

Neighborhood Watch

Early Detection and Rapid Response to
Biological Invasion along US Trade Pathways

John D. Waugh



NEIGHBORHOOD WATCH

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Along US Trade Pathways*

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“We must make no mistake: We are seeing one of the great historical convulsions in the world’s flora and fauna. We might say, with Professor Challenger, standing on Conan Doyle’s ‘Lost World,’ with his black beard jutting out: ‘We have been privileged to be present at one of the typical decisive battles of history-the battles which have determined the fate of the world.’”

CS Elton, *The Ecology of Invasions by Animals and Plants*, 1958

“...There must have been plenty of them about, growing up quietly and inoffensively, with nobody taking any particular notice of them - at least it seemed so, for if the biological or botanical experts were excited over them, no news of their interest percolated to the general public. And so the one in our garden continued its growth peacefully, as did thousands like it in neglected spots all over the world.

“It was some little time later that the first one picked up its roots and walked.”

John Wyndham, *The Day of the Triffids*, 1951

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PREFACE

Change is the defining feature of our time. Mankind's handiwork is by now ubiquitous, shaping the land in the name of progress. We have raised the material condition of humanity beyond the dreams of ancient avarice, greening the planet and, in principle, taming the dragon of famine. We move from place to place easily, if not entirely freely. We live longer, see more, go further, faster and consume more than ever before. We have been very successful in bending the earth to our will.

But change comes with a price. What was almost inconceivable a generation ago, that mankind could change the levels of the sea, alter weather patterns, erode the protective atmosphere, and melt the poles, is not only a realistic but has already begun. Our vast global commerce brings new organisms that easily survive the relatively short trips over long distances. Sometimes the translocated organisms thrive in their new environs, and when they do, it is, to a greater or lesser extent, to the detriment of the existing biota. When the impacted biota is economically important, humans take notice, and try to contain the new organisms. Usually they fail. By the time we notice the visitors, they are generally well-established, and we must either adapt to their presence or try to control them at vast expense.

One of the best control measures involves treatment with a gas called methyl bromide, which is an ozone depleting substance, banned under international law. While exceptions to the ban remain, there is tremendous pressure to avoid its use. Yet we have found no acceptable substitutes. To paraphrase a maxim attributed to legendary television journalist Eric Sevareid, every problem begins as a solution.

An effective biosecurity strategy must look beyond intentional biological harm and address the unintentional, but perhaps more insidious harm of our quotidian life - our appetite for the exotic, the scarce, and the cheap that drives world trade. The companion volume to this publication, *Denying Entry: Opportunities to Build Capacity to Prevent the Introduction of Invasive Species and Improve Biosecurity at U.S. Ports* (Jamie K. Reaser and John D. Waugh, IUCN, 2007) addressed the challenges of "regulatory exclusion" of potentially invasive species through trace pathways. Given the challenges identified there, and the further burdens of eventual withdrawal of a key treatment and a warmer climate in which to nurture new

arrivals, it is more important than ever before that the U.S. and its trading partners redouble efforts in early detection and rapid response.

This report offers recommendations to improve biosecurity measures at U.S. ports, as well as a possible funding mechanism based upon the “polluter pays” principle. Other countries may also benefit from some of these recommendations. We feel that it is time that the U.S., as the world’s largest economy, steps up as a leader in addressing a growing global problem while the opportunity presents itself. Failure to adopt a more realistic biosecurity strategy will be costly, and will be paid in perpetuity.

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FOREWORD

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Much of the work to control invasive species has focused around interception in high hazard areas as determined by the analysis of risk of introductions by specific organisms, usually associated with economically significant biological assets such as crops and forestland. This report reviews this strategy and proposes a different, complementary, but more precautionary approach, monitoring around key control points along the trade-related pathways for introduction. These control points are tied to the disturbance of cargo and cargo containers, primarily in the process of offloading at ports. Other control points include inland ports where unopened containers may be shipped under bond, points at which the containers themselves are moved, and finally the places where the containers are unpacked and the cargo distributed.

In order to achieve the degree of coordination required to monitor for all taxa at control points requires a shift in the security paradigm of a country. The growing movement of people and materiel across natural barriers in a globalized economy, and the compounding problem of global climate change, suggests the potential for profound changes in biological resources. Such changes have already demonstrated economic and ecological impacts in the world's forests, farms, and waterways. The well-documented risk is now sufficient to warrant a reconsideration of biosecurity. It may be reasonable to conclude that nations are at as least as much risk from invasive species accidentally introduced through world trade than from terrorists. Indeed, one might argue that, aside from the need to prove the agency that constitutes terror, it would be easier for the enemies of a country to sit back and allow an industrial power to undercut itself through risky behavior.

From an economic perspective, seaports and airports serve as a nation's principal gateways for import and export of millions of tons of freight every year – freight that sometimes harbors hitchhiking pests. Since it is impractical to inspect 100% of all shipments, there will always be a chance that undetected pests will escape while a shipment is being held at the port of entry. Over the past 100 years, in spite of ongoing agriculture

quarantine inspection of imported cargo, a number of invasive species have become established in port environs and then spread into surrounding lands.

Clearly, inspection of imported cargo is not enough - we need a nationally coordinated program for survey and monitoring of ports of entry. Here are some examples of species introductions – some with profound consequences, including species that could have been eradicated had they been detected in or around the ports where they were first introduced, one halted in its tracks, and some dramas still unfolding.

Red Imported Fire Ant – Port of Mobile, Alabama - 1930.

The Red Imported Fire Ant (*Solenopsis invicta*) was first introduced into the U.S. as a hitchhiker on cargo in the Port of Mobile, Alabama, in about 1930. After being identified as a new species, it was not initially considered to be much of a threat to the Southeast since it had originated in a tropical region. However, fire ants now infest over 260 million acres of land from Texas and Oklahoma to North Carolina, and cause a tremendous amount of economic and ecological damage (e.g., pasture production, ground nesting birds) - not to mention human suffering.

Zebra Mussel – Ballast Water – Lake St. Clair, Michigan - 1988.

Zebra mussel (*Dreissena polymorpha*) is a freshwater bivalve from Eastern Europe that was introduced into the Great Lakes via ballast water from cargo ships in 1988. The zebra mussel is best known for its ability to colonize and restrict water intakes of hydroelectric and nuclear power plants, public water supply plants, and industrial facilities. As a filter feeder, the zebra mussel is quite effective in removing zooplankton and other suspended particles from the water column. While water purity and clarity is very desirable in many ways, the removal of a large percentage of zooplankton from the water can have a devastating effect on the rest of the aquatic food chain. Zebra mussels will colonize, and completely cover any submerged structure (e.g., native clams, piers, boat hulls, even shopping carts).

As a result of the problems caused by zebra mussels and other introduced aquatic invaders, the U.S. Coast Guard now has rules that require ships to exchange their ballast water in mid-ocean before coming into the Great Lakes Region. In the absence of overarching federal rules that apply to all states, a patchwork of state ballast water rules is starting to emerge in coastal and Great Lakes states such as California, Hawaii, Minnesota,

Oregon, Virginia, Washington, and Wisconsin.

Even with such state and federal rules in place, there is an ongoing need to survey waterways around ports of entry, in order to detect and quickly respond to aquatic nuisance species that are accidentally introduced by ocean-going freighters.

Asian Gypsy Moth – Sunny Point Military Ocean Terminal, Southport, North Carolina – July, 1993.

The Gypsy moth is a pest from Europe and Asia that defoliates hardwood trees. The European strain of Gypsy Moth, which was first introduced into Massachusetts in 1869 for the silk industry, has caused serious economic losses in timber production in the northeastern U.S. In July, 1993, when the hatches of a military transport ship from Germany were opened at the Sunnypoint Military Ocean Terminal, in Southport, North Carolina, the cargo was found to be infested with Asian Gypsy Moth, a near relative of the European strain. Fortunately, in this case, quick action by state and federal officials eradicated the released moths and prevented a full-blown invasion in southeastern North Carolina.

Raspberry Crazy Ant – Port of Houston, Texas – 2002

The Raspberry Crazy Ant (RCA), a new exotic ant species that was first noticed around the Port of Houston, Texas, in 2002, is starting to spread, with human assistance. The ant, which has not yet been positively identified, appears to be related to the Caribbean Crazy Ant (*Paratrechina pubens*). It is commonly referred to as the Raspberry crazy ant, after Tom Raspberry, the pest control exterminator who first called attention to it. Unlike Red Imported Fire Ants, which have stingers, the RCA is a biting insect, and is thus a threat to people, livestock, and ground nesting birds. However, this particular ant is also attracted to electrical equipment where its large numbers cause short-circuiting and clogging of switching mechanisms.

Laurel Wilt Disease – Port of Savannah, Georgia – 2002

In 2002, Red Ambrosia Beetle (*Xyleborus glabratus*), which is native to India, Japan, and Taiwan, was captured in a monitoring trap near to warehouses in Port Wentworth, which is near the Port of Savannah, Georgia (this is the 12th new species of Ambrosia Beetle that has been introduced into the U.S. since 1990). In 2003, native redbay trees (*Persea borbonia*), on Hilton Head Island, South Carolina, started dying. In 2004-2005, it

was determined that the trees were actually being killed by a previously unknown fungus wilt (*Ophiostoma* sp.) that is being spread by the new beetle. The fungus is spread from tree to tree by the beetle, for which it is a food source. The disease is spreading throughout the southeastern United States at a rate of about 20 miles per year.

While redbays are of limited commercial value (they are used on a limited basis for cabinetry), they are important from an ecological perspective. Redbays are host plants for three butterflies: the Palamedes Swallowtail, the Schaus Swallowtail, and spicebush swallowtails. The Palamedes Swallowtail is at serious risk due to the invasion of Laurel Wilt. This particular butterfly lays its eggs on redbay leaves and the emerging caterpillars eat the leaves. The disease has also been discovered on individual plants of the federally endangered pondberry (*Lindera melissifolia*), the threatened pondspice (*Litsea aestivalis*), sassafras (*Sassafras albidum*) and avocado (*Persea americana*). There are, at present, no effective control methods for the Laurel Wilt Disease or the Red Ambrosia Beetle.

The transition from a piecemeal approach to biosecurity to a more coordinated, more vigilant one requires a highly sophisticated approach to information and knowledge management, budgets and finances, and inspection/quarantine and containment/control operations. Several countries are making important strides in this direction, including the United States. The world will benefit if governments would redouble efforts to collaborate, develop, and share improved approaches to the protection of biological resources from external threats. Coordinated, holistic monitoring of port environs would be a good place to start.

LIST OF ACRONYMS

ANSTF	AQUATIC NUISANCE SPECIES TASK FORCE
APHIS	ANIMAL AND PLANT HEALTH INSPECTION SERVICE (USDA)
CAFTA/DR	CENTRAL AMERICA/DOMINICAN REPUBLIC FREE TRADE AGREEMENT
CAPS	COOPERATIVE AGRICULTURAL PEST SURVEY (OF APHIS)
CARICOM	CARIBBEAN COMMUNITY
CBO	CONGRESSIONAL BUDGET OFFICE
CBP	CUSTOMS AND BORDER PROTECTION (OF DHS)
CISSIP	CARIBBEAN INVASIVE SPECIES SURVEILLANCE AND INFORMATION PROGRAM
CISWG	CARIBBEAN INVASIVE SPECIES WORKING GROUP
CLC	CONVENTION ON CIVIL LIABILITY FOR OIL POLLUTION DAMAGE
CRISIS	CARIBBEAN INVASIVE SPECIES INTERVENTION STRATEGY
DAF	AUSTRALIAN DEPARTMENT OF AGRICULTURE FISHERIES AND FORESTRY
DHS	US DEPARTMENT OF HOMELAND SECURITY
DNR	DEPARTMENT OF NATURAL RESOURCES
EAB	EMERALD ASH BORER
EDRR	EARLY DETECTION AND RAPID RESPONSE
EPA	US ENVIRONMENTAL PROTECTION AGENCY
ERMA	NEW ZEALAND ENVIRONMENTAL RISK MANAGEMENT AUTHORITY
ESF	EMERGENCY SUPPORT FUNCTION (OF ICS)
FICMNEW	FEDERAL INTERAGENCY COMMITTEE FOR THE MANAGEMENT OF NOXIOUS AND EXOTIC WEEDS
GEO	US GOVERNMENT ACCOUNTABILITY OFFICE
GPS	GLOBAL POSITIONING SYSTEM
ICS	INCIDENT COMMAND SYSTEM

IJC	INTERNATIONAL JOINT COMMISSION FOR THE GREAT LAKES
INTERPOL	INTERNATIONAL CRIMINAL POLICE ORGANIZATION
ITAP	US FEDERAL INTERAGENCY COMMITTEE ON INVASIVE TERRESTRIAL ANIMALS AND PATHOGENS
IUCN	INTERNATIONAL UNION FOR CONSERVATION OF NATURE
MAF	NEW ZEALAND MINISTRY OF AGRICULTURE AND FORESTRY
MOE	MINISTRY OF THE ENVIRONMENT
NAL	NATIONAL AGRICULTURAL LIBRARY (USDA)
NAQS	NORTHERN AUSTRALIA QUARANTINE SURVEY
NIFC	NATIONAL INTERAGENCY FIRE CENTER
NIMS	NATIONAL INCIDENT MANAGEMENT SYSTEM
NISC	NATIONAL INVASIVE SPECIES COUNCIL
NPS	US NATIONAL PARK SERVICE
NRCA	NATURAL RESOURCES CONSERVATION SERVICE (USDA)
PPQ	PLANT PROTECTION AND QUARANTINE (UNIT OF USDA/APHIS)
RAPDET	RAPID DETECTION AND RESPONSE TEAM (USFS)
TNC	THE NATURE CONSERVANCY
USDA	US DEPARTMENT OF AGRICULTURE
USFWS	US FISH AND WILDLIFE SERVICE
USFS	US FOREST SERVICE (USDA)
USGS	US GEOLOGICAL SURVEY
WONS	WEEDS OF NATIONAL SIGNIFICANCE
WTO	WORLD TRADE ORGANIZATION

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INTRODUCTION

Cheaper and more efficient shipping and communications technologies and growing consumer demand have led a surge in global trade in the past half-century. During the past 50 years the growth in air travel passenger numbers increased approximately 9% per annum. Since 1993, shipping traffic has increased by 27%. In addition, agricultural exports have increased in value from US \$ 568 billion in 1998 to US \$ 1.128 trillion in 2007, according to the World Trade Organization (WTO 2008).

One almost invisible risk of increased international trade is that of harm due to biological invasion. An effort to facilitate the flow of trade without proper concern for potential biological downsides affects not only to the environment but also to the world's food security, health, and economy. The risk of introduction of harmful organisms into the United States is increasing exponentially, with costs to the American economy measured in hundreds of billions of dollars¹.

Trade pathways can compromise biosecurity through risks such as the introduction of agricultural and forest pests and diseases, the introduction of diseases that affect humans, and the vectors that transmit the diseases, and nuisance species that affect ecosystem functions and impact infrastructure. In the United States, trade regulators have not yet consistently made it a priority to assess biosecurity aspects of trade agreements, nor have governments invested sufficiently in the infrastructure and processes that would make this possible (Reaser and Waugh 2009). Invasive species undermine human health and security and economic development either directly (e.g., through damage to economically important crop or forest species) or indirectly, through the disruption of ecosystem services. Their impacts pose significant risks to human well-being. Pathways for their introduction include casual introduction (e.g., through distribution of seeds by birds), intentional introduction (e.g., through new crops and ornamental plants, and pets), and accidental introduction, including activities often associated with migration, military activity, tourism and trade.

¹ Pimentel et al 2005 estimate nearly \$120 billion per year.

Recent growth in the volume of small parcels transported by and courier services linked to Internet sales should be viewed as growing risk.

The expansion of air travel and seaborne trade overcomes geographic barriers, enabling organisms to move great distances in short periods of time. These organisms include agricultural postal pests and diseases, their vectors, and invasive species injurious to agriculture and human health to ecosystems and environmental services. They may be bacterial, viral, or mycological organisms as well as flora and fauna. They may be present not only in raw and processed commodities, but also in manufactured goods and in packing materials.

Such invasions constitute a “hidden cost” of international trade, and one that is a serious risk to economic, as well as ecological health, of all nations, developed and developing. The inspection and quarantine services of the US are ill equipped to effectively inspect for this risk (Reaser and Waugh 2007). New introductions may be an inevitable consequence of international trade (McNeely, 2001); therefore effective planning for early detection and rapid response is crucial for effective risk management.

