary spending for defense as a percentage of the total GDP has been decreasing from 1962 to 2001. Domestic needs are competing heavily for tax dollars. Given the drastic increases in spending

for Social Security, Medicare, and Medicaid, expenditures for national defenses will undoubtedly be constrained.

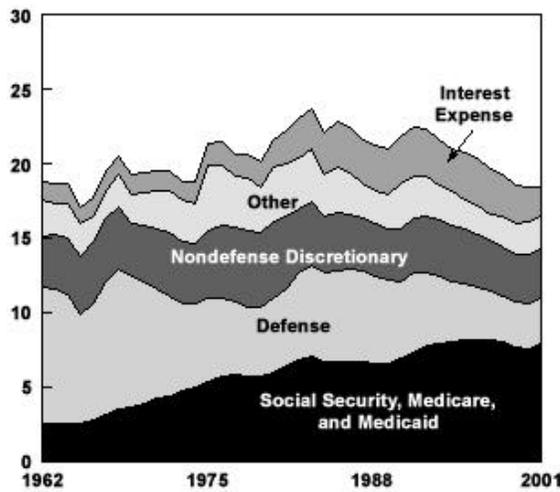


FIGURE 3. DISCRETIONARY SPENDING
SOURCE: CONGRESSIONAL BUDGET OFFICE (CBO)

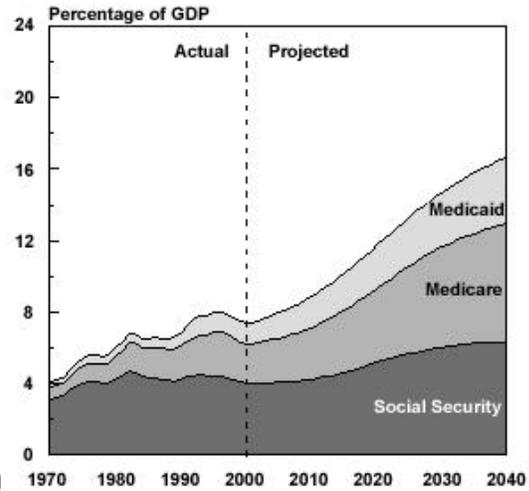


FIGURE 2. SPENDING FOR SOCIAL SECURITY, MEDICARE, AND MEDICAID UNDER CBO'S MIDRANGE ASSUMPTIONS(1970-2040) SOURCE: CBO

If an adversary chooses the right invasive species, the additional cost to counter its effects could be dramatic. Coupled with a depressed economy and a tight budget, it would be difficult to sustain funds to fully man and equip necessary forces at current levels. It would be extremely difficult to man and equip costly transformation forces. Therefore the second or third order effect of an invasive species would mean less money for discretionary spending and ultimately a weakened military.

Second, military resources would also be diverted to support the emerging crisis. Military forces would be used to cordon off infested areas or assist in caring for the sick from an invasive bacteria or virus. Consider an outbreak of Ebola or Small Pox. National Guard forces would be diverted for homeland security missions and thus not be available for small-scale contingencies or major regional wars. Military forces would also suffer direct casualties from an invasive species attack, as the same invasive microbes that attack the civilian population would attack military personnel. Whole Army divisions and specialized units could be rendered physically ineffective from an invasive disease. The ensuing psychological impact would be immense.

Third, invasive species would impact the industrial capability and productivity of the United States used to support a war. Resources used to mobilize the nation's industrial base would be diverted to control the effects of the invasive species. Personnel needed to support industry and augment military forces could be sick or unwilling to work in areas where they may be exposed to an infectious invasive species. Invasive species may directly attack natural resources used as raw material for industry such as timber, thereby forcing the United States to rely on imports or other alternatives for raw materials.

Fourth, illness and disease could be spread rampantly by an invasive disease. A biological attack of this type could begin with one infected person or the release of toxins in a highly populated area, such as a subway or a sports stadium. Victims would not initially know they were infected. The first victims would report to their doctor with common flu-like complaints. The symptoms could easily be misdiagnosed. Even after suspicion of a deliberate attack, it would take time for the Center of Disease Control (based in Atlanta) to identify the agent. Meanwhile, the contagious disease would spread leading to widespread illness. Critical community services, where available, would be strained. Officials would consider quarantining affected communities. But quarantines are very difficult if not impossible to enforce on a large scale. In the end the disease would spread in epidemic proportions.³⁵ Health care costs for an invasive contagious disease would be phenomenal. The health care system - in terms of its capacity to handle patients and monies to support the health care needs - would be greatly stressed. The cost of providing such massive care would eventually be placed on the consumer, further straining the economy.

