

Forest Health Evaluation
Of
Southern Pine Beetle Infestations
In
Southern New Jersey

(2002 - Year 1)

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New Jersey Forest Service

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***Revised: February 7, 2003**

Changed acreage on SPB2 from 18.5 to 14.6

Changed acreage on SBP11 from 68.4 to 62.6

Abstract

During December 2001 southern pine beetle (Dendroctonus frontalis Zimm.) (SPB) was discovered and reported for the first known time in New Jersey. Evidence of scattered dead and vacated trees showed signs of SPB activity in 2001. A spring 2002 *Billings* Trap Survey performed in cooperation with the USDA Forest Service resulted in low to declining projected SPB populations for 2002. SPB infestations expanded very rapidly throughout the summer 2002. Aerial surveys in late summer 2002 detected approximately 264 outbreaks ranging from single trees to 250 acres in size. Infested acreage is estimated to be 1,270 acres. Pine species infested are pitch, shortleaf, Virginia, loblolly, red and white pine. Winter 2001-2 was mild in New Jersey. Concurrently, NJ is experiencing the worst recorded drought in state history. Increases in SPB infestations in 2003 similar to those of 2002 have the potential to significantly impact species composition, wildlife habitat, outdoor recreation, private landowners, RxB, and wildfire suppression in Southern New Jersey. Plans for SPB suppression and control activities are currently being developed for winter-spring 2002-3 implementation. SPB monitoring planning/activities for 2003 are being refined.

Introduction

A possible SPB (Dendroctonus frontalis Zimm.) outbreak (1/2-acre) was reported by a consulting forester on private land near the town of Buckshutem in Cumberland Co. early December 2001. New Jersey Forest Service (NJFS) personnel collected insect samples and outer bark tissue samples which were forwarded to a USDA Forest Service, Morgantown, WV field office representative for analysis. The USFS positively identified the samples as SPB and SPB activity, respectively. Due to the unique situation, the USFS forwarded these samples to the Maryland Dept. of Agriculture (MDA) for a second opinion. The MDA confirmed the original identification.

A helicopter reconnaissance flight was performed in February 2002 in order to determine the extent of infestations and damages occurring in areas of southern NJ that have a pine component. Aerial support was provided by the NJ Forest Fire Service (NJFFS). This flight indicated between 10 and 20 possible infestations in Cape May and Cumberland counties. These areas ranged from a few trees to 1 acre in size. NJFS foresters began to locate via GPS and flag infested trees/spots, as they were identified. Sample points for volume estimations were also taken.

NJFS in cooperation with USFS (Northeastern Region) entomologists surveyed SPB numbers beginning in April 2002 using the *Billings*'s trap method. Six- (6) traps were placed throughout the NJ pinelands. Traps were placed in areas where pine was not a component so as not to draw the SPB into non-infested stands. The traps were then checked weekly in order to determine the populations of SPB and the predatory checkered beetle (Thanasimus dubius Fabricius). During the spring, two- (2) late season frosts combined with unseasonably warm temperatures extended the survey period from the typical 4-week collection to 7-weeks. Initial results of trapping and corresponding SPB-checkered beetle ratio calculations indicated that the SPB population prediction was static and/or declining population. However, as the season progressed southern NJ actually showed a dramatic increase in SPB activity as evidenced by increased yellowing of forest stands. The number of SPB spot locations also increased from approximately 24 (all sizes) to 264 during the spring-summer 2002 period.

Most of the SPB infestations occur in the Belleplaine State Forest and Peaslee Wildlife Management Area (WMA) region. The largest know spot is 250 acres and is located in Peaslee WMA. Drainage/lowland areas appear to be the most heavily infested possibly due to pine being stressed by severe drought. These areas are known to have populations of the barred owl (Strix varia). Although, the Barred owl is secure in its range it is listed as threatened and endangered (T&E) in NJ. SPB may have a negative impact on existing and future Barred owl populations because of the mortality of pine in the drainage/lowland areas. Trees that occur in these areas are generally larger in diameter than the surrounding upland stands therefore have the potential for cavities. Continued mortality will open the crown canopy and possibly make favorable conditions for the great horned owl (GHO). The GHO is a predator to the barred owl and could reduce existing populations. Suppressing the SPB infestation rates in these areas is of great importance.

