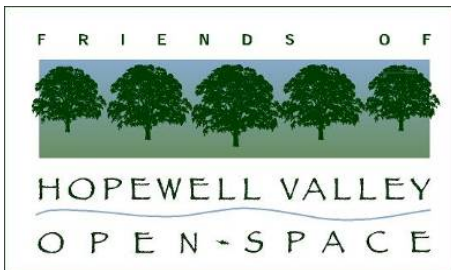


Central Jersey Invasive Species Strike Team

Project Manual

May 2009

Prepared by
Friends of Hopewell Valley Open Space
Upper Raritan Watershed Association



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Executive Summary

This manual is intended to provide guidance to Central Jersey Invasive Species Strike Team (CJISST) project partners and encourage broader application of early detection & rapid response (ED/RR) to emerging invasive species throughout New Jersey. CJISST is the first cooperative public-private partnership to formulate a coordinated response to emerging invasive species in New Jersey.

Invasive species produce a tremendous burden on biodiversity and natural resources. Collectively, invasive species have an annual cost of \$120 billion dollars to agriculture, forestry and recreation and are considered the greatest threat to global biodiversity after outright habitat destruction. Unfortunately, the problem is worsening through the continued introduction of new invasive species – it is estimated that fifty new plant introductions to New Jersey have occurred over the last twenty-five years. There are currently 30 widespread invasive plant species in New Jersey and an additional 71 emerging or potentially invasive plant species threatening New Jersey. There are also 50 invasive animals, pests, and pathogens with an additional 14 emerging or potentially invasive species. Effective and efficient strategies must be devised to combat both currently widespread and emerging invasive species.

The overarching strategic vision for invasive species control involves the following prioritized list of stewardship strategies: 1) Deer herd reduction, 2) Eradication of emerging invasive species, and 3) Protection of sites with high conservation values by a) eradicating new populations all invasive species, and b) intense, long-term control programs to reverse larger infestations (as resources allow). The primary focus of CJISST is item #2 - eradication of emerging invasive species.

The management of invasive species has been an ongoing struggle for land stewards. Many groups have made significant localized control efforts that have improved ecological health. However, most land stewards agree that existing control efforts are a ‘drop in the bucket’ relative to the enormity of the problem and many new species are establishing without impediment throughout the state. This realization was the impetus for CJISST. The strategy of early detection & rapid response to eradicate emerging invasive species can “prevent the next Japanese barberry” and reduce future ecological degradation. Carrying this hopeful message of prevention has been a strong factor in partner recruitment.

This manual describes methods and integrates lessons learned from the initial 2008 field season. Particular sections include building partnerships, recruiting and training volunteers, and collecting, managing, & analyzing data, formulating eradication strategies, and describing control techniques. Specific examples are provided and links to web-based resources to facilitate project success are provided in this manual.

A brief discussion on establishing a statewide early detection & rapid response network is included in this manual. CJISST partners acknowledge that a statewide program, linked to larger regional and national programs, is critical toward the eradication of emerging invasive species and prevention of continued degradation of natural habitats (both state and national invasive species management plans emphasize the importance of early detection & rapid response to emerging threats). CJISST provides a regional example for efficient and effective invasive species management that can serve as a model for an expanded statewide program.

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Appendix B. CJISST Evaluated Non-Native Plant Species

Appendix C. Emerging Non-Native Animals, Pests, and Pathogens

Web-based Training and Information Sources

CJISST provides a number of training and information documents through both FoHVOS and URWA websites. Topics include:

Google Maps-based presentation of all 2008-2009 species data – includes location and eradication details of 71 emerging plants in central New Jersey

Project Overview and Partnerships:

- Project Manual, Partner Memorandum of Understanding, List of Project Partners & Funders, Volunteer Information

Resources for Homeowners

- “Go Native” Brochure, Official Invasive Plant Letter

2008 Survey and Eradication Reports:

- 2008 Final Report & Figures, 2009 Eradication Strategies

Field Survey Documents:

- 2009 Plant List, Data Collection Sheet, Raw Data Spreadsheet (for data submission)

Species Identification and Eradication Efforts:

- Target Species Fact Sheets
- Invasive Species Phenology & Treatment Recommendations
- Invasive Species Control Methods
- Overview of Control Methods
- Summary of Herbicide Characteristics

Introduction

The Invasive Species Problem

Humans have introduced species, including plants, animals and pathogens, both intentionally and unintentionally, to parts of the world outside of their natural range. Only a small percentage of these introduced species become invasive, which is formally defined by the National Invasive Species Council as “a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health” (NISC 2001). Invasive plants often grow in dense stands, taking up large amounts of space that would normally be occupied by a diversity of native species, leading to negative impacts on both native flora and fauna. Invasive animals, insect pests, and pathogens cause significant damage through the degradation of whole native systems or through competition and predation of native species. The financial impacts of invasive species are enormous. Pimentel et al. (2005) estimate an annual cost of \$120 billion dollars to agriculture, forestry and recreation. Importantly, invasive species are considered the greatest threat to global biodiversity after outright habitat destruction (Wilcove et al. 1998). Unfortunately, the rate of new plant introductions continues to rise. Snyder and Kaufman (2004) estimate that there have been fifty new plant introductions to New Jersey over the last twenty-five years. In total, there are approximately 1,000 non-native plants documented in New Jersey’s flora. Currently, there are 30 widespread invasive plant species and 71 additional species considered invasive or potentially invasive. Additionally, there are 50 widespread species of invasive animals, pests and pathogens with another 14 species considered emerging or potentially invasive. Although there are no estimates of the extent of New Jersey infested by invasive species, it is likely that hundreds of thousands of acres are impacted.

