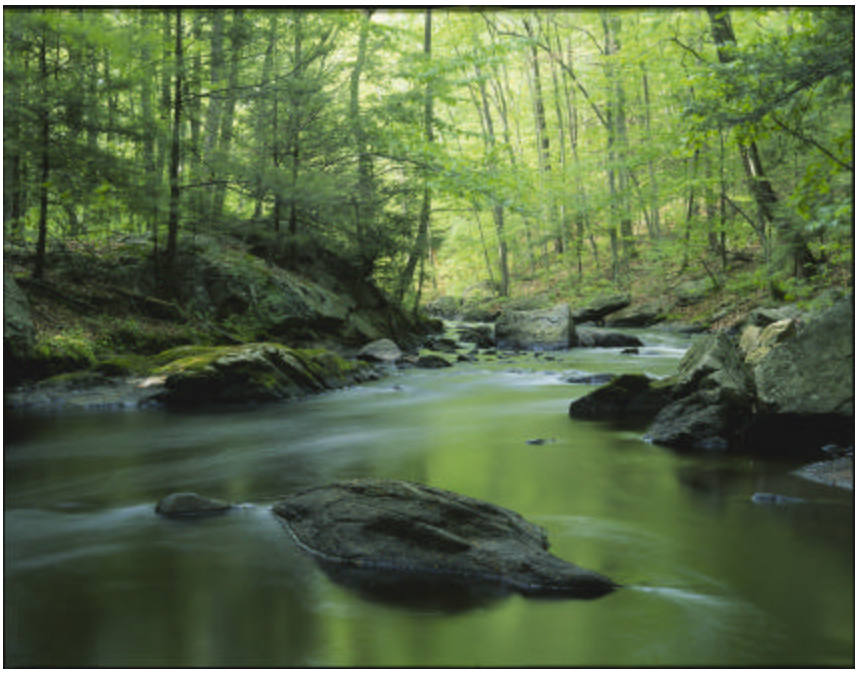
Proceedings of the

State of the Forest Symposium:

Ecological Issues Regarding Highlands Forest Degradation & Restoration

Held October 3, 2002



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NEW JERSEY AUDUBON SOCIETY

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EXECUTIVE SUMMARY
STATE OF THE FOREST SYMPOSIUM PROCEEDINGS

The ecological issues surrounding Highlands forest degradation and restoration were the focus of the State of the Forest Symposium on October 3, 2002, at the Morris County Cultural Center. Over 120 people attended this symposium, which was jointly sponsored by the New Jersey Audubon Society, the New Jersey Conservation Foundation, and The Nature Conservancy.

The objectives of the symposium were to present scientific research and expert views regarding the current health of the forests in the Highlands and to provide a forum for discussing solutions and future actions to preserve and enhance the forest resources in the region. It was recognized by all that land acquisition in the Highlands by conservation agencies and groups alone is not going to safeguard our future. Proactive, integrated management and stewardship will be required to ensure protection of water, wildlife and our forests for future generations.

Keynote speaker Marc Matsil, Assistant Commissioner for Natural and Historic Resources for the NJ Department of Environmental Protection, stressed the importance of maintaining healthy forests for reducing air pollution and preserving water resources. He provided an overview of forest management responsibilities and current state-sponsored management actions.

Other speakers addressed specific ecological stressors and challenges in preserving the Highlands forests, as well as methodologies for restoring the forests to a healthy state. The threats posed by invasive plant species and by herbivory by superabundant deer were two key topics that were also featured in the afternoon's panel discussions. Also presented were scientific studies of the destructive impact of non-native Asiatic earthworms on forest soils and how ecosystem degradation affects wildlife diversity and habitat.

The two afternoon sessions included interactive discussions in which expert panelists and conference participants brainstormed possible solutions and actions. Ideas for future actions included new legislation on invasive plant species and better management of white-tailed deer populations.

The symposium's steering committee included Eric Stiles of the NJ Audubon Society, Emile DeVito and Stephanie Monahan of the NJ Conservation Foundation, and Michael Van Clef of the Nature Conservancy.

A copy of the symposium proceedings is available online at www.njaudubon.org/conservation.

