PINELANDS PRESERVATION ALLIANCE

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Via Email
August 17, 2011

Lynn E. Fleming
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Department of Environmental Protection
P. O. Box 402
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Dear Ms. Fleming,

I would like to follow up on my comments given at the July 26, 2011, Pinelands Municipal Council meeting regarding consideration of high-intensity prescribed burns to help control the spread of the Southern Pine Beetle (SPB) in New Jersey's pine forests. I understand that the NJDEP has considered using prescribed burns, but has concluded that this technique would not be appropriate for a number of reasons, including that prescribed burn fires do not burn hot enough to kill the SPB residing under pine tree bark and that the fires would not reach high enough to kill the SPB residing in the upper extent of the trees. Having evaluated several studies on the historical interaction between the SPB and fire in southeastern U.S. pine forests, I would encourage the NJDEP to again consider the use of high-intensity prescribed burning to help manage the recent SPB outbreaks in New Jersey.

My hope is that this information will be considered by you and your staff as you continue to refine your plan for dealing with the SPB. I am aware that you have likely encountered this information before, but I thought it would be worthwhile to review it here.

Background Information

- The southern pine beetle is native to the southern U.S. and has historically been a consistent participant in the natural forest dynamics in that region (Schowalter et al. 1981).
- In those southern forests, populations of the SPB fluctuate between being present in low numbers on stressed trees and outbreaks that kill large forest patches (Lafon and Kutac 2003).
- The range of the SPB has likely advanced north into New Jersey due to climatic changes and a recent series of warmer winters (Ungerer et al. 1999).
- The SPB prefers crowded, aged trees (Schowalter et al. 1981).
- Scientists have suggested that in southern U.S. pine forests, the interaction between the SPB and wildfires naturally maintains the structure and function of these forests (Schowalter et al. 1981).

- Suppression of wildfires has disrupted this natural dynamic and could be contributing to SPB outbreaks (Schowalter et al. 1981).
- Additionally, without the help of fires to reset succession at the pine stage, transition to hardwood forests is accelerated by the SPB (Schowalter et al. 1981; Lafon and Kutac 2003; Waldron et al. 2007).

The following seven articles were reviewed and details of their findings, as well as complete citations, are provided as an addendum to this letter:

1. Boyle et al. 2004 – Impact of prescribed fire and thinning on host resistance to the southern pine beetle: preliminary results of the national fire and fire surrogate study
2. Knebel and Wentworth 2007 – Influence of fire and southern pine beetle on pine-dominated forests in the Linville Gorge Wilderness, North Carolina
3. Lafon and Kutac 2003 – Effects of ice storms, southern pine beetle infestation, and fire on table mountain pine forests of southwestern Virginia
4. Waldron et al. 2007 – Simulating the impacts of southern pine beetle and fire on the dynamics of xerophytic pine landscapes in the southern Appalachians
5. Safranyik et al. 2001 – The effects of prescribed burning on mountain pine beetle in lodgepole pine
6. Schowalter et al. 1981 – Role of southern pine beetle and fire in maintenance of structure and function of the southeastern coniferous forest
7. Ungerer et al. 1999 – Climate and northern distribution limits of *Dendroctonus frontalis*

Our conclusions from reviewing the above seven articles are as follows:

- Intermittent disturbance is beneficial to Pine Barrens forests. It maintains habitat heterogeneity and biodiversity, suppresses non-natives, and encourages native regeneration.
- The SPB is likely to be a continuous threat to Pine Barrens forests as long as warmer winter temperatures persist.
- The cut-and-leave approach may help control the spread of the SPB in isolated spots but does not seem practical in the long-term given the continuous threat. This approach is a reactionary rather than a preventative method, and is small-scale and short-term rather than large-scale and long-term.
- Even if the SPB is not a natural historic component of the New Jersey Pine Barrens ecology, the observation that fire-thinned forests can keep the SPB in check in warmer southern pine forests suggests that if it is to become a regular part of the New Jersey Pine Barrens ecology as winter temperatures remain elevated, then fire-induced thinning may keep its populations in check here as well. Luckily, the Pine Barrens thrives with high-intensity fire, so we would not be introducing a new disturbance source solely to suppress the SPB.
- To be an effective technique against the SPB, prescribed fires will need to burn at higher temperatures than the current burning strategy. Hotter prescribed burns will likely benefit natural regeneration processes as well.
- If there is concern that the fires would not reach the tops of infested trees, perhaps a combination of cut-and-leave and high-intensity prescribed fires would be appropriate. Either way, an area that has been cut to control for the SPB should also be burned to reduce fuel loads and to stimulate pine regeneration.

- Perhaps most importantly, between mortality due to SPB attacks and mortality due to manual cutting and felling, the abundance of pine trees will be reduced, but there is nothing acting to suppress the more competitive oaks. This means that the SPB will accelerate the transition from pine-dominated forests to oak-dominated forests – a trajectory that is already encouraged by wildfire suppression. Cut-and-leave will not suppress oaks, will not reduce the litter layer, and will not encourage pine regeneration.
- High-intensity prescribed burning could be used not just as a response to areas of SPB infestation, but as a tool to prevent future outbreaks. The ecological benefits of fire in the Pine Barrens are many, and using fire to thin the forest and discourage SPB outbreaks can be added to the list of reasons for high-intensity burns in the Pinelands.