An important weapon in the quarantine arsenal is methyl bromide, a gas used as a fumigant that is highly effective against pests. Methyl bromide also depletes the stratospheric ozone layer, and as such, is being phased out under the Montreal Protocol on Substances that Deplete the Ozone Layer and the Clean Air Act. Quarantine and pre-shipment treatment of agricultural products is an allowable exemption under the treaty. While pressure is mounting to find a suitable alternative, to date no such alternative has emerged. Finding the balance between biosecurity and protection of the ozone layer is an issue that will be resolved at the highest levels of government; in the meanwhile, the possibility that this commonly used quarantine tool may not be available in the future indicates the urgency of strengthening early detection and rapid response measures. This report recommends the following:

- Establish Interagency and Intergovernmental Cooperation through risk committees
- Build response capacity, beginning with a scenario exercise for use at a medium-sized port with an active Pest Risk Committee, building upon pioneering work by USDA / APHIS.
- Promote international cooperation through the establishment of an “INTERPOL” for pests and invasive species.
- Establish Learning Networks linking inspection services and port authorities to the scientific community
- Develop and implement a comprehensive surveillance system that builds upon the sectoral work done in agriculture and forestry to capture the full range of potentially harmful organisms, beginning with a small number of ports as a proof of concept.
- Develop a sustainable finance mechanism to support EDRR.
- Undertake further study on the legal aspects of early detection and rapid response, including authority for instigating rapid responses in different jurisdictions and contexts.

Donella Meadows (Meadows, 1999) has described twelve points of leverage (Table 1) in intervening in a system. Presently, even state of the art efforts do not gain sufficient leverage in the trade and transportation system to effect the changes needed to ensure biosecurity. This report, with its companion, *Denying Entry* (Reaser and Waugh, 2007), reviews the system and gives recommendations for incremental improvements, primarily in addressing freshwater and terrestrial invaders, as ballast water has received substantial attention as a pathway already.

Ultimately, we have to overcome the inherent inertia that all long term challenges meet when faced with the exigencies of the day-to-day. Changing the biosecurity paradigm to recognize that biological invasions are linked not only to threats to ecosystems, but also threats to food security and public health will allow us to place the issue in its proper context.

Given the proliferation of pathways and increasing speed of port-related introductions of new species, a tremendous potential exists in the United States for a state-of-the-art emergency response mechanism for invasive alien species centered on US ports of entry. **US leadership in developing such a mechanism could drive innovation on emergency response worldwide if the issue of invasive species were given the priority in government policy commensurate with the risk that it poses to the national economy and biological infrastructure.** Moreover, global trade demands global cooperation to prevent the spread of invasive species. International cooperation on monitoring and rapid response is an important unmet need where US leadership is called for.

Table 1: Points of Leverage in Regulatory Exclusion (after *Meadows, 1999*)

12 points of leverage to intervene in a system (in descending order of effectiveness)	Application of the levers to invasive species
Transcend the biosecurity paradigm	Eliminate the false dichotomy of human and ecosystem health; change the values of the system to favor biosecurity and incorporate ecosystem health
Identify the weaknesses in the dominant biosecurity paradigm	Demonstrate that the system fails in its mission because it does not recognize and respond to threats emanating from economic values it is designed to protect.
Change the goal of the biosecurity system	Change the goals of the pest and weed management system to the protection of human and ecosystem health, thus changing information requirements and feedback loops.
Give the biosecurity system the power to add, change, evolve or self-organize its own structure	Recognize that the ecological foundations of productivity are reorganizing due to invasive species; invasive species are a game-changer, and a security threat. Lengthen the timeline and understand the hidden costs of inaction.
Change the rules of the system	Amend list of actionable species to better reflect the problem. Clarify roles and responsibilities, and provide cross-cutting budgets as incentives to cooperation
Improve structure of information flow	Early detection and rapid response, better data collection, learning networks
Reduce the gain around positive feedback loops that amplify invasions.	Reduce or negate the volume of propagule pressure (early treatment and/or manual removal of established invasives)
Enhance the strength of negative feedback loops	Penalties on shippers of contaminated commodities
Reduce the length of delay relative to the rate of system changes	Application of precautionary approach, white lists, protocols for rapid response
Control the structure of material stocks and flows	Blacklists
Enhance the size of buffers and other stabilizing factors, relative to flows	Compulsory inspection, regulatory exclusion
Change parameters	Bar or restrict trade

BACKGROUND

On February 3, 1999, U.S. Executive Order 13112 (Federal Register 1999) established the federal National Invasive Species Council (NISC) as a coordinating mechanism for federal invasive species efforts. The Executive Order charged NISC with creation of a National Management Plan (NMP) for Invasive Species. Action Items 21-24 of the first version of the NMP identify specific programs for improving the nation's early detection and rapid response capacities, and the NMP states (p. 3) "...early detection of introductions and quick, coordinated response can eradicate or contain invasive species at much lower costs than long-term control, which may be infeasible or prohibitively expensive. Invasive species should be detected and dealt with before they become established and spread. An integrated approach involving research and development, technical assistance, and operations is needed to facilitate and implement effective action. No comprehensive national system is in place for detecting and responding to incipient invasions. Unfortunately, inadequate planning, jurisdictional issues, insufficient resources and authorities, limited technology, and other factors often hamper early detection and rapid response in many locations." (NISC 2001)

Our review of early detection and rapid response shows that these action items have not been fully implemented. Significant gaps remain, both in and around ports of entry and throughout the United States. Awareness of the need for these mechanisms is growing. However, in general, current efforts are highly fragmented, and miss opportunities for collective learning and shared resources. In short, the US has not yet implemented an effective rapid response system.

The 2008-2012 National Invasive Species Management Plan (NISC, 2008) seeks to bring order to the existing, largely fragmented, efforts. It features an Organizational Collaboration strategic goal, calling for maximized collaboration between agencies. This will entail streamlining laws, regulations, and policies, coordination of research, collaboration in planning and budgeting, reporting processes, and contributing to international coordination efforts.

Implementing the new draft Plan entails overcoming some significant obstacles to policy coordination at ports of entry. For example, in 2002 a non-native ant invasion was discovered in the vicinity of the Port

of Houston. By 2003 this ant was found in “overwhelming numbers” and was known to short-circuit electrical components (Meyers, 2008), including computers, telephone exchanges, even iPods (Ayres, 2008), making it, arguably, the emblematic invasive species of our day. Of particular concern is the potential damage that this invasive species could inflict on NASA’s Johnson Space Center.

Identifying officials submitted specimens to the US Department of Agriculture (USDA), following standard protocol. The USDA identified the ant as a member of the *Paratrechina* genus, native to Latin America and Asia. *Paratrechina*, also known as “tramp ants”, includes several species known to be highly invasive (Meyers, 2008). At the time of discovery, USDA was not able to identify the ant to species, and subsequently ruled it as a “non-actionable” species, due to incomplete identification and absence of clear evidence of agricultural impacts (Reaser 2006). Since the US Department of Homeland Security’s Customs and Border Protection’s authority to take a rapid response action is based upon USDA risk determinations, it was unable to mount an effective response.

The State of Hawaii and countries such as New Zealand and Australia have put biosecurity measures in place in order to prevent introductions of *Paratrechina* spp. Species of this genus are known to demonstrate ecological dominance and cause infrastructure damage and agricultural impacts, small animal death, grassland and crop damage, and even small farm abandonment. The origin of the Houston specimen is unknown, but given that a large amount of the trade for the Port of Houston is inter-American, there is a basis for suspecting that it came from Central or South America or the Caribbean.

The *Paratrechina* case illustrates the potential for incoherence in the current national biosecurity system. In seven years it has already spread to eleven Texas counties, possibly aided by hurricanes. According to Texas A&M entomologist Roger Gold, the state of Texas estimates that the ants inflict \$30 million in damages annually (Peveto, 2008).

This review discusses issues and options for early detection and rapid response in and around US ports that take into account the gaps in

regulatory responsibilities for new invasions as well as the policy coordination needs among multiple agencies of the U.S. state and local governments within a high-volume port area. The review identifies principles of early detection and rapid response, describes some state and federal early detection and rapid response efforts, and similar efforts in other countries. It discusses best practices in rapid response within the United States, and proposes application of this practice to early detection and rapid response systems in and around ports and other trade-associated hotspots, through general coordination of efforts by Federal, State, and local authorities and the private sector.

PART I: EARLY DETECTION AND RAPID RESPONSE

Goals of Early Detection and Rapid Response

“There is a golden hour between life and death. If you are critically injured you have less than 60 minutes to survive. You might not die right then; it may be three days or two weeks later - but something has happened in your body that is irreparable.”

(University of Maryland Medical Center, 2007)

Early detection and rapid response (EDRR) is a coordinated framework for the management of new invasive species introductions. Elements include detection, identification and vouchering, verification and archiving, rapid assessment, and rapid response (Westbrook, 2004)

EDRR’s function is to prevent the establishment of an invasive species before it can begin to reproduce. Introduced species typically show a lag time before exponential population growth occurs (Crooks and Soulé 1999). The period before rapid expansion is the “golden hour”² for EDRR; once invasive populations cross a critical threshold, putting the genie back in the bottle will prove to be expensive and, in some cases, futile. The goal of EDRR is the elimination of an invasive species before it can become established, and while eradication is still a cost-effective option with a strong likelihood of success.

Intervention to prevent spread, including eradication and containment of founder colonies, must be initiated at an early phase in the invasion process (Hobbs and Humphries 1995). Late intervention allows the more successful species to become permanent members of the environment over large geographic regions. The total cost of control plus the negative economic and environmental impacts are much higher for late intervention. Furthermore the annual costs of late intervention continue

² In emergency medicine, the “golden hour” is the first hour after severe trauma, after R. Adams Crowley MD, (see University of Maryland, 2007)

indefinitely into the future. The invasion process can be seen as consisting of four stages; exclusion, eradication/containment, suppression, and, once a threshold of abundance has been reached, adaptation (as effective control is unlikely). Each stage involves a different strategic approach to management, as an organism spreads throughout its potential geographic range and finally approaches the carrying capacity of the new region (see figure 1, below).

Depending upon the species and the context, the lag time before exponential growth may vary between months and years. To focus on the lag time before a species establishes a critical mass is to miss the point when considering introductions at major transportation hubs such as container ports; realistically the lag time is the period before the organism enters the transportation arteries into the continental interior, and this is measured in hours and days.

The probability of success is dependent upon the species in question and the context in which it is detected, and this must be taken into account in mounting a response. If eradication is not a viable option, containment may be the best available option. Effective EDRR reduces the likelihood of long-term, expensive containment efforts (Minnesota, 2007).

EDRR measures for invasive species fit in principle into a government-wide policy on emergency response, the National Response Framework (US Department of Homeland Security, 2008). The National Response Framework is organized into a series of Emergency Support Functions, of which ESF #11 addresses agriculture and natural resources. The US Department of Agriculture is the coordinator of ESF #11, and shares primary responsibility for implementation with the US Department of the Interior. The primary responsibilities under ESF #11 include emergency nutritional assistance, emergency animal and plant disease and pest response, food safety and supply, and protection of natural and cultural resources and historic properties. Ideally, given the historic cost of invasive species to the US economy, rapid response to the introduction of invasive species rises to the level of emergency action as a biosecurity threat. In reality, the National Response Framework gives short shrift to important aspects of biosecurity such as invasive species, and the absence of systematic monitoring and surveying for invasives means that the “golden hour” may pass before a risk assessment is made, leaving managers with few options beyond containment and damage control.

Care must be taken to ensure that decisions to mount a rapid response are not trammled by short-term administrative considerations such as the triggering of compensation mechanisms, such as are provided for in the US Plant Protection Act of 2000 (US Congress, 2000).

An adequately funded and well-coordinated EDRR process would do much to address these problems.

Steps in Developing an Emergency Detection and Rapid Response Program

Step 1: have a well-developed capacity for detecting potential invasions.

There are several complementary approaches to detection:

Risk Assessment. The identification of high-risk pathways and offshore threat identification methods is necessary in order to align trade policy, port management, and biosecurity. This is best accomplished through robust data collection (Reaser and Waugh, 2007), ideally in conjunction with trade partners. APHIS' Caribbean Basin Initiative, discussed below, builds capacity and conducts risk assessments with trading partners in the Caribbean, identified by APHIS as a high-risk pathway. Risk analyses should be made more transparent and should be shared between trading partners to avoid duplication. In the USA the Trade Secrets Act (US Congress 2007) is a potential impediment to access to data for risk analysis, and an example of legal and policy incoherence and inconsistency that must be addressed in the process of developing a coherent biosecurity policy.

Monitoring of areas at risk. Through an innovative partnership with the US National Aeronautic and Space Agency (NASA), the US Geological Survey (USGS)'s Invasive Species Solution Center is developing ecological forecasting models with high performance computing and advanced modeling capabilities to predict change in the population and distributions of invasive species. Using ecological forecasting, risk-based decision support tools will provide more effective prioritization for managers working with limited resources. The USGS also provides an Internet-based alert system to notify subscribers of new aquatic species

introductions³. Field methods for detecting new invasive species are producing new surveillance and sampling designs (see, e.g., the Citizen Science website, <http://citsci.org>).

The US Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) is charged with the control of agricultural pests. APHIS meets this responsibility through survey and analysis, mitigation, clean production, outreach and education. It works in support of the agricultural inspection process of the US Department of Homeland Security's Customs and Border Protection division, with counterpart agencies abroad, and with domestic stakeholders, including industry and the States. APHIS' Cooperative Agricultural Pest Survey program (CAPS), although primarily focused upon known agricultural threats and noxious⁴ weeds, serves as a model for the integration of local, state, and Federal surveillance capabilities.

Surveys. Proactive surveys are a key component of comprehensive pest and invasive species risk identification and analysis systems. The National Park Service (NPS 2002) recommends that monitoring for EDRR be integrated with ongoing inventory, monitoring, and research efforts, and that the strengths and weaknesses of various survey and mapping methods (e.g., grid based surveys, probabilistic surveys, species or patch-focal mapping, and adaptive sampling) be investigated.

Opportunistic identification. Detection typically involves a combination of public observations and formal survey data collected by land managers and researchers. Because formal surveys and monitoring are expensive and public expenditure on invasive species is often inadequate, surveillance programs are heavily dependent upon reports from the public. Individuals that frequently travel within areas vulnerable to invasion should be sensitized to the need to identify invasive species. In addition to inhabitants and workers within an area, recreational visitors, security personnel, and infrastructure workers such as road and utility crews can provide crucial intelligence. Stakeholders that stand to be harmed by invasive species, such as farmers and horticulturalists, the tourism industry and utilities, will also have a vested interest in early detection. The private sector is continually monitoring crop systems and has significant survey infrastructure; the integration of private sector observations

³ <http://nas.er.usgs.gov/>

⁴ Noxious weeds can include plants that impact upon public health, navigation, and the environment, in addition to agriculture.

into official reporting systems can be improved through enhancements to the communications structure for reporting. Quarantines and other EDRR measures may constitute disincentives to voluntary disclosure, and further work is required to promote voluntary disclosure without compromising the integrity of the system.

Public education. Awareness campaigns are of vital importance to EDRR systems. The Nature Conservancy's Weed Watchers Program⁵ is a volunteer network of field naturalists trained to spot weeds of particular concern. The program encourages "viral" growth through the development by program participants of additional networks of weed watchers. Other examples include the US Fish and Wildlife Service's Volunteers and Invasive Plants Program⁶ and the Hawaii Department of Agriculture's toll-free Hawaii Pest Hotline.

Step 2: have a reporting system in place.

A formal reporting system is necessary to capture observations for analysis. The Soybean Rust Pest Information Platform for Extension and Education⁷ is an example of a partnership with the Department of Agriculture to develop tools for information exchange in integrated pest management.

In Maine, individuals reporting observations of aquatic invasive species are encouraged by the government of Maine to fill out a standardized form, available on their website. The form includes questions regarding the following key points:

- Specific locations (using GPS) within the water body of the sighting/ collection and size of water body,
- Uses of water body, sources of water, and any downstream waters,
- Date and time of the sighting/ collection,
- Phone number and postal and email addresses for the person reporting,

5 Oregon state guide available at www.westerninvasivesnetwork.org/pdfs/nature_conserve/all_weed_watchers/WeedWatcherResourceGuide_12_11_07.doc

6 (<http://www.fws.gov/invasives/volunteersTrainingModule/index.html>)

7 ipmPIPE, www.ipmpipe.org

- Known or suspected method of introduction,
- Character of site(s) likely to be affected, and
- Vectors of spread.