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The Interaction Between Deer, Native Shrubs, and Invasive Species, and Recommendations for Deer Herd Reduction and Forest Restoration in New Jersey

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Land managers are aware of the catastrophic impact of superabundant deer on tree regeneration and the loss of biodiversity in New Jersey's forests (Tilghman, 1989; Anderson and Katz, 1993; deCalesta and Stout, 1997; Stromayer and Warren, 1997). Now another phenomenon has reached a critical stage across most of New Jersey (outside the Pine Barrens). Above-ground stems of a native forest shrub are relatively short-lived compared to the plant's lifespan. Vigorous new shoots replace senescent stems on a regular basis. Deer now completely inhibit the establishment of new shoots as old stems die (Townsend and Meyer, 2002). Deer create a "crew-cut" of dead basal shoots and exhaust a shrub's root energy. This phenomenon is occurring in all native shrub species, from the *Aronias* to the *Viburnums.* Right now in much of New Jersey, forest shrub layers are melting away; the last forest shrubs are within one or two years of death. As shrubs die, the forest floor becomes more brightly lit, allowing alien invasive plants like Japanese Stiltgrass (*Microstegium)* to explode in density, gaining a stronger foothold even beneath intact forest canopy.

In the Watchung Reservation (Union County Park System), inside deer exclosures now six years old, native woody and perennial herbaceous plants have colonized sites that had absolutely zero visible native plants in the understory when the fences were erected. This colonization has been mostly via seed dispersal and establishment, but some deer-suppressed root material has resprouted. These new patches of forest understory are dense and shade the ground, more or less suppressing alien species that were abundant at the time of fencing. There is variation between plots; in some locations alien species are still outcompeting native regeneration. Yet it is clear that our forests may have some ability to recover from both over-browsing and alien plant invasions if we can provide a sharp reduction in the deer herd, to a low level that achieves the functional equivalent of an exclosure.

More field research is neither useful nor required before initiating an immediate deer herd reduction under a "*Forest Ecosystem Recovery-Based Deer Management Program."* The deer population in New Jersey needs to be reduced to 10 deer per square mile everywhere in order for our forests to have any chance to begin slow recovery. Later, as the deer herd nears reasonable levels and plants start to reappear, research on fine-tuning for optimal deer density will be needed.

New approaches to deer management must be instituted. These may include:
1. State income tax credits for every female deer (doe) harvested by an individual.
2. Doe harvest requirements for landowners receiving woodland (farmland) assessment.
3. Economic incentives for municipalities and counties to initiate doe control programs.
4. Legalizing the sale of venison under certain circumstances.
5. Other changes and innovations that represent "out-of-the-box" thinking.

Our native forests will melt away if we continue to ignore this threat to New Jersey's biodiversity. The end product of today's forest trajectory is a collection of alien weeds and vines in which there is no reproduction of native woody trees and shrubs. It is time for all non-profit environmental groups, government agencies, sportspersons clubs, the farming community, and forestry organizations to work together to reduce New Jersey's deer population. We need a biodiversity-based carrying capacity, which may be even lower than 10 deer per square mile. If we do not pursue such a course, future generations will consider our inaction to be an example of gross negligence in the management of natural resources.

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Invasive Plant Species Threaten Our Native Flora

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Throughout the world, invasive plants are threatening the native flora as they outcompete and displace native species (Sakai et al., 2001). New Jersey is no exception to this general trend.

Plants (as well as other organisms whose life histories are dependent on the plants) from other parts of the world have been introduced into New Jersey, including the Highlands region. These species are spreading rapidly. For example, Oriental bittersweet *(Celastrus scandens)* is more common in New Jersey than the native American bittersweet *(Celastrus orbiculatus).* In New Jersey, one is much more likely to encounter a non-native species of honeysuckle *(e.g., Lonicera japonica, L. maackii, L. morrowii)* than a native one *(e.g., L. sempervirens).* Once botanically diverse marshes are now dominated by non-native strains of the common reed *(Phragmites australis)* (Saltonstall, 2002).

The threat of invasives is much more insidious than is the threat of development. To the untrained eye, many of New Jersey's forested regions may look perfectly "natural." However, the trained eye sees something quite different. In a given forested region, non-native Norway maples *(Acer platanoides)* may predominate; the shrub layer may consist of chiefly invasive shrubs (*e.g.*, Japanese barberry); and the herb layer can be dominated by non-native stiltgrass *(Microstegium vimineum)* and Oriental lady's-thumb *(Polygonum caespitosum* var. *longisetum).*

New invasives continue to enter the state. In 2002, two invasive species from Eurasia -- piedmont bedstraw *(Galium pedemontanum)* and variable flatsedge *(Cyperus difformis)* -- were reported from New Jersey for the first time. There are even several populations of kudzu *(Pueraria montana* var. *lobata)* in New Jersey.

