## Threats Template Matrix-- Age class diversity

1. **Threat:** The current age class distribution of the ANF is very unbalanced, and the creation of early structural habitat is occurring far too slow. Current condition of Management Area (MA) 3.0: 71% is 80 years of age or older; other MAs are comparable.

2. **Location:** MAs suitable for timber harvest (1.0, 3.0, 2.1, 2.2, and 6.1)

3. **Impact or Severity:** Very significant–many of the other threats outlined by the collaborative would benefit from a more balanced age class distribution.

4. **Desired Outcome:** A stated acreage goal for yearly regenerated acres (by MA). Consistent planning efforts that move the forest towards a balanced condition over time. This includes prescribing of sufficient shelterwood seed cut acreage to result in adequate shelterwood removal harvesting rates. Harvest activities would occur where they are most needed (hotspots). Initial efforts may exceed the annual target. The intent is to have a more balanced age class distribution – not a perfectly balanced distribution.

5. **Strategies to Achieve the Desired Outcome**

   **Strategy 1**: Define rotation ages (will vary by forest type and management area (MA); run models to calculate what level of annual activity is required to balance the age class distribution), or define desired objectives for early age class by MA and develop harvest schedules from those objectives.

   Based on existing ANF Forest Plan direction, the following rotation ages can be inferred, and potential harvest schedules developed for each suited MA based on Forest Plan objectives for each:

   - **MA 1.0 (7,937 acres):** 50-100 year rotation (10-20% 0-10 years old, LRMP p. 102)
     - **Current Condition:** 1.6% 0-20 years old
     - **MA 1.0 Potential Harvest Schedule:** Harvest 227 acres shelterwood seed cuts; 160 acres final harvest annually.
   - **MA 2.1 (2,387 acres):** 90-150 year rotation (Use uneven-aged management on 500-750 acre per decade, assuming 3 entries to achieve 3 age classes in each treated area, LRMP p. 106)
     - **MA 2.1 Potential Harvest Schedule:** Harvest 75 acres annually using uneven-aged regeneration methods.

## Threats Template Matrix-- Age class diversity

- **MA 2.2 (121,176 acres- 23,301 acres oak types; 93,723 acres non-oak types; 4,152 acres non-forest):** Connectivity, predominantly managed using uneven-aged regeneration methods. 300-500 year rotation Oak forest types (4-6% 0-20 years old). 500-1,000 year rotation non-oak forest types (2-4% 0-20 years old). (ANF LRMP p. 109). Note: intent is not to regulate this Management area using even-aged regeneration methods. Management activities focused on sustaining mid-late structural habitat on >85% of area with contiguous high forest canopy.
    - **Current Condition:** Oak Types= 0.3% 0-20 years old, Non-oak types= 1.8% 0-20 years old.
    - **MA 2.2 Potential Harvest Schedule:**
        - **Oak forest types-** Harvest 100 acres shelterwood seed cuts; 70 acres final harvests annually.
        - **Non-oak forest types-** Harvest 268 acres shelterwood seed cuts; 187 acres final harvests annually.
- **MA 3.0 (287,380 acres):** 167-200 year rotation (10-12% 0-20 years old, ANF LRMP p. 113)
    - **Current Condition:** 5.0% 0-20 years old
    - **MA 3.0 Potential Harvest Schedule 1 (LRMP modeled rate):** Harvest 2,224 acres shelterwood seed cuts; 1,556 acres final harvests annually.
    - **MA 3.0 Potential Harvest Schedule 2 (Accelerated rate):** Harvest 2,668 acres shelterwood seed cuts; 1,868 acres final harvests annually.
- **MA 6.1 (16,421 acres):** 286-333 year rotation (6-7% 0-20 years old, LRMP p. 126)
    - **MA 6.1 Potential Harvest Schedule:** Harvest 82 acres shelterwood seed cuts; 58 acres final harvests annually.

**When:** Prior to the next collaborative meeting (September 7)

**Who:** ANF staff and Group #1 members.

**Cost:** --

**Strategy 2:** Develop area control model for all suited MAs with decadal regeneration requirements. Develop an internal target (acres treated annually) that clearly defines annual planning expectations.