Local woodpecker populations have benefited by the SPB as evidenced by the foraging and scraping of bark from infested trees. Woodpecker activity has followed the infestation 'heads' and may have a positive effect of control. However, these benefits may not be realized for several years. The checkered beetle has also helped in control and can be observed preying on SPB on the bark of newly infested trees.

Technical Information

The SPB is the most destructive forest insect pest in the southern and the southeastern United States. Since its migration to southern NJ it has attacked all pine species growing in the pinelands region. These species include pitch, shortleaf, loblolly, white, and red. Pond pine may also be at risk.

The infestations are occurring in pure pine stands, mixed stands with hardwoods and on pine occurring in Atlantic white-cedar swamps. Stands with the greatest risk of attack have one or more of the following characteristics: biologically mature to overmature, high stocking densities; stresses from drought, and storm damage. However, even apparently healthy stands are being mass attacked. Pines are being killed in groups ranging from a few trees to whole stands covering hundreds of acres. It appears that this may be the second year of SPB outbreak or epidemic.

Life Cycle

The SPB has four life stages: egg, larva, pupa, and adult (Photos 1 and 2 – blue arrow). Complete metamorphosis is accomplished in approximately 1-month and there can be up to seven generations/year in the southern US. It appears there has been three generations in southern NJ as witnessed by progressing heads during spring-summer 2002.

The adult SPB attacks living trees and construct a winding, characteristic s-shaped gallery in the inner bark. Individual niches are constructed perpendicular to this s-shaped gallery where the female deposits her eggs (Photo 2. red arrow). When multiple galleries are constructed, overlapping will occur and the eventual girdling of the tree will occur. Girdling prevents the translocation of nutrients. The SPB can introduce blue-stain fungi (*Ophiostoma* spp.) into the tree, which penetrates the wood and clogs the water conducting system, thereby accelerating mortality. The SPB eggs hatch into white c-shaped larvae with glossy reddish-brown heads. The larvae mine the inner bark where they construct pupal chambers just below the surface of the corky outer-bark. When pupation is complete, the new broods chew exit holes through the bark and infest green trees. The SPB will fly up to 0.4 miles in the spring and fall months to infest trees and will attack trees nearby in the summer months.

Photo 1. Adult SPB (not to scale)



Photo 2. S-shaped galleries



Types of Damage

The damage caused by SPB activity is tree mortality. Depending on the time of year, number of SPBs attacking, presence of blue-stain and environmental factors, mortality may become noticeable within a few weeks to four months after an attack. Newly infested trees will begin to turn yellow progressing to red. This discoloration will also indicate the direction the infestation is spreading. Fresh reddish and yellowish-white pitch tubes can also help to determine the direction of spread. Eventually the trees will turn brown and lose their needles. Many of the spots in the Belleplain State Forest and Peaslee WMA region have multiple heads moving in different directions.

Methods

Geographical Information Systems (GIS) and Global Positioning Systems (GPS) mapping procedures were used for the aerial surveys conducted during the summer 2002. All areas within the NJ Pinelands and the Atlantic Highlands with a pine component were surveyed. Flight lines were flown east-west and west-east approximately two miles apart. All areas of infested pine detectable were plotted onto a laptop computer with an estimate of the area in acreage or number of trees.

Aerial detected SPB spots ranged in size from a few trees to over 250 acres. Dozens of spots were selected for ground verification of SPB activity and potential for spread. Spot selection was based on size, location, and potential for control. At each spot, the following stand data and infestation information was recorded:

- Date
- Species
- Diameter
- Volume in cords
- Percent green/yellow/red tops
- Direction of spread
- Digital photo
- Control priority
- Ownership (public or private)
- Condition (active, inactive or reactive)
- Potential future stand

This information was collected using an Allegro Data Logger with Two Dog inventory software installed and a Trimble GPS unit with a customized SPB data dictionary. This data has been entered into ArcView software for the development of a GIS coverage. The methodology used for the aerial survey and ground verification will be performed each year and follow USFS aerial survey guidelines.