Concepts for Invasive Species Control

The underlying philosophical context for invasive species management is the obligation to counteract negative human impacts on natural systems, which is often referred to as stewardship. The guiding principle of stewardship is fostering health of native plant communities that support our flora, fauna and general ecosystem health. The ultimate goal of stewardship is ‘ecological control’ that allows native plant communities to reduce overall invasive species cover through direct competition for light and soil nutrients. However, this goal cannot be accomplished in many parts of New Jersey because of the problem of overabundant deer (See Text Box 1). Deer produce severe impacts that are most pronounced in areas where hunting is prohibited, but significant negative impacts also occur where hunting pressure is insufficient. The gold standard for effective deer management programs is the observation of native plant communities that exert ecological control over invasive species. The Ted Stiles Preserve at Baldpate Mountain provides a working example of the role of effective deer management leading to a resurgence of native species. The Mercer County Park Commission established its deer management program over a decade ago by focusing on doe harvests. Currently, portions of the park are in full recovery. Dense stands of native species like spicebush, freed from excessive deer browse, are beginning to overtop invasive species such as Japanese barberry, multiflora rose, and Japanese stiltgrass (see photos below). Similar processes can be observed at the D&R Greenway Land Trust’s Northern Stony Brook Preserve. Several locations within the Hunterdon County Park System (e.g., Cushetunk Mountain) exhibit healthy native forest ecosystems where invasive species form only an insignificant part of the vegetative cover. Collectively, these examples provide strong evidence that infestations can be prevented or reversed under effective deer management programs.

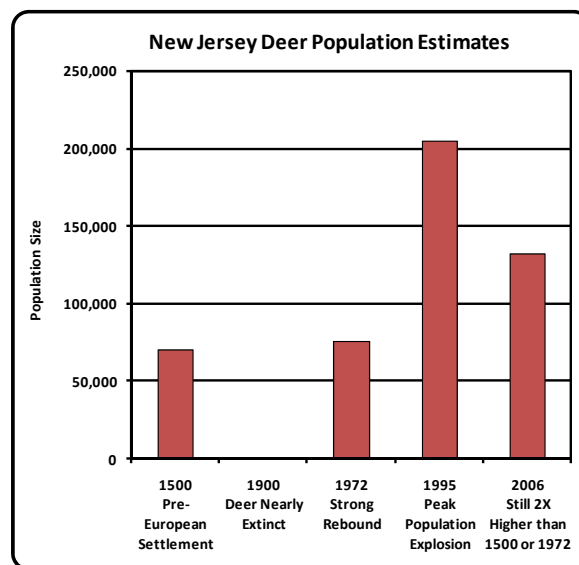


Left: Photo of native spicebush thicket at the Ted Stiles Preserve at Baldpate Mountain.
Right: Close-up photo of thicket showing spicebush (larger leaves) overtopping Japanese barberry.

Text Box 1 - Deer Overabundance: A critical impediment to invasive species control

The control of invasive species and restoration of healthy native plant communities will not be successful without addressing the impacts of deer overabundance. The pre-European colonization deer population estimate is 70,000 for New Jersey (McCabe and McCabe 1984). Unregulated hunting throughout the 1800's nearly drove deer to extinction and conservation efforts allowed a rebound to historic population sizes by 1972. However, the deer population had tripled by 1995. Innovations in hunting regulations (e.g., liberalization of doe harvests) have reduced the population in recent years, but the 2006 population was still double historic sizes. The population growth during the later part of the 20th century may have been caused by multiple factors including the production of habitats ideally suited to deer (e.g., forest edges, suburban landscapes and agricultural fields) and reduced hunting opportunities primarily caused by suburban development and hunting restrictions on both private and public lands.

The food preferences of deer foster the spread of unpalatable invasive species by preferential browsing of more palatable native plants. The differential impacts of deer on native and invasive plants has been documented in New Jersey (Eschtruth and Battles 2008) and more widely recognized in the eastern United States (Rawinski 2008). In general, New Jersey's land stewards commonly perceive a causative link between deer population size and invasive species abundance. Overabundant deer and their preferences for native plants has degraded New Jersey's forests by eliminating native understory growth and reducing the abundance of animals that require those plants for their survival.



Generally, direct management of invasive species is achieved through targeted control measures that minimize, but do not eradicate, particular invasive species. Eradication within pre-defined boundaries should only be considered a valid goal when populations are relatively small and the threat of continued spread is significant (i.e., emerging invasive species). In all cases, stewardship efforts should aim to stimulate native plant communities to resist infestation and minimize the use of herbicides and any other intervention. However, in the broad absence of ecological control due to overabundant deer, direct invasive species control by land stewards is vital. Overabundant deer and other human impacts on natural systems are diverse and perpetual, which will necessitate continuing stewardship of natural resources within the context of a human-dominated environment in order to support healthy native plant communities.

There are two general approaches related to invasive species management. These involve a species-based approach or a site-based approach. A species-based approach should be employed when an invasive or potentially invasive species can either be eradicated or contained. This approach is warranted for invasive species that are emerging locally or regionally (e.g., Siebold's viburnum). A site-based approach, which involves controlling invasive species on a particular site, should be employed when high value conservation targets (e.g., rare species populations, large contiguous habitat blocks) are threatened by either emerging or already widespread invasive species.

Based upon the discussion above, the overarching vision for invasive species control involves the following prioritized list of stewardship strategies: 1) Deer herd reduction, 2) Eradication of emerging invasive species, and 3) Protecting sites with high conservation values by a) eradicating new populations all invasive species, and b) intense, long-term control programs to reverse larger infestations (as resources allow). The primary focus of CJISST is item #2 - Eradication of emerging invasive species.