Fifth, the agricultural sector and a reliable food supply could be deeply affected. Recently, a U.S. government report asserted that the "U.S. agricultural sector is especially vulnerable to agro terrorism....and a successful attack could result in local or regional economic destabilization," ultimately affecting international commerce.³⁶ Citizens have come to expect a safe and cheap food supply. Although American agriculture is diverse and spread over many states, large portions of it are concentrated in local areas. The top five agricultural states account for 34 percent of the nation's total agricultural production. Some crops are far more concentrated in regions than others. California leads this concentration with 100 percent of the almonds, 92.2 percent of the grapes, 77.8 percent of the lettuce, 75.5 percent of the strawberries, 47 percent of the tomatoes, and 33.8 percent of the oranges. Such concentrations can be further localized. Forty-one percent of California's strawberry production, which is seventy-five percent of the nation's strawberry production, is concentrated in two contiguous counties. Seventy percent of the cattle production is concentrated in a 200-mile radius. This

concentration makes our agricultural assets especially vulnerable to an attack by an invasive species.³⁷

The cost to agriculture from the introduction of one or several invasive species would be difficult to predict. The invasion would not only affect the producer, but the entire producer/consumer chain, from the grower and those employed in agriculture related fields, through packagers and distributors, and ultimately the consumer. In 1999, farming and its related industries accounted for 16 percent of the U.S. gross national product (GDP). In the same year agriculture employed 17 percent of the U.S. work force or 24 million people.³⁸ In 1997 in the United States, farmers sold 208 billion dollars of agricultural products.³⁹ The amount of economic damage from an invasive species attack would vary considerably depending on the extent of infestation, the crops or livestock effected, the response, and the ability to counter, contain or destroy the species. Effects would be dependent on availability of substitute products and the elasticity of supply, or the ability to ramp up production elsewhere.⁴⁰

Last but certainly not least, as joint Vision 2020 notes there would be psychological or political costs to the introduction of an invasive species: "The psychological impact of an attack might far outweigh the actual physical damage inflicted."⁴¹ The apparent inability of the government of the United States to protect its people and resources would have severe detrimental effects on the social contract between government and those governed. The government would loose credibility, with a resulting loss of confidence and productivity from its citizens.⁴² Historically, consumer confidence has been the objective of attacks on agriculture.⁴³ For example, in 1989, a previously unknown group called the Breeders threatened to spread the Medfly to damage crops in California if the state did not stop aerial spraying of pesticides. Although no one was caught or prosecuted, that season's dense Medfly population confirmed that a deliberate infestation was being conducted. Although their "attack" may not have been successful, the Breeders attracted much publicity by destroying crops and reducing consumer confidence.⁴⁴

Another example is the West Nile Virus. It was first detected in 1999 in the state of New York. In 2000 it spread up and down the East Coast. In 2001, it spread north and further into the central part of the United States. In 2002, it was reported in 32 states, Canada, and is suspected to be in Mexico. As of September 2002 there have been 1,965 West Nile cases resulting in 94 deaths.⁴⁵ It is a non native species and it is not known how it was introduced into the United States. As the number of cases and deaths continue to increase and further affect public health and possibly our blood supply, it is uncertain what psychological effects will result and what effects it will have on everyday life. Will an elderly person who is not in the good

health risk outdoor activity? If it was determined the introduction of West Nile virus was intentional, would it be wise to inform the public? The answer to these questions is clear: West Nile virus will definitely have a psychological effect on the populace. If the disease goes unchecked, citizens will lose their confidence and trust in the government and its services. The elderly and the immune suppressed will change their lifestyles and reduce outdoor activity. The government would have to seriously consider informing the public if West Nile Virus was known to be released intentionally. Announcement of an intentional infestation could spread panic, fear, lack of trust in the government and its services and in turn support the goals of the perpetrator.⁴⁶

An invasive species coupled with other forms of asymmetric warfare would have a synergistic effect. If an enemy focused on creating maximum economic impact and attacked along multiple, low profile paths, he would be more likely to generate overwhelming effects. Such an attack could include an invasive species coupled with a cyber attack, the use of weapons of mass destruction such as a “dirty bomb,” and the use of more standard terrorist bombing techniques. Likewise, invasive species could be coupled with more symmetric methods of conventional force on force warfare. This multiple attack would have a greater chance of destroying or severely damaging American national power. If two or more methods proved successful, the combined synergistic effect would be much greater, producing more physical and psychological damage.