- **MA 1.0 Potential Harvest Schedule:** Harvest 227 acres shelterwood seed cuts; 160 acres final harvest annually.
- **MA 2.1 Potential Harvest Schedule:** Harvest 75 acres annually using uneven-aged regeneration methods.
- **MA 2.2 Potential Harvest Schedule:**
    - **Oak forest types-** Harvest 100 acres shelterwood seed cuts; 70 acres final harvests annually.
    - **Non-oak forest types-** Harvest 268 acres shelterwood seed cuts; 187 acres final harvests annually.

## Threats Template Matrix-- Age class diversity

- **MA 3.0 Potential Harvest Schedule 1 (LRMP modeled rate):** Harvest 2,224 acres shelterwood seed cuts; 1,556 acres final harvests annually.
- **MA 3.0 Potential Harvest Schedule 2 (Accelerated rate):** Harvest 2,668 acres shelterwood seed cuts; 1,868 acres final harvests annually.
- **MA 6.1 Potential Harvest Schedule:** Harvest 82 acres shelterwood seed cuts; 58 acres final harvests annually.

**When:** Prior to the next collaborative meeting (September 7)

**Who:** ANF staff and Group #1 members.

**Cost:** --

**Strategy 3:** Future projects should be commensurate with regeneration requirements and continue to incorporate the regeneration of larger contiguous areas and limit intermediate harvests; they should take advantage of low hanging fruit, e.g., uncut stands with adequate advanced regeneration already established, when possible.

**When/Frequency**: Beginning now/Annually. The priority for each District should be the completion of one vegetation management project annually.

**Who**: District personnel

**Cost**: --

**Strategy 4:** Silvicultural prescriptions should describe **desirable and acceptable** outcomes clearly, and the desired condition should be attainable. Most foresters strive for perfection, e.g., a fully stocked stand with a diverse mix of desirable species, and the reality is this condition may be impossible to obtain in poorly stocked stands with multiple forest health concerns.

- **Desirable outcome +> 70% stocked with preferred seedling species-** including cherry, oaks, maples, tulip poplar, cucumbertee, hemlock, pine, etc..
- **Acceptable outcome=>70-**% stocked with commercial species, including birch, The amount of birch that is acceptable will vary by site quality, pre-existing overstory condition, etc..

**When/Frequency**: Beginning now/always.

**Who**: Foresters – both ANF and other landowners. Researchers. Research can facilitate regular interactions among foresters from different landownerships to learn from each other's experiences.

**Cost**: --

## Threats Template Matrix-- Age class diversity

**Strategy 4:** Develop local contractor pool to support and keep pace with implementation of forest health strategies. Local contractor base (e.g. chainsaw site preparation and broadcast herbicide application) is critical to implementation strategies to address this threat, and there is a need to develop additional service contracting resources.

**When/Frequency**: Beginning now/always.

**Who**: ANF, State, private landowners, contracting staff and Foresters.

**Cost:** --

6. **Monitoring Strategies**

**Strategy 1:**

- Monitor status of stands in process of regeneration much more closely. Monitor and adapt … encourage foresters to utilize adaptive management and think outside the box.
- Strive to field visit all treatment areas at the end of their 2nd growing season to determine next appropriate action.

**When/Frequency:** Always

**Who:** District staff/Research (Administrative studies, for example)

**Cost: --**

7. **Additional Information Needs:**

8. **Other:**

## Threats Template Matrix - EAB

1. **Threat:** The Emerald Ash Borer (EAB) has caused significant mortality to date and threatens to ultimately cause near100% mortality of the ash trees on the ANF. (Handout 6/8 Meeting and anecdotal experience of committee members). The majority of ash trees are projected to fall or break within 5 year of mortality. (Handout 6/8 Meeting). This mortality will negatively affect all users and interests on the ANF. A Large concentration of trails and camping areas are within the mortality area, 13,000 active oil and gas wells are located on the ANF owned by approximately 120 operators; a conservative estimate of roads serving said wells is 985 miles. 401 miles of PA state Routes are located in the ANF with an additional 274 municipal road miles. 609 miles of utility lines are located in the ANF. Ash mortality creates a major safety and economic threat to all of these parties in terms of cost of cleanup of downed trees, lost production, damage to infrastructure etc. The direct economic impact due to the loss of the timber volume to the municipalities and school districts could number in the millions of dollars in lost revenue if the ash species is not sold into the timber industry. 500,000 acres X 5,000 board feet per acre X 3% ash basal area X $500 per MBF stumpage= estimated present Ash stumpage value of $37,500,000.00. 25% timber sale revenue to school districts and municipalities would equal $9,375,000.