Early Detection & Rapid Response Strategy

Early detection and rapid response (ED/RR) primarily describes a program that eradicates invasive species just beginning to establish in natural areas (i.e., species-based approach to emerging invasive species). It may also describe efforts to prevent the spread of any new populations of invasive species into relatively pristine sites with high conservation values (i.e., site-based approach). ED/RR is the most cost efficient mechanism to control the spread of invasive species because it prevents the formation of large infestations that would be difficult or impossible to control through direct human efforts. The most effective ED/RR program in the Northeast is IPANE (Invasive Plant Atlas of New England, <http://nbii-nin.ciesin.columbia.edu/ipane/>). Another promising regional (i.e., mid-Atlantic states including New Jersey) reporting, mapping, and information clearinghouse is currently under development through EDDMapS (Early Detection & Distribution Mapping System - <http://www.eddmaps.org/>). Active or developing state and regional programs include Delaware, Maine, New Hampshire, and the Great Lakes region. Plans and guidelines for a comprehensive national ED/RR program have also been created (FICMNEW 2003, NISC 2003, NBII 2007, USDA Forest Service - undated).

The backbone of any ED/RR program is an established and efficient centralized organization. Aspects of a successful program include: 1) science-based approach to identify targeted invasive species; 2) standardized searching and reporting formats to catalog emerging populations; 3) maintenance of GIS and tabular databases to store and share recorded observations at a designated office; and 4) data analyses that prioritize a coordinated rapid response to eradicate emerging populations. In addition to paid staff members from various stakeholder groups, an effective ED/RR program is also comprised of a core of trained volunteers and has the ability to capitalize on coincidental observations of natural resource professionals, outdoor enthusiasts and the general public.

Formation of the Central Jersey Invasive Species Strike Team

The Central Jersey Invasive Species Strike Team (CJISST) was organized in 2008 by the Friends of Hopewell Valley Open Space (FoHVOS) and the Upper Raritan Watershed Association (URWA). CJISST represents

New Jersey's first comprehensive effort toward ED/RR through public-private partnerships. Currently, the project has 29 partners that have agreed to work cooperatively (Appendix A). This effective and efficient approach utilizes a network of professional staff and dedicated volunteers to detect and eradicate emerging invasive species, which prevents serious ecological harm for a fraction of the resources that would be required to control large, future infestations.

Methods

Invasive Species Selection Process

Plants

The first step taken by CJISST was to evaluate the non-native flora of New Jersey to determine target species. There are approximately 1,000 non-native species documented in the flora of New Jersey. David Snyder (NJ State Botanist) ranked the invasive status of 964 species in 2000 (Snyder, unpublished). His ranks ranged from 1 (widespread and invasive) to 4 (essentially non-invasive). Snyder ranked some species with straddling ranks, therefore ranks of 1.5, 2.5 or 3.5 were assigned to particular species.

The starting point for CJISST's list was species ranked between 1 and 2.5 by Snyder (152 species). Additional species were added (including species originally ranked > 2.5 by Snyder) based upon more recent observations and examination of invasive species lists from regional organizations and neighboring states (e.g., *Aralia elata*, *Pyrus calleryana*). However, there were nearly 800 non-native species ranked by Snyder as > 2.5 that were not evaluated by CJISST. It is possible that this large number of species will produce multiple new invasive species, but current information does not justify further consideration of these species at this time (periodic re-evaluation of the entire non-native flora is warranted).

The above procedure resulted in a list of 201 species to consider for further evaluation (See Appendix B). Each species was assigned a Current Distribution Code, Threat Code and an ED/RR Action Code (see Tables 1-3). These new ranks were based upon information presented as Appendix 3 - List of Non-Native Plants in the draft New Jersey Strategic Management Plan for Invasive Species, which considered distribution within New Jersey, invasive status in surrounding states and the region, and various species attributes (see state plan for complete list of attributes and source citations). Finally, broad habitat categories threatened by each species were identified (see Appendix B). This was simply noted as a 'Yes/No' (i.e., risk or no risk posed to particular habitat types by particular species). Of course, the assignment of any of these ranks is ultimately an informed but subjective exercise that is biased / limited by the experiences of the authors and will be re-evaluated by CJISST partners as field data is synthesized.

The results indicate 30 widespread invasive species, 71 newly emerging invasive species and 100 non-invasive species. CJISST efforts will focus on the 71 newly emerging species. Eradication of all encountered individual plants is recommended for 62 emerging invasive species beginning to establish in New Jersey (i.e., Stage 0 through Stage 2). The objective for 9 more common emerging invasive species (i.e., Stage 3) will be stemming their continued spread through eradication of newly forming populations. No current action is recommended for 100 species with limited invasive potential. Already widespread invasive species (30) will not be mapped or eradicated as part of the CJISST project, but individual organizations may decide to eradicate new/small populations of these species, especially at sites with high conservation values.

All CJISST project species have been divided into five 'natural groupings' for searching purposes. This is primarily to assist those with limited plant identification experience by allowing careful searching of particular suites of species found in specific habitats or groups of species with particular growth forms. Those with more advanced identification skills should simultaneously search for all listed species. The groupings are: 1) Forest Invasives - 26 species, 2) Invasive Vines - 14 species, 3) Open Upland Habitat Invasives - 17 species, and 4) Open Wetland Habitat Invasives - 9 species, and 5) Open Water Invasives - 5 species.