PRODUCTION / PURPOSEFUL INTRODUCTION

Invasive species are relatively cheap and easy to produce and introduce into the environment. Large numbers need not be introduced – only enough to start a population base. Introduction at multiple locations in numbers large enough to begin colonization reduces the risk of detection or failure of one or two clusters to colonize and establish a population base for spread. Introduction in multiple locations also decreases the amount of time to establish and spread the invasive species to dangerous levels.

Most microbes can be easily produced. Kathleen Bailey, who interviewed pharmaceutical manufacturers, professors, and graduate students, concluded “Several biologists with only 10,000 dollars worth of equipment could produce a significant quantity of biological agents. The required site equipment would fit in a small room, and the glass ware, centrifuges, growth media, etc., can all be manufactured by virtually any country.”⁴⁷

Detection at American borders would be extremely difficult. The mere fact that billions of dollars of illegal drugs are smuggled into our country annually speaks for itself. Border

inspectors have difficulty finding unintentional smuggling violations, let alone detecting purposeful concealed smuggling of invasive species. Insects, plant seeds, or a vial of microbes could be easily hidden. Most likely, inspectors would not even know what to look for.

Once an invasive species is established it would be extremely difficult to discern who had implanted it unless the perpetrator or group claimed credit for the attack. In turn, it would be virtually impossible to track it to its source. If the United States could not identify who introduced the species, it would be difficult to counter or apply national power in retribution for such an attack. With all the accidental introduction of so many invasive species, how could we legitimately and credibly blame a suspected adversary? A current example is the West Nile Virus. No one knows how it was introduced to this country. Many, including the Center for Defense Information, suspect it was brought to the United States as a terrorist act.⁴⁸

Once an invasive species becomes established, it is very difficult if not impossible to exterminate it without a huge expenditure. Our history is replete with failures to control invasive species once they are established. The gypsy moth, zebra mussel, purple loosestrife, and Kudzu are just a few examples. The foot and mouth disease in England is an example of an invasive species being controlled, but at a high cost (30 billion dollars).⁴⁹ The Asian long horned beetle is another example. Thought to have been carried into this country in wooden pallets from China, it was detected in New York City and Chicago in 1996. The U.S. has been battling the beetle ever since. In 1996, the cost to control the beetle was 4 million dollars in New York alone. Total annual revenue from all New York related industries affected is 11 billion dollars, and the total for the affected U.S. industries is 138 billion dollars. Secretary of Agriculture Dan Glickman declared a states of emergency authorizing 5.5 million dollars to aid in the prevention, detection, control and eradication of the pest in 2001. Even with all this expenditure of effort and resources, the Asian long horned beetle has yet to be exterminated.⁵⁰

GENETIC ENGINEERING

Webster's Ninth New Collegiate Dictionary defines genetic engineering as "the directed alteration of genetic material by intervention in genetic processes." Adversaries of the United States may modify the genetics of an invasive species to increase its competitiveness, virulence, lethality, or resistance to control measures. Subtle changes in gene and DNA sequencings can have drastic effects on the characteristics of an organism.

