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NEW YORK STATE SOUTHERN PINE BEETLE MANAGEMENT PLAN

Division of Lands and Forests – Forest Health

Southern Pine Beetle Response

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Executive Summary

The management goals of the DEC Southern Pine Beetle (SPB) Response are to protect native habitats and rare ecosystems that have SPB-susceptible tree species and to restore affected ecosystems. The strategies to address these goals are to (1) use early detection and monitoring to determine the extent of SPB to inform the public, local land managers and the DEC's SPB Response Team, (2) stop or slow the spread of SPB to reduce tree mortality in priority areas, (3) restore stands and ecosystems negatively impacted by SPB and (4) provide municipalities and non-for-profit agencies support to remove dead trees that pose a danger to public safety, remove trees for spot suppression, and replant trees in areas impacted by SPB.

Pheromone-baited traps will be used for early detection in non-infested areas and to monitor existing SPB populations. Aerial surveys will be conducted in planes and helicopters to map SPB infestations (commonly referred to as "spots") across the landscape to inform the public. More focused surveys will be conducted over priority areas to inform management. Ground-based surveys will verify infested trees after spots are detected and mapped in aerial surveys.

The two main management strategies used to stop or slow the spread of SPB will be spot suppression and preventive thinning. To concentrate DEC's efforts, suppression and thinning by the department will occur within and around large forested blocks and unique ecosystems designated as priority areas. Southern pine beetle will not be managed by DEC in urban settings. In spot suppression, infested and buffer trees will be cut. This kills beetles in infested trees and the open area from cut buffer trees reduces the beetle's ability to find healthy trees to attack. Cut-and-leave suppression tactics will be used on Long Island. Preventive thinning will only occur in forest stands located more than 2 miles from heavy infestations. Forest stands with >700 trees/acre will be reduced to ≤450 trees/acre and stands at or above 120 ft^2/acre will be thinned to a residual basal area of <80-100ft^2/acre.

Background of Southern Pine Beetle in New York

The southern pine beetle (SPB, *Dendroctonus frontalis* Zimmermann) was first trapped in New York in July, 2014, by NYS Agriculture and Markets and was found in trees on Long Island in October 2014. Prior to this, SPB had been detected as far north as Pennsylvania and New Jersey (Payne, 1980). SPB has now been found farther north in Connecticut, Massachusetts, and Rhode Island. In New York, SPB has been found in traps as far north as Bear Mountain and Minnewaska State Parks. Southern pine beetles attract each other to individual living trees using pheromones and attack pine trees en masse, which overwhelms a tree's defenses and kills it in 2-4 months. Southern pine beetle is responsible for widespread tree losses throughout the southeastern U.S, and has already killed tens of thousands of trees on Long Island.

In New York, SPB has infested pitch pine (*Pinus rigida* Mill.), eastern white pine (*Pinus strobus* L.), Japanese black pine (*Pinus thunbergii* Franco), and Norway spruce (*Picea abies* L.). Other species identified as susceptible in NY include shortleaf pine (*Pinus echinata* Mill.), Virginia pine (*Pinus virginiana* Mill.), Japanese red pine (*Pinus densiflora* Sieb. and Zucc.), Austrian Pine (*Pinus nigra* Arnold), Scots pine (*Pinus sylvestris* L.), and red pine (*Pinus resinosa* Ait.) (Figure 1, p.2). Other pine and spruce species may also be affected by SPB. There are several pine and spruce-dominated communities in New York State that are rare globally or statewide including Dwarf pine plains, Dwarf pine ridges, Maritime pitch pine dune woodland, Pitch pine-scrub-oak barrens, Sandstone pavement barrens, Pitch pine-oak-heath woodland, Boreal heath barrens, Ice cave talus community, Spruce-northern hardwood forest, Mountain spruce-fir forest, and Pitch pine-health barrens. These and all

other forest, urban, or commercial communities that contain pine tree species may be threatened by SPB infestation, impacting ecological, recreational, and fire dimensions.