More focus must now be placed on the stewardship of natural lands to manage the areas for the control of invasive plants. The deliberate planting of invasive species on public and private lands must be discouraged. Furthermore, more floristic and ecological research is needed on invasive plants. Just as monitoring programs are now in place to track rare and endangered species, monitoring programs are needed for invasive species. Such monitoring programs will allow for the early detection of recent introductions, which can facilitate an early response. Ecological research is needed to better understand the traits associated with plants that are successful invasives (*e.g.*, modes of reproduction, seed viability, rate of growth, ability to grow in heterogeneous environments).

If more is not done to stem the rapid spread of invasive plant species, much of the land conservation efforts of the 1900s aimed at protecting our native biodiversity will have failed, since much of the land will be dominated by invasives. Successful farmers and gardeners must diligently remove the weeds that invade their lands; the stewards of New Jersey's natural lands must take a similar approach.

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Earthworm Effects on Forest Soils: The Good, The Bad, and The Ugly

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Earthworms are the charismatic fauna of the soil (Groffman and Bohlen, 1999). While earthworms are considered desirable in agricultural and horticultural systems, their net effect on forests is unclear. What is clear is that earthworms are *agents of change*, since they can rapidly alter the forest floor and stimulate nitrogen turnover in forest ecosystems. Long-term activity by earthworms in forested ecosystems results in a *mull* surface soil layer. Mull soils have lower fungal biomass, less leaf litter, and higher nitrification rates than soils without earthworms. These attributes result in the erosion of soil, a loss of nutrients, and for some tree species lower seedling germination rates.

Surprisingly, exotic species of earthworms are widely distributed throughout North America, while native species are relegated to areas that were not glaciated during the Pleistocene (Gates, 1976). Observations of glaciated regions in North America suggest that forest stands associated with urban and suburban areas tend to support higher populations of non-native species of earthworms relative to forests in rural areas (Steinberg et al., 1997).

Why earthworm abundance is higher in urban and suburban forests than in rural forests is open to speculation. The lack of earthworms in the rural forests supports the view that Pleistocene glaciation destroyed a large portion of the earthworm population in northern North America. However, the existence of earthworms in the urban and suburban forests suggests that the introduction of exotic species was more intense and persistent in urban and suburban than in rural stands (Steinberg et al., 1997). Gates (1976) has suggested that exotic earthworms were accidentally introduced from the ballasts of ships and in soil accompanying imported plants originating from Europe and Asia. As New York City and other northeastern cities served as important international seaports, earthworm inoculation probably occurred early and repeatedly in these cities for over a hundred years.

Although exotic earthworms are widely distributed throughout forests in North America, the lack of earthworms in many areas with suitable habitat indicates there is opportunity for the invasion of new forest habitats (Groffman and Bohlen, 1999). We have anecdotal evidence that suggests exotic earthworms are increasing their distribution from urban and suburban areas to rural areas in the mid-Atlantic and northeastern United States. The impact of exotic earthworm invasion on these forests will certainly be profound, especially forests that have had little history of earthworm activity. Currently research is underway to investigate the impact of invading earthworms on forest ecosystem structure and function.

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Impacts of Ecosystem Degradation
on Forest Wildlife Diversity

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Forest wildlife diversity depends on large contiguous forest patches, connections to other habitats, structurally complex vegetation, intact seasonal wetlands, and the presence of native vegetation. Disruption of any of these components can dramatically reduce wildlife diversity. Ecosystem degradation affects all of these factors.

A healthy ecosystem results from a complex mix of decomposition cycles, nutrient circulation, soil systems, hydrology, and energy flow. Each of these processes may be analyzed at the smallest (chemical) level or on a grander scale, encompassing physiographic areas. Regardless of scale, we can trace current ecological degradation to several long- and short-term human-induced mechanisms of change.

One of the most devastating causes of ecological degradation is fragmentation resulting from new developments and roads. The results of development are known to anyone with a backyard, but they should still be documented. Fragmented forest and wetland habitats have more predation, more parasitism, and less vertebrate diversity than intact habitats. Overall, the productivity and ecological stability of the land suffers significantly. Edge effects from development and roads are not restricted to areas immediately adjacent to the edge. Overhead pictures of roadways show that visible forest degradation extends for 600 meters from the borders of major roads.