High-Intensity Prescribed Burns could:

- Reduce tree density, which (1) decreases competition and associated stressed trees which are more vulnerable to SPB attack, and (2) creates a more open forest in which the aerosol pheromones produced by SPB are not as concentrated, reducing communication efficacy among SPB.
- Directly kill SPB adults and brood.
- Suppress the oaks which would otherwise dominate following destruction of pines.
- Stimulate regeneration of pines following a SPB attack.
- Reduce forest fuel loads.

Schowalter et al. (1981) best encapsulates the natural role of the SPB in southern pine forests with the following:

> "*D. frontalis* also rejuvenates patches of the forest by (1) thinning old or stressed stands as a means of maintaining community diversity and vigor, (2) providing concentrations of fuel to enhance the effect of fire, and (3) opening the canopy to enhance the effect of wind. The resulting dynamic mosaic of communities, representing various stages of succession, increases the relative stability of the ecosystem by reducing the overall impact of disturbance (Bormann and Likens 1979, Wright and Heinselman 1973)."
>
> "Fire control interferes with the natural means of interrupting succession at the pine stage. Consequently, pine forests tend to be replaced by hardwood forests, a transition accelerated by *D. frontalis*. The development of dense understories characteristic of unburned forests increases nutrient demand. Eventually, as a result of stand aging or changes in geoclimatic conditions or both, light and nutrient demand may equal or exceed availability. The pines suffer greater stress than hardwoods, as a result of higher light and nutrient requirements, and consequently become susceptible to *D. frontalis* attack. Whereas naturally occurring fires tend to minimize fuel accumulation and rarely become crown fires, fire control results in dense decadent forest which may be destroyed by fire over extensive areas. Recovery from such drastic disturbances may be slowed by the distance between seed sources and remote portions of the disturbed areas. The system is subject to excessive erosion and nutrient export."

If warmer winter temperatures continue, we may not be able to completely resist the northern range expansion of the SPB and, in that case, we would need to accept its new role in our local ecology. The pine forests would likely benefit if we also accept that high-intensity fire should be restored as a natural disturbance process. We may need to shift our management efforts from those focused on

directly killing the SPB to those that create forest conditions unfavorable to SPB outbreak in the first place.

Low-intensity burns, which do not actually result in significant pine tree mortality, will not reduce pine stand density. Low-intensity burns only result in weakened, but still over-crowded, wildfire-suppressed, even-aged pine stands, which are highly favored by the SPB. These burns do not emulate the ecological benefits associated with natural higher-intensity wildfires.

In addition, I'd like to bring your attention the Albany Pine Bush Preserve Management Plan (available as a PDF document through albanypinebush.org). This inland Pine Barrens in Albany, New York has been subjected to ecological management through prescribed burns over the last 20 years. The Pine Bush Preserve, like the New Jersey Pine Barrens, is surrounded by encroaching development. Even though it is much smaller in area than the New Jersey Pine Barrens, it is routinely burned without posing a significant threat to the surrounding development and without violating EPA Clean Air Act standards. The slow-moving, high-severity burns achieved in the Preserve have reversed the effects of decades of fire suppression.

Thank you for your consideration of this information. Please feel free to contact me if you would like to discuss this further. The following individuals and organizations have signed-on in support of this letter.

Sincerely,

Amy Karpati, Ph.D.
Director for Conservation Science

Maya K. van Rossum
Delaware Riverkeeper Network

Emile DeVito, Ph.D.
Manager of Science and Stewardship
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cc: Nancy Wittenberg, New Jersey Pinelands Commission
Candy Ashmun, New Jersey Pinelands Commission
Bob Martin, New Jersey Department of Environmental Protection
Bob Smith, New Jersey State Senate
John McKeon, New Jersey General Assembly
Bob Cartica, Office of Natural Lands Management, NJ DEP

Addendum: Research Article Details

1. **Ungerer et al. 1999 – Climate and northern distribution limits of *Dendroctonus frontalis***

   - Northern distribution of the SPB is controlled by minimum winter temperatures (-16°C air temperature results in almost 100% mortality).
   - Rejected the hypotheses that summer temperatures or the distribution of host trees constrain the northern distribution of the SPB.
   - "Because of short generation time, high dispersal abilities, and cosmopolitan distribution of suitable host trees, changes in either the mean or variance of minimum annual temperatures could have almost immediate effects on regional patterns of beetle infestations." An "increase of 3°C in the minimum annual temperature could extend the northern distribution limits by 170km."
   - At the New Jersey Pine Barrens latitude, the SPB is predicted to have 4 generations/year.