The need to develop an SPB control and suppression project is based on the projected volume losses, fire hazard, reduction of T&E habitat, crown closure, accessibility, logistics, and economics. The fire hazard is directly related to NJ's history of wildfire in the pinelands region. As the trees brown, they drop their needles onto understory vegetation. This creates a fuel ladder effect that can cause a ground fire to quickly climb into the tree crowns. A crown fire can spread fast, be difficult to control, and contribute to spot fires hundreds of feet away where this process could be repeated. Direct suppression by cutting and removing, at minimum, the heads of infestations would be advantageous. The NJFS will work directly with the NJFFS in choosing target areas for suppression. Areas previously selected and approved for prescribed burning (RxB) will be reevaluated due to the potential of adverse burning conditions created by SPB.

Suppression Project Criteria

These factors have been taken into consideration prior to recommending SPB suppression:

1. Aggressive suppression early in apparently building populations

The SPB is new to southern NJ and a population cycle may be in the early stages (1-3 years) and starting to build in numbers. Suppression activities at this stage could prevent future generations from becoming established.

2. Potential for change of forest type from pine overstory to scattered overstory or no overstory

This factor is of importance due to the sites infested having little or no tree regeneration in the understory. Understory composition is a mixture of shrubs (mountain laurel, sweet pepperbush, highbush blueberry, etc) and low quality red maple and tupelo. SPB suppression in conjunction with salvage operations followed by reforestation is necessary to prevent these sites from becoming shrubby lowland areas. This will also provide future canopy closure for barred owl habitat and reduce fragmentation.

3. Presence of fresh attacks

Freshly attacked trees also give an indication that infestation expansion is occurring. Trees that have soft pitch tubes with no exit holes indicate that they are currently under attack by adult beetles constructing egg galleries.

4. Forest management objectives

The existing and future effect of SPB infestations upon the entire forest resource (multiple use concept) is also considered.

5. Loss of recreation use

Belleplaine State Forest has a high level of recreational use such as camping, picnicking, bird rodeos and hiking. Further mortality of the pine component could lead to personal injury (as fragmentation of trees occur) and decreased quality of the outdoor experience. Annual monetary loss from camping fees could approach \$200,000 dollars.

Results and Discussion

Approximately 264 active SPB spots that are documented in the Belleplaine State Forest – Peaslee WMA region by aerial and ground truth surveys from late July through late September 2002. This region contains approximately 280,000 acres of susceptible host type.

Economic analysis of timber volume loss is difficult to calculate. The timber market in southern NJ for pine is primarily pulpwood. The dominant host type, pitch pine is of extremely low quality, is low in phenotypic qualities and usually has fire damage (past or present). Pine that is harvested is generally performed with low monetary return to the landowner. The benefit of this type of management is an investment for the future forest and anticipated better future markets due to introduction of better genetic stock through reforestation, fire management benefits and intermediate stand treatment opportunities.

Presently uninfested pine stands within the Belleplaine – Peaslee region are at risk for continued SPB attack. Many of the stands are high in basal area and occur in low-lying areas. These poor stand conditions, in conjunction with drought and mild winters subject this host pine type as highly susceptible to future attack and an increase in SPB populations. Table 1. below indicates conditions of 11 priority sites for control.

Table 1. Characteristics of SPB Infestations

Spot ID	Ave DBH Pine	Ave DBH all Species	Ave # Trees per acre	Ave # Trees per acre Pine	Volume Pine in Cords per acre	Basal Area per acre	Acres
SPB2	11.1	6.5	637.4	119.2	23.4	148.0	14.6
SPB3	9.7	8.6	148.6	97.7	11.7	60.0	1.5
SPB4	7.7	7.7	215.5	215.5	13.8	70.0	11.0
SPB5	6.3	5.9	397.8	257.7	14.7	75.0	14.7
SPB6	6.8	6.8	674.9	674.9	55.5	170.0	0.7
SPB7	9.5	6.8	662.9	193.9	30.2	165.0	13.1
SPB8	9.9	6.8	669.2	172.6	33.9	50.0	26.9
SPB10	8.1	7.7	489.8	388.0	37.4	160.0	1.0
SPB11	10.1	8.3	282.9	132.8	17.5	106.7	62.6
Peaslee	8.6	7.5	321.0	110.3	16.8	98.3	250.0
Peas1	9.7	10.1	157.0	94.5	17.0	86.7	1.4