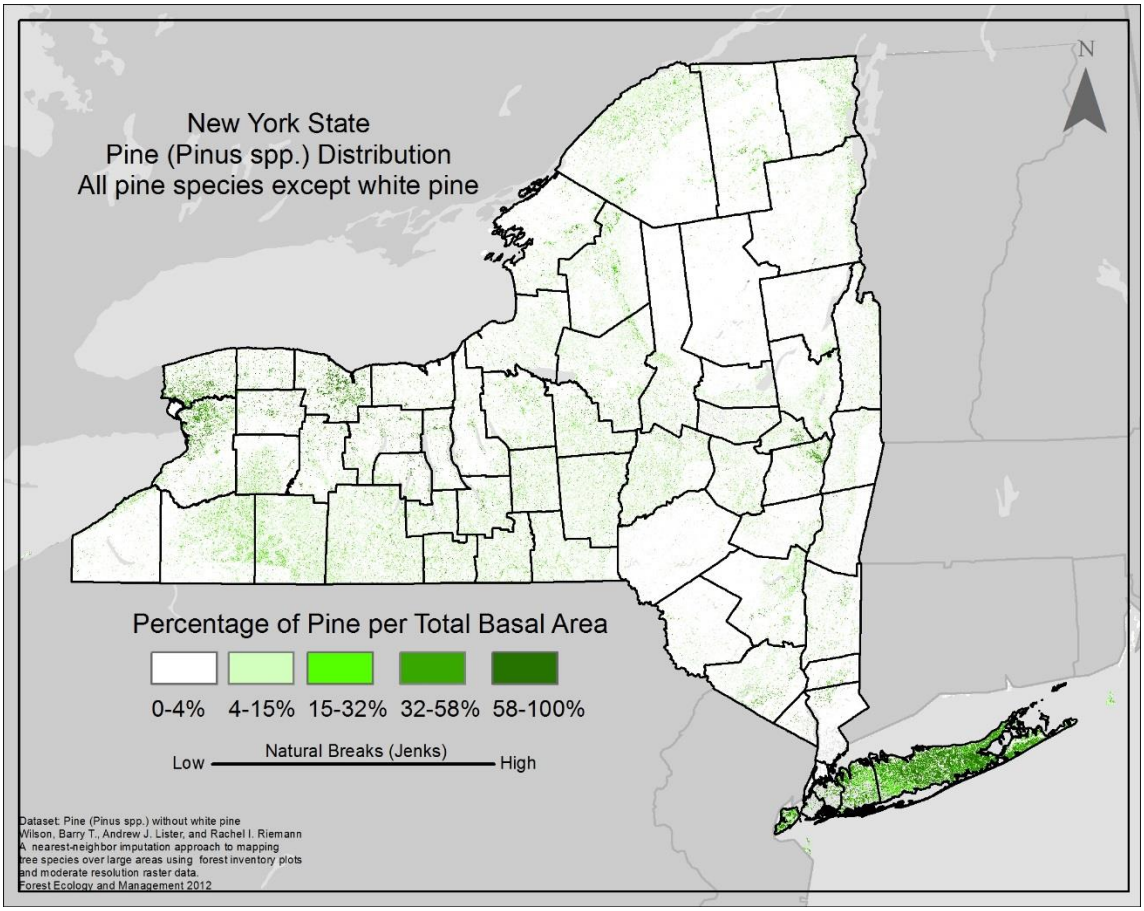


Figure 1. Distribution of potential susceptible New York State pine species including pitch pine, red pine, Scots pine, Austrian pine, shortleaf pine, and Virginia pine. White pine and Norway spruce were not included due to higher resistance to SPB attack.

In New York State, pitch pine has experienced the most mortality from SPB. Pitch pine is common on Long Island, occurring in pure, dense stands and in mixed stands with oak trees and other hardwoods. In particular, the Central Pine Barrens, an area of more than 100,000 acres co-dominated or dominated by pitch pine is at risk for extensive tree mortality.

Southern pine beetle form spots that expand during warm months. Spots can grow quickly in dense stands of host trees, expanding from a few trees to hundreds or thousands of trees in one summer. Aerial and ground surveys show that SPB is widespread and abundant on Long Island, has killed thousands of trees so far, and continues rapid expansion to infest more trees. Early detection traps have captured SPB in the Hudson Valley, showing that SPB is extending its range farther north in New York.

Unfortunately, complete eradication of SPB in New York is not possible. Because of this, an integrated management approach of science-based strategies including targeted spot suppression and preventive stand thinning will be used for the reduction of SPB-caused tree mortality. In stands affected by SPB, efforts will be made to restore desired forest conditions by replanting trees.

Document Objective

This document describes the management goals, priorities, selected strategies, and alternative strategies of the DEC Forest Health Southern Pine Beetle Response in New York. This document will also provide additional information for others managing SPB in New York.

Management Goals of the DEC Southern Pine Beetle Response

I. **Protect native habitats and rare ecosystems that have SPB-susceptible tree species**
II. **Restore forest stands and ecosystems negatively impacted by SPB**

The strategies to address these goals are to (1) use early detection and monitoring to determine the extent of SPB to inform the public, local land managers and the DEC's SPB Response Team, (2) stop or slow the spread of SPB to reduce tree mortality in priority areas, (3) restore stands and ecosystems negatively impacted by SPB, and (4) provide municipalities and non-for-profit agencies support to remove dead trees that pose a danger to public safety, remove trees for spot suppression, and replant trees in areas impacted by SPB.

SPB Response Management Structure

To help effectively manage the response to SPB in New York, an incident command system has been established (Figure 2, p.4). This management system allows for communication between and participation of several partner groups such as DEC Central Office and Region 1, the Central Pine Barrens Commission, the US Fish and Wildlife Service, the National Park Service, the US Forest Service, Brookhaven National Laboratory, NYS Office of Parks Recreation and Historic Preservation, Suffolk County, the Town of Brookhaven, the Town of Islip, and the Town of Southampton. We will expand this to include other partner groups as the SPB infestation expands.