Implementation of a Response Command Structure

In order to avoid confusion and disputes over authority, a detailed command structure should be followed during EDRR efforts. Within the USA, the Minnesota Emerald Ash Borer plan has one of the best-developed and specific command structures, making use of the incident command system (ICS). The first step in the event of EAB detection is the establishment of a Unified Command that combines individuals from different agencies and groups when multiple jurisdictions are involved. If the infestation is on non-tribal land within Minnesota then the Incident Commanders of the Unified Command will consist of a representative from the Minnesota Department of Agriculture (MDA) and a representative from the USDA-APHIS PPQ. If the infestation is detected on tribal land then the Unified Command consists of a representative from the tribe and a representative from the USDA-APHIS PPQ.

In addition to the Incident Commanders the Unified Command consists of three other types of staff:

Safety Officer(s) – The person or persons in this role report directly to the Incident Commanders and advise them on any potentially unsafe conditions that may be created through response actions such as the felling of trees. This officer has the power to immediately halt any operations if they are deemed unsafe.

Liaison Officer(s) – Each agency involved in the rapid response designates a liaison officer to facilitate communication and coordination of activities between each of the agencies involved in the operation.

Joint Information Center (JIC) – The JIC acts as a clearinghouse for all media information related to a rapid response operation.

(Minnesota, 2007).

Information from the reports is then entered into a central database. The website also includes instructions for collecting and mailing in specimens to the Department of Environmental Protection for inspection (Maine, 2006).

In addition to reporting via the Internet, a 24-hour hotline for individuals to make their reports is suggested in the Washington State draft aquatic invasive species EDRR plan (Washington 2005).

Once a sighting has been reported, it is important to confirm the identity of the organism in the laboratory if possible, or if a specimen is unavailable, on-site confirmation by a reconnaissance team is required.

Step 3: confirm the identification of the species.

Survey without identification is worthless. An EDRR plan requires a designated scientific authority to confirm observations. At US ports, Customs and Border Protection staff assigned to agricultural inspections are trained to make initial observations. The US Department of Agriculture's Animal and Plant Health Inspection Service (USDA APHIS) verifies their identifications⁸; they can refer questionable identifications to taxonomists at the Smithsonian Institution or universities. Technical support to confirm identifications from the field is provided through several sources, including the USDA APHIS Plant Protection and Quarantine unit (PPQ) (Reaser and Waugh, 2007). APHIS' Center for Plant Health Science Technology is working with research institutions to develop improved diagnostic tools, including molecular diagnostics using hand-held lateral flow microarrays.

The USDA Agricultural Research Service's Systematic Entomology Laboratory provides critically important research on the identification and classification of species of potential quarantine significance. Unfortunately, a decline in the budget of the laboratory is a reflection of the confused state of support for biosecurity in the US.

Step 4: identify options for containment, suppression, and eradication.

Without the confidence of an assured response, detection and notification might give one concerned about the natural environment the macabre

⁸ APHIS also provides verification of field detections of regulated species and species not known to occur in the US.

sensation of reading an obituary. Response options are problematic, however, because of the confused tangle of mandates, legal authorities, technical capacity, and budgets. Options for containment, suppression and eradication often involve some form of restriction of access to the site, or quarantine, to prevent further spread of the species. Incoherence in laws and regulations governing the containment of invasive species is a major impediment to response to confirmed invasive species outbreaks, including:

- The absence of a designated lead authority to coordinate the efforts of multiple jurisdictions and landowners
- The absence of legal authority to impose quarantine
- The absence of funds or the authority to expend funds.

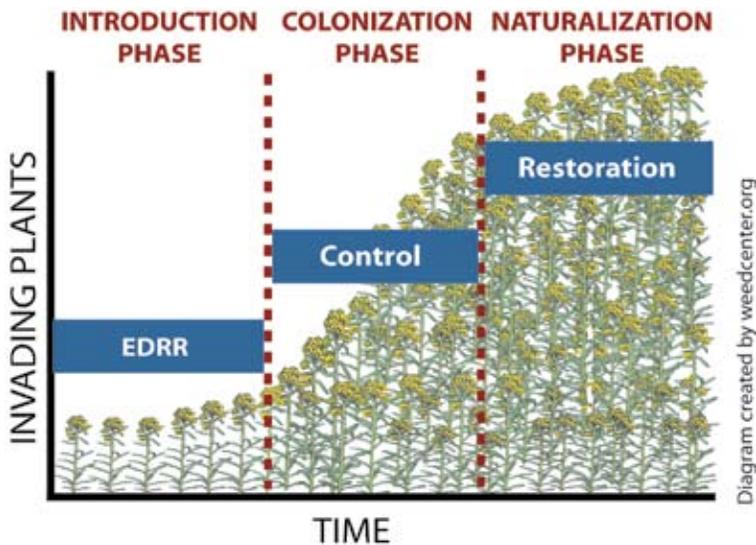


Figure 1: phases of invasive species management

There is a trend towards legal reform at national and provincial levels to address the policy incoherence that limits the ability to respond to new introductions of threatening species. For example, in National Biodiversity Strategies and Action Plans prepared by Caribbean island states for the UN Convention on Biological Diversity, three out of eight states identified

legal reform as a priority. In the United States, several states have or are in the process of revising invasive species policy and laws in response to the National Invasive Species Council's action planning process.

Step 5: Evaluation

Once an initial quarantine has been agreed upon and implemented, rapid response efforts shift to a more in-depth evaluation of the infestation including more detailed surveys of the affected areas, the source of infestation, and whether or not artificial movement of invasive organisms has occurred. During this period, the area of quarantine may be adjusted as more data on the extent of infestation is collected. Tools for assessing and responding are readily available from integrated pest management practice.

Treatment options may be identified and tailored to the specific situation as part of the evaluation process. Depending upon the extent of the infestation, its response to treatment, and risks associated with treatment, treatment options available may not permit total eradication. A thorough assessment of the consequences of any treatment plan should be considered before the plan is executed. Environmental and economic impacts vary from treatment to treatment, and it is not within the scope of this review to discuss the advantages and limitations of each treatment.

Once a treatment plan has been selected and applied to the infested area, a period of close monitoring and evaluation of the biological, chemical, and physical impacts should ensue until the infestation is eradicated or the treatment plan is terminated.

Whether a treatment involves a physical response such as manual removal, application of pesticides or the use of a biological control agent, a designated communications officer should notify the public immediately of the response.

For transboundary waterways and for terrestrial infestations near a border, other relevant jurisdictions should be notified of the treatment plan (Maine 2006). Finally, if funds permit, a long-term restoration plan for the infested area should be made in the event of a successful eradication. Ecological restoration is beyond the scope of early detection and rapid response, but it is an important consideration for a comprehensive biosecurity regime.

PART II: REVIEW OF CURRENT EARLY DETECTION AND RAPID RESPONSE EFFORTS

A. Federal Efforts

Under Executive Order 13112 of Feb 3, 1999, Federal agencies are required, within the limits of their budgets and authorities, to:

“(i) Prevent the introduction of invasive species;

“(ii) Detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;

“(iii) Monitor invasive species populations accurately and reliably;

“(iv) Provide for restoration of native species and habitat conditions in ecosystems that have been invaded;

“(v) Conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and

“(vi) Promote public education on invasive species and the means to address them...”

National Invasive Species Council

The order established a National Invasive Species Council (NISC) to oversee implementation of the Executive Order, and mandates the establishment by NISC of a National Invasive Species Management Plan outlining “specific objectives and measures” to achieve the objectives set forth by the Executive Order.

In its first National Invasive Species Management Plan, NISC acknowledged the absence of a comprehensive national system for detecting, responding to, and monitoring incipient invasions as required by the Executive Order (NISC, 2001). The plan identifies key elements of an early detection and rapid response system, including access to up-to-date reliable scientific and management information, rapid and accurate species identification, a standard procedure for rapid risk assessment, new and enhanced mechanisms for coordinating the efforts of Federal, State and local agencies, tribal governments, and private entities, and adequate

Incident Command System

A key feature of the National Incident Management System is the Incident Command System (ICS), developed in California to coordinate firefighting efforts involving emergency responders from multiple jurisdictions. Emergency responders found that the command structures and communications systems of multiple agencies and jurisdictions were not interoperable, nor, resulting in poorly coordinated efforts and leading to ineffective and unsafe emergency operations. The ICS provides an agreed management protocol for all emergency response agencies, local, state, and federal, resulting in more effective and safe fire suppression efforts. The Federal government adopted the ICS in the National Incident Management System for use in all civil emergencies, including environmental hazards such as toxic spills, extreme weather events, geological hazards such as earthquakes, and public health hazards such as epidemics.

The Department of Homeland Security defines the Incident Command System as:

“A standardized on-scene emergency management construct specifically designed to provide for the adoption of an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. ICS is the combination of facilities, equipment, personnel, procedures, and communications operating with a common organizational structure, designed to aid in the management of resources during incidents. ICS is used for all kinds of emergencies and is applicable to small as well as large and complex incidents. ICS is used by various jurisdictions and functional agencies, both public and private, or organized field-level incident management operations.” (Department of Homeland Security, 2004a). Under the system, specific Federal agencies are assigned as the lead for certain types of incidents. For example, the Environmental Protection Agency (EPA) is the lead agency in the Environmental Response Team, providing technical advice and assistance to the On-Scene Coordinator for discharges and releases of oil and hazardous substances into the environment.

There is a trend towards adoption of the ICS internationally, because it provides a framework for sharing resources at all levels. Disparate countries such as Ireland and India are studying ICS compatible approaches. The United Nations has adopted the ICS for security operations. The growing standardization of emergency response systems facilitates international cooperation in managing invasive species outbreaks, creating the possibility not only of cross-training, but also of burden sharing for rapid response, an important factor for states with transboundary risk and small island developing states.

technical assistance and rapid access to stable funding for emergency response efforts.

In the 2001 plan, NISC set a target of systematic surveys of locations where introductions of invasive species would most likely occur by January 2003, including ports and airports. On this basis, “rapid response” teams were to be established, based upon guidance produced for response measures, regulatory compliance, and jurisdictional and budget issues.

In June 2003 the Council adopted General Guidelines for the Establishment and Evaluation of Invasive Species Early Detection and Rapid Response Systems (NISC, 2003), “to provide information to those who wish to establish or evaluate ED&RR systems for invasive species.” The NISC Guidelines describe the framework of early detection, rapid assessment, and rapid response reflected elsewhere in the Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW) and Forest Service Early Warning System strategies described below. Key features include:

- The importance of prioritizing, so that resources are available for active detection of “high-priority targets, high-risk locations, high-value resources, important pathways, and populations and species of specific concern.
- The need for improved data accessibility, data interoperability, and integration of detection technologies, and improved communication between EDRR systems.
- The importance of preliminary risk assessment for high priority species and susceptible ecosystems in advance of detection.
- Standing rapid response teams, including use of the federal Incident Command System (Department of Homeland Security 2004) and scalable rapid response plans.
- Adequate, flexible funding.
- Public outreach and stakeholder engagement (NISC 2003).

This list of federal examples is not exhaustive, but illustrates the parallel evolution of response systems developed by agencies to address specific

agency mandates. Within the Federal system there are many and diverse approaches focused on specific sectors, biomes, species, or agencies. What is missing is the absence of an overarching EDRR framework within which to support the various EDRR programs and harmonize their operations. Without such a framework, knowledge and resources are locked into silos, robbing the agencies and the government of flexibility and reach. The 2008 National Invasive Species Management Plan (NISC 2008) recommends important incremental steps in the creation of such a framework.

Department of Homeland Security

Homeland Security Presidential Directive 5 (Executive Office of the President, 2003), issued on February 28, 2003, requires that all federal agencies adopt the National Incident Management System (NIMS) for the management of emergencies. HSPD-5 applies to “terrorist attacks, major disasters, and other emergencies...” NIMS is not restricted, however, to mass casualties, damage and disruption, but applies to domestic incidents regardless of size or complexity.

NIMS defines “incident” as:

“An occurrence or event, natural or human-caused, that requires an emergency response to protect life or property”. Incidents can, for example, include major disasters, emergencies, terrorist attacks, terrorist threats, wildland and urban fires, floods, hazardous materials spills, nuclear accidents, aircraft accidents, earthquakes, hurricanes, tornadoes, tropical storms, war-related disasters, public health and medical emergencies, and other occurrences requiring an emergency response.

...and “emergency” as:

“Absent an emergency declared by the President, any incident(s), human-caused or natural, that requires responsive action to protect life or property. Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an emergency means any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the United States” (Department of Homeland Security, 2004b)⁹

⁹ The National Response Framework (US Department of Homeland Security, 2008) is triggered by Incidents of National Significance, which are determined through one of the following:

A federal department or agency under its own authority requests the assistance of the Secretary of Homeland Security Federal assistance is

Several federal agencies involved in invasive species EDRR systems have assigned roles under NIMS. USDA / APHIS, for example, has the responsibility for emergency response to highly contagious animal diseases, as well as plant pests and diseases. APHIS has adopted the use of the Incident Command System and employed it in the containment of several recent introductions of agricultural pests. In addition to agency procedures, the President can invoke NIMS by declaring a national emergency under the National Emergencies Act.

US Environmental Protection Agency

The Comprehensive Environmental Response, Compensation, and Liability Act (US Congress 2002b), and the Federal Water Pollution Control Act (Clean Water Act) (US Congress, 2002c), established broad Federal authority¹⁰ (Department of Homeland Security, 2004a) to respond to releases or threats of releases of hazardous substances and pollutants or contaminants that may present an imminent and substantial danger to public health or welfare and to discharges of oil, with key roles assigned to the EPA. Under this authority the EPA cooperates with port authorities on environmental management issues. The Clean Water Act gives EPA authority to address aquatic invasive species.

US Department of Agriculture (USDA)

Objective 4.2 of USDA's 2005-2010 Strategic Plan is to reduce the number and severity of agricultural pest and disease outbreaks. Acknowledging, "economic sustainability of the agricultural crop and livestock systems and participation in global markets is limited by disease status" USDA cites globalization and international commerce as risk factor in meeting this objective (USDA, 2006). Strategies detailed to achieve the objective include intensifying research and education efforts to support rapid detection, increased monitoring of a broader array of emerging pests and diseases, and strengthened disease surveillance systems.

requested by appropriate state and local authorities after their resources are overwhelmed

More than one federal agency or department has become substantially involved in responding to an incident

The Secretary of Homeland Security is directed to assume responsibility for managing a domestic incident by the President.

10 http://www.dhs.gov/xprepresp/committees/editorial_0566.shtm

USDA's capacity to address this objective rests primarily in the Animal and Plant Health Inspection Service (APHIS), the repository of Federal expertise in sanitary/phytosanitary measures regulated under international trade regimes. In addition to research, monitoring and surveillance (including supporting Customs and Border Protection activities of the Department of Homeland Security in monitoring pests and diseases at US borders), APHIS is also responsible for organizing emergency response measures for pest and disease outbreaks, including agroterrorism, under the National Response Plan. This requires partnering with, and the coordination of, other Federal and state agencies.

APHIS relies heavily upon partnerships with state agencies in surveillance and detection, and is now expanding its partnerships to include industry and other stakeholders (USDA / APHIS, 2007). In recent years APHIS has also partnered with counterpart agencies in countries that are trading partners with the United States in order to exchange information and build capacity for rapid detection. To meet its responsibilities in implementing the National Response Framework, APHIS is developing a network of trained emergency response personnel within USDA, in other Federal agencies, and in state and local governments and among other stakeholders.

B. Early Detection and Rapid Response: State Level Activities

In the past decade, formal efforts to address the problem of invasive species at the State level have slowly taken root, with the formation of state and regional invasive species councils, committees, and working groups. As of July 2007, about 26 states have established statewide invasive species councils; about 46 states have invasive plant programs, and about 33 states have aquatic invasives programs (ANSTF, 2007). Of those states with aquatic programs, 20 have completed and approved Aquatic Nuisance Species plans.

Many states have plans to address invasive species introductions that include provisions for EDRR systems, but only a fraction of those states have designated a specific timetable to implement the systems. EDRR systems are, for the most part, still poorly developed or nonexistent across many states. However, at least 16 states have limited but explicitly designated EDRR functions. The states of Arizona, California, Hawaii, Idaho, Maryland, Minnesota and Oregon have or are in the process of establishing an EDRR that is not limited by sector, biome, or taxa. The remainder

of states have EDRR processes in place that are specific to weeds, aquatic nuisance species, or pests.