Roadways and other impervious surfaces that go along with development produce dramatically increased water runoff. Increases in impervious surfaces ? now 10% of New Jersey land ? have resulted in erosion and flooding that eliminate vernal pools and species reliant on them. Less directly, flash floods remove food sources and nutrients from the water and correspond with decreasing groundwater recharge. Less water feeds streams, lakes, vernal pools and vegetation. Parched ground increases plant mortality, decreases plant diversity, and further impacts the ecological cycle.

Runoff from developed areas also carries contaminants into neighboring ecosystems. These substances, combined with larger-scale air and water pollution, heavily impact native plants and animals, leading to a further reduction in diversity.

Native plants and wildlife suffer additional damage from invasive species. Introduced earthworms can change forest nutrient cycles, impacting plant communities. In many forests, invasive plants are outcompeting natives and becoming the abundant forest vegetation. These non-native plants alter forest structure and provide less food for native wildlife. Domestic cats prey heavily on wildlife, particularly birds and small mammals, and compete with native predators. All of these exotics directly or indirectly reduce wildlife diversity.

Even native species can have dramatic negative effects under altered conditions. As forest land has been fragmented, deer density has increased; deer are now a major destabilizing force in New Jersey forests. When population density exceeds ten deer per square mile, plant diversity begins to decline. In some New Jersey locations, there are now as many as one hundred deer per square mile. Superabundant deer virtually eliminate certain shrub layers. Under these conditions, forest structural complexity drops and invasive plant species that tolerate or resist deer browse become abundant. Native plant species, upon which wildlife depend, become scarce.

Strategies for forest wildlife conservation should bring together good science, planning, and opportunity. Carefully conducted scientific studies are needed to determine wildlife distribution and abundance, landscape and habitat needs, and productivity and survivorship of the plant and animal life. Strategies can then be developed that involve land acquisition and work with land managers and cooperative landowners. The large scale at which ecological degradation affects ecosystem integrity and wildlife diversity necessitates such broad solutions.

Several steps are often ignored in attempts to restore wildlife. A restoration attempt should focus on a select site and one or a few species. It is important to ascertain why the selected species are currently absent and whether they will survive and reproduce if a seed population is supplied. Precautions should be taken to ensure that the species are not overly successful to the detriment of other ecological aspects. Once species are restored, monitoring is necessary to assure their long-term success and to produce data for future efforts.

In bird and amphibian restoration, public participation has proven essential for success. The public can play a major role in monitoring, managing adjacent locations, establishing human-free areas, and publicizing the intentions of the project. Even an apparent failure can be a success if it increases public awareness and inspires attempts at restoration in other locations.

Even small actions can alleviate effects of ecosystem degradation on wildlife diversity. The keys to effective action are maintenance or restoration of habitat contiguity, preservation of seasonal wetlands, increases in plant structural complexity, and promotion of native vegetation. Repairing ecosystem degradation is a mammoth project, but the most immediate and necessary steps in smart growth, conservation, and restoration are overdue.

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Restoration Ecology Primer

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The author makes the following recommendations to restore and maintain the health of the forests in the New Jersey Highlands:

Recognize and address the impacts of air pollution (and climate change), impoverished soil biota, higher levels of browsing and larger concentrations of deer, increased numbers of exotics, greater susceptibility to disease, and lost capacity for pollutant reduction, rapid range changes of species, losses due to more severe drought.

Take strong steps to limit the transport and sale of invasive species in NJ and direct all state agencies to use native species in their programs. New Jersey, although more impacted by exotics than most other states, is far behind others in the regulation of pest species. The state itself, until recently, was actively disseminating some of the most aggressive species, such as autumn olive. Instead, the state must become a leader by using native species in all state agencies.

Manage deer at biologically sustainable levels. All restoration efforts are compromised where deer populations are too high (which is most of the state). The depletion of native seed stocks is reaching frightening levels. Action must be taken now.

Implement regulations to protect groundwater and baseflow. Water resources and forest resources are inextricably linked. Forests are vital for maintaining infiltration and protecting water resources, and maintaining historic hydrologic regimes is necessary to sustaining forest biodiversity. Current stormwater management regulations focus on limiting floodflows but are completely inadequate for sustaining historic levels of infiltration. The allowable volumes and velocities of high-frequency storms (3 inches or less) are excessive, damaging stream channels. Reduced baseflow and groundwater jeopardize wetlands as well as uplands, especially during periods of drought. Water quality and supply are also reduced by excessive runoff. Development regulations also need to limit grading as well as site clearance, both to protect forests and to maintain soil infiltration capacity and soil organisms.