2. **Schowalter et al. 1981 – Role of southern pine beetle and fire in maintenance of structure and function of the southeastern coniferous forest**

   - The SPB and fire interacted historically to maintain the structure and function of southeast U.S. coniferous forests.
   - The interaction between fire and the SPB led to high community diversity and productivity, enabling these forests to reduce nutrient losses and respond rapidly to disturbance.
   - In combination, fire and the SPB maintained open, uneven-aged pine forests.
   - Current forestry practices have disrupted this interaction and have created forests particularly susceptible to SPB infestation.
   - Fire control interferes with the natural means of interrupting succession at the pine stage. Consequently, pine forests tend to be replaced by hardwood forests – a transition accelerated by the SPB.

3. **Safranyik et al. 2001 – The effects of prescribed burning on mountain pine beetle in lodgepole pine**

   - Looked at attack and brood production by mountain pine beetle in a lodgepole pine forest in Canada (a forest type adapted to frequent fire) following a controlled burn with five burn intensity classes.
   - "Prescribed fire can result in an immediate average reduction of pre-existing beetle reproduction of up to about 50% in areas burned to the level we studied. Individual heavily burned trees will have up to 100% of the brood killed."
   - On average, beetle production per tree in burned trees was reduced by 47.8% and population increase in the burned area was reduced to a static level (that same year).
   - The following year, mean attack, egg gallery and brood density over all burn intensity classes were significantly lower than outside the burn area. Attacks per tree were reduced by 48.5%; brood per tree was reduced by 56.5%.

- Low intensity burns had no effect on beetle survival (total number of beetles per tree). Higher intensity burns reduced the beetle brood per tree (reduced to 0 in highest intensity burn).
- Beetles avoided attacking trees showing signs of burning and attacked a shorter length of burned trees.
- Lower incidence of beetle attacks on burned trees could be due to the reduced attractiveness of burned trees, or to lower local population levels, or a combination of these factors.
- Miller and Patterson (1927): "Fires which are not severe enough to burn the bark from infested trees are of little value in controlling bark beetle infestations. Fires of moderate severity do not kill bark beetle broods in infested trees at the time of the fire." Therefore, vigorous burns would be needed if the main objective is directly killing beetles.

4. Waldron et al. 2007 – Simulating the impacts of southern pine beetle and fire on the dynamics of xerophytic pine landscapes in the southern Appalachians

- Model simulations showed how pitch pines increase in abundance with fire, maintain current levels of abundance with fire combined with SPB infestation, but are removed from the forest with SPB infestation alone.
- Concluded that the key disturbance process of fire will need to be reintroduced to maintain pine forests affected by the SPB.

5. Lafon and Kutac 2003 – Effects of ice storms, southern pine beetle infestation, and fire on table mountain pine forests of southwestern Virginia

- Looked at the interaction of ice storms, SPB, and fire on dry pine forests in Virginia.
- Ice storms can be likened to mechanical thinning (they physically damage/remove pines, open the canopy, do not confer the beneficial effects of fire, do not affect other tree species [like oaks] as severely, do not reduce thick litter layers).
- Ice storms + SPB = decline in pine trees and low regeneration potential in pines (regeneration was not stimulated). The abundance of pines was lowered more than the abundance of hardwoods.
- Ice storms + SPB + Fire = both hardwoods and pines declined; stimulated pine regeneration.
- Periodic disturbances by ice storms and SPB are hastening the loss of pine stands.
- Without fire, long-term maintenance of the pine forest is improbable.
- Whether ice storms and SPB harm or benefit pine forests is determined chiefly by whether fire is also included.

6. Knebel and Wentworth 2007 – Influence of fire and southern pine beetle on pine-dominated forests in the Linville Gorge Wilderness, North Carolina

- Fire, occurring after SPB infestation, is responsible for pine regeneration.
- "The southern pine beetle infests mature pine stands, killing trees and leaving high fuel loads on the ground. High intensity fires typically consumed these fuels and thus opened

stands for regeneration of pines in the southern Appalachians. Without high intensity fires, the beetle-killed pines decay, while shade tolerant hardwoods become established and out-compete the pines for dominance."

- Resin flow is the main defense of pines against beetle attacks, both in chemically and physically killing the beetles. But under intense beetle attack, a tree's resin resources are depleted, and the beetle can then successfully invade.
- Resin flow was significantly higher in trees that were burned than in unburned trees.
- It is thought that this increase in resin flow after exposure to fire increases a tree's ability to withstand SPB infestation. Therefore, burning could confer a sort of acquired resistance to SPB.

7. Boyle et al. 2004 – Impact of prescribed fire and thinning on host resistance to the southern pine beetle: preliminary results of the national fire and fire surrogate study

- Land use trends over the past century, such as fire exclusion, conversion of pine forests to high density pine stands, and frequent cutting have increased pine susceptibility to SPB attack.
- Greater resin flow has been linked to lower SPB attack rates.
- Did not find short-term effects of mechanical thinning or prescribed burning on SPB, but stated that long-term effects could be pronounced through increased tree vigor. Fire and thinning can reduce tree density, leading to an increase in leaf area, which should result in greater resin production. Also, drought years could contribute to SPB vulnerability as trees cannot produce as much resin during drought. (Could a similar effect be produced in the Pine Barrens by declining water tables?)

References

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