Table 1. Assessment of Non-Native Flora - Current Distribution Codes**Note: Represents estimated statewide abundance and does not necessarily denote invasive characteristics.**

Code	Description
Stage 0	Absent or very rare - 34 species
Stage 1	Rare (may be locally common) - 20 species
Stage 2	Uncommon (may be regionally common or abundant) - 39 species
Stage 3	Common (may be regionally abundant) - 9 species
Widespread	Very common - 99 species

Table 2. Assessment of Non-Native Flora - Threat Codes**Note: Represents demonstrated or potential invasiveness (i.e., ability to form monocultures).**

Code	Description (Denotes observed or potential invasive characteristics)
None	Currently non-threatening to natural plant communities - 100 species. These species are currently considered non-invasive, but may grow densely in heavily disturbed/modified areas -- includes species that may dominate a site for short periods of time (e.g., <i>Barbarea vulgaris</i> – yellow rocket in fallow farm fields), common lawn weeds (e.g., <i>Taraxacum officinale</i> - dandelion), and roadside weeds (e.g., <i>Cichorium intybus</i> - chicory).
Mild	Mildly threatening to natural plant communities - 4 species
Moderate	Moderately threatening to natural plant communities - 30 species
High	Highly threatening to natural plant communities - 67 species

Table 3. Assessment of Non-Native Flora - ED/RR Action Codes**Note: Codes based upon current distribution and threat assessments.**

Code	Description
None	No action recommended because species are currently considered non-invasive in natural plant communities - 100 species
1	Eradication of ALL detected occurrences (Applies to Stage 0, Stage 1, and Stage 2 species that are considered to pose a threat to natural plant communities) - 62 species
2	Eradication of newly emerging occurrences only (Applies to Stage 3 species that are considered to pose a threat to natural plant communities) - 9 species. Mapping and eradication decisions should be based upon the local extent and size of the occurrence.
3	Species should be considered for site-based early detection/rapid response (Applies to already widespread invasive species) - 30 species. An example would be protection of a healthy wet meadow by eradicating a newly forming population of purple loosestrife.

Animals, Pests, and Pathogens

There are an estimated 50 invasive animals (vertebrates), pests (usually insects), and pathogens (diseases/microorganisms) in New Jersey. Many of these species are already widespread (e.g., European gypsy moth). There are an additional 14 species that may be considered emerging or potentially invasive. The most notorious emerging insect is the Asian longhorned beetle, which is the subject of eradication efforts being led by the New Jersey Department of Agriculture and the United States Department of Agriculture with assistance from the New Jersey Department of Environmental Protection – Division of Parks & Forestry. The emerald ash borer is an invasive insect that is likely to arrive in New Jersey because it has spread to numerous states from the Midwest to the Mid-Atlantic in recent years. A list of all emerging species is provided in Appendix C (Source: Appendices 5 -7 of the draft New Jersey Strategic Management Plan for Invasive Species). These species have not yet been subject to CJISST efforts, but will be included in the future.

Partner Building

The management of invasive species has been an ongoing struggle for land stewards. Many groups have made significant localized control efforts that have improved ecological health. However, most land stewards agree that existing control efforts are a 'drop in the bucket' relative to the enormity of the problem and many new species are establishing without impediment throughout the state. This realization was the impetus for CJISST and its strategy of preventing further damage through eradication of emerging populations of invasive species. The hope of completely eradicating newly emerging species has been especially motivating for CJISST partners.

In addition to FoHVOS and URWA, there are currently 27 additional organizations that have formally agreed to participate in CJISST (Appendix A). Partners include state, county & municipal governments/agencies, private conservation groups and other private groups (e.g., Native Plant Society of New Jersey, Mercer County Master Gardeners). The partner building process started with requests to sign letters of support for the initial round of joint grant proposals submitted by FoHVOS and URWA. This was followed by requests for attendance at outreach and training events. Initial surveys and eradication efforts were spread across CJISST partner sites, which demonstrated the cooperative approach and helped strengthen and grow the partner base throughout 2008. This process will be strengthened in 2009 as CJISST partners conduct searches on their own preserves and participate in joint eradication work days (e.g., FoHVOS and D&R Greenway Land Trust have planned joint efforts to eradicate populations of Oriental photinia). Continuing efforts will attempt to broaden the partnership by recruiting private conservation groups, government agencies, Natural Resource Conservation Service (NRCS), Soil Conservation Districts (SCD's), Resource Conservation & Development Programs (RC&D's), public utilities, professional foresters and forestry organizations, transportation departments, universities, Rutgers Cooperative Extension (RCE), Master Gardeners, Environmental Stewards, and corporate and private landowners.

CJISST has established a Memorandum of Understanding among its constituent partners (Appendix A). This document, although non-binding, provides guidance and structure to the partnership. The MOU consists of five sections: Purpose, Statement of Mutual Purpose and Interest, Partner Responsibilities, Steering Committee Organization and Partner Representatives (includes contact information to facilitate communications). The overarching theme is that partners will, to the extent possible, commit resources to fulfill CJISST's mission. Specific areas of resource allocation may vary by partner, but include the topics of education, prevention, control, information exchange, cooperation and funding.

Volunteer Recruitment / Training

CJISST is dependent upon a trained community of partner staff and volunteers that play a key role in both the education/outreach and early detection/rapid response components of the project. Recruitment strategies include working closely with the non-profit, corporate and government sectors to publicize the project and identify staff members, trustees and/or supporters of these entities who could serve as project volunteers. We are attempting to match interested volunteers with partners and survey sites close to their location. Local landowners also play an important role, volunteering their properties to be included in surveys/eradications as well as hosting educational events. The goal of these "landowner events" is to inform local citizens about the project's goals and accomplishments and encouraging the public to replace invasive landscape plants with native species.

Any volunteer or partner that is interested in joining the Strike Team and conducting early detection surveys must first be trained both on plant identification and CJISST survey methods. These trainings can be either in formal, large group sessions or occur during smaller field sessions. Formal trainings are typically classroom style, where the focus is on the project method, including identification of parcels, use of the data sheet and GPS unit, reporting of data and prioritizing an eradication schedule. The plant list is reviewed and if the time and place are appropriate, a field plant identification session is included. Less formal on-the-ground trainings take place during actual property surveys, with new volunteers accompanying lead or previously trained Strike Team members. These trainings focus on conducting an Early Detection survey, plant identification and hands-on use

of the data sheet and GPS units. In addition to attending trainings, we encourage all volunteers who will be identifying plants to utilize the CJISST Fact Sheets plus any other available sources to learn key plant identification strategies. Since many of these plants are rare in central New Jersey, volunteers may not have the opportunity to see the plant during a training session and must be comfortable identifying it during a search.