Provide better protection for first-order streams, ephemeral wetlands and vernal pools as well as riparian corridors. Headwater streams serve as vital infiltration areas and need protection from culverting and burial. Small, isolated wetlands are afforded virtually no protection, although they support many species that are presently in decline. Riparian corridors need to be enlarged and protected from removal of native plants.

Develop a State-wide strategy to conserve landscape-scale forest habitat in the Highlands similar to the protection afforded the Pinelands. The Highlands will not be protected within the existing regulatory framework and must be managed at a regional level.

Increase regulatory protection for forests. In addition to protection from developers, forests throughout the state need protection from infrastructure development. As build-out occurs, the remaining natural areas often end up the targets of a land grab for rights of way for roads, sewers, pipelines and transmission lines. Without regulation, this will happen until there is no effective protection at all of "preserves".

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Panel: Mitigating Effects of Intense Deer Herbivory

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Natural Lands Trust's Deer Management Program focuses on decreasing the adverse effects of high deer populations on native flora. To that end, the Trust has conducted controlled hunting programs on some of its preserves since 1992. The Trust currently manages deer populations on 13 preserves through controlled hunting programs. We have installed demonstration deer exclosures on eight preserves to help monitor deer impact on vegetation and to determine the effectiveness of our hunting programs.

The rules that hunters must adhere to reflect a general concern for safety, not only for the participants of the management program, but for other preserve users such as walkers and bird watchers. The number of hunters on each preserve is limited. The mandatory proficiency test assures that hunters are familiar and competent with their sporting arm. A flagged map locates hunter positions for the preserve manager and other hunters. Participants wear bright NLT armbands that allow preserve managers as well as others to tell from a distance if a hunter has permission to hunt.

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The Wildlife Society Bulletin: Volume 25, Number 2, Summer 1997

Panel: Mitigating Effects of Intense Deer Herbivory

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The goals of New Jersey's Deer Management program are:

- To maintain a healthy deer population on suitable habitat throughout the state
- To keep the deer population at a density compatible with land use
- To maximize the recreational and economic benefits derived from this renewable natural resource.

A common characteristic of all deer problem areas in New Jersey is a lack of deer population control through traditional hunting due to governmental or landowner prohibitions against hunting or the discharge of weapons. Past efforts to control deer populations have largely been successful in areas with good hunter access. New Jersey sportsmen have harvested more than one million deer since 1909. Population control efforts include the liberalization of hunting seasons, bag limits and other regulatory changes, including the requirement that hunters harvest an antlerless deer first, and limiting hunters to one (or two) antlered deer per season. The 2001-02 deer seasons run between September 7, 2001, and February 15, 2002, and it is legal in many parts of the state for one hunter to harvest an unlimited number of antlerless deer. These efforts have had limited success in those areas of the state where deer remain inaccessible to hunters.

Another more recent effort by the Division of Fish and Wildlife (the Division) to assist local authorities in dealing with serious urban/suburban deer problems is the development of the Community-Based Deer Management Program (CBDMP). Under this program, the Division cooperates with municipal, state and federal agencies to develop and implement alternative management strategies where traditional hunting programs are either not a viable option or where hunting alone will not provide the desired level of reduction in deer numbers. Alternative options permitted under the CBDMP include trap and transfer to a research facility or commercial deer farm; trap and euthanize; shooting deer by volunteer or paid agents outside of the regular deer hunting season dates and regulations; and experimental methodologies, including contraception and contragestation. All costs of alternative control options are borne by the applicant for the CBDMP.

Panel: Mitigating Effects of Intense Deer Herbivory

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Reports of impacts from out-of-control deer nearly always focus on damage to plants such as destruction of crops, elimination of forest tree reproduction and loss of forest understory shrubs and spring ephemeral flora. However, local eradication of specialized herbivores can occur before the plants themselves are in serious jeopardy.