The EDRR plans that have been developed are relatively new, and it will not be possible to assess their long-term efficacy for some time to come. Monitoring and evaluation of EDRR efforts would be a useful contribution to planning for invasive species containment.

The coordination of surveillance and detection of potentially invasive species involves a wide range of jurisdictions, land managers, and owners, including federal, state, and local authorities and private owners. Few states have comprehensive legislation assigning overall jurisdiction for invasive species issues, and no states have budgets adequate to afford comprehensive surveillance. The only practical way to achieve wide-scale surveillance and detection is through partnerships between landowners and technical authorities or “land-care” conservation organizations. At least 20 states have multisectoral advisory bodies to exchange information and coordinate activities. Some have formal roles such as the provision of advice on legislation and regulations. In some cases, state government plays only a minimal role in invasive species surveillance and detection, and the coordination is, of necessity, provided through a non-governmental organization (NGO). Some NGO advisory bodies are regional in nature, and some are state affiliates of a regional network.

Non-governmental voluntary surveillance and detection is a first line of defense. In addition to advisory and coordination roles, NGOs play a critical role in public education and outreach.

Notable are Weed Watcher¹¹ programs, providing support for private citizen surveillance efforts, backed in some states by The Nature Conservancy. Private producers can also contribute significantly to surveillance and survey infrastructure if a way can be found for industry data to be integrated into official reporting systems. The agriculture industry continually surveys crop systems. For example, the seed industry can provide intelligence on weeds identified from the places where it sources its seeds.

The National Plant Board, comprised of representatives of state plant pest regulatory bodies, promotes harmonization of plant health programs and serves as a link between states and the US Department of Agriculture.

¹¹ http://www.ergonica.com/clubs/weed_watchers.htm

The National Plant Board also advises the agriculture and horticulture industries and state regulators on good practices, such as guidance on plant quarantine, nursery inspection and certification (http://nationalplantboard.org/policy/appendix_m.html). Promotion of standards has the effect of enlisting producers in a widespread, though sector and taxa specific, surveillance effort.

The need to establish a baseline against which to compare biological invasions makes mapping of known invasive species a priority in many jurisdictions. In the absence of an adequate base, mapping of existing outbreaks often constitutes their major EDRR investment, in which case the detection of new biological invasions will be *ad hoc* and heavily dependent on opportunistic identification, mainly through volunteer efforts.

State-Level Confirmation and Initial Response

In many cases, state departments of agriculture or natural resources, supported by state land-grant colleges, provide the confirmation for identification of invasive species. For example, in Maine the Department of Environmental Protection is responsible for the identification of aquatic plants drawing upon university experts as needed. The Maine EDRR plan for invasive aquatic plants designates a window of one week from the time that a sighting is reported to confirm the presence of an invasive plant unless outside DNA testing is required. The Maine plan also treats hybrids of any invasive species in the same way as any true species of invasive plant in their rapid response protocol (Maine 2006).

Technical support is available through a variety of federal programs, including the USDA APHIS and the US Geological Survey. Minnesota's Emerald Ash Borer plan calls for an initial confirmation by the Minnesota Department of Agriculture. If a positive confirmation is made, then USDA APHIS is notified and asked to make a secondary analysis of the data. Response measures are not initiated under the Minnesota plan unless APHIS confirms the presence of the Emerald Ash Borer (EAB) infestation (Minnesota 2007).

The next step after a positive confirmation has been made is typically an initial quarantine of the affected area. In Minnesota's EAB plan, the area quarantined will vary depending on the situation. Factors that may influence the area initially quarantined include whether the EAB is detected at a point source or non-point source, and whether adult emergence of the

infestation has occurred or not.

Under the Maine aquatic invasive species plan, before any surface use restriction of a body of water is issued, a risk assessment is conducted. The Maine plan does not give a specific protocol for assessing the risk of invasive species¹²; however it generally prioritizes risk based upon 1) the likelihood of eradication and 2) the risk of spread (high or low). For all cases except for when eradication is unlikely and the risk of spread is low, the Maine DEP will consider surface use restrictions within the infested body of water. If a surface use restriction is deemed necessary, the Invasive Aquatic Species Program Coordinator (in the Department of Environmental Protection) will consult with the appropriate Regional Fisheries Biologist (Department of Inland Fisheries and Wildlife, DIFW) to determine if an agreement can be reached over the extent of restriction. Furthermore, if Department of Conservation boating facilities, parks, or other lands are involved, the Invasive Aquatic Species Coordinator will also consult with the Director of the Boating Facilities Division and / or the appropriate Regional Manager of the Division of Parks or Division of Lands within the Departments of Conservation (Maine 2006).¹³

Many treatment plans require some degree of biomass removal. The Minnesota EAB plan encourages rapid response staff to find creative ways to utilize leftover biomass from mitigation operations. In the context of EAB, this means finding a more valuable use for leftover ash wood other than simple disposal via wood chipping. The Minnesota plan designates the Minnesota Department of Natural Resources as the most appropriate agency for carrying out this operation (Minnesota 2007).

State-Level Delimitation, Investigation, and Formal Response

The Minnesota EAB plan describes several detection scenarios along with appropriate mitigation methods for each scenario. The Maine plan has a more detailed description of the treatment options including a table in the appendix that addresses the estimated financial costs of different options, the factors that promote success of each method, the advantages and limitations of each option, follow-up activities involved, and the permits required to implement each option (Minnesota 2007).

¹² Several weed risk assessment systems are under development within the United States. For more information on WRA systems that are adopting a modified version of the Australian system, see: <http://www.hear.org/wra/>

¹³ In contrast, in Australia, once identification is made, the cognizant authority is fully empowered to institute restrictions without the need to negotiate with other authorities.

State-Level Command Structures

Lack of a designated lead authority makes command structure problematic in many states, meaning that the response measures fall on the owners and managers of the jurisdiction in question. Rapid responses mounted under this condition will tend to be limited, both in terms of efficient pooling of available resources, and in terms of relations with surrounding jurisdictions. This tends to produce *ad hoc* containment and control efforts, and in a worse case scenario can lead to cessation of containment and control efforts at the jurisdiction boundaries. To address this problem, states are gradually establishing overarching authorities and interagency coordination arrangements. At least nine states have adopted the Incident Command System as an organizing framework for emergency response, under Emergency Support Function Number Eleven of the National Response Framework of the US Department of Homeland Security (US Department of Homeland Security, 2004a). State agriculture authorities receive training in the Incident Command System from USDA/ APHIS. State governors can declare an emergency and petition the federal government for disaster and emergency assistance, under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (US Congress, 2002d).

For example, in Minnesota the state Department of Agriculture (MDA) is designated as the lead state agency for preventing the introduction and dissemination of terrestrial pests of plants within the state¹⁴. The MDA serves as the Incident Command Center and is in charge of providing website and geographic information system (GIS) data for sharing between agencies, supplies and equipment for operations, training of staff, maintaining data and maps, and documentation. The MDA is also involved in maintaining and publicizing intrastate quarantines, leading survey efforts, and coordinating mitigation and eradication actions or suppression.

The Minnesota Department of Natural Resources (DNR) is the lead state agency for forest pests that have become established within the state of Minnesota (Minnesota 2007). The DNR will provide an operations center if needed and aerial survey data if available. They are in charge of maintaining aerial data, holding public meetings, and restoration projects. If an infestation is found on federal land within Minnesota, then the US Forest

¹⁴ Minnesota Emerald Ash Borer Response Plan (2007) p. 3

Service will carry out the duties that would otherwise be carried out by the DNR.

The Minnesota Incident Command System (ICS) also includes a contact list with individuals in each agency or group of stakeholders that may potentially be involved in a rapid response incident along with the designated roles that each agency/owner/manager will play (Minnesota 2007).

USDA's APHIS provides technical and financial support to Minnesota if eradication actions are taken. APHIS is also in charge of maintaining and publicizing interstate quarantines, and investigation efforts looking into the source of infestation and whether or not artificial movement of pests has occurred. APHIS has authority to initiate emergency action or support State actions.

Other organizations that play a role in rapid response efforts include local municipal, county, tribal governments as well as utility companies. These organizations may provide assistance with restoration, hold public meetings, participate in surveys/investigations if their land is affected, and aid in the utilization of materials leftover from treatment operations.

Potential Role of Regional Bodies

State-level command structures do not automatically link to regional mechanisms, although lines of communications are established in some areas and for some taxa. In addition to Federal networks (e.g., the Aquatic Nuisance Species Task Force, q.v.) there are in some cases regional bodies, such as the International Joint Commission for the Great Lakes, which has developed, with the relevant states and provinces, a binational rapid response policy framework for aquatic invasive species (<http://www.ijc.org:8080/glo/glo-web/priorities/2007-09/AIS>). In general, ecoregional approaches by state consortia would be a logical progression in EDRR.

State-Level Program Finances

The costs of any EDRR plan will be significant and it is important for states to set aside funds for such operations. The Washington State draft plan calls for the establishment of an interagency rapid response fund (Washington 2005). The Minnesota plan outlines for the establishment of a financing branch in the event of a rapid response incident that is in charge of tracking expenditures, work hours, grants and contracts. Each

agency or group involved is expected to keep track of its own expenditures for staff working on the incident (Minnesota 2007). Under the Minnesota plan there is no discussion of any kind of interagency fund in order to finance operations. Lastly, the Maine plan makes no mention of how early detection and rapid response operations will be financed.

Summary of State Rapid Response Operations

The state EDRR plans discussed are still very young and have yet to get much use in rapid response operations. Therefore, it is of the utmost importance to make sure that EDRR plans are dynamic and evolving documents. It is suggested that EDRR plans should be evaluated for their efficiency and effectiveness on a regular basis.

The needs of and situations encountered in each state will vary depending on the specific characteristics of the invading species and the local environmental conditions. However, in order to avoid clutter, a generalized EDRR system should be developed for each state. Part of the problem with invasive species issues right now is that they are usually constituent driven, meaning that legislation and agency efforts are usually narrowly directed toward one or a handful of species, such as the Minnesota plan which was drawn up specifically for Emerald Ash Borer. A general EDRR plan would create more transparency and serve as a foundation upon which specific EDRR efforts could be modeled and adapted to carry out operations for different incidents.

Detailed Incident Command structures such as the one developed in the Minnesota plan will streamline communication, coordination between agencies, and streamline rapid response operations for new invasions (when time is not a luxury). Furthermore, funding should be clearly and explicitly set aside for EDRR efforts in agency budgetary plans. Creating a detailed EDRR plan will help outline the costs that will be associated with various EDRR operations.

Lastly, the success of any EDRR system will be dependent on the training of agency staff and individuals in the public sector that are key stakeholders. Frequent communication between agencies and with the public during rapid response operations will facilitate cooperation and prevent any interference with mitigation or eradication efforts.

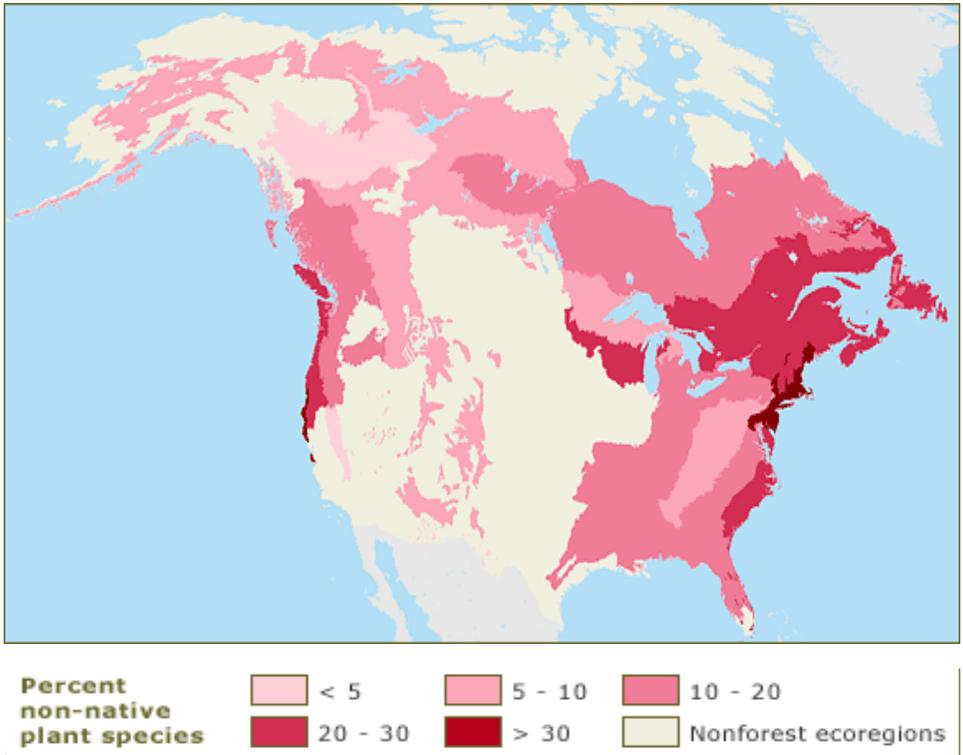


Figure 2: Nonnative Plant Species in North American Forests, source World Resources Institute - PAGE, 2000

C. Lessons From Other Places

There is a high degree of consistency between biosecurity plans for Australia and New Zealand and EDRR strategies in the United States. The major difference is that the biosecurity plans of Australia and New Zealand enjoy a more integrated management structure, supported by better-articulated authorities and including dedicated funds. Annex I discusses Australia and New Zealand biosecurity protocols.

The multiplicity of approaches in the United States produces the risk of duplication and overlap on the one hand, and on the other, the possibility that a pathway for introductions, a class of organisms, or a vulnerable locality will fall between the tectonic plates of jurisdictions and themes, exposing the economy to unnecessary and unwelcome risk.

In the absence of clear leadership from the federal government, innovation has often occurred first at local levels, where state and federal agencies and other stakeholders have been forced to improvise solutions to find an appropriate fit between institutional and ecological realities. Fortunately, as the NISC Guidelines recognize, lessons have been learned from other ecological crises, particularly wildfires. Systems have been designed and tested that can readily be applied to invasives outbreaks. The question is, can a sense of urgency be imparted that will generate the support needed to implement the appropriate measures? In this there is a significant difference between the United States, Australia and New Zealand, for the risk of harm from invasive species to the unique and insulated biota of Australasia and Oceania is perhaps more readily apparent than it is to the United States. Nevertheless, the costs of biological invasions in the United States are sufficiently high that the benefits of prevention, early detection and rapid response should be obvious. If it is not so, it reflects inadequate public and professional awareness of biosecurity risk, and indicates a major policy failure.

Part III of this report proposes a pilot effort to bring into practice the sound thinking reflected in the EDRR systems described above. The rapid growth of traffic through the ports of the United States in this era of globalization makes ports high-risk locations where an important pathway, that of international trade, is concentrated.

PART III: EARLY DETECTION AND RAPID RESPONSE AROUND US PORTS

Introduction

International trade drives the primary pathways for invasive species entry into the United States (Burgiel et al. 2006; McNeely et al. 2001). Maritime ports are the threshold across which the vast quantities of materials move between nations and around the world in the service of the global economy, marking the convergence of an array of vectors for the transboundary movement of non-native species (Reaser and Waugh, 2007). These include vessels (e.g., through ballast water, hull fouling, and conveyance on the above-water fabric of the vessels, containers, cargos (including containerized cargo, break-bulk cargo such as timber, roll-on/roll-off vehicles, bulk cargos such as grain, packing materials and crates, and wooden dunnage used to secure cargo. Added to that in some cases is passenger traffic via cruise ships, and the personal effects of these tourists. From ports cargo is rapidly transported to the interior of the North American continent via rail and road links; often it is transported “under bond” to inland ports in sealed containers, where it may not be inspected by US Customs and Border Protection’s agricultural specialists. More than 70,000 containers, 304,000 vehicles, 251,000 incoming international air passengers, and over 82,000 shipments of goods approved for entry come through one of 307 ports of entry into the USA every day (CBP, 2008).

The Asian tiger mosquito *Aedes albopictus* was first discovered in Houston, Texas (the 2nd largest port in the USA) in 1987. By 1997 it had spread to 25 states, with an early pattern of dispersal tracking with the US Interstate Highway system. It is believed that the vector of entry was a shipment of used tires from northern Asia (Moore and Mitchell, 1997). In addition to being an invasive pest species, *A. albopictus* is a competent vector for a wide range of disease-causing viruses. Introductions in Europe have also been correlated to used tire shipments, and one introduction (in the Netherlands) is believed to be linked to horticultural imports (IUCN-ISSG, 2006).