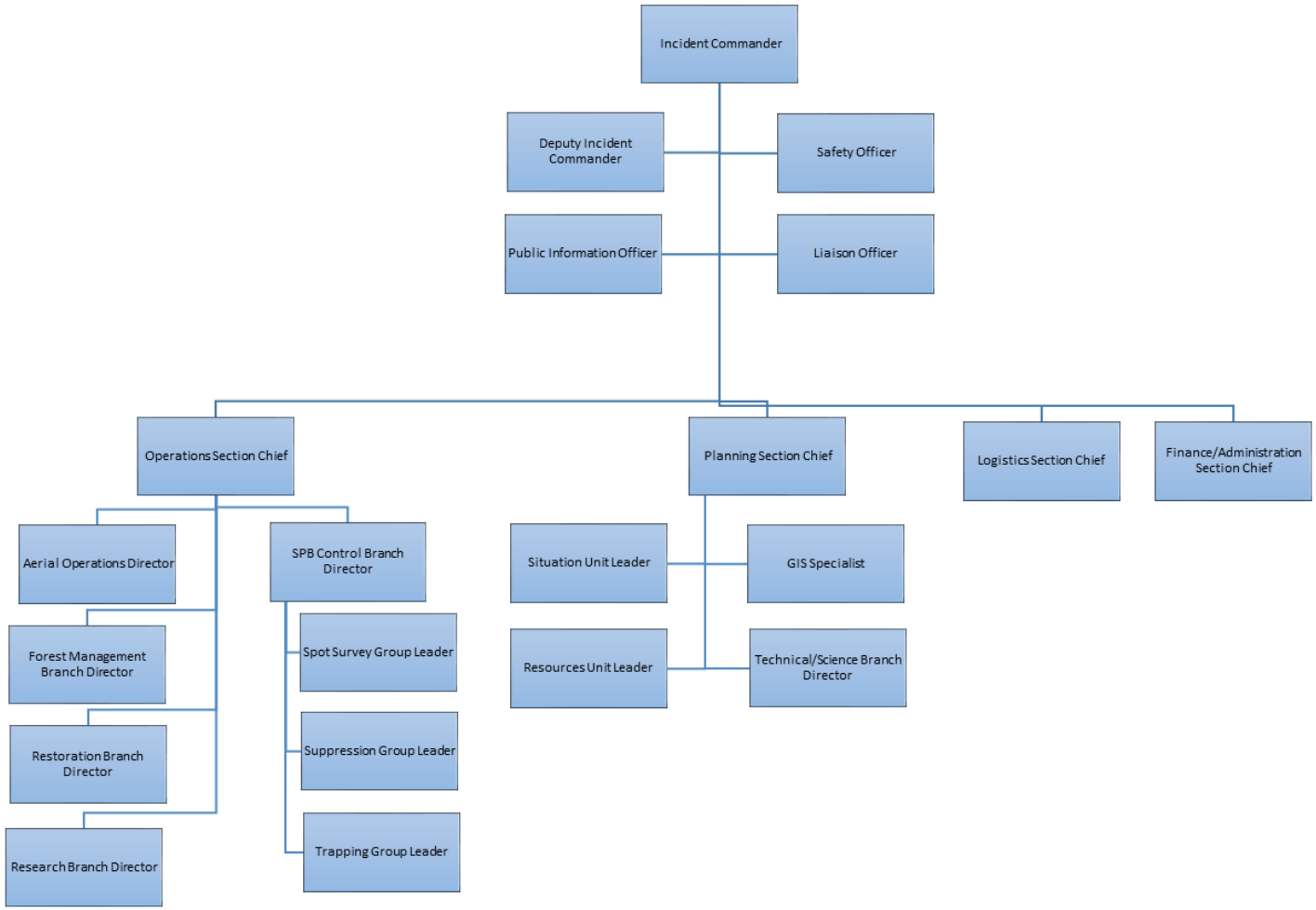


Figure 2. Generalized incident management structure for the SPB response.

Landscape Management Prioritization

A landscape management prioritization plan will be followed for all SPB management decisions. **To concentrate efforts, suppression and preventive thinning treatment activities by DEC will occur within and around the areas designated under these priorities.** Prioritization includes:

1. Large forested blocks
2. Unique habitats
3. Buffer areas

These areas may include county, state, and federal parks, preserves, private lands, open space, unique habitats, rare and endangered species habitat, and habitat corridors. Southern pine beetle management will occur in these areas to the extent treatment measures are compatible with rare species protection and other values. On Long Island, this includes the Central Pine Barrens Core Preservation Area. In the Hudson Valley, this includes State Parks and other unique areas designated by the NYS Natural Heritage Program. Other areas may be targeted by partner municipalities through the Southern Pine Beetle Community Recovery Grant Program.

Portions of the landscape within the prioritization areas that are low hazard or have already had SPB will not have preventive thinning treatment applied by DEC.

SPB in Urban Settings

Southern pine beetle will not be managed by DEC in urban settings. Urban settings in areas with SPB may be targeted by partner municipalities through the Southern Pine Beetle Community Recovery Grant Program. Managing SPB in urban environments will involve removal of SPB infested or killed trees, hazard tree mitigation, and preventive treatments (i.e., pesticides).