Genetic engineering is a common practice in agriculture. Plants are engineered to be hardier, more chemical tolerant, and resistant to insects. For example, *Bacillus Thuringiensis* or a bacterium commonly known as "Bt," is used as a natural insecticide. The toxin gene, which

makes it an effective insecticide, was identified by scientists and inserted into agricultural crops such as field corn to make it resistant to corn borers. When the corn borer ingests plant material, it dies from the toxic gene.⁵¹ Another example is Glyphosate, the active ingredient in Roundup herbicide. Glyphosate is a broad-spectrum herbicide used to kill most herbaceous plants. Microbiologists inserted a glyphosate resistant gene into corn, soybeans, and other agricultural crops. Farmers can liberally spray glyphosate and kill all other plants except the resistant variety. Inserting these same genes into an aggressive invasive plant would nullify many of the chemicals used to control unwanted plants and even make them resistant to some natural biologic insect controls – thereby making the invasive species a more lethal, fast-spreading asymmetric weapon. Another example is the laboratory mouse on display in the Smithsonian institute that scientists genetically modified to be susceptible to cancer. Scientists identified and inserted the gene to aid in the research of cancer. If scientists can modify the mouse's genetic make up, they can modify an invasive species to make it more competitive, resilient, or tailored for a particular need.

Adversaries with technological and scientific support could genetically modify all types of organisms. If the technology or the scientific support is not available, they could purchase or acquire them through the black market. Alastair Hay, an expert on biological warfare from the University of Leeds in the United Kingdom, debriefed defecting scientists from Biopreparat (a clandestine group of facilities spread across Russia and Kazakhstan). From these interviews, he believes genetically modified organisms currently exist. One of them is a form of the plague that is resistant to 16 different antibiotics.⁵² Stephen Block, a biophysicist at Stanford University and the leader of JASON (a study of a group of scientists hired by the U.S. government for technical advice), commenting on the possibilities of genetic engineering observed that “if you put a bunch of biologists in a room and asked them to brainstorm, you'd come up with countless possibilities.”⁵³

In the wrong hands, genetic engineering technology applied to an already competitive or virulent invasive species would make control methods difficult, if not impossible. New methods of control would have to be developed, tested, and fielded to control the genetically modified organism. Serums would be less effective, and diagnosis of human pathogens could change and become harder to recognize. It would take a considerable amount of time to isolate, test, and determine what control or treatment methods are necessary to battle the organism.⁵⁴ Additionally, production and distribution of counter mechanisms in large numbers would take significant time and resources.

HYPOTHETICAL ATTACK

What would an attack from an invasive species or a group of invasive species look like? What effects might it have? There are many possibilities, but let's consider one hypothetical example:

The year is 2025. America remains a strong military power, but her national power is waning. Adversaries of the United States have subversively smuggled invasive species into the country and attacked her in the first years of the 21st century. The attacks were designed to weaken the United States and stifle her influence around the world. The instrument or method of attack was the introduction and establishment of invasive species which would disrupt the United States economy and weaken American will. Asian long-horned beetles have decimated the American forests and severely weakened the related 138 billion dollar industry.⁵⁵ The brown tree snake was introduced in Hawaii and the population is rapidly growing nearing densities of 12,000 per square mile, as was seen in Guam in 2002.⁵⁶ Hawaii's tourist industry and economy are faltering. American agriculture and its food supply are in jeopardy. Foot and mouth disease has killed many livestock, and hundreds of thousands of livestock were destroyed before the disease could be contained. Most countries have banned American exports of meat due to concerns about the spread of disease. Similar problems occurred in the grain industry after a contagious rust was identified on summer and winter wheat. West Nile virus deaths continue to rise. A "small" outbreak of small pox left 5 million dead, requiring vaccination for the remainder of the population and further stressing the health care system. No country or organization takes credit for the attacks, nor has the United States been able to determine who or what organization is responsible. The American economy is in a full depression. America has shifted what little discretionary funds remain in the federal budget away from defense spending. The military has abandoned its revolution of military affairs to maintain current military strength and programs. Adversaries are rapidly approaching parity in military strength and should surpass America's strength in the near future. America's national security is gravely threatened.

GOVERNMENTAL PROTECTIONS UNDER EXECUTIVE ORDER 13112

This distressing scenario indicates that the detrimental effects of invasive species are potentially insurmountable. Local governments, state governments, environmental groups, farmers, ranchers and scientists collectively have urged the federal government to coordinate the effort and make invasive species control a priority issue. In response to this pressure in 1999, President Clinton issued Executive Order 13112 on invasive species.⁵⁷ It was designed to coordinate and enhance Federal activities "to prevent the introduction of invasive species and

provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.”⁵⁸

Executive Order 13112 established The National Invasive Species Council, with members from eight Federal departments: Secretary of State, the Secretary of the Treasury, the Secretary of Defense, the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Transportation, and the Administrator of the Environmental Protection Agency.⁵⁹ The purpose of the National Invasive Species Council is to prepare and oversee a “National Invasive Species Management Plan,” which would detail the requirements, goals, objectives, and efforts of involved Federal agencies.⁶⁰ Additionally, the Council was established to “provide national leadership on invasive species; see that their Federal efforts are coordinated and effective; promote action at local, State, tribal and ecosystem levels; identify recommendations for international cooperation; facilitate a coordinated network to document and monitor invasive species for Federal agencies to use in implementing the National Environmental Policy Act; and prepare the plan.”⁶¹