Four non-native *coccinellid* (lady beetle) species have become established, beginning at or near seaports in the USA since the 1970s, and spreading into the interior, coinciding with decline in native *coccinellid* species.

Competitive displacement is suspected but not proven (Day et al, 1994, Day and Tatman 2006). One of the *coccinellids*, *Harmonia axyridis*, is reported as a potential horticultural pest, feeding on fruit and infesting wine grapes (Koch, 2003).

Other examples linking invasive species with ports include the Asian Longhorn Beetle *Annaphlophora glabripennis*, believed to have been introduced through wood packing material from east Asia, and the plant pathogen *Phytophthora ramorum*, responsible for “sudden oak death”, first identified in Mill Valley, near Oakland, CA in 1995, and believed to be spread through infected nursery stock. Historically, many invasive grasses have been introduced through contaminated imported seed or through imported animal fodder (and /or livestock). Figure 2 shows the concentration of non-native plant species in North American forests clustered around ocean and inland ports.

Given the volume of trade and the time and expense of inspection, regulatory exclusion can only be marginally effective (Westbrooks 2006). Weaknesses in US border controls for invasive species are deeply entrenched due to overlaps and gaps in agency mandates and budgets (Reaser and Waugh, 2007). A second line of defense must support border controls. This report recommends the establishment of multisectoral, multistakeholder partnerships to monitor around major US ports and implement rapid responses to non-native species intercepts organized using the Incident Command System.

Achieving an Integrated EDRR System

Budgetary policy can unite agencies in a common purpose or pit them against each other. Given that the responsibilities for various aspects of Federal biosecurity activity are divided between so many agencies, in addition to the roles of the states, an appropriated cross-cut budget at the Federal level is indicated (Reaser and Waugh, 2007). In hand with a government wide budget, an interagency process for early detection and rapid response is needed to provide for cross-training, research and development, data management, and rapid deployment. One possible model for interagency cooperation is the example of wildland fire management. The Wildland Fire Leadership Council was established in 2002 by the Secretaries of Agriculture and Interior to oversee the development and implementation of the Federal Wildland Fire Management Policy. The Council is made up of representatives of Federal, State, tribal, and

local government officials, including several of the same agencies responsible for aspects of biosecurity management (e.g., Agriculture, Interior, Homeland Security). An Interagency Strategy for the implementation of the Federal Wildland Fire Management Policy provides the guidance for the interagency combined measures reflected in the operation of the National Interagency Fire Center (NIFC), located in Boise Idaho, which is funded through a cross-cutting Interior Department fire budget pooled with resources from the Department of Agriculture's Forest Service wild-fire budget. This differentiates the Federal fire program from the National Invasive Species Council (NISC) and the incorporation of the Incident Command System. The vision for NISC as an interagency coordinating measure has not been reflected in agency budgets, perhaps because the insidious harm from invasive species are "slow motion" disasters, without the acute and instant effects of a fire or weather catastrophe. A functional interagency unit to support individual agency efforts through research, capacity building, data management, and the coordination of surveillance and rapid response approaches may galvanize Federal approaches to EDRR. Advocates for improved Federal invasive species efforts may wish to draw lessons from the successful Federal fire coordination effort and seek a cross-cutting budget allocation to initiate the process.

Precedents for a cross-cutting budget to achieve a Federal policy can be found in recent Federal science appropriations, including a cross-cutting budget for the South Florida Ecosystem Restoration program under the Federal Comprehensive Everglades Restoration Plan, a National Nanotechnology Initiative (National Science and Technology Council, 2009), and the US Climate Change Science Program (GCRI, 2002).

Long Term Funding

Even if budgets and staffing were to be coordinated it may be difficult to achieve a level of effectiveness commensurate with the growing pressure of species introductions through trade pathways. Domestic discretionary funding is projected to be a shrinking share of the Federal Budget. According to the Congressional Budget Office, the rising costs of health care and social security will cause spending to increase rapidly in coming decades. Without significantly increasing revenue or sharply reducing discretionary spending, rising deficits and accumulating debt are projected (CBO 2009). The Government Accountability Office projects that

between 2030 and 2040 mandatory spending (debt, entitlements, etc) can under current trends exceed public revenues (GAO, 2007). It may not therefore be realistic to expect a complete solution for EDRR from Congressional appropriations.

An approach that may be more sustainable in the long term is one that eliminates the free ride that traders in commodities receive when the economic and environmental impacts of invasive species introductions are passed along to taxpayers and public utilities. A possible model lies in the Boll Weevil Eradication Program.

The boll weevil (*Anthonomus grandis* Boheman) is a beetle that feeds on cotton buds and flowers. A native of Mexico, the boll weevil migrated into the cotton fields of the southern US in the late 19th century. Since introduction, boll weevils have cost cotton producers an estimated 15 billion dollars, according to the National Cotton Council. In the late 1970's USDA/ APHIS initiated the Boll Weevil Eradication Program. The program, which is jointly funded by the Federal government and by cotton producers, features early detection (through the monitoring of traps, made possible by the discovery of a boll weevil sex pheromone in the mid-1960s) and treatment (through alterations of cultivation practices and application of pesticides). The program is implemented on a regional basis. Producers must agree by a majority to participate, and participation, once agreed, is compulsory. Participating regions require mandatory financial contributions by producers to state managed boll weevil eradication funds. States also provide regulatory authority, and, in some cases, additional financial contributions to reduce the burden of the program on private producers. In most cases funds are disbursed through state-chartered foundations.

The program has been successful in containing and controlling boll weevils, one of the most costly agricultural pests in the United States, while sharply reducing pesticide applications, and methyl bromide treatments to cotton for export. Initiated in 1983, by 2006 all cotton-production acreage in the US was included in the eradication program, and in 2009, the program expects the entire US cotton belt to be weevil-free. This makes the boll weevil program one of the most successful pest eradication programs in US agricultural history.

Through the history of the program, 70% of the cost of the program has been borne by the producers and roughly 30% has been borne by the

Federal cost share, according to USDA / APHIS¹⁵

Ports throughout the US charge security fees, often on a per container basis or on a per ton basis, for cargo to recover direct costs incurred by the ports beyond what is available through the Federal port security grant program to meet Federally mandated security measures. A five-dollar surcharge on each of the estimated twenty million containers that enter or leave US ports annually would yield a \$100,000,000 fund to match federal and state funds for EDRR. The Department of Homeland Security's Customs and Border Protection division collects an *ad valorem* harbor maintenance fee for the US Army Corps of Engineers (made available to the Corps subject to appropriation by Congress), as well as merchandise processing fees. The precedent and the infrastructure are in place for a cost recovery system with the potential to save taxpayers substantial sums of money as future economically-harmful invasive species are cornered in at the point of entry.

A structural problem with user fees is that while many costs are fixed, "use" fluctuates with the economy. A trust fund to capture and hold resources may be necessary to level out the peaks and valleys of international trade.

Internationally, another model exists in the International Oil Pollution Compensation Fund, created through a treaty process, the International Convention on Civil Liability for Oil Pollution Damage (CLC). Under this arrangement tanker owners pay into protection and indemnity funds to pool risk of liability for oil spill cleanup costs, and in return enjoy limited liability for an accident (IOPCF 2005). Such an arrangement to cover the costs of prevention of introductions along trade pathways would potentially create a global pool to build the capacity of less-developed countries and highly vulnerable small island states, and to facilitate cooperation between trading partners.

The CLC compensation scheme works because oil spills can generally be traced to a specific vessel that can be made liable. In the case of invasive species, it is generally not possible to attribute a release to a specific cargo or carrier, and the invasion is often a feature of serial introductions sufficient to build a critical reproductive capacity in the newly established population. The impact of invasive species introductions through trade pathways is usually chronic and the practice of passing the costs on to

¹⁵ (http://www.aphis.usda.gov/plant_health/plant_pest_info/cotton_pests/index-bw.shtml.)

the receiving nations is long-established. The sense of urgency to prevent biological invasions is significantly less than that of cleaning up oil spills, even though the costs are potentially much higher. It will be significantly more difficult to establish a mechanism such as the CLC. However, an economic analysis should be undertaken to assess the utility of such an approach.

Criteria for EDRR Success

An early detection and rapid response system for US ports, if it is to be successful, must be based on a shared understanding not only of the problem but also of the basic rules for addressing the problem, including the answers to the following questions:

- What triggers an emergency response?
- Who is responsible for monitoring and surveillance?
- What defines an “incident” (what are the indicators)?
- How are outbreaks reported, and to whom?
- What is the mechanism for declaring an “incident” and initiating a reaction? Who has the authority to make such a declaration?
- Who is to be considered as the competent authority for key steps in the reaction (e.g., identification, application of eradication methods, worker and site safety, confirmation of eradication)? Would the responsible agencies have access to prepositioned resources such as tools, equipment, and pesticides?
- What eradication strategies are available? Is there a widely accepted body of guidance and best practices for eradication of pests/invasive species?
- How “rapid” does a response need to be?
- How is an incident communicated to the public, both for mobilization and to allay fears?
- How would response effectiveness be monitored, i.e., when would the outbreak be declared contained or controlled? And by whom?
- Who pays for the measures identified as necessary (monitoring, identification, eradication)? Are there existing budgets?
- How is restoration included in treatment planning, and who is responsible for implementation and monitoring?
- Does sufficient legal authority exist to implement a response?

Recommendations for US Port Surveillance and Response

Recommendation 1: Establish Interagency and Intergovernmental Cooperation through Risk Committees. Many US ports have interagency Pest Risk Committees, which meet periodically for information collection and exchange and informal discussions concerning coordination. These committees typically consist of representatives of the port authority, and of the relevant inspection authorities active at the port (e.g., Customs and Border Protection, APHIS, the US Fish and Wildlife Service, the USDA Smuggling Interdiction and Trade Compliance Service, and the Food and Drug Administration). Their objective is to coordinate prevention efforts.

Pest Risk Committees can also provide the necessary coordination for a rapid response. Typically, they don't involve the line agencies that would be involved in an eradication effort. These agencies could include, *inter alia*, state, county, and municipal environmental and health authorities, state and federal transportation authorities, local jurisdictions bordering the port, and federal agencies with particular competencies, e.g., the Forest Service where forest pests are involved. Where aquatic species are involved, the Environmental Protection Agency (on water quality issues) the National Atmospheric and Oceanic Administration, and the US Coast Guard (on enforcement issues) may also be involved.

Recommendation 2: Build response capacity. NISC and/or member and partner organizations should develop a sample scenario exercise for use at a medium-sized port with an active Pest Risk Committee. APHIS PPQ Incident Command System training¹⁶ employs tabletop and mock field exercises, including interagency scenario planning where federal emergency response guidelines could be applied to hypothetical case as a preparatory exercises in interagency cooperation. This could be expanded to look at a full suite of biosecurity issues under an enhanced EDRR program at international trade control points. Participants could include the Port Pest Risk Committee plus relevant implementing agencies (PRC+). Scenarios should address the questions in the criteria for EDRR success described above. In particular, agencies involved should understand the particular legal and administrative issues leading up to a declaration of an emergency, given that they will vary by jurisdiction. While inspection and quarantine authorities will have competency in

¹⁶ ICS training is required of all APHIS PPQ Emergency and Domestic Program managers and field operation positions.

validating incidents and may have containment mandates, their remits are in most cases limited to the ports and will not extend to eradication. It must be clear who has the authority to initiate an action, who will communicate to relevant agencies and to the public, and who has competency to respond. Role-playing simulations will help to clarify uncertainties and identify gaps in knowledge, communication, and resources. The results of the simulations should be documented and shared in periodic national meetings of the augmented Pest Risk Committees (PRC+) of participating ports. Simulations should also help to assess the needs for the establishment of standing emergency response teams.

Recommendation 3: Promote international cooperation through the establishment of an “INTERPOL” for pests and invasive species. As urged by participants in a stakeholder consultation conducted in June 2009 by APHIS/PPQ, an international clearinghouse of diagnostic tools and techniques, risk assessments, and intelligence on pathways and identifications of pests. A pilot could be undertaken under a regional trade agreement and scaled to encompass the global trading system after the concept is demonstrated.

Recommendation 4: Establish Learning Networks linking inspection services and port authorities to the scientific community. In support of this effort, a learning network should be established to provide day-to-day intelligence and communication among practitioners. Drawing upon social network methodologies being developed via the Internet, a learning network should address practical information requirements of participants, including, port authorities, Federal regulators, and concerned state and local authorities. The learning network would differ from existing invasive species information portals, by having its interactive components linked to decision support. In addition to resources for the identification of invasive species, manuals developed by NISC, its participating agencies, and other expert bodies, this may include information that should have restricted information such as databases of experts, as well as interactive features such as real or near real-time communication tools such as Twitter, chat, and Internet bulletin boards for peer-to-peer discussions.

The learning network could be expanded to include on-line courses and certification programs for professional development. Access to

commonly-used social networking tools is often prohibited in the workplace; care will need to be taken that policies on the use of social networking tools are consistent with the learning requirements of the agency.

Ideally, a port-based learning network could be extended to engage counterparts at ports overseas in order to tighten the chain of custody of trade-related pathways for invasive species introductions.

Recommendation 5: Develop and implement a *comprehensive surveillance system in the area around a small number of ports as a proof of concept*, building upon the sectoral work done at the Federal and state level in agriculture and forestry, to capture the full range of potentially harmful organisms. Consultations should take place with science bodies such as the USGS and the National Science Foundation concerning the possibility of developing an expanded monitoring system. Measures are required to improve the detection of species that evade inspection and quarantine measures at nodes in trade pathways and become established in and around ports of entry. Regulatory exclusion must be complemented by a comprehensive biosecurity approach involving interagency cooperation for early detection and rapid to new introduced invasive species at ports of entry. Such a system would provide another line of defense.

Annex III provides a more detailed example of a pilot port surveillance system.

Recommendation 6: Develop a sustainable finance mechanism to support EDRR. A cross-cutting budget for rapid response will facilitate the sharing and rapid deployment of resources such as mobile quarantine units, following the example of the National Interagency Fire Center in support of wildfire management and suppression. In order that the costs of trade-based invasive species and pest introductions not be passed on entirely to the taxpayer, investigation should be made of the feasibility of a co-financing mechanism following models given in this report, such as the Boll Weevil Eradication Fund.

Recommendation 7: Establish an EDRR legal studies group to provide advice on regulatory and administrative frameworks for effective EDRR implementation, including authority for instigating rapid responses in different jurisdictions and contexts, and harmonization of the Trade Secrets Act with Federal invasive species policy and law in such a way that it does not prevent appropriate knowledge management.

Rapid response strategies must be cognizant of state and federal requirements governing the use of key response tools, such as the application of herbicides and pesticides. EDRR strategies for anticipated introductions could address potential tensions with the requirements of the National Environmental Protection Act (NEPA). For example, spread prediction models could define treatment areas, allowing an evaluation of site conditions prior to the need to apply treatment, expediting NEPA requirements.

Preparation through analysis of legal requirements can help to expedite compliance with regulations and trigger access to emergency funding. An EDRR legal studies group should be established to provide advice on regulatory and administrative frameworks for effective EDRR implementation, including legal barriers to risk analysis and regulatory disincentives for cooperation or coordination. Consideration should also be given to the harmonization of the global patchwork of regulations concerning certification of commodities in international trade as being free of pests or invasive species.

Guidance should be provided for the conditions under which invasives outbreaks could be addressed as emergencies according to federal and state rules. Policy inconsistency and incoherence in trade promotion and biosecurity should be examined and proposals made for harmonization.

CONCLUSION

Several good examples of Federal and state interagency cooperation in monitoring and EDRR are described in this report and its annexes (CAPS, FICMNEW, ANSTF, RAPIDET). However, all of them are limited by biome, taxa, or economic interest to a narrower subset of the invasive species problem. None of the programs reviewed included a *comprehensive* all-taxa monitoring around a key trade pathway node.

A pilot EDRR program for major ports will help to simultaneously achieve strategic coverage of high-risk localities associated with a major pathway, and provide a laboratory for implementation of key NISC recommendations, particularly concerning the use of the Incident Command System and the establishment of standing emergency response teams. Recommendations for a learning network and periodic meetings of extended port teams will help to build a body of knowledge concerning EDRR.