1. Infested trees
   Trees that are infested should be removed as quickly as possible to prevent infestation spread to nearby uninfested host trees. Infested trees should not be moved to a different area during the summer without plans for bark removal or immediate disposal or destruction. Homeowners are advised to contact an arborist if infested trees are found.
2. Killed trees
   Killed trees (foliage brown or fallen off) do not pose a threat to nearby healthy trees. However, landowners, parks, highway departments and others may need to consider risks killed trees pose to people, structures, public roads, utilities, etc. and may need to remove killed trees.
3. Uninfested trees
   Although trees located near active infestations are likely more prone to attack, trees located far from infestations have also been attacked. Trees can be protected from attack with preventive insecticide bark sprays containing permethrin or bifenthrin and labeled for such use. Trunk injection with emamectin benzoate (Tree-äge, available for commercial applicators only) more than one month before spring emergence, has been shown to have some protective value. The choice of whether to treat a tree or not should be made on a case-by-case basis. Management recommendations have been developed and shared with nursery and landscape professionals and with homeowners through Cornell Cooperative Extension of Suffolk County and trade groups.

Strategy 1: SPB Detection and Monitoring Strategies

Detection and monitoring allow for assessment of SPB presence, extent, and infestation severity. Detection and monitoring efforts need to be consistently applied to catch new and growing infestations for timely management.

1. SPB Trapping

   Pheromone-baited traps will be used for early detection of SPB in uninfested areas and to monitor existing SPB populations. Traps outside of areas that have shown SPB damage in aerial surveys will use a stronger lure combination that includes (+)-*endo*-brevicomin (Sullivan and Mori 2009). In areas known to be infested, such as on Long Island, SPB traps are baited with the aggregation pheromone frontalin and an alpha/beta-pinene lure. All SPB traps will be placed at least 40-50ft. from potential host trees to avoid initiating an infestation.

   In areas known to be infested, population monitoring will be used to help determine the severity of infestations by comparing the number of beetles trapped each year. In years with higher trap catches of southern pine beetles, a more severe outbreak may be expected. In addition, SPB's predator *Thansimus dubius* (Coleoptera: Cleridae) will be collected from traps. In years with higher trap catches of this predator, the expected outbreak severity may be decreased as more SPBs will be killed. To take these into account, the Department will compare the average number of SPB/trap/day and the ratio of SPB to total catch of SPB and *T. dubius* between years to how the populations have changed (Billings and Upton 2010).

Table 1. SPB and Clerids caught in traps at Long Island sites and comparison to 2015 trap catches. Ratio changes with a [1]subscript next to them were based on small datasets.

	2015		2016		2015 to 2016
Trap location	**# SPB**	**# Clerids**	**# SPB**	**# Clerids**	**Change in SPB/Clerid Ratio**
Wertheim NWR north	43	153	52	352	↓ 9%
Wertheim NWR south	262	1,130	109	951	↓ 9%
Southaven	…	…	1,723	5,598	…
Serenity Place	295	1,664	6,411	8,167	↑ 29%
Otis Pike	…	…	628	115	…
Barcelona Neck	6	524	826	309	↑ 72%
Sarnoff Preserve	…	…	346	172	
Henry's Hollow	533	8,815	993	2,943	↑ 19%
Fire Island #1	5	0	1	0	0[1]
Fire Island #2	…	…	0	2	…
Fire Island #3	…	…	1	1	…
Fire Island #4	7	1	0	0	↓ 88%[1]
Fire Island #5	…	…	0	0	…

Early detection traps will be used near uninfested susceptible host stands to collect SPB from mid-April thru August throughout the state. Traps used to monitor existing SPB for populations will be out from mid-April (flight in southeast coincides with dogwood (*Cornus florida* L.) blossoms) to June. Use of traps earlier in the spring will help indicate when SPB begins to be active and will be help to determine when treatments should be applied. Flight phenology for New Jersey SPB populations is shown in Figure 3 (p.6).