NATIONAL INVASIVE SPECIES COUNCIL MANAGEMENT PLAN

The National Invasive Species Council developed a national management plan within the 18-month period set by the executive order. The plan identified nine interrelated and equally important areas of concern for addressing invasive species issues and countering their potentially devastating spread; the coordinated activities emanating from these areas thus comprises the defense of the United States against attacking invasive species.

LEADERSHIP AND COORDINATION

The Council is directed by the executive order to provide national leadership on invasive species issues and problems. The Council is authorized to draw on various groups and existing organizations for expertise. It is required to ensure that actions are coordinated and that working partnerships are developed between the Federal, State, regional, and local agencies. Currently over 20 agencies share responsibility for various aspects of invasive species management.⁶² Specifically, the Council serves as an oversight mechanism - reporting procedures; addressing jurisdictional and legal regulatory issues; managing budgets and resources; and overseeing implementation of the overall plan.⁶³

In response to this Directive, the Council assumed the leadership and coordination role. Itl conducted extensive consultations with individuals, groups, and organizations with differing interests and goals. It conducted public listening sessions across the country and established a

set of Guiding Principles recommended by the Advisory Committee. As a result, the council developed the National Invasive Species Plan, which included timelines and a general blueprint for actions to deal with threats posed by invasive species.⁶⁴

Leadership and coordination has been a major challenge in coordinating 20 agencies and the efforts of Federal, State, and local authorities. The National Invasive Species Plan made a good start by establishing leadership and effecting coordination, but it requires ongoing refinement. The Department of Homeland Security as well as the Department of Health should be incorporated into the Invasive Species Council for adequate greater coordination of efforts. It is not clear how the council will interface or support the new Department of Homeland Security. Will the new Department of Homeland Security participate in the Council with the other Departments? Or will the Department of Homeland Security assume executive authority over the Council? Will the Department of Homeland Security then take a leadership role? The answers to these questions have yet to be determined and are not yet on the Department of Homeland Security agenda.

PREVENTION / RESEARCH

The National Management Plan for Invasive Species identifies prevention as the first line of defense in combating this threat. Prevention is also the most cost-effective approach. Executive Order 13112 mandates a risk-based approach that considers the degree of harm an invasive species would cause and the likelihood of its establishment and spread. The National Management Plan calls for timely screening and evaluation of any proposed intentionally introduced species. This process will identify and interdict the method or pathway of introduction. Threats will be ranked according to impact. Mechanisms to minimize the introduction and movement of invasive species will be proposed. A risk assessment will be made for both intentional and accidental introductions.⁶⁵ Research is also necessary to support each phase of the National Management Plan. Federal agencies should push down to the lowest level research results, so all parties can effectively join in the fight and prevent introductions of invasive species.⁶⁶

The Invasive Species Counsel is currently in the process of implementing these recommendations. In December 2003, the Council will produce a screening system for evaluating the first-time intentional introduction of an invasive species. The Council also offers guidance and suspense dates in the Invasive Species Management Plan for federal agencies to interdict pathways of non-intentional introductions. It is currently finalizing a risk assessment

program to assess risks and implement a system to evaluate its effectiveness.⁶⁷ Finally, it proposed a budget to adequately fund Federal invasive species research programs.⁶⁸

Protection of agriculture appears to be the primary focus of the Invasive Species Management Plan, rather than protection of the populace or prevention of introduction into natural areas.⁶⁹ The Animal and Plant Health Inspection Service (APHIS) and the Fish and Wildlife Service are dedicated to strengthening inspection services at points of entry, but they are constrained by limited resources and budget shortfalls.⁷⁰ The plan cites invasive pathogens that affect human health, but does not fully address the problem or propose coordination with the Center for Disease Control. In fact, the Department of Health is not represented on the Council, indicating that the Management Plan is not currently addressing terrorist threats.