   Clearly all interests and users of the ANF will suffer great economic loss and recreation access loss if the Ash species is not treated to prevent mortality or removed.

2. **Location:** The majority of this projected mortality is located around the Kinzua impoundment, to the south of the New York Border and to the north of PA route 59, roughly speaking. Please see the mortality projection maps. Very noteworthy regarding the location of the threat is the ANF designated **Management Areas** that a significant amount of project mortality will likely occur. Significant mortality is projected in Management Area 8.2 “National Recreation Area,” Management Area 2.2 “Late Structural Linkages” and Management Area 5.2 “Wilderness Study Area.” Please see Management Area Maps. Each of these areas have specifically defined roles and restrictions within the ANF as discusses in the Allegany National Forest Land and Resource Management Plan.

3. **Impact or Severity** This group believes it is hard to overstate the severity of the threat that is presented by Ash Mortality. The anecdotal experience of the members of this group is that on the in-holdings within the ANF and the parcels immediately surrounding the ANF, the attack of the EAB has been swift and relentless. Many ash trees which appeared healthy in the 2016 growing season did not leaf in 2017. In recognition of the extreme severity of the problem owners of private timber holdings in and next to the ANF have harvested in excess of 90% of the white ash, with work diligently underway to harvest the remainder before mortality renders the trees valueless and/or too dangerous to harvest. The rapidly closing time-window within which to harvest is an additional element of severity that cannot be overstated.

4. **Desired Outcome:** To eliminate, or reduce to practical means, the threat of dead and dying ash trees falling on people and property, public and private, as quickly as possible all while providing forest products to area industry and financially supporting municipalities and school districts.

## Threats Template Matrix - EAB

**5. Strategies to Achieve the Desired Outcome**

**Strategy 1**: Expedite pre-mortality timber harvesting in order to treat the largest amount of acres at the lowest cost to the public.

Ash pre mortality based timber sales should be designed in a manner to gather as much interest from the timber industry as possible in order to ensure projects are purchased in a timely manner and treated. Ash timber harvests should have minimum stumpage pricing set low to ensure the market value of the timber exceeds the minimum estimated pricing. Ash timber harvests should not be included in Stewardship contracting project. Ash timber sales should be exempted from small business concern timber sale bidder class restrictions. Categorical exclusion process should be employed at each possible opportunity.

Comments received from the ANF working group were generally filtered into two categories, aesthetic concerns and regeneration.

Our group believes that a temporary change in crown structure in a controlled manor such as a timber harvest will have a shorter term visual change and will be overall more pleasing than retaining thousands of dead trees for an indeterminate amount of time, until they fall over. One or the other will happen, this collaborative group and the ANF staff will make these decisions.

This group is not recommending and stand level silvicultural, regeneration or timber harvest recommendations, rather an overall strategy for mitigating a forest health issue. Concerns such as competing vegetation, sunlight management, deer herd pressures, desirable regeneration etc. all must be addressed on a case by case basis by the on the ground forest management staff of the ANF as is the current case with all ANF timber sale management projects.

Ash Timber sales should be prioritized to treat areas of high public safety and high infrastructure concerns. Pre salvage harvests should focus resources around harvesting along road corridors, utility lines, OGM production locations, trails and campsites. Ash Timber sales should also be large in scope and size. A very recent fine example is the **Hollow Trail** Timber sale with a sale area of 870 acres and harvest confined to 271 acres with a specific design to harvest ash.