NISC Guidelines (NISC 2003) allow that international information resources may be required for effective EDRR implementation. For trade-related pathways, coordination along trade routes and corridors is essential; biological invasion is a phenomenon rooted *inter alia* in global trade, and is inherently international. Domestic solutions cannot by themselves be effective. The United States will be in a better position to protect its citizens and their interests from the biological risks posed by participation in global trade only by instituting a comprehensive biosecurity approach funded by a cross-cutting budget for interagency response, similar to the approach employed for fighting forest fires. The hard-working men and women protecting our borders from biological threats deserve our support. If the authorities merely shift blame instead of providing leadership, they will be unable to adequately protect the America's people, infrastructure, agriculture and natural resources. The results will be costly, and will be paid in perpetuity.

The USA has much to contribute to global knowledge of environmental management, including in invasive species early detection and rapid response. It also has much to gain, through exchange with other countries already engaged in EDRR activities, especially Australia and New Zealand. Ultimately, the biosecurity of the US, insofar as biological introductions are involved, will be enhanced through the implementation of biosecurity strategies by all nations.

APPENDIX 1: EFFORTS IN OTHER COUNTRIES AND REGIONS

A. Australia

by Marie Karlberg

Surveillance and Detection in Australia

The rapid response system to invasive species and pests in Australia operates under both federal and provincial law. The Department of Agriculture, Fisheries and Forestry (DAFF) coordinates and manages invasive species including weeds, vertebrate pests and diseases of plants and animals. The entity also outlines policies and has technical and operational responsibility for pre-border, border, and emergency response to invasive species outbreaks (DAFF 2008). Emergency response plans dealing with invasive species and weeds includes AUSWETPLAN, AQUAVETPLAN, AUSTRALIAN EMERGENCY MARINE PEST PLAN¹⁷.

In the majority of incursions by an introduced pest of national concern, the lead response agency will be a State or Northern Territory government agency and federal agencies will provide a national communication and advisory support role.

The provinces have their own incursion management protocols under their own legislation (FAO 2003). DAFF, in liaison with State/Territory and industry stakeholders, has established arrangements concerning management of pest and disease incursions that are considered to have potential and significant impact on Australia's primary industries. As such the Primary Industries Ministerial Council has responsibilities for plant and animal pests while the Natural Resource Management Ministerial Council handles weeds and marine pests (Dawson, 2005)

Consultative committees hold a primary role when it comes to coordinating the Australian Government and State Government involvement in incursion management. The consultative committees make recommendations to a Standing Committee on further action before deciding if eradication is viable. At this stage the Standing committee may either

¹⁷ Plans are available at available at http://www.outbreak.gov.au/response_plans.html (April 2008)

Case Study: management of marine incursions

The following information is gathered from the Australian Emergency Pest Plan, EMPplan 2005.

What triggers a pest alert? The Senior Manager may declare a notification is likely to trigger a pest emergency alert when:

- The description matches a species represented on target species list that represents a new outbreak
- The species detected is not on the target list but meets one or more of the following criteria:
 - Demonstrable invasive history;
 - Demonstrable impact in native or invaded ranges the economy, environment, human health, or amenities.
 - Is inferred as likely to have major impacts in Australia based on the available data and characteristics of Australian environments and marine communities.
 - Vectors for introduction are still operating (Natural Heritage Trust 2005)

Alert Phase

An emergency investigation team of scientists/field officers is assigned and dispatched to the infested site(s). The primary objective of an emergency investigation team is to collect appropriate specimen to ensure that pest identification can be confirmed as soon as possible. The investigation team reports their findings to the affected jurisdiction and informs the lead agency about its consideration on the appropriate course of action.

Operations Phase

An Operational Pest Control Centre (OPCC) is then created to immediately manage an emergency eradication operational response within the affected region. An Operational pest control center is established at the direction of the State/Territory director who has overall strategic command of eradication and containment activities. Management of the OPCC will, in liaison with the regional police disaster coordinator, determine who will take the appropriate actions to call on other support services as required under the State/Territory emergency plan. Initially the OPCC's defined area of responsibility will include an infested site and surrounding areas. State/Territory Pest Control Headquarters (SPCHQ) will manage and coordinate emergency eradication operational response at the State/Territory level. This includes coordination with the management of State emergency services and other supporting agencies as necessary. The coordinator of State emergency services will provide a liaison officer at the SPCHQ and coordinate input from all State/Territory emergency services and supporting agencies from the State emergency operations centre.

Stand-down Phase

When a stand down phase is initiated relevant managers will notify all relevant personnel and stakeholders about the decision. Managers will need to ensure resources match but do not exceed actual operational requirements.

agree on a recommendation not to proceed with further actions or decide on recommendations regarding eradication and financing (Dawson, 2005).

Alert List

A National Environmental Alert List for environmental weeds was developed in year 2000 with the aim to identify plants that are in the early stages of advancement towards becoming weeds and which have the potential to make a significant impact on biodiversity. The list consists of 28 non-native weeds that have established naturalized populations in the wild (Department of Environment and Heritage 2004). Twenty weeds have been classified as Weeds of National Significance (WONS), with the purpose to restrict its spread and eradicating its presence in Australia (Weeds Management Australia, 2008). Furthermore Animal Health Australia maintains an alert list of animal diseases. Some high profile pests (and even some environmental pests) that are not yet current in Australia have been targeted in surveillance programs. These include the guava rust fungus that infects numerous eucalyptus species and poses the most significant threat to eucalyptus plantations and native plant communities in Australia (Dawson, 2005).

The Australian Weed strategy

The Australian Weeds Committee provides a mechanism for identifying and resolving weed issues at the national level and is represented by all levels of Australian Government. The Committee facilitates coordination between the Australian Government and the states and territories and with other agencies and other stakeholders participating in the Australian Weeds Strategy. The Committee's primary role is to provide advice and guidance to the Natural Resource Management Ministerial Council on weeds issues (Weed Strategy 2007)

Determining and Handling an Emergency

The initial report of a suspected pest emergency may come from a variety of sources, including surveys, farmers, foresters and fishermen. At the border level, the Northern Australia Quarantine Strategy, NAQS, combines border activities, scientific surveys and monitoring of invasive species and pests (NAQS, 2008). Relevant information will be collected from the suspect site(s) for evaluation and follow-up action by personnel

within the lead response agency of an affected jurisdiction. The public can alarm response agencies through an Exotic plant pest hotline as well as through an Emergency Animal Disease Watch hotline. DAFF has established an Emergency Risk Management Unit to coordinate and facilitate the entity's involvement in such emergency preparedness and response activities (DAFF, 2008 b). Notification of a suspected pest emergency will then be provided to the director of the lead response agency, who is to determine how to proceed. The scale and potential impacts of a pest emergency will determine whether a State/territory response is sufficient or if there is a need for a joint initiative between lead agencies and State Control Headquarters (Dawson, 2005).

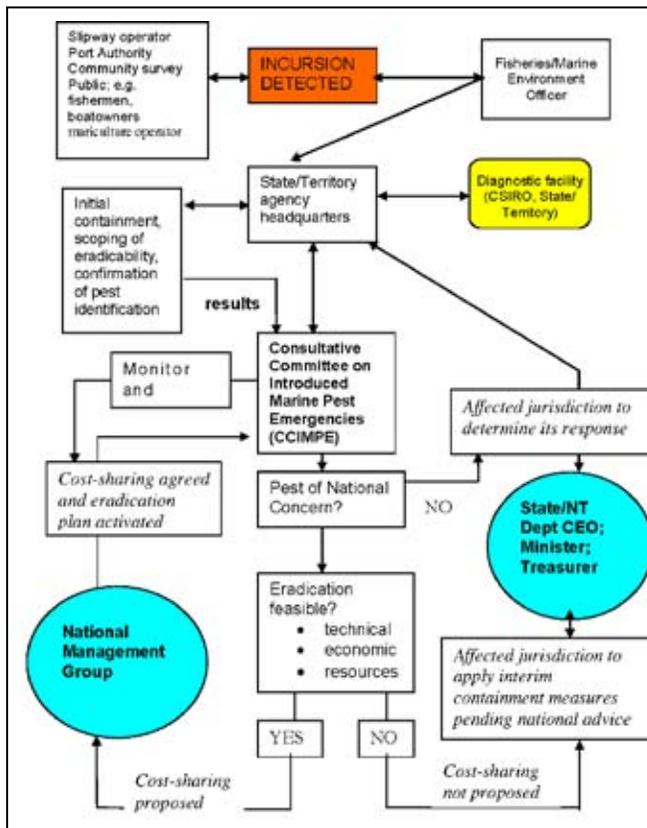


Figure 3: Schematic of the Australian national emergency response framework for incursions of marine pests of national significance (EMPPlan 2005)

B. New Zealand

by Marie Karlberg

Surveillance and Detection

In 2004 the Ministry of Agriculture and Forestry (MAF) was appointed the leading agency for biosecurity issues in New Zealand. The agency is responsible for providing a clear and effective national leadership and coordination as well as integrating all biosecurity activity. Furthermore, MAF is in charge of international trade and animal welfare responsibilities as well as encompassing economic, environmental, social and cultural outcomes. The agency also holds the responsibility to implement New Zealand's Biosecurity Strategy, also known as *Tiakina Aotearoa* (Biosecurity New Zealand 2008).

Command structure

MAF input into whole-of-government responses is co-coordinated through the MAF National Response Centre. Regional pest management strategies are not compulsory and regional councils may choose to respond to organisms that impose risks within their regional jurisdictions (Northland Regional Council, 2008).

The primary mechanism for regional council Biosecurity activities is a regional pest management strategy under the Biosecurity Act (Biosecurity Act 1993). Nevertheless, regional councils may initiate a small-scale response in accordance with section 100 of the Biosecurity Act (Biosecurity Act 1993).

Financing

The Government has overall responsibility for funding biosecurity. Around NZ\$500 million is spent annually on biosecurity in New Zealand, with activities undertaken by central government, regional councils, industry and private landowners. Approximately NZ\$304 million are managed allocated to government agencies (MAF 2008).

New Zealand's Process Principles

In 2007 a new policy document was drafted by MAF on strategies and policies for responding to pests and diseases (MAF 2007). The following information on New Zealand's process principles are gathered from above mentioned document.

Where legislation stipulates the process to be followed and/or criteria to be applied for a specific decision, these must be followed and applied. Additionally, obligations described in international standards or treaties ratified by the Government should be followed.

Conducting an analysis including an understanding of the issue, the context, the risks and opportunities and the objectives. The analysis should end in solutions to manage the issue and assessing strategic fit, net benefit, feasibility, and resources.

Decisions should be made by appropriate officers. Unless specified in legislation, decisions should be made by the people who possess relevant information and skills.

Timely and well-informed. Decisions should be made with the best information available at the time. The level of information sought and analysis should be proportional to the size of the risk/opportunity identified in the available timeframe and the urgency required.

Consistency. The decisions process must be consistent but only to reasonable extent. Decisions principles, criteria and tools should be applied consistently so that decisions do not differ in assessment approach.

Consult affected parties, including Maori (indigenous population of New Zealand). Identify and consult with affected parties including Maori, as soon as possible in the decisions process. Sufficient time and information should also be given to affected parties in order for them to be able to provide effective feedback before final decisions are made.

Transparency. Communicate the decision in a manner that affected parties grasp the meaning of the conclusion and the reasoning behind it in order for them to understand the implications, and the behaviors being sought.

Determining appropriate response

The investigation phase begins a notification of a suspect risk organism, or a change in the behavior of a known pest, and concludes with a recommendation by the investigators on most appropriate actions. MAF maintains an Exotic Pest and Disease Hotline through which notification of potential biosecurity risk organisms are received. The credibility of all notifications of potential risk organisms is determined on the basis of:

- The likelihood that non-biosecurity factors are the causes of the issue notified; and
- The likely seriousness of the potential impacts arising from the issue notified.

MAF identifies or diagnoses all credible notifications so that decision to stand down can be made, a recommendation is that a response be initiated, or the transferred to a more appropriate organization (when a determination is made that it is not a biosecurity issue) (MAF 2008).

In terms of collaboration, MAF works with parties to establish long-term arrangements for the management of an organism where needed. MAF may issue transfer of accountability if another organization appears as more appropriate for managing a response. MAF has developed memoranda of understanding with the Ministry of Health, Department of Conservation, Ministry of Fisheries and with the Environmental Risk Management Authority, ERMA, on roles and responsibilities for invasive species management (MAF 2007).

Regarding urgent measures, actions may be taken to prevent or slow the increase in risk to New Zealand's overall economic, environmental, health and social/cultural values arising from the risk organism. Urgent measures may also be taken where failure to take the urgent measure would jeopardize an otherwise doable response option.

A rule of thumb is that the extent of an urgent measure should be appropriate, in proportion to the risks involved. Furthermore the decision to act should be based on best available information at that time. When determining whether urgent measures are needed, the Biosecurity Decision Steps, and associated Process Principles and Content Principles should be considered as well as:

- The adequacy of available information;

- The feasibility of the proposed measure(s);
- The likely change in biosecurity risk if the measures(s) are taken, including the probability of losing or significantly impacting on future potential response option(s);
- The consequences of undertaking the measures(s), including the public acceptability and impact on resources available for the rest of the response;
- The need for access to statutory powers required to take the measure(s);
- A high-level review of the overall net benefit of the measure(s) including costs and benefits and their likelihoods; and
- The relative priority of the measure(s) with respect to other work in relation to this response and other responses.

The response phase comprises seven areas of activity:

- Undertaking direct actions to preserve the range of potential response options until such time as a full response plan has been approved. For example, measures may be taken to maintain the option of later eradication.
- Determine the risks (likelihood x consequence) that the risk organism poses to the values being protected.
- Taken into account the relative priority of the response with respect to other responses.
- Developing and evaluating response options in order to determine the most appropriate course of action.
- Approval (and funding where required) of the course of action seen as the most appropriate response to the risk organism. A documented Incident Action Plan with defined response objectives underpins this.
- Implementation of the Incident Action Plan.
- Ongoing evaluation of the Incident Action Plan and agreed adjustments to that plan as needed.

MAF evaluates all feasible response options, which include the following baseline scenarios addressing (i) the likely impacts and outcomes if the Government does not intervene; (ii) eradication of the risk organism from all parts in New Zealand; (iii) and continuous control to decrease the im-

pacts of the risk organism, including exclusion from an area or excluding from populations of a host species or social marketing to raise awareness (MAF 2007).

MAF's task is also to outline objectives for each response option regarding an estimation of the biosecurity risk, the level of intervention justified; the consequences of failure related with each option; the costs and benefits of each option, the strategic match with the Government's strategies and goals, feasibility, resources and barriers to success. MAF re-evaluates response objectives during the response, using the same approach taken to evaluating potential response options during initial response (MAF 2007).

Learning from response

MAF possesses the role to ensure that the lessons learned during a response is captured and communicated. The performance of responses, policies and procedures is formally reviewed at the conclusion of a response. Lessons learned are then used to update the generic response systems and risk organism-specific plans. A formal debriefing is held when a response has been stood down or the responsibility formally has been designated to another organization (MAF 2007).

Exit point

MAF considers standing down when the costs of responding outweigh the benefits; when an organism is considered not to be of national interest, when the risks posed by the organism are considered to be less than other response priorities; or when no feasible response option exists. MAF also considers standing down when the risks posed by the organism can be referred to a specific sector that possesses the capacity to manage risks without further government involvement. In such a scenario MAF informs other affected parties and may participate in a response co-coordinated by those parties. If no one is willing to coordinate a response, MAF may hand over further management of the organism to individuals or landowners (MAF 2007).

Prevention

New Zealand has a hazard list in screening organisms. When considering whether an identified organisms or disease should be included in the hazard list, the following questions are considered:

- Is the organism or disease associated with a commodity or conveyance? The organism or disease should not be considered as a hazard if it's not linked to a commodity or conveyance under consideration. Highly processed commodities, such as live virus vaccines or hormonal products derived from sera are not referred to as likely to be infected with certain bacteria or viruses due to their methods of production.
- Is the organism or disease absent from New Zealand but likely to be present in the exporting country? An evaluation of an exporting country's relevant service, surveillance, control programs and zoning and regionalization systems are important factors to consider when determining risks of goods. If a country claim that it is free of a particular hazard supporting evidence must be provided, such as a certification from the Veterinary Authority or National Plant Protection Organization in the exporting country.
- Is the organism or disease present in New Zealand and likely to be present in the exporting country, and meets one of the following criteria?
- The organisms are vectors of pathogens or parasites, but whose populations in New Zealand are free of the pathogen or parasite of concern.
- The organisms have strains¹⁸ that do not occur in New Zealand, although the overall species is present in New Zealand. Measures to exclude strains that are likely to cause significant impact may then become necessary¹⁹.
- The organisms differ genetically from those that are present in New Zealand in a way that may impose potential for greater consequences, either in terms of characteristics of the organism itself or through interactions with existing organisms in New Zealand.
- The organisms or diseases are already present in New Zealand but the nature of the imports could significantly increase the existing hazard.
- The organisms or diseases are already introduced in New Zealand however their presence is geographically bounded (Biosecurity New Zealand 2006).