EARLY DETECTION AND RAPID RESPONSE

Critical to the success of eradicating or controlling an invasive species is rapid response following early detection. Responding actively before the threat spreads increases the probability of success and reduces costs to control or eradicate the species. An example of a failure to respond rapidly and control an invasive species is the ruffe, a perch-like Eurasian fish. It colonized bays and tributaries along parts of Lake Superior in the early 1980s. A dispute over whether to use chemical controls among State, Federal, Canadian and other groups delayed response. This dispute allowed the ruffe to establish itself in significant numbers. Although subsequent control methods have slowed its spread, it is expected to reach the lower Great Lakes where its economic consequences could be devastating. The fishery industry in the Ohio Great Lakes alone is worth over 600 million a year.⁷¹

The National Management Plan has recommended draft legislation to the President in FY2003. This legislation will address rapid detection and response, obtain permanent funding in order to ensure detection and identification, and develop a program in close cooperation with all levels of government for a coordinated rapid response to invasions.⁷² The Council is developing a time line to implement these efforts. In January 2002 the integrated Taxonomic Information System (a database of scientists and experts) was implemented to identify sources of taxonomic expertise. In January 2003, the USDA, in consultation with other government agencies, will implement a program to develop new methods of detection for specific invasive species (to include those affecting public health) and institute systematic monitoring surveys to predict where introductions of invasive species are most likely to occur. In July 2003, the Council will propose a program for a rapid response to an invasive species; the program will coordinate efforts at all government levels, from local to Federal.⁷³

Currently, no comprehensive collective national system is in place to detect and respond to all types of invasive species. A single, unified, and integrated system is needed to greatly enhance early detection and response; a single system would as well provide integration and coordination.⁷⁴ The National Management Plan identified insufficient resources, inadequate planning, jurisdictional issues, insufficient resources and authorities, limited technology, and other factors to account for lack of early detection and rapid response.⁷⁵ Officials from the Departments of Agriculture, Interior, Commerce and Defense concurred with that rapid response needs are not being met.⁷⁶ The lack of sufficient detection systems is severely hindering rapid response. Many species are difficult to detect or even recognize as invasive species.

CONTROL, MANAGEMENT, AND RESTORATION

Where invasive species are permanently established and eradication is not feasible, control and management may provide the only option. The goal of control is to limit spread, suppress the population, and reduce its effects. Methods vary, but integrated pest management that considers environmental factors and examines all available information, methods, and technology, to determine the best approach for control is generally used. Methods include mechanical removal, physical restraints (such as fencing), and release of biological control agents, pesticides, and cultural practices. In addition, Executive Order 13112 requires restoration of native species; if restoration does not occur, a new invasive species may colonize the area or the area may be re-infested by the original invader.

The National Management Plan responds to this requirement by seeking legislation to acquire additional resources to support control, management and restoration projects to manage invasive species. It proposes sanitation and exclusion methods to prevent spread of invasive species, to prioritize invasive species control projects, and to develop a proposal for the acceleration of the development of biological controls and chemical controls to manage or control the spread of invasive species. Finally, it recommends guidelines and monitoring requirements for restoring native species.⁷⁷

Since February 2002, the Council has identified and adopted exclusion and sanitation methods for preventing the spread of invasive species. This has been only moderately successful in containing the continued spread of invasive species within the United States. As stated earlier, the rate of spread is 14 percent a year and it does not appear to be slowing.⁷⁸ Managing and controlling invasive species, as well as restoring native species, requires a

tremendous amount of resources. Since such resources have not been provided, there has been minimal progress in preventing the spread of invasive species, if any.

INTERNATIONAL COOPERATION, INFORMATION MANAGEMENT, EDUCATION AND PUBLIC AWARENESS

Efforts to adequately address and prevent the spread of invasive species must include international cooperation. After all, if a species is not allowed to leave its native country, it can not become an invasive species. Efforts of other countries to manage and prevent the export of invasive species at their borders greatly enhances our ability to protect ourselves from invasive species. Information on invasive species must be readily available and communicated at all international levels. Executive Order 13112 directs the Council to develop a system for up-to-date information sharing. The Council further identified the need for training and education programs. Awareness and understanding of species and ways to prevent invasions critically enhance early reporting and identification.