Our Group recommends a Categorical Exclusion request to allow pre-mortality timber harvesting in the Management area 8.2 to reduce risk to the public caused by having dead or dying trees so close to high use recreation areas. Also to reduce cost to the ANF of cleaning and maintaining these the dead woody debris that will quickly accumulate recreations areas. The Pennsylvania DCNR has instituted these types of timber sales within the PA State Parks systems for these reasons. Currently the state park system has received very little negative push back from the public for these projects.

**Management Area 5.2** allows for “Natural Succession, No Timber Harvest.” An argument could be made that EAB infestation is not a Natural Succession event as it is an exotic invasive species. The management goals of this area have already been manipulated by human interference even if it is or was unintentional.

**MA 5.2** is a logical area within the ANF to introduce biological control measures as discussed below.

## Threats Template Matrix - EAB

**When**: ASAP

**Who:**

**Cost:** This strategy will provide economic benefits to local economies, school districts and municipalities.

**Strategy 2: Biological control.** This strategy would consist of releasing three species of parasitoids for the control of emerald ash borer:

- *Tetrastichus planipennisi*, larval parasitoid
- *Oobius agrili*, egg parasitoid
- *Spathius galinae*, larval parasitoid

The current goal of APHIS is to release in all EAB-infested counties. The Bureau of Forestry is already releasing in Forest and Elk Counties. The Forest County site is immediately adjacent to ANF land. The Elk County site is approximately 20 miles from the edge of the National Forest. A site has been identified and is awaiting approval for Warren County. A tentative site has been identified in the Management Area 5.2/8.2 area. This site still has to be finalized and sent to APHIS for approval These organisms are believed to move about 7 miles per year.

*Tetrastichus planipennisi* and *Oobius agrili* have established in other parts of Pennsylvania. In addition, there is scientific evidence that *T. planipennisi* is able to reduce EAB larval levels where there is thin bark (i.e. young trees and high branches) to levels that allow trees to survive. Neither *O. agrili* nor *Spathius galinae* have been released long enough to confirm their efficacy against EAB. The fact that *O. agrili* is established in Pennsylvania necessarily means that it is reducing the number of EAB eggs to some degree. Further, if *S. agrili* can establish, it should be able to attack larvae beneath thicker bark than *T. planipennisi*.

Unfortunately, it is still likely that a large percentage of larger size class ash will be lost. What is hoped at this point is that the next generation of ash trees will be protected by these parasitoids. Ash seedlings are abundant in many parts of the ANF, and getting these organisms established should offer them some protection.

**Site requirements:**

- Not to be harvested/developed in the next 5 years
- Diversity of size classes
- At least 40 acres
- At least 25% ash

These releases can also be conducted in the vicinity of chemically treated trees. This might be an option where hazard trees are a concern.

Refer to Tim Tomon's expertise on this topic. Management areas 5.2 and 8.2 seem to be logical concentration areas for these controls of experiments.

**When**: Starting late summer, 2017. Releases will continue through the 2018 season and possibly all or part of 2019.

| **Threats Template Matrix - EAB** |
|---|
| **Who**: Cooperating agency personnel will assist with assessing and setting up release sites. Parasitoids provided by APHIS-EAB Biocontrol Program.<br><br>**Cost**: The cost of the parasitoids is covered by APHIS. Costs for personnel to conduct site assessments and releases are covered by cooperating agencies. |
| **6. Monitoring Strategies *(Add more as needed)*** |
| **Strategy 1:** |
| When/Frequency: |
| Who: |
| Cost: |
| **Strategy 2:** |
| When/Frequency: |
| Who: |
| Cost: |
| **7. Additional Information Needs:** |
| **8. Other:** |

## Threats Template Matrix - Safety and aesthetics along multi-modal corridors

1. **Threat:** As the health of various species of trees continues to decline, the result will be many trees falling throughout the forest. The safety of the public is placed at risk due to the potential of the trees falling in developed or other public access areas. The risk to public safety may be direct, such as a tree falling directly on a camper or hiker, or indirect by falling into the path of a motorized vehicle and causing an accident. All multi-modal transportation corridors are at risk to numerous downed trees impeding the continuance of travel.