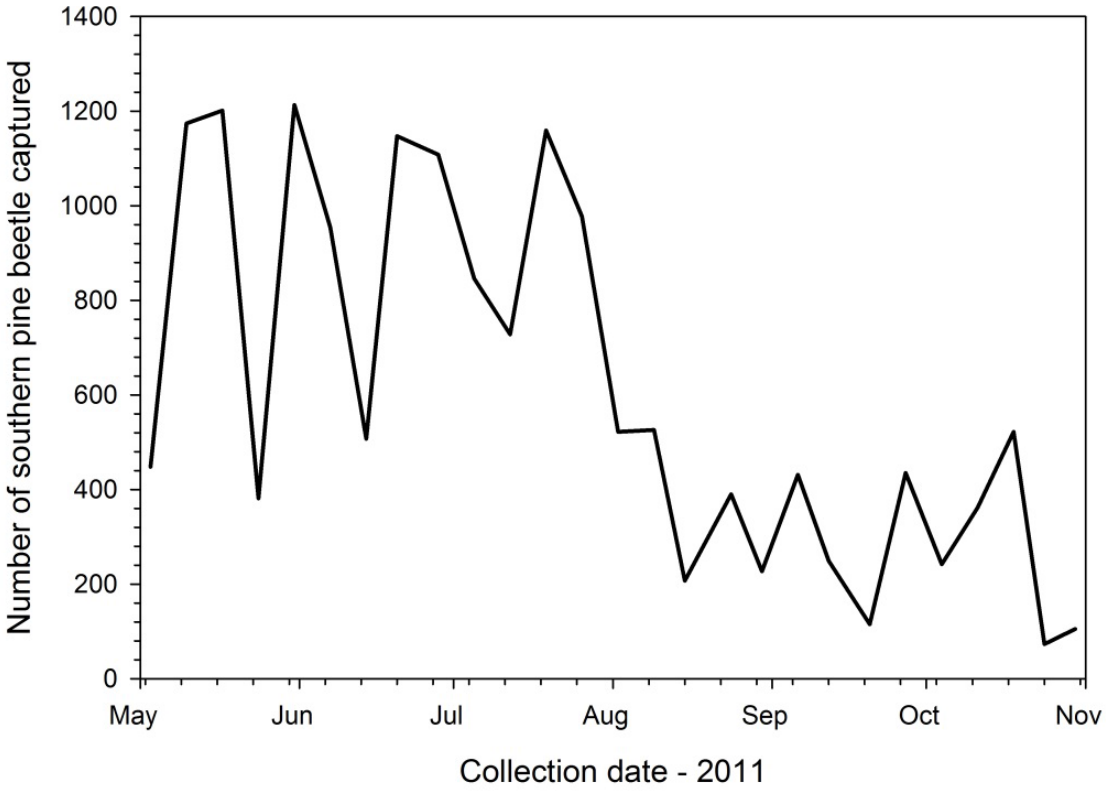


Figure 3. SPB flight phenology from pheromone-baited traps in New Jersey during 2011.

DEC will upload trapping data to the USFS National SPB Data Portal: http://svinetfc12.fs.fed.us/SPB_DataPortal/DataEntry.aspx.

2. Aerial detection surveys

Aerial surveys will be conducted in planes and helicopters at heights of at least 1000 ft. to map SPB infestations ≥10 trees across the landscape to inform the public, with more focused surveys conducted over priority areas. Aerial Surveys will be conducted multiple times throughout the year to provide an approximate number of infested trees and acres, based on tree color-change as visible from the air. Aerial surveys in the winter months will be used to map potential SPB infestations and serve to inform the public on the extent of SPB. These areas will be ground surveyed to confirm SPB presence and further delimit the mapped area on the ground.

Aerial detection surveys map the presence of probable SPB infestations based on tree fade characteristics and are especially suited for forest situations. As trees decline, foliage fades from green, to yellow, red, and then brown. It is unknown how long it takes a tree to fade to shades detectable by aerial observers in New York and this likely varies with time of year, so it is not yet known how quickly new SPB infestations can be located from the air. DEC is currently conducting a study to better determine how quickly trees fade colors. It is critical to validate aerial observations and quantify newly infested green trees with follow-up ground surveys.

3. Ground surveys
   Ground-based surveys will verify infested trees after spots are detected and mapped in aerial surveys. Ground surveys provide a more accurate number of infested trees and acres. Ground surveys also provide the number of newly infested (stage 1), older infested (stage 2), and dead (stage 3) trees and the direction of spot growth (i.e., active front, spot head). If ground surveys are conducted prior to a planned suppression effort, surveyors mark infested and buffer trees to be removed.

Strategy 2: SPB Preventive Management Strategies

The two main management strategies that will be implemented to stop or slow the spread of SPB will be spot suppression and thinning. It is unlikely that SPB spot suppression or preventive thinning treatments will be completely successful when used alone so both strategies should be integrated to manage SPB. However, efforts by DEC will mainly be focused on spot suppression.