Detection of Emerging Populations of Invasive Species

The goal of CJISST is to complete ED/RR surveys on as much open space in central New Jersey as possible. This includes searching both public preserves and private parcels. We have invited any entity that owns or manages open space in the region to become a Strike Team partner, including federal, state, county and municipal level groups, land trusts, not-for-profit organizations, easement holders and private landowners. As organizations agree to become a CJISST partner, they can either volunteer their land for ED/RR surveys to be completed by other partner staff or volunteers, or they can implement their own ED/RR project. Private citizens may become Strike Team partners by volunteering their property to be searched for invasive plants and allowing eradication efforts. Through this community effort of surveying open space, we can determine the location and movement of newly emerging invasive plants in the region and make our goal of eradicating these plants from our landscape more feasible.

In order to synthesize all data collected for this project, it is imperative that each surveyor is using a consistent method of surveying and recording information. CJISST has prepared data sheets which all surveyors are required to use. On the data sheet, the surveyor records a GPS number for each detection, the species name, population size and habitat type. The data sheet is a simple form and is easy for new volunteers to use. In the absence of this data sheet, any observer can report “incidental sightings” of invasive plants. They can contact CJISST to report a species sighting and its approximate extent and location. It is most helpful if they can offer a GPS location of the sighting so that a Strike Team representative can return to confirm and treat the emergence. All incidental reportings are recorded onto the accepted data sheet to be included in the larger data set.

A GPS unit is used to collect both the track log of the survey and record waypoints of detected occurrences. The GPS unit that CJISST recommends is the Garmin eTrex Venture HC High-Intensity Color Mapping Handheld GPS which retails for just over \$100. This exact unit is not required for the project but we found it to be user friendly, small to carry in the field and inexpensive. In order to make sure the data is collected in a standard fashion, the following points must be addressed:

- Set the correct time and date onto the GPS unit.
- Set the projection to UTM (Universal Transverse Mercator grid). (This is most likely the default setting).
- Turn the track log on at the beginning of each survey and off at the completion. On some units, it may be possible to name the track log. Avoid driving with the track log on.
- Waypoints are collected directly into the GPS unit. The surveyor will record the matching number on to the data sheet.

Data Management

A key strength of CJISST is providing unified management, interpretation, and distribution of data collected by project partners. This provides partners and the whole conservation community with information that cannot be obtained or interpreted by any individual organization. Ultimately, CJISST will be able to fully determine the status and distribution of emerging invasive species which will guide the partnership’s eradication efforts and broadly define effective invasive species management strategies across central New Jersey.

Currently, FoHVOS and URWA are jointly providing data management services for CJISST. Perpetuating this role will depend upon continuing organizational support and additional financial support from project partners or additional grant funds, which both organizations are seeking from various sources.

URWA is currently the clearinghouse for receipt of electronic data sheets from CJISST partners. For survey information to be included in the project, the data collected must be input into a standardized spreadsheet (available through FoHVOS and URWA websites). It is important that the user inputs the data without making any changes to the formatting. This spreadsheet, along with all GPS waypoints and track logs collected during surveys, is emailed to URWA's GIS Director. (Note: Even if partner organizations do not have GIS capabilities, the purchased GPS units should come with the appropriate software to allow the partner to download and email the data to URWA. In the event that the partner is unable to send the GPS data to URWA, a local partner should be contacted to assist.)

URWA will synthesize all data into a Geodatabase and make all detected plant occurrences available through a central New Jersey web-based map. Each detected occurrence will appear on the map as a point and will be named by species as well as color coded based on population size. Site manager, municipality and county, plus details of eradication strategies, will also be displayed. All existing data will be publicly accessible via web-links. Spatial and tabular data will be updated annually to include continuing progress of survey and eradication efforts.

FoHVOS is currently serving the role of summarizing and interpreting CJISST data. An annual report will be prepared to provide insights into the status of particular species and guidance on eradication strategies/species control methods across the project area. This will be distributed to all partners as well as made available to the general public. Data assimilation and distribution will alert land owners and managers to newly emerging invasive populations in their vicinity.

To eradicate an occurrence, the GPS data is loaded back into the unit (through GIS software or GPS software that comes with each unit) and used to re-locate the infestation. The area around the detected occurrence should be searched in a 100-foot radius to be certain that all individuals in the area are found and treated. The eradication status, method and date are entered electronically into the original spreadsheet; the population size can also be updated if it is discovered to be larger than originally thought. During the eradication, if any new species are discovered, data and GPS information should be collected. The updated spreadsheet is sent to URWA, along with any GPS information collected for new species. The web-based map will be updated to display the data points as "eradication initiated" or "eradication complete".

Determining Eradication Strategies

The overarching theme of eradication efforts is to have the greatest protective impact per unit effort, which requires careful prioritization. The species-based approach is the primary function of CJISST and the targeted end result is complete eradication or containment of emerging invasive species. Eradication efforts will be conducted as a series of cooperative and individual efforts of CJISST project partners toward this common goal.