In some cases a single event can eradicate a local population. For example deer ate virtually an entire lupine population in one or two nights, eradicating a deme of Karner blue butterflies more than a decade ago in New York. Deer were the primary or sole cause of the loss of the globally rare *Catocala pretiosa pretiosa* from The Nature Conservancy's Eldora Preserve in Cape May County. In a major effort to restore the insect's foodplant (*Aronia*) in the closed canopy forest, there was limited success even with a deer exclosure. Perhaps this and other understory shrubs were initially established under more open conditions.

Several rare butterfly and moth species have been greatly reduced or eradicated by deer on serpentine barrens in Maryland and Pennsylvania. One of these, the mottled dusky wing (*Erynnis martialis*), is probably extirpated from New Jersey, eastern Pennsylvania and New England. Another, the frosted elfin (*Callophrys irus*), is state-listed in New Jersey and several other states. The food plants of both species are highly favored by deer in spring, making deer both severe competitors and direct consumers of butterfly eggs and larvae, thus potentially or actually threatening remaining populations. Deer now eat nearly all seed heads or flowers of turkey beard plants annually in many parts of the Pinelands. Eventually this could lead to the extinction of the Pinelands' endemic moth *Crambus daeckellus* as its apparent food plant fails to reproduce.

In North Jersey the status of Lepidoptera whose larvae specialize on herbs, shrubs and even native grasses of forest understory or openings is now mostly unknown, due in large part to limited moth collecting since the 1970s. There is no question deer and exotics have severely damaged or virtually eliminated native understory vegetation in many areas. For example, northern New Jersey and adjacent areas to the north were the global center of diversity for *Papaipema* moths with about 35 species. About a third of these are now historic in New Jersey and one is globally historic. *Papaipema* larvae bore into herbaceous stems, including forest understory and wetland plants. Specimen-based inventory is needed simply to determine which of these and other forest understory moths still exist at all in the state. Accurate and current information on the status of remaining butterflies whose larvae feed on forest-associated herbs or grasses, such as *Calephelis borealis, Celastrina neglectamajor,* and both *Amblyscirtes* skippers, is also needed.

Specialized herbivores besides Lepidoptera should also be addressed. Observations are especially needed regarding which known food plants for specialized herbivores are favored by deer. This would suggest which herbivores are really at risk or potentially already extirpated. Between habitat fragmentation, out-of-control deer and invasive exotic plants, the herbivore fauna of forest under stories and openings is in jeopardy in many parts of the state.

Panel: Impacts & Management of Invasive Plant Species

Comments on Exotic Species in the Forest Understory

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My perspective is that of a plant ecologist who views the soil as a critical and primary aspect of the plant environment. While it is clear that different communities of plants are found on different types of soil, it is equally clear in the scientific literature that plants can profoundly affect and alter the soils in which they grow.

From this perspective and my observations of exotic species occurrence in the understory of forests and natural areas throughout central and northern New Jersey, I can make the following points about exotic species impacts and management:

- My qualitative observations suggest that some soils are more likely to support damaging invasions than others. In particular, farmland that has been relatively recently abandoned and reforested (i.e., within the past 50 years) appears to be more heavily invaded than areas that were more continuously forested. This suggests that farming activities have altered soil conditions in ways that promote the exotics. Given the large areas of land in New Jersey that have reverted to forest in the post-World War II era, there may be a large fraction of our forest land that is susceptible to invasion.

- My research at Rutgers has clearly demonstrated that at least some exotic species (notably Japanese barberry and Japanese stilt grass) actively modify the soils in which they grow, causing decreases in acidity and increases in the amount of available nitrogen. If this is the case with other exotics, and exotics in general are nitrogen-loving species that thrive in nitrogen-enriched areas, then the effect of the exotics on soil properties may promote further invasions and may make it difficult to restore native species.

- We have little knowledge of both the extent of invasion in forested areas in New Jersey, other than very general knowledge of species occurrence in regions, and so we have little ability to predict the susceptibility to invasion of our forested lands.

- We have little knowledge of restoration techniques that can be used to slow the spread of the most damaging species and equally that can be used to restore native species and render them competitive with invasive exotics.

- We should be working to prevent the further spread of exotics into as-yet-uninvaded forests (especially those in the Natural Lands Trust system), as well as to prevent the entry of new damaging exotics into the state.

- We should aggressively develop a policy of establishing and protecting "biodiversity reserves", areas that currently contain intact understories of herbs, shrubs, and young trees. These reserves will be critically important in the future to serve as a seed source of native species and a model of natural forest structure in our region.