¹⁸ A "strain" refers to any group of organisms which are part of the same species, but with different shared characteristics, which makes the group distinct to the currently occurring population at a sub-specific level

¹⁹ This approach is in line with the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)

- The organisms or diseases have host associations different to those currently present in New Zealand. Measures against such organisms may be justifiable when there are clear differences in host associations between the foreign and the one present in New Zealand.
- The information available on organisms or diseases is minimal thus it should be considered a hazard at this stage. A more detailed risk assessment process will then determine the level of likely risk.
- The organisms and diseases have free zones or zones of low prevalence in New Zealand that are established under a national or regional pest management strategy or small-scale program and where the movement of host products into the zone is under statutory control.
- The organisms or diseases are listed on the unwanted organisms register as a notifiable organism (Biosecurity New Zealand 2006).

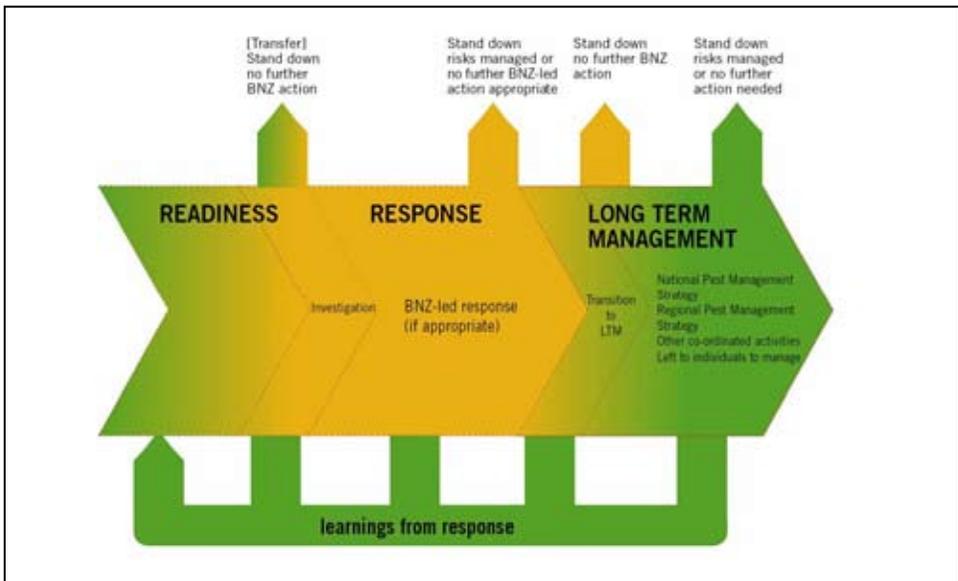


Figure 4: Biosecurity New Zealand Response Phases (MAF 2007)

C. Greater Caribbean and Florida Pathway for Invasive Species Introductions

Globalization is increasing the numbers and rate of exchange of invasive species (McNeely et al, 2001, Wittenberg and Cock 2001, Burgiel et al, 2006). Major pathways of biological invasion include ballast water, hull fouling, food supply, and aesthetics (Ruiz and Carlton 2004). "Because every nation is an exporter and importer of goods and services, every nation is also a facilitator and victim Wealthy nations therefore need to help raise the capacity of island nations and territories to minimize the spread and impact of IAS." (Reaser et al 2007).

The US Department of Agriculture recognizes the greater Caribbean as a path for the introduction of invasive species into Florida (Balaam, in Caribbean Food Crops Society 2007). This "Florida Pathway" reflects the agricultural and horticultural trade between Florida and the United States (including fresh fruits and vegetables, cut flowers, and propagative materials), shipping in general, a very high passenger volume due to the tourism trade, recreational boating, and species dispersal due to natural causes such as extreme weather and birds.

According to the Federal Maritime Commission, trade and shipping between the southeastern US, the Caribbean, and Latin America may triple from 2005 levels by the year 2020 as a direct result of the CAFTA/DR trade agreement (Federal Maritime Commission, 2005). Major modernization efforts are underway at key ports in the region, which are vying to become the hub for efficient, economic shipping that will be key to competitive success in a free-trade environment. There is little evidence to date of efficient sanitary/phytosanitary measures that will be necessary to manage the risk of introduction of invasive species as a collateral effect of this growth in traffic between countries.

The University of Florida has tracked a surge of invasive species into the state of Florida in the USA from the greater Caribbean region, and initiated technical contacts with counterparts throughout the region. In 1999 it convened an international workshop on mitigating the effects of exotic pests on trade and agriculture, followed in 2003 by a workshop in Grenada on challenges and opportunities in protecting the Caribbean, Latin America, and the United States from Invasive Species. This led to the formation of the Caribbean Invasive Species Working Group (CISWG) and the drafting, at a 2004 workshop in Trinidad and Tobago en-titled

“Facilitating Safer US-Caribbean Trade: Invasive Species Issues”, of the Caribbean Invasive Species Intervention Strategy, CRISIS. CRISIS was approved by CARICOM (The Caribbean Economic Community)’s Council on Trade and Economic Development. The CISWIG developed a proposal for a Caribbean Invasives Surveillance and Information Program (CISSIP). This was presented to a CARICOM donors’ conference in June 2007, and considered by the InterAmerican Development Bank, but was not funded.

USDA APHIS has initiated a Caribbean Safeguarding Initiative in support of CRISIS in 2007 to build safeguard capacities within the region through cooperation with Caribbean states, with the goal of reducing the risk of introducing species into the United States via the Caribbean pathway. Elements of cooperation include:

- An offshore pest information program - provides technical assistance to build infrastructure and capacity for risk assessment and mitigation measures;
- A risk notification system - to share information on pest interceptions and work with exporters to reduce pest risks;
- A clean stock pilot program - to meet the demand in the US for pest-free stock through an offshore certification process (being piloted in Costa Rica);
- A biological threat advisory group - to develop tools, capacity, and risk management strategies at ports
- Offshore pest mitigation - cooperative implementation of pest surveys, and implementation of chemical and biological controls; and
- Caribbean Invasive Species Surveillance and Information Program (CISSIP) - a regional program in support of the Caribbean Regional Species Intervention Strategy, including three elements:
 - Pest survey and inspection
 - Digital diagnostics (the Caribbean Regional Diagnostic Network)
 - Information and communications

The University of Florida (UF) has developed the software needed for the Caribbean Regional Diagnostic Network, one of the key components of CISSIP. It has also provided a Spanish language version the Distance

Diagnostic and Identification System to the University of Puerto Rico-Mayaguez and the Secretariat of Agriculture of the Dominican Republic. UF has used the DDIS since 1999 as a tool for diagnosticians to share information on plant diseases and other pest diagnostics. The system allows users to submit digital samples from the field for pest identification, allowing problems to be quickly identified and evaluated in near real-time. It boasts a 60% success rate with plants, 80% with insects. UF and the University of Puerto Rico will train professionals in the Dominican Republic on distance diagnostics. UF is also working with USDA APHIS to introduce the DDIS in Haiti, with funding from USAID.

Although CISSIP was turned down for funding by the InterAmerican Development Bank in late 2007, elements are being implemented through the Caribbean Safeguarding Initiative. The process shows promise of becoming a model for regional cooperation for invasive species early detection and rapid response. However, in its current formulation it is primarily attendant to US needs; it is important to note that the pathway for invasives introductions in the Caribbean can also run in reverse and should also be addressed (e.g., through horticultural supplies to resort hotels in the Caribbean from Florida suppliers) (Waugh, 2009).

In 2009 APHIS produced a Caribbean regional pathways analysis on behalf of CISWG members, as a contribution to CRISIS (Meissner et al 2009). This report calls for regional coordination, public engagement, early warning and rapid response, and a unified pest information system. It also represents a major step towards a comprehensive approach addressing invasive species not only from the region to trading partners, but also vice versa. It is expected that pathway summaries including risk analysis will serve to catalyze further discussion on regional collaboration and advance the work of the CISWG.

APPENDIX 2: SELECTED US FEDERAL AGENCY INFORMATION SOURCES

The US Department of Agriculture (USDA)

Because of the economic impact of invasive species on the agriculture and forest sectors in the form of pests and diseases, and because the Department of Agriculture's US Forest Service is one of the nation's largest land managers, the USDA is a major contributor to EDRR efforts within the Federal government.

Natural Resources Conservation Service (NRCS)

NRCA maintains the Plants Database²⁰ to provide information on plants of the United States. This includes an invasive species portal containing links to some Federal and state datasets and some references.

National Agricultural Library

The National Agricultural Library has created a National Invasive Species Information Center to provide information to specialists and the general public, in support of NISC (<http://www.invasivespeciesinfo.gov>). The Information Center has created an on-line clearinghouse of invasive species information, including early detection and rapid response information. The NAL aggregates and provides access to information on all aspects of agriculture and seeks global cooperation through international information exchange and technical assistance. Although suffering from a declining budget in recent years, the NAL provides a world-class resource not fully utilized for EDRR.

USDA Animal and Plant Health Inspection Service (APHIS)

APHIS is the lead agency in the federal government for the implementation of regulations pertaining to plants and animals imported into the United States. APHIS sets sanitary and phytosanitary standards and supervises screening for plant and animal pests and diseases. It provides technical assistance to foreign governments to prevent the reintroduction of pests that have been eradicated in the USA.

The Plant Protection and Quarantine (PPQ) unit of APHIS is the agency within the Federal government responsible for plant health emergencies.

²⁰ (<http://plants.usda.gov>)

APHIS/PPQ provides a key technical component of an effective EDRR process. Its mandate is limited to plant health, however, and does not extend to cover invasive species more broadly. APHIS/PPQ has a strong track record in emergency response to pest outbreaks, typically working in cooperation with state agencies. As such, it provides a critical resource for building an effective invasive species rapid response system. In particular, APHIS' Cooperative Agricultural Pest Survey Program (CAPS) is an important partnership mechanism for agricultural pest and disease surveillance and detection. Although focused on known pests for specific commodities, the CAPS program provides a model of integration of capacities from Federal and state agencies and universities.

USDA Forest Service (USFS)

The Forest Service has developed a National Strategy and Implementation Plan for Invasive Species Management (USFS 2004) and a draft Early Warning System (EWS) for environmental threats to forest lands in the United States (USDA Forest Service, 2005). The EWS is intended to be a comprehensive approach addressing a wide range of environmental threats, including, in addition to invasive species, fire, catastrophic weather events, and outbreaks of native pests and diseases, responding to a mandate from the Healthy Forests Restoration Act of 2003. As with other large-scale EDRR efforts, the Forest Service approach involves cooperation with partners and stakeholders, including other federal agencies, state agencies, tribal authorities, and the private sector. It draws on the experience of the Federal Interagency Committee for the Management of Noxious and Exotic Weeds' (FICMNEW, q.v., below) EDRR system for invasive plants. EWS also provides for the coordination of communication and outreach, and significantly, for monitoring treatment effectiveness and post-restoration restoration.

The Forest Service has established an Eastern Forest Environmental Threat Assessment Center (EFETAC), an interdisciplinary program to develop the technology and tools to anticipate and respond to emerging forest threats in the eastern half of the United States. The EFETAC provides a platform for cooperation in research and early warning systems for multiple federal, state, and local authorities, academia, and NGOs.

The USFS EWS designates the Forest Service's Forest Health Protection Program as the national coordinator for forest insects and diseases. It identifies key reference resources, including the North American

Exotic Pest Information System developed under the aegis of the North American Forestry Commission of the Food and Agriculture Organization of the United Nations (FAO), and the National Agricultural Pest Information System. The EWS designates USDA/ APHIS (q.v., above) as the lead for pest risk assessments. Based upon careful analysis of risk, including contributing environmental influences and vulnerable ecosystems, EWS provides for systematic surveys, and for surveillance drawing upon a network of Forest Health Specialists, forest managers, arborists, port inspectors, and the general public. Through a pilot Rapid Detection and Response Program (RAPDET), the Forest Service is working with other agencies to establish an emergency response measure.

RAPDET

“Since 2001, the RAPDET program has coordinated pilot tests for the detection of invasive bark beetles ... in high-risk locations throughout the USA. The RAPDET program places traps at selected sites and sends unknown captured specimens to an insect taxonomist for identification. In April 2003, the banded elm bark beetle, *Scolytus schevyrewi*, a Siberian species previously unreported in North America, was first collected and identified in 2 western states. By August 2003, additional RAPDET trapping had detected *S. schevyrewi* in at least 23 states. Currently APHIS, State forestry organizations, and the Forest Health Protection program are working together to map the potential range and impacts of this beetle.” (USDA Forest Service, 2005)

Building on a memorandum of understanding between the Forest Service and APHIS signed in 2001, a Rapid Detection and Response Team (RAPDET) was established by the US Forest Service to coordinate pilot tests for the detection of nonnative bark beetles and the nun moth. Team members included, among others, Oregon and Maryland state departments of agriculture, Cornell University, the USDA Agricultural Research Service, APHIS, and the Forest Service’s Forest Health Protection unit. Between 2001 and 2004 this program placed baited funnel traps in urban forests and forests around port facilities and wood-handling facilities in several regions of the United States. Five species not previously recorded in North America were trapped by RAPDET between 2001-2003 triggering rapid response measures.

RAPDET demonstrates the feasibility of coordinated monitoring efforts targeting high-risk localities. As with most US EDRR efforts, however, RAPDET samples for specific organisms linked to an agency mandate. A *comprehensive* monitoring program to sample for non-native species in and at the periphery of US ports and along key transportation corridors linking the ports would be feasible using RAPDET's cooperative model. Local universities, state and federal authorities, and even civil society organizations and civic groups could participate in long-term monitoring, drawing on the experiences of and perhaps in some cases linking with the US Long-Term Ecological Research network (LTER).

The Department of the Interior - US Geological Survey (USGS)

The USGS is the principal Federal agency for earth and biological sciences, supporting other branches of government and society at large through information for effective decision-making. It accomplishes its mission of providing reliable scientific information through research and through information infrastructure. The USGS National Biological Infrastructure Initiative has developed a National Framework for Early Detection, Rapid Assessment, and Rapid Response to Invasive Species (<http://edrr.nbii.gov/>). Through its framework USGS seeks to identify and prioritize gaps in the EDRR framework in order to better identify future funding needs. According to USGS, recognition and application of the EDRR approach is growing and the approach is coming into sharper focus.

The USGS National Framework is presented as an Internet portal cataloging early detection and rapid response resources, grouped under seven EDRR components, including species identification, reporting mechanisms, sources of expertise for verification, sources of documented occurrences, assessment methodologies, planning tools, and descriptions of various rapid response mechanisms (mainly organized by state/local governments or organized along thematic lines). Key to the success of the EDRR Framework is ensuring that the system is populated with links to authorities with resources to act upon incidents. The National Framework portal also links into the Invasives Information Network (I3N) of the Inter-American Biodiversity Information Network, for which USGS is the US national authority and overall coordinating institution.

The USGS National Framework portal includes a decision tree for rapid response for use by EDRR authorities, and checklists, identification guides, and species profiles.

USGS has also produced Guidelines for Early Detection and Rapid Response Systems (USGS, 2003) that advocate the identification of high priority species and risk assessment prior to their detection in order to shorten the response time. These guidelines recommend consistent data definitions and interoperable formats. They also prescribe standing trained response teams with rapid response manuals, organized using the Incident Command System (q.v., below).

The USGS mandate is not one of stewardship, but of science. Its role in EDRR is heavily weighted towards detection and surveillance, to planning, and to evaluation. It strives to provide sound science for subsequent action by agencies with regulatory authority.

Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW)

FICMNEW, an interagency coordinating body consisting of key land management and regulatory agencies, including inter alia the Forest Service, APHIS, USGS, the US Fish and Wildlife Service, the Federal Highway Administration, the Environmental Protection Agency, and the Armed Forces Pest Management Board. FICMNEW is specified in Executive Order 13112 as an advisory body to NISC. FICMNEW produced a conceptual design for an EDRR system for invasive plants in 2003 after a five year long consultation effort. Field-testing of the system began in 2003.