The current SPB infestations impose serious negative effects to forest management objectives to Belleplaine State Forest. These management objectives include but are not limited to forest health, timber production, watershed protection and improvement, forest fire management, wildlife management, and recreational values. The SPB has the

potential to drastically effect all of these objectives. The probability of additional population expansion and impact by the SPB is very high.

Recommendation

The NJ Forest Health Program recommends the initiation of SPB suppression activities for the southern NJ region in fiscal year 2003. The most effective method of control is cut-and-remove. This method removes the beetle from the site, thus preventing future generations. Where and when cut-and-remove is not logistically feasible, other methods can be applied.

Suppression Alternatives for SPB Control

Below are four alternatives that represent current control strategies used for SPB in the southern US. Due to the SPB expanding its northern range, the effectiveness of any method(s) selected for use in NJ will be determined over time. The combining of alternatives is possible in controlling SPB infestations. Individual or a combination of alternatives (2-4) will be based on a site-by-site basis.

Alternative 1 – No Action

Under this alternative, if weather patterns remain consistent it is anticipated that the SPB will continue to spread and destroy host type habitat. Historically SPB populations increase periodically in the southern US. The existing SPB population may still be in the building stages. If the existing NJ populations increase is 2-years old and historical southern US population increases last 3-5 years, NJ may have 1 –3 years to go until the population decreases. With approximately 1,270 acres already infested in two years, it is possible that 12,700 acres could be infested by summer-fall 2003. This projection is because SPB multiplies in factors of ten. Property, both public and private will be at risk.

Alternative 2 – Cut-and-Remove

Removal of infested trees should begin immediately. Where needed, a 50 to 100 foot buffer strip should be marked and cut next to and ahead of the most recently infested trees. A percentage of trees on-site that have been vacated entirely by SPB could be left standing if they do not pose a fire or other public health hazard. This may help populations of checkered beetles to increase and prey on SPB. The priority of removing infested trees is as follows:

Spring – Fall

1. Remove trees in the buffer zone. A 50 - 100 foot buffer strip of uninfested green trees around the spot head should be removed to minimize reinfestation and to disperse the beetles. The buffer zone should be equal to the height of the trees in the stand being treated.
2. Infested green trees. This will remove SPB pheromone source and potential broods.
3. Fading trees. This removes the potential brood.
4. Red-topped trees. It may not be necessary to remove these trees if the SPB have exited. These could be left standing for the development of predators to the SPB.

Fall to Spring

1. Red-topped, fading and green infested trees. These trees may still contain living brood during the fall and winter.
2. Trees with fresh attacks.
3. Trees in the buffer zone.

Alternative 3 – Cut-and-Leave

Cut-and-leave is designed to disrupt spot growth and reduces mass attacks by dispersing the SPB.

1. Identify all active trees within the spot
2. Fell all active trees toward the center of the spot

3. Fell a horseshoe shaped buffer around green, uninfested trees with fresh attacks toward the center of the spot. In small spots, the buffer can encircle the spot. The buffer width should not be greater than the height of the trees being treated.
4. Dead trees where the SPB have emerged do not have to be felled unless there is a fire or other public health hazard.

Alternative 4 – Pile-and-Burn

Felling, piling and burning is one of the oldest methods to control the SPB. All of the bark must be thoroughly burned to achieve control. This alternative should be performed when the chance of the fire to escape and when wildfire danger is low.

1. Identify and fell all infested trees toward the center of the spot.
2. Pile and burn until all bark is thoroughly burned.
3. Do not burn if fire danger is moderate or high

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