The National Management Plan's proposes international agreements as part of future trade agreements and strengthening existing agreements among nations trading with the United States. This proposal should include the future Free Trade Area of the Americas agreement that is scheduled for completion in 2005. In January 2001, the Council began information-sharing in workshops with foreign countries to promote environmentally sound control and management practices for controlling invasive species. They also began sponsoring technical assistance workshops in other countries.⁷⁹ A website to consolidate and disseminate available data on invasive species was developed with links to government databases to assist relevant agencies and to enhance public awareness.⁸⁰

The Council has implemented programs for international cooperation, information management, education and public awareness, but it is too early to reliably evaluate the council's effectiveness in this area. The web site at www.invasivespecies.gov provides a wealth of information and technical support in combating invasive species. As with all other areas of this plan, it must be adequately funded to remain effective.

ASSESSMENT / EVALUATION

Executive Order 13112 makes an excellent start toward development of a much-needed national plan for invasive species control. The establishment of the Invasive Species Council's National Management Plan continue the move into the right direction. Despite this good start, we have a long way to go. Al Qaeda terrorists are currently threatening the United States and could be introducing invasive species at this moment to weaken the United States.

First we must prepare for the purposeful introduction of invasive species. The National Invasive Species Management Plan and the Government Accounting Office's Report to Congress do not currently consider the intentional introduction of an invasive species as a security threat. Identification of all asymmetric threats and pathways must be anticipated in order to defend the U.S. homeland, to include an adversary's use of invasive species. Potential pathways must be identified and analyzed in the Council's prioritizing of invasive species problems. Adversaries may choose pathways or methods of introduction that are considerably different from those that facilitate accidental introductions.

Second the plan conveys no sense of urgency. The management plan is not being implemented fast enough, particularly to counter a known hostile threat. The Plan's time line should be accelerated to quickly mobilize resources and efforts of all agencies involved. As with any new Plan, deficiencies surface and problems arise during implementation. The Plan was issued in 2001, and many of the proposed programs have yet to be implemented. The sooner the plan is fully implemented, the sooner its deficiencies and problems can be identified and fixed. Rapid identification and response is critical to success in controlling invasive species. If the Plan is not fully implemented, invasive species may become established and spread before proposals to control them are fully implemented.

A third deficiency of the Plan is the development and implementation of a comprehensive national system for detecting all types of invasive species infestations and responding to them. All levels of government, national through local, must work together under one national system to adequately detect and combat invasive species and protect the homeland. Both the GAO report and the National Invasive Species Management Plan identify this weakness. According to the GAO report this "system could provide (1) integrated planning to encourage partnerships, coordinate funding, and develop response priorities; (2) technical assistance and other resources; and (3) guidance on effective response measures."⁸¹ The Invasive Species Council's Management Plan adequately identified this need, thereby recommending that by July 2003 the development of a program of coordinated rapid response and support. Again, this is a slow process, with nothing currently produced. The Center For Disease Control's reaction plan to an invasive disease dangerous to human health offers a good model plan for responding to invasive species. The plan indicates that insufficient resources, lack of funding, jurisdictional issues, limited technology and other factors are the prominent reasons for lack of a national system.⁸²

The fourth deficiency is rapid response. Officials from the USDA, Interior, Commerce, and Defense have reported: "rapid response needs have not been and are not being adequately

met.”⁸³ Reasons for this include lack of resources, lack of attention to the problem, not detecting infestations in their early stages of spread, insufficient understanding about the potential risk, and lack of technology to thwart the colonization of the invasive species. In addition, the nation needs a systematic national approach with criteria to determine when a rapid, crisis response is needed. Many agencies stated they did not know when or what criteria to use when requesting a rapid response. Rapid response criteria should be based on a fair risk analysis. Currently, responses to invasive species on agricultural land receive a higher priority than on non-agricultural land or native areas. This may not be the right priority for a terrorist attack on a city. Rapid response decisions should be based on common risk criteria, and these risks should include intentional introductions of invasive species.⁸⁴