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Panel: Impacts & Management of Invasive Plant Species

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Efforts to mitigate the effects of invasive species fall under the two broad categories of control and prevention. Control of existing invaders is unlikely to occur on a regional basis without significant commitment. However, control efforts are critical to protect our most biologically significant sites. There are many examples of concerted effort resulting in the removal of invasive species at specific sites.

Unfortunately, replacement of existing invaders with more recent and future introductions will occur. The number of species from other parts of the world which grow in temperate climates assures that many new invaders will be introduced. Clearly, it would be much more effective, both monetarily and biologically, to keep new potential invaders from being introduced as a primary strategy to protect natural areas.

There has been little effort in New Jersey to halt the flow of invasive species. The first step in this process would be the creation of comprehensive species lists that categorize invasive and potentially invasive species that would affect natural and agricultural systems. This list could be approved by an Invasive Species Council/Advisory Committee that represents a broad spectrum of stakeholders. Potential list types include ”clean,” “watch,” and “dirty.” Clean lists represent species that are shown to be non-invasive, while dirty lists consist of species that are proven or potential invaders. Watch lists consist of species that cannot be confidently placed in either group, but should be monitored. An effective program to reduce the risk of introduction of new species and limit the spread of existing invaders will require a system utilizing the three categories of plants (”clean,” “watch,” and “dirty”).

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The New Jersey Agricultural Invasive Species Council (NJAISC) was established by the New Jersey Department of Agriculture (NJDA) to address the threats posed by invasive species on agricultural operations and to develop a plan to manage them. Major aspects of the management plan include definitions of descriptive and technical terms, the criteria for identifying a species as invasive, and management options based on the degree of threat and the extent of economic and environmental harm.

The following statements, based on a questionnaire distributed to the agricultural community, reflect general feelings and attitudes concerning invasive species: A regulatory agency should establish a list of species that warrant concern or management, and the primary function should be for information and public awareness. There should be government funding for regulation of invasive species if warranted, and state government should have the greatest responsibility for preventing the further spread and sale of invasive species already present in New Jersey.

For the agricultural community, the biological category of greatest concern was diseases, followed in descending order by insects, plants, other animals, and nematodes. There is high concern about the current or potential impact of invasive species on the agricultural industry in New Jersey. Those species that pose the greatest threat, prioritized according to biological category ranking, should be so identified and prevented from entering NJ if not already present. When found, they should be aggressively managed based on economic and environmental necessity and feasibility. The major responsibility for conducting a prevention and control program should be with state government, but it needs to be substantially supported by other public and private agencies and the agricultural community in order to be successful.

Future goals of the NJAISC and the NJDA are to continue the development of the management plan, including determining the criteria for identifying a species as invasive, and the management options available, which should be based on the degree of threat, the extent of economic and/or environmental harm, and the feasibility of accomplishing the selected management goal. If regulatory authority is warranted, based on the scientific analysis of the biological, economic and environmental factors, then the NJDA should pursue acquiring the necessary authority if it is not already held and develop a brochure that defines what makes a species invasive and outlines the threats posed by invasive species. It should also identify species of concern by degree of threat and provide guidance for recognition, prevention, and management of invasive species to individuals, organizations, businesses, educators and other government agencies.

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NPS View on Invasive Species and Deer Herbivory

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The Native Plant Society (NPS) is keenly aware of the alarming nature of the fate of ecosystems in New Jersey. As one of only eleven states that does not have a formal policy on invasive species (outside of agriculture), and saddled with "home rule" that puts power at the local level, the state is hard-pressed to address this issue. It is most definitely at the state level where this problem needs to be addressed. More damage is being done while the state is formulating and/or contemplating policy and law. Clearly, a voluntary adoption of weed policies has not worked, as a trip to any garden center or nursery will attest to. Most average citizens are unaware of the problem.

The Native Plant Society feels that at a minimum, a "good list" and a "bad list" needs to be adopted and enforced statewide. Resources and grants should be given to campuses, parks and private lands that conform to the principles of ecological and sustainable planning. The county should have native street tree lists approved for ordinances. Nurseries and garden centers could be certified for compliance for acceptable and unacceptable species. All the county cooperatives and the NPS could advertise the lists of garden centers, contractors and designers who are certified by the state. The information is available, even if it is incomplete. The state currently knows enough to enact effective legislation. As behind as we are here in New Jersey, the combined degrading effects of deer herbivory and invasive species on our ecosystems and the species that depend on them is going to get worse before it gets better!