Goals for particular species depend upon their current spatial distribution and population sizes (i.e., species classified as Stage 0 through Stage 2 are targeted for complete eradication). For data collected in 2008, examples of this strategy are exemplified by species such as Siebold's viburnum. There were 20 detected populations and each population has less than 10 individuals. Water chestnut provides another example – 3 populations were detected and one large population will be the subject of a collective CJISST eradication effort. There are numerous additional emerging species where eradication of all detected populations is possible (e.g., five-leaf akebia), but multi-year efforts will be required for several species (e.g., Oriental photinia, Japanese wisteria). See Appendix C of the 2008 CJISST Final Report (see FoHVOS or URWA websites), which outlines strategies for all detected species.

Unfortunately, it must be recognized that some species can no longer be practically eradicated from New Jersey (i.e., species classified as Stage 3) and containment becomes the primary strategy. Containment strategies involve eradicating small outlier populations and minimizing spread from larger core populations. The strategy for linden viburnum provides an example. In 2008, there were 141 populations detected over 18 sites. Many closely packed populations were found in the eastern half of Baldpate Mountain and adjacent private property. Washington Crossing State Park (Hopewell) and Fairview Farm Wildlife Preserve (Bedminster) also contain significant clusters of populations. Isolated populations were found across Hopewell Township and Tewksbury Township. The initial strategy for 2009 involves eradication of all isolated populations and beginning the work of eradicating populations at Washington Crossing State Park and Fairview Farm Wildlife Preserve. Efforts in subsequent years will involve reducing the overall infestation at Baldpate Mountain and adjacent private property to minimize damage at these sites and reduce further spread onto adjacent lands.

Initially, preventing new infestations of already widespread invasive species was also a CJISST goal. However, through the mapping process it has become apparent that this goal was too ambitious and will be eliminated from the project. It is hoped that additional funding can be obtained to address this severe threat. In the meantime, isolated efforts of individual CJISST partners may be conducted to eradicate small, newly forming populations of already widespread invasive species, especially at sites with significant conservation values.

Control Techniques

The control of invasive species can be classified into five broad methods (Table 5). Particular control methods may be used alone or in combination depending upon the resource to be protected and budgetary constraints. In the past, many groups performing invasive species control relied entirely on mechanical methods. Although mechanical methods are the most appropriate choice in limited situations, many groups have abandoned this approach because progress is exceedingly slow and the re-sprouting ability of many invasive species is very high. Chemical control is the most commonly used method. It can be used in concert with mechanical control (e.g., cutting plants and applying herbicide to the stump), but can also be used with great efficiency on its own merits (e.g., basal bark applications). For CJISST, chemical and/or mechanical control will be the predominant methodologies because the nature of eradicating emerging populations precludes biological, cultural, and ecological control. Particular control techniques can be broadly applied to particular classes of invasive species (Table 4).

Details on control methodologies are provided by CJISST through FoHVOS and URWA websites and include an “Overview of Control Methods”, “Invasive Species Phenology and Treatment Recommendations”, and “Summary of Herbicide Characteristics”. The overview of control methods includes descriptions of all typical methodologies including target types, typical herbicide concentrations, basic techniques, pros/cons, and other notes. The phenology and treatment recommendations cover species-specific flowering and fruiting times, and control method techniques to consider based upon species characters and size of individual plants. The summary of herbicide characteristics reviews some of the common herbicides’ target species types, cost considerations, and wildlife and human safety considerations.

Summary of Pesticide Application Certification Requirements

The application of pesticides is regulated by the NJ Department of Environmental Protection’s Pesticide Control Program (PCP). Lead staff members involved with the application of herbicides must become ‘commercial pesticide applicators’, which requires attendance in a one day course on pesticide safety, passing PCP’s core exam and at least one PCP category exam, and completing 40 hours of on-the-job training for a particular category of pesticide application. There are two pesticide application categories that cover any potential applications in natural areas and organizational staff would be required to pass both category exams along with the core exam. These categories include Category 2: Forest Pest Control and Category 5: Aquatic Pest Control. The PCP may waive on-the-job training requirements if it can be shown that an organization currently does not have anyone certified in these two categories to provide training.

Staff (including interns or regular volunteers) may opt to become ‘certified pesticide operators’, which are required to attend the one day training course on pesticide safety and receive 40 hours of on-the-job training for each category of pesticide application. Operators are not required to pass any examinations and must be directly supervised by a certified pesticide applicator. According to regulations, direct supervision beyond the 40 hour on-the-job training consists of operators being within “very timely voice contact” and within “three travel hours by land”. Staff members or volunteers that are not certified applicators or certified operators may still apply herbicides if a certified applicator is always physically present and in the line-of-sight of the non-certified staff member or volunteer.

The PCP also requires a permit for any wetland applications of pesticides. Currently, this involves a simple reporting form and an associated \$75 fee. In some cases, the PCP may require an additional permit from the NJ Department of Environmental Protection - Division of Land Use when control work is deemed to significantly alter the vegetative structure of a wetland (e.g., removal of significant invasive shrub cover to promote emergent wetland).

Table 4. Specific Control Techniques by Invasive Species Class

Invasive Species Class	Suggested Treatment Techniques ¹	Notes
Large tree	Girdling or Harvesting	May be combined with herbicide application to girdled area
Large shrub / small tree	Basal bark, Hack-and-Squirt, Cut Stump, Girdling	Mowing may be used as a pre-treatment to reduce plant size prior to chemical treatments
Small shrub / tree sapling	Basal Bark, Foliar Spray, Cut Stump, Pulling	Mowing may be used as a pre-treatment to reduce plant size prior to chemical treatments
Large vines	Basal Bark, Cut Stump, Hack-and-Squirt	Many vine species have extensive root systems that require herbicide treatment
Forest herbs, woody seedlings and small vines	Foliar Spray, Pulling	Mulching may be utilized in garden beds or other human-modified areas