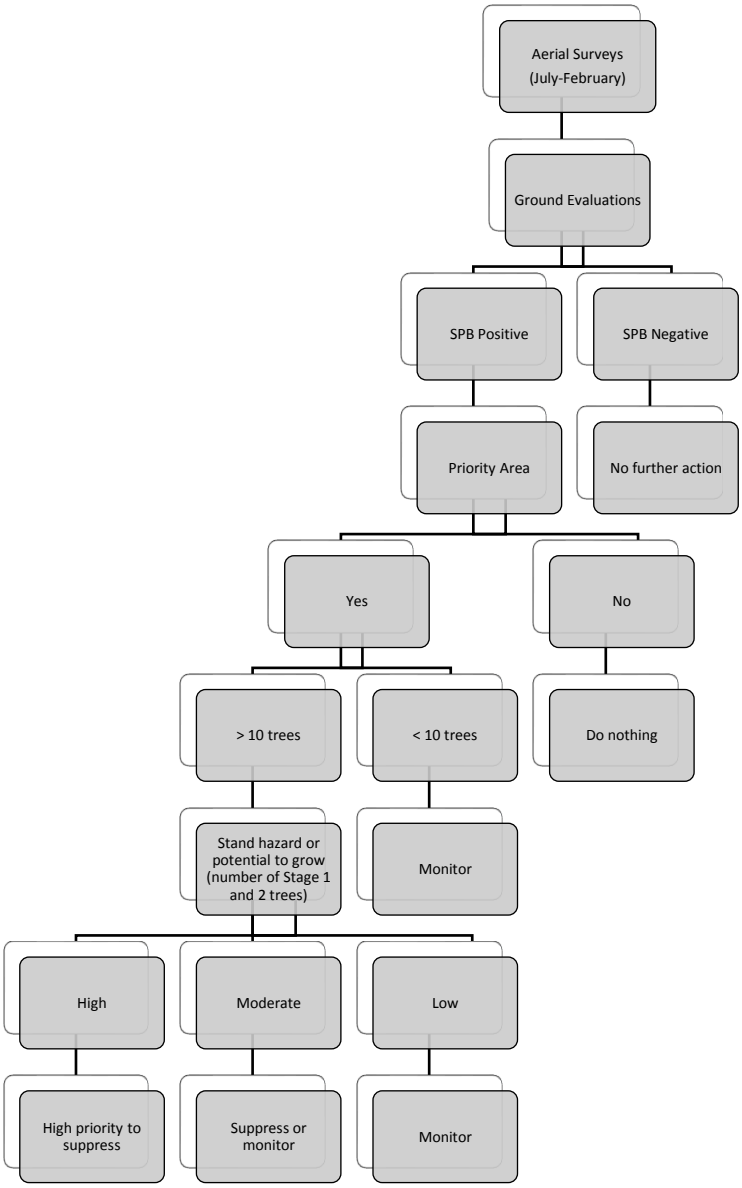
Spot Suppression

Prioritization for Spot Suppression

Based on Billings and Pase (1979), the most important factor in prioritizing spots for suppression is the number of Stage 1 and Stage 2 trees. DEC uses the number of Stage 1 and Stage 2 trees to create the initial prioritization of spots for suppression. In addition, DEC further prioritizes spots that are within the Central Pine Barrens and spots on the edges of large infestations to slow the spread of SPB into new areas.

After spots are prioritized following this protocol, DEC will select the highest-rated spots that can be cut within a two-week period. Typically, about 2,000 trees have been cut during each growing season (2 seasons, about 10 weeks each), depending on the number of cutters and the experience of cutters. Because suppression is ineffective if all trees are not cut during the season, spots that have fewer than 500 Stage 1 and Stage 2 trees will be targeted for suppression.

Trees already vacated by SPB will not be included in suppression cuts and can provide valuable wildlife and SPB predator habitat. However, they should be removed if they pose a risk to public safety. A flow chart of SPB suppression treatment prioritization decisions is presented below (p.9).



Infested and buffer trees will be cut during spot suppression. These methods disrupt spot growth and reduce the chances remaining pines will be attacked. The spot's growth is interrupted because cutting the trees disrupts the beetle's pheromone communication. The two common techniques used to disrupt and suppress SPB infestations are (1) cut-and-leave and (2) cut-and-remove.

1. Cut-and-leave
   In cut-and-leave suppression, infested and buffer trees are felled toward the center of an infestation. Felling infested trees has a negative effect on developing SPB brood, with brood survival depending on cut timing and treatment of logs (Hodges and Thatcher 1976). In cut-and-leave suppression, trees are left on the ground at the site. In fall and winter suppression, beetles are exposed to the elements to increase brood mortality. In the summer, suppression disrupts SPB pheromone plumes, making it more difficult for beetles to find and attack trees in high numbers.

Trees cut with cut-and-leave suppression will be grooved with hopes of further increasing the beetle brood's exposure to moisture and cold temperatures. A scientific experiment by Kevin Dodds (USFS) is underway to determine the success of this tactic. Cut-and-leave suppression will be followed up by aerial or ground surveys to make sure the infestation has been eliminated.

2. Cut-and-remove
   In cut-and-remove suppression, infested and buffer trees are felled and removed from the site to be utilized as wood products or otherwise disposed of (e.g., landfill, burn pit, chipper, etc.). Because beetles are removed from the infested area, this tactic is more effective than cut-and-leave suppression. Although it would be the preferred method of SPB suppression, cut-and-remove suppression so far has not been feasible on Long Island due to a lack of local timber markets and tree removal resources.

Although cut-and-remove suppression has the added benefit of removing beetle populations from an area, this method will not be used on Long Island due to a limited forest resource industry. Consequently, **suppression activities on Long Island will primarily rely on cut-and-leave tactics**. Both suppression methods remove a green-tree buffer from around the active front of an infestation. This buffer is especially important in growing season suppression activities as it creates a gap between SPB pheromones emanating from freshly attacked trees and healthy, uninfested pines. Buffer width may vary based on size of an infestation, but should be a minimum of 60 ft.

Preventive Stand Thinning

Preventive stand thinning has been extensively researched and used as a strategy to manage SPB in the southeastern United States and in the New Jersey Pine Barrens. In preventive thinning, some trees are removed from crowded forests, which allows the remaining trees to get more nutrients and more sunlight, making them healthier and more resistant to pests; such as SPB. Preventive thinning ecosystem restoration reduces the likelihood of an SPB infestation becoming established or of large tree losses if an area becomes infested (Belanger 1980, Brown et al. 1987, Fettig et al. 2007, and references therein). **Preventive thinning will only occur in forest stands that are located more than 2 miles from heavy infestations.** Preventive thinning reduces competition between individual trees and has been proven to make trees more resistant to SPB attack. Increasing the distance between trees also makes it more difficult for beetles to communicate and mass attack through use of pheromones (Thistle et al. 2011).