Adequate funding is currently unavailable for an aggressive invasive species program. Implementing the strategies identified in the Invasive Species National Management Plan will be costly. In fiscal year 2000 the total expenditure of the federal government on invasive species-related activities was over 611 million dollars. The U.S. Department of Agriculture (USDA) spent over 556 million dollars – 90 percent of the total Federal outlay to fight invasive species. The Department of Interior spent over \$30 million, and the Department of Defense spent over 12 million dollars.⁸⁵ Of the 611 million dollars budgeted, rapid response costs were less than one-quarter, resourced at 148.7 million dollars. This is not adequate.⁸⁶ More monies are necessary to support the Plan. If the Federal government cannot handle the monetary burden then it needs to be shifted to the State and local level. An official from the Bureau of Land Management aptly observed, “You can pay now or later, but you will eventually pay sometime.”⁸⁷

The Invasive Species Management Plan does not address invasive pathogens that affect human health. However, invasive human pathogens fall under the Presidential Executive Order 13112 definition of an invasive species; it should be included in the Management Plan. The Center for Disease Control currently responds to the introduction of invasive human pathogens, but its efforts are not integrated into the Invasive Species Management Plan. Nor is the Department of Health or the Center for Disease Control represented on the Council. The plan simply does not include all of the needed agencies.

Last, the Department of Homeland Security must be integrated into the Council and assume the lead agency role in the Council. Although the Department of Homeland Security is very new, the Executive Order must be amended to add the Department of Homeland Security as a full member. Invasive species management is a homeland security issue. The new Department must lead the Council's efforts to integrate inspection, detection, prevention and

crisis response capabilities across government agencies. Invasive Species management should be embedded into the Homeland Security Strategy mission.

RECOMMENDATION / CONCLUSION

An adversary's purposeful introduction of invasive species into the United States presents a potential devastating threat. Currently, the United States is not adequately prepared for such an attack. The Invasive Species Management Plan is designed more to protect U.S. Agriculture from accidental introductions of invasive species than to counter intentional, hostile introductions. To better protect the United States from an attack, we need to prepare now. Recommendations to improve protection from an adversary's use of invasive species must include timely national identification of the employment of an invasive species as a potential weapon and appropriate planning and preparation to counter its use as a weapon. Additionally, the Federal government must speed up the process for full implementation of the Council's Plan to fully implement a comprehensive national system for management and control of this potential threat. The Council must develop and implement criteria for rapid response based on risk correlation. The Plan should be fully resourced and actively supported at an accelerated pace. Mitigation measures should include invasive human pathogens as part of the Management Plan; the Department of Health and Department of Homeland Defense should participate on the National Invasive Species Council. Finally, invasive species protection and management must become a key part of the Homeland Security Strategy.

Despite the U.S. status and strength as a superpower, the United States was tragically vulnerable to attack on September 11, 2001. It came not from cruise missiles, ballistic missiles, bombing, or other conventional weapons - but from an unconventional asymmetric attack. Today, the Homeland is vulnerable to a different type of asymmetric attack, a biological attack from invasive species. We must act now by strengthening our defenses to protect ourselves...Our future and our children's future depend on it.

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⁵⁸ “Executive Order 13112, Invasive Species,” 3 February 1999; available from <<http://ceq.eh.doe.gov/nepa/regs/eos/eo13112.htm>>; Internet; accessed 30 December 2002.

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⁶⁰ United States Department of Agriculture-Animal and Plant Health Inspection Service.

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⁶³ Management Plan, 3, 4.

⁶⁴ Ibid, 15.

⁶⁵ Ibid, 4, 5.

⁶⁶ Ibid, 8.

⁶⁷ Ibid, 33, 34.

⁶⁸ Ibid, 8.

⁶⁹ Ibid, 19.

⁷⁰ Ibid, 32.

⁷¹ General Accounting Office, 18, 19.

⁷² Management Plan, 5.

⁷³ Ibid, 36.

⁷⁴ General Accounting Office, 20.

⁷⁵ Ibid, 18, 19.

⁷⁶ Ibid, 17.

⁷⁷ Ibid, 5-7.

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⁸⁰ Ibid.7,9.

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⁸⁴ Ibid, 27-34.

⁸⁵ Ibid, 4.

⁸⁶ Ibid, 12.

⁸⁷ Ibid, 20.

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