Table 5. Description of Invasive Species Control Methods

Control Method	Description	Pros	Cons	Notes
Mechanical	Physical removal of all or portions of an invasive species	No requirement for specialized training, can be performed by volunteers	Very labor intensive, may require specialized equipment, site accessibility issues, impractical for large infestations, re-sprouting or further invasive species dissemination may occur	Common techniques include mowing, cutting, pulling, girdling.
Chemical	Application of herbicides to all or portions of an invasive species	Most effective and efficient method in most cases, staff can be assisted by volunteers	Labor intensive, site accessibility issues, requires specialized training/license and equipment, may require repeated applications for more difficult species	Common applications include foliar, cut stump, basal bark, and injection
Biological	Introduction of a biocontrol agent (e.g., insect) from the invasive species' native range	Dramatic reductions in abundance with minimal costs, minimal accessibility issues	Limited number of invasive species have control agents, potential for unintended consequences if the biocontrol agent 'switches' to non-target host species	Requires extensive research to provide effective, host-specific agents, which requires initial investment but is ultimately very cost effective
Cultural	Removal of invasive species through coincidental human activities	Very cost effective	Can be difficult or expensive to coordinate, may apply to a small fraction of infested areas	Generally a subset of mechanical or chemical control; primarily applies to agricultural systems, but may apply to the maintenance of early successional natural systems. Could also include prescribed fire, which can be cost effective.
Ecological	Allowing natural ecological processes (e.g., competition for light and soil resources, predator-prey relationships, etc.) to reduce invasive species over time	Very cost effective, allows natural processes to 'balance'	May not occur in many systems due to persistent or continuing human impacts (e.g., overabundant deer, continued physical disturbance, fragmentation, etc.)	This can only occur when deer populations are low. Research and strong anecdotal evidence suggest that overabundant deer facilitate infestations by invasive species in forests.

Creating a Statewide Early Detection & Rapid Response Network

The ultimate goal is to create a statewide early detection/rapid response (ED/RR) network that has regular communications with neighboring states, and regional and national groups to achieve maximum effectiveness in preventing the spread of newly emerging invasive species. The methods, organizational framework, and outreach efforts being established through CJISST can guide the creation of a statewide ED/RR program in New Jersey.

Ideally, a statewide ED/RR program would be administered through the New Jersey Invasive Species Council with support from the NJ Department of Environmental Protection, NJ Department of Agriculture, and regional cooperative efforts across the state (e.g., CJISST). The draft New Jersey Invasive Species Strategic Management Plan for Invasive Species includes several figures relating to the conceptual design for such a program.

Figure 1 depicts species selection considerations. The decision factors include evaluation of the risk posed by particular species, current distribution, and feasibility of control. CJISST has performed this function (see Appendix B), but broader technical participation from botanists and ecologists would be required for a statewide program. Figure 2 depicts feasibility of control considerations for individual species by asking a series of questions relating to the intensity of effort to affect eradication or containment of newly emerging species. CJISST has created a species list and began tracking emerging plant species distribution in 2008. Initial feasibility decisions have been made for the 2009 eradication efforts and further decisions regarding feasibility will occur through continuing survey efforts in coming years. These efforts could be facilitated through meetings with botanists to discuss locations of known occurrences of invasive species, which would assist CJISST and a future statewide program. Figure 3 depicts a conceptual framework for lead organizations and participants for a statewide ED/RR program. The conceptual design incorporates a wide variety of natural resource professionals that could detect newly emerging species. A centralized data management and decision-support program would guide and track eradication efforts performed by a wide variety of organizations. This system could produce an effective ED/RR program based upon the concepts of open communication and cooperative efforts. Although some key aspects of the conceptual framework have not been addressed through CJISST, there has been substantial progress addressing the framework and continuing efforts will be made in coming years.

A large number of existing organizations could contribute to a statewide ED/RR program. Many private and public partners are already participating in CJISST (See Appendix A), but other groups could be effective on a statewide basis including the NJDEP – Division of Watershed Management, Rutgers Cooperative Extension including Master Gardener and Environmental Steward Programs, private foresters, and the Flora of New Jersey Project. These groups, and others, have broad ranging constituencies/programs/volunteer bases and/or have significant technical expertise that will be required to make a strong statewide ED/RR program.

Figure 1.
Selecting Species for an ED/RR Program
Source: Adapted from Timmins and Owen (2001)