Prior to preventive thinning, stands are inventoried and analyzed. Data collected includes basal areas, densities, species, and diameters. This data is used to estimate competition factors such as stand basal area (amount of area occupied by tree stems), stand density index (based on number of trees in the area and the trees' diameter, or how large the trees are), and quadratic mean diameter (estimates average tree diameter) to create SPB hazard models within forests.

To help determine which NY forests should be targeted for thinning, a hazard map was created incorporating the competition factors and the distributions of susceptible pine species (pitch pine, red pine, Scots pine, Austrian pine, shortleaf pine, and Virginia pine) using data collected by USFS (Figure 4, p.9). This map will be used more generally to target areas especially susceptible to SPB attack. Targeted areas considered for preventive thinning will need to have more specific stand inventories and analyses conducted prior to treatment.

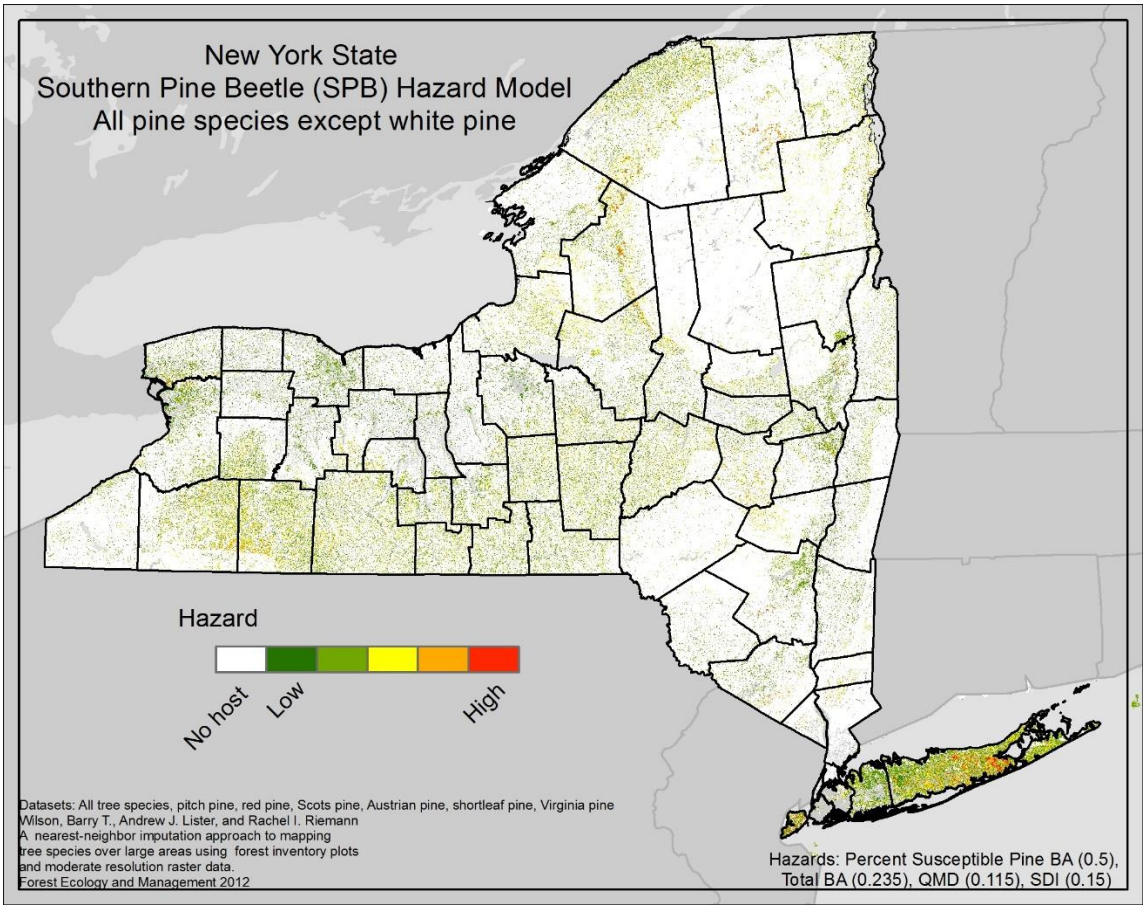


Figure 4. SPB hazard based on competition factors and distributions of susceptible pine species including pitch pine, red pine, Scots pine, Austrian pine, shortleaf pine, and Virginia pine.

Following the hazard models, thinning prescriptions for high-hazard areas will outline how each stand will be thinned and how the treatment will affect management goals and unique and endangered species in that area. **Forest stands with >700 trees/acre will be reduced to ≤450 trees/acre and stands at or above 120 ft^2/acre will be thinned to a residual basal area of <80-100ft^2/acre. This process has begun at Rocky Point State Forest.**

Where feasible, a commercial harvest will be used to accomplish preventive thinning. In areas such as Long Island, where there is not a robust timber industry, DEC may need to pay to have the thinning completed. Commercial harvesting may be more viable in other areas where there is a timber industry, such as in the Hudson Valley. More detailed site analysis will need to be completed to determine if preventive thinning can be used in more sensitive habitats in New York such as the Shawangunk Ridge or the dwarf pitch pine plains.