As with contemporary efforts elsewhere (some of which have benefited from FICMNEW leadership), FICMNEW's EDRR system provides a logical stepwise process for detection, reporting, identification and vouchering, rapid assessment, planning, and rapid response (FICMNEW, 2003). FICMNEW's EDRR proposes a generic rapid response plan, a knowledge base and network of experts to administer and guide rapid response efforts, develop decision support systems for managers, and to integrate new knowledge into a framework for adaptive management.

FICMNEW has identified the need for new and additional resources for national and regional coordination, taxonomic expertise, information resources, and a global early warning system for invasive species.

As an interagency coordination body, FICMNEW does not have operational authority or a budget to implement its recommendations.

Aquatic Nuisance Species Task Force (ANSTF)

The National Oceanic and Atmospheric Administration and the US Fish and Wildlife Service share the responsibility for the management of aquatic invasive species under the Nonindigenous Aquatic Nuisance and Control Act of 1990. The interagency Aquatic Nuisance Species Task Force (ANSTF) has developed a model system for the coordination of early detection and rapid response measures for aquatic invasives and is working with the states to develop statewide systems for rapid response. Forty of the fifty states either have completed or are in the process of completing a state ANS management plan using a model developed by the ANSTF. Eleven species or taxonomic group management plans have also been developed. ANSTF member agencies have established systematic monitoring for aquatic invasives in several heavily trafficked bays and estuaries including the Chesapeake and San Francisco Bays and the lower Columbia River. Plans and other documentation are available at ANSTaskForce.gov. The ANSTF collaborates with NISC on invasive screening processes, and has developed a risk analysis review process, which has been broadened beyond aquatic species, and addresses uncertainty and data quality issues. The emphasis of the risk analysis review process has moved away from decision support to expert elicitation for risk assessment, taking into account characteristics of the ecosystem and of alien species to determine the probability and the ecological consequences of establishment and spread.

Federal Interagency Committee on Invasive Terrestrial Animals and Pathogens (ITAP)

ITAP complements the Federal interagency processes for weeds and for aquatic nuisance species with a process focusing on animals and on pathogens. ITAP facilitates Federal responses vertebrate, invertebrate, and plant and animal pathogen species in terrestrial ecosystems. ITAP's strategic plans for vertebrate and invertebrate invasives include measures to prioritize potential invasive species and their pathways, for harmonization of rapid response actions, and for information management. In the case of the latter, ITAP's vertebrate strategic plan calls for the creation of a participatory mechanism for reporting sightings. It's invertebrate plan calls for extension of the Pest Information Platform for Extension and Education discussed within this report to invertebrate species.

APPENDIX 3: A PILOT INTERAGENCY EARLY DETECTION AND RAPID RESPONSE LOCAL AREA NETWORK

Background/Context

In the United States, the potential impacts of economic globalization, free trade, and biosecurity on natural and managed resources have come into sharper focus in recent years as the result of high profile disease and pest outbreaks. Two recent examples include the introduction of monkey pox through the international pet trade, and the discovery of an unknown species of ant (crazy raspberry ant - *Paratrechina* sp. nr. *pubens*) in Houston, Texas.

Supplemental measures are still required to improve the detection of species that evade regulatory exclusion (inspection and quarantine measures) at nodes in trade pathways and become established in and around ports of entry. Regulatory exclusion is unlikely ever to be totally foolproof, and must therefore be complemented by a comprehensive biosecurity approach involving interagency cooperation for early detection and rapid to new introduced invasive species at ports of entry. Such a system would provide another line of defense in the ongoing effort to develop a National Early Detection and Rapid Response System within the United States.

The proposed project would build upon current efforts. For example, in support of the 2008-2012 National Invasive Species Management Plan, the USDA Animal and Plant Health Inspection Service (APHIS) is working to develop and implement new methods for screening introduced plants proposed for importation that have a history of invasiveness. This is an important step in preventing intentional introductions of known invaders.

Project Purpose

The objective of the proposed project is to conduct a three-year pilot test to demonstrate the feasibility of a comprehensive interagency early detection and rapid response system around a US point of entry for international trade. The project results that will achieve this objective are:

- Selection of a medium-sized port of entry as a pilot site that is large enough to be representative the regulatory exclusion issues without being overwhelming.
- Convocation of a small focused Port of Entry EDRR Expert Panel consisting of federal and state plant regulatory officials, port inspectors, port authorities, shippers, and other relevant stakeholders to recommend early detection and rapid response mechanisms at the ports of entry.
- Implementation of a comprehensive surveillance program in concentric zones around the port to detect introductions of all flora and fauna species.
- Engagement of the port pest risk committee as a coordinating body.
- Organization of an interagency rapid response team using the Incident Command System
- Cross training of staff of the participating agencies in detection, response, and reporting.
- Data collection and the establishment of a common data infrastructure.
- Adaptive management and evaluation of project results throughout the project lifecycle to refine and improve the methodology.
- Production of a sustainable financing model for the system.
- Production of lessons learned from the experience.

Strategic Direction

The project will build upon the *ad hoc* interagency pest risk committees already in place in many ports, the interagency cooperation under NISC and Executive Order 13112, and processes such as the Aquatic Nuisance Species Task Force and the Federal Interagency Committee for the Management of Noxious and Exotic Weeds, and surveillance systems such as those established by USDA/ APHIS, the Invasive Plant Atlas of New England and by the US Forest Service under the RAPDET program.

The innovation in this project is to link efforts at a high-risk area and thereby provide a comprehensive and cost effective screen for invasives introductions.

Implementation

An interagency steering group will carry out the project, using funds raised to match and leverage existing agency resources. Stakeholders will include the port authority, Federal, State and local authorities with mandates relating to pest or natural resource management, disease vector control, and wildlife conservation, and private land-owners in and around the port. Natural resource user groups, including farmers, foresters, and public utilities, also have a long-term vested interest in the project outcomes. The institutional host may be a research institution, a government agency, or a private non-profit organization with credibility among the stakeholder community and a science capacity.

Plan of Action

Stage one (six months) – a steering committee will be convened. A situation analysis will be conducted and an expert consultation undertaken to recommend surveillance methods, zones, and participants. An implementation plan will be prepared, including delimitation of the zones of surveillance in concentric circles around the port, using the best available science and knowledge gained from prior surveillance programs.

Stage two (24 months) – The surveillance implementation plan will be initiated and a data management system accessible to all participants will be established.

Stage three (concurrent with stage two) – a rapid response plan based upon the incident command system will be developed and initiated. A joint training syllabus will be developed and training courses initiated.

Stage four (concurrent with stages two and three) - a sustainable finance plan will be studied and proposed.

Stage five (six months) – a review of lessons learned from the experience will be produced and a replication plan to scale up the activity will be considered. Recommendations will be made to the NISC.

Assumptions

Fundamental assumptions of the project are that early detection and rapid response is cost-effective and will provide long-term benefits to taxpayers and other stakeholders, and that it is in the interests of the agency to collaborate on a chronic problem with growing risks and costs in light of climate change, and in which no single agency has the mandate or capacity by itself.

APPENDIX 4: AN EARLY DETECTION AND RAPID RESPONSE LEARNING NETWORK

Background/Context

The majority of new introductions of terrestrial and aquatic invasive species occur along trade pathways. The majority of these are associated with marine ports of entry where trade volumes are substantial and growing. According to the Federal Maritime Commission, trade and shipping between the southeastern US, the Caribbean, and Latin America may triple from 2005 levels by the year 2020 as a direct result of the CAFTA/DR trade agreement. Major modernization efforts are underway at key ports in the region, which are vying to become the hub for efficient, economic shipping that will be key to competitive success in a free trade environment. There is little evidence to date of efficient sanitary / phytosanitary measures that will be necessary to manage the risk of introduction of invasive species as a collateral effect of this growth in traffic between countries. Measures to assist trading partners to keep pace with the biosecurity challenges inherent in growth in trade are necessary, as are actions to diminish introduction of invasives and to institute procedures that will reduce transboundary movement of invasive species, including pests and diseases.

It is in the interest of governments to prevent the introduction of invasive species from multiple perspectives, including food security, public health, and ecosystem services. The dissemination of timely, accurate and species-specific information will be of immense benefit in process of regulatory exclusion of invasive species. In order to fully understand biosecurity issues and to capitalize on investments in border security, there is also a need for consistent, continuous documentation and exchange of scientific information on discoveries of both known invasive species and new species among port inspection and quarantine officials. Ideally, nations engaged in trade with one another can share information work together to build capacity throughout the system to prevent invasive species introductions.

Purpose

Communication between ports, agencies responsible for pest, invasive species and disease vector management and trading partners is a key to

more effective management of the trade pathway. A port-to-port learning network is proposed to improve the capacity of port inspectors to be more effective and efficient in blocking pathways and the invasives they bring. This concept note describes an opportunity to work collaboratively with agencies in the US and in trading partners with line responsibilities for invasive species research, interdiction, and control to collectively improve knowledge of the linkages between trade pathways and introductions, while at the same time developing a pragmatic, results oriented model for capacity building for the interdiction of potentially invasive species.

Implementation

This proposal provides a proof of concept for creation of a learning network on the early detection of and rapid response to invasive species in trade pathways. Learning networks are social constructs that can function within an agency, across agencies within a government, or across governments to facilitate rapid exchange of information between peers to facilitate corporate learning. Learning networks are well suited to deployment within the context of a trading bloc that provides a foundation of agreed rules for trade facilitation.

Plan of Action

1) A study that provides baseline information on the inspection and quarantine measures in place pertaining to ports, the inspection practices, and resources available to inspectors at selected partner ports. The study will identify options, recommend and test a preferred alternative for information sharing, early warning, and rapid response measures in order to better manage the risk of introductions via trade-related pathways about new introductions of invasive species at two ports in countries that trade with the US. The study will design an appropriate port-specific and/or country-specific rapid response system that will implement actions to be taken when an invasive species threatens nearby urban, agricultural or natural ecosystems. The study will assess the interoperability of key databases for information sharing in the trading countries and recommend changes to promote the exchange of the appropriate invasive species information.

2) A review of the options for establishing access to information on known and potentially invasive species, including their identification and

assessment of potential risks.

3) The design of social networking tools to be used by the learning network, based upon consultation with stakeholders to assess communication technologies, cultures of communication, and communication priorities. As a demand-driven process, the learning network will adapt to accommodate specific demands and requirements from participating agencies, including, if appropriate, aquatic organisms.

4) Capacity building through technology transfer and training in discovery methods, species identification, data entry and analysis, regulatory tools (e.g., quarantines, treatments, rejection etc) and eradication measures.

Implementation will focus on establishing the network through custom officials, inspectors, and pest/vector/invasive species monitoring authorities at the selected ports. The ports chosen will have strong and growing trade relationships- both ways- which enhances the potential for new introductions of invasive species to or from the country.

Evaluation will provide direction to “scale-up” follow-on activities. A future project could for example focus on the expansion of the learning network to address specific requirements for aquatic species information sharing, including information on best management practices for ballast water discharges and methodologies for rapid response to aquatic invasive species.

Indicative Project Timeline for 36 month project

Task 1: Baseline study months 1-6

In the first year, a study will be conducted to assess the capacity of selected ports in:

- Interdiction/identification of invasive species;
- Data collection and reporting standards;
- Governmental structures in place to address invasive species introductions;
- Clearinghouse mechanisms, in-country, for information sharing on invasive species.
- Rapid response measures in place for eradication of invasive species,

pests, and disease vectors.

Task 2: Taxonomic identification months 2-7

Technology and information resources to facilitate improved species identification will be identified and a plan for technology transfer will be developed for task 3.

Task 3: Information Access – months 6-12

Options and a recommendation for an appropriate mechanism for communication between the US and participating partner countries will be identified. The communication will inform of incoming invasive species at the port of entry. It can link to other databases that have scientific information on invasive species. The purpose is to provide access to existing information resources that will assist the ports with pathway assessment tools such as records of vectors for intercepted species, species identification tools, such as identification keys and photo libraries of known or potentially invasive species, and management tools for containment and eradication. The information access and technology transfer strategies will be implemented in task 4.

Task 4: Peer-to-peer networking development – months 12-24

Information access and technology transfer plans will be implemented. A help-desk function for inspectors will be established, consisting of a multilingual staff with inspection and quarantine experience to support partner efforts. Resources such as on-line forums for open discussion will be developed on the basis of consultation with agencies and staff to ensure that the products are properly demand-driven. Collaborative tools with translation facilities such as Google Wave will be used, possibly through a strategic partnership with a technology provider. Key inspection and quarantine experts will be identified at the participating ports by function and legal entity. We will assess the availability of taxonomic and other technical expertise, and the processes of interaction between inspection and quarantine authorities and technical experts. Specific recommendations, by port and by country, will be made to create or enhance appropriate interaction among the port staff and the invasive experts. Experts will communicate via the Internet, video conferencing and other electronically-mediated methods.

Task 5: Training – months 18-36

After a needs-assessment, partners will provide the appropriate train-

ing to the port staff and natural resource management authorities in this project on issues such as phytosanitary controls, early detection, rapid response, invasive species identification and any other appropriate skill or knowledge necessary to make the effort successful.

Task 6: Implementation of learning network to prove the concept months 18-36

The learning network will begin with information sharing on terrestrial invasive species and on rapid response to those species once they are introduced at a participating port. The information/communication protocols will be established.

Task 7: Development of a sustainable finance model for the network.

Sustaining an intensified level of surveillance and rapid response capability will require an ongoing effort. The project will conduct a study of sustainable finance options and the cost/benefit ratio for the activity against baselines including the status quo and the absence of regulatory exclusion efforts, and present it to participating countries for consideration.

Task 8: Review and evaluation

Future Task 1: Expansion of learning network

The network will be expanded to encompass information sharing on terrestrial species on a regional basis (e.g., APEC, CARICOM, etc)

Future Task 2: Enhancement of the network to include aquatic species

Aquatic species will include legally traded products, such as fish and species in the pet trade, as well as aquatic species introduced through hull fouling and ballast water discharges. Including the experts and information related to invasive aquatic species will enhance the network.

Technical Feasibility

Targets and Benchmarks

By the end of year one, a baseline will be established on information about the appropriate and selected ports. Procedures for taxonomic identification of species and experts in the US will be available.

By the end of year two, the information access, a desk help function and

peer-to-peer networks essential to the learning network for invasive species will be established for the partner ports. Training will have been initiated. The information sharing will focus on trade-related pathways.

By the end of year 3, a scalable learning network model will have been tested and evaluated, in preparation for deployment in a broader framework.

Monitoring Mechanisms

Results based management principles will be integrated into project design to ensure that project goals and assumptions are tested rigorously and performance is gauged against clear targets. Routine evaluation against project indicators will identify impediments to implementation and adaptive management processes will incorporate lessons learned in the implementation process into the overall project design. A comprehensive evaluation of the project will inform the development of follow-on activities and the incorporation of lessons from the project into the workplans of participating agencies.

Estimated Costs

A series of tasks in year 1 and 2 will gather the basic information to formulate the learning network. Tasks for year 3 will establish the network and prove the concept. The total costs associated with year 1 tasks are approximately \$200,000; \$250,000 in year 2 and \$150,000 in year 3.

Funding will be utilized by partners and their agency counterparts in the target countries, leveraging US government agency resources and expertise to implement joint capacity-building efforts.

Task 1: Baseline study: Estimated cost \$125,000

Task 2: Taxonomic identification: Estimated cost \$75,000.

Task 3: Information Access: Estimated cost \$100,000

Task 4: Peer to peer networking: Estimated cost \$200,000

Task 5: Training: Estimated cost \$150,000.

Task 6: Implementation of learning network: Estimated cost \$150,000.

Project Impact on Capacity/Sustainability

Full year 3 establishment of the proof of concept of the learning network will lead to tangible results –port authorities in partner countries and their quarantine and inspection services will gain precise understanding of the data analysis, taxonomic identification, and have appropriate procedures to detect and rapidly respond to new introductions of invasive species. U.S. port authorities, quarantine and inspection services will gain a better grasp on potential new species threats from partner cargos, vessels and other related trade pathways from these two countries, and greater insight as to the need to build biosecurity capacity into side-agreements to market access pacts.

In years 2 and 3, enhanced use of Internet-based detection tools, a clearinghouse and training exercised based on the results of gap analyses conducted in year 1 will lead to increased and verifiable detections of invasive species and to the use of rapid response mechanisms that will minimize the economic, ecological, animal and human health damage incurred by invasive species that entered partner countries or the US through port-related trade pathways.

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