Arrow Answer Key
 —————> = Yes
> = No

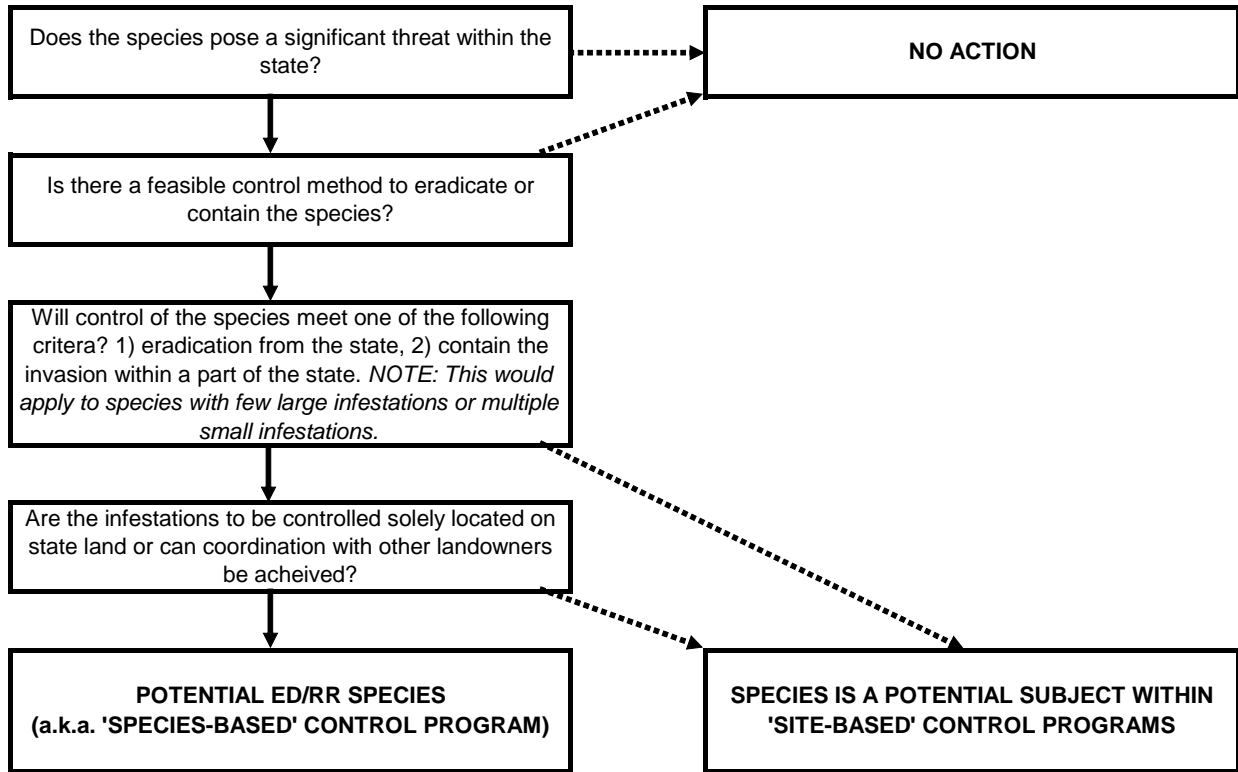


Figure 2.
Feasibility of Control Considerations for ED/RR Species
Source: Timmins and Owen (2001)

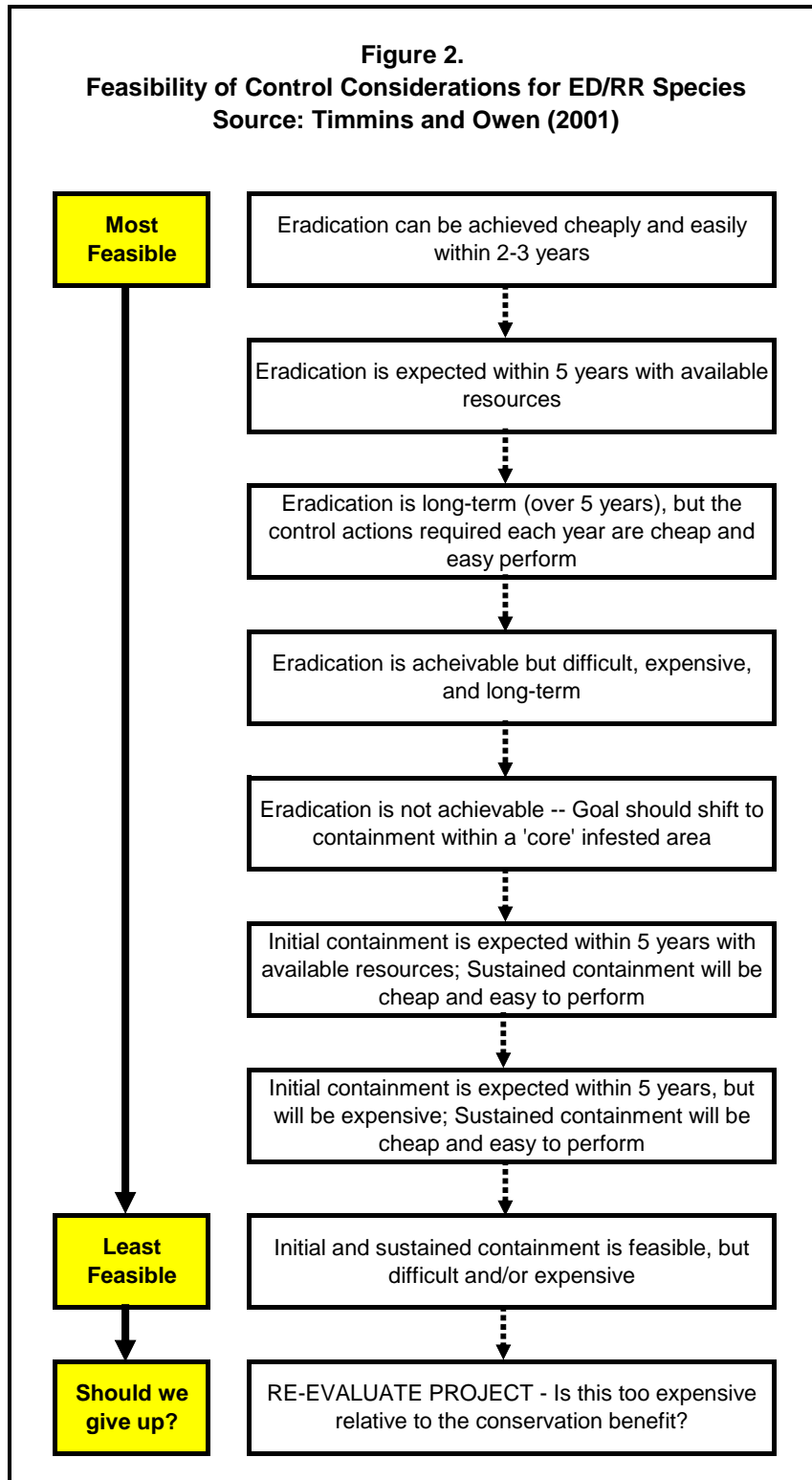


Figure 3.
Conceptual Design of an ED/RR Program in New Jersey