Strategy 3: Stand and Ecosystem Restoration

In stands attacked by SPB, a science-based forest management plan that defines goals and includes monitoring appropriate to those goals (e.g., factors such as vegetation composition and structure, pine tree regeneration, invasive species detection and management, etc.) should be created by the land manager. Some stands will need restoration activities (e.g., replanting, vegetation management) to reach desired conditions, while others may benefit from the overstory removal by SPB. An assessment of SPB suppressed areas will be conducted and customized restoration plans will be developed with the goal of encouraging and maximizing natural regeneration of desirable forest conditions and ecosystem functions.

Seeds from pitch pine, other at-risk species, and other native species will be collected from susceptible stands and ecosystems throughout the state and sent to the NYS Tree Nursery in Saratoga Springs. Collection of pitch pine cones for seeds has already begun on Long Island. DEC's Trees for Tributaries Program will incorporate SPB restoration into their riparian planting efforts across New York State. On Long Island, DEC's Trees for Tributaries Program and partner groups will plant pitch pine seedlings as well as other non-SPB host species in stands negatively impacted by SPB to restore and maintain diverse pitch pine forest ecosystems.

Strategy 4: Provide Municipalities and Non-for-profit Agencies with Support to Conduct Work in SPB-impacted Areas

The Department has created a Competitive Grant Program to support communities in SPB-impacted areas. The Southern Pine Beetle Community Recovery Grants Program provides funding to communities to remove dead trees that pose a danger to public safety, conduct spot suppression, and replant trees in areas impacted by SPB. The projects funded by these grants will help manage SPB in areas not targeted by DEC's direct management. Grants are available to municipalities, municipal corporations, soil and water conservation districts, school districts and community colleges that have a public ownership interest in the property or are acting on behalf of a public property owner. Awards range from $25,000 to $75,000, and have a match requirement of 25% of the grant amount requested. Projects funded by these grants will supplement the work conducted by DEC – including work in non-priority areas and removal of hazard trees.

Other Considerations

Systemic insecticides

Systemic insecticides are insecticides that are injected directly into the trunk of uninfested pine trees. From inside the trunk of the tree, systemic insecticides kill and repel insects that attempt to feed on the tree. Systemic insecticides have fewer nontarget effects compared to bole-sprayed insecticides and have shown some success in protecting individual trees. However, systemic insecticides take 15 minutes to apply per tree (Fettig et al. 2013), do not protect trees from the blue-stain fungi introduced by bark beetles, and take at least four weeks to disperse throughout the tree and become effective. Although systemic insecticides may be helpful in protecting individual high-value, uninfested trees, systemic insecticides are not practical to use for controlling SPB on a landscape-level scale. For this reason, **systemic insecticides will not be used by DEC to protect trees from SPB on Long Island**.

Verbenone

Verbenone is a type of pheromone that is emitted by SPB and other bark beetles for communication which has been synthesized in the laboratory. Verbenone is emitted by SPB when a tree is fully attacked and causes host-seeking SPB to avoid attacking that tree. Although some scientific studies have shown verbenone to be successful in dispersing SPB, overall, verbenone trials have produced mixed results. In addition, SPB attack behavior is not only affected by verbenone, but also the numbers and sexes of the beetles in an area, the amount and timing of pitch response by the host tree, and other factors. Due to these complexities, no published studies can fully confirm the ability of verbenone to protect individual pines against SPB attack (Strom and Clarke, 2011). For these reasons, verbenone is not used for management of SPB and SPB-specific verbenone-based products are not currently available for pest management. **Until the research becomes more definitive, DEC will not incorporate verbenone use into our management strategy**.

Pitch Pine Fire Hazard

The presence of SPB in pitch pine and pitch pine-oak forests will result in a rapid increase in standing dead wood and/or an increase in downed coarse woody debris. It is unknown at this time what effect the increase of dead woody material will have on fire hazard, but in other bark beetle systems an increase in fire hazard has not generally been recorded (Harvey et al. 2014). Local fire response organizations will be notified of the areas containing potential fuels from pitch pine mortality in their jurisdictions. Fire mitigation measures by local fire agencies, such as wood removal or chipping, or otherwise clearing a fuel free buffer zone around suppression areas should be considered when feasible. In areas that they are applied, thinning and prescribed burning may reduce available fuels for wildfires and serve as fire mitigation.

Outreach

It is critical to adequately explain management goals, methods, and expected outcomes of the SPB response to elected officials, the public, landowners, environmental groups, landscape professionals, regulatory agencies, and others. An outreach group has already formed as part of the overall incident command system for SPB management on Long Island. Separate outreach groups will be formed between DEC Central Office and Regional staff for regions in which SPB causes substantial damage.

Research

Research is being conducted and will continue to be conducted to guide management decisions in New York. Research on SPB on Long Island is being conducted by several organizations including DEC, US Forest Service, Cornell University, and Southern Illinois University. Research conducted by DEC so far has examined the age and size structure of trees in suppressed stands, expansion rates in infested stands and further research is being conducted on SPB densities and flight timings, winter temperatures and mortality, color change, roadside tree density, and suppressed stand regeneration. Studies of management alternatives and options in this non-timber product setting would also be beneficial. DEC will continue to engage the research and academic community to formulate the most effective and efficient response to SPB.

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