2. **Location:** All roadways, developed campgrounds, disperse campsites, trailheads, boat or canoe launches, hiking trails, biking trails, equestrian trails, ATV trails and other administrative public sites are at risk.
   For locations, sites, & total miles, Utilize:
   1. *Allegheny National Forest Administrative Map;*
   2. *ANF Geographic Information System (selected map layers and associated database);*
   3. *Allegheny National Forest – Recreation Map Brochure*;
   4. *Four county area of local school district's transportation needs (bus routes)*

3. **Impact or Severity:** The roadways in the ANF with the highest average daily traffic hold the highest immediate risk to public safety. However, all dead and dying trees along trails, trailheads, campgrounds, campsites, boat or canoe launches, and other administrative sites utilized by the public pose a significant and immediate danger.

4. **Desired Outcome:** Mitigate the hazard to the traveling public along multi-modal transportation corridors by reducing the risk of injury from falling or fallen trees while maintaining the forest aesthetics, through selective reforestation and planting efforts. Utilized up-to-date public education and notification efforts, while establishing continuous monitoring and maintenance programs for the public access areas.

5. **Strategies to Achieve the Desired Outcome**

   **Strategy 1**: Prioritize for removal the dead and dying trees within 100 feet of the edge of the major road network. Priority should be given to open public roads such as US, PA State, Township, and open Forest Service system roads, including roads restricted to seasonal use. Concentrate efforts spatially around areas of highest tree mortality as a priority. Utilize reforestation of the cutting limits with low growing, pest tolerant species of trees and shrubs such as the techniques being developed through the University of Connecticut "Stormwise" program. http://stormwise.uconn.edu/

   Consider using ANF Scenery Implementation Guide, Version 1.2, December, 2009 for a list of existing Scenic Concern Level corridors (Appendix B) on the ANF and other strategies for implementation.

   **When**: Initiate projects as soon as possible and practical. Consider in USFS FY 2018 program of work and 3-Year Strategic Plan

| Threats Template Matrix - Safety and aesthetics along multi-modal corridors |
|---|
| **Who**: The USFS in cooperation with right-of-way ownership including state, township, private and other federal ownership to work collaborator on the planning and NEPA portion of the project. Consider using "Good Neighbor Authority" for work on other than federal lands. Also, consider PA State planning personnel and resources for areas on federal land.<br><br>**Cost**: The potential high costs can be decreased by including the select dead and dying tree removal with other timber sales. Consider using USFS stewardship sponsored projects as "goods for services agreements" to implement some of the projects through felling, chipping, or salvage of wood on selected sites for wood product utilization. Other considerations could include a firewood sale or revamping the ANF permit to allow fire wood gathering along selected routes or sites to retain wood product utilization. |
| **Strategy 2:** Increase the public awareness to the safety threat of the dead and dying trees through public education and outreach. Create an electronic reporting app to enable citizens to accurately and timely report the threat of fallen trees on a modal corridor or an impending unsafe condition. Consideration should be given to establishing an ANF Facebook page and/or establishing the application through the ANF public website. Responsible signing and education of the public for site specific projects.<br><br>**When**: ASAP<br><br>**Who**: ANF (Jeanne Hickey has explored the feasibility of the citizen reporting app). USFS Public affairs personnel for establishing or maintaining Facebook or ANF website internet options. Consider contracting options for Facebook establishment and/or monitoring.<br><br>**Cost**: Minimal, cost associated with personnel to establish application, and selected personnel to update, monitor, and transfer information. |
| **Strategy 3**: Address the threat of dead and dying trees during the construction of any new transportation multi-modal corridor or public access sites. Establish both a maintenance and monitoring plan for addressing the threat in any subsequent NEPA planning document.<br><br>**When**: During the planning phase on any new project on the ANF. Consideration should be given to potential projects such as Knox, Kane Railroad corridor or any other potential new trail systems.<br><br>**Who**: USFS in cooperation with partners, volunteers, and landowners.<br><br>**Cost**: By placing a maintenance and monitoring plan within a NEPA document, cost is minimal. Implementation costs – **See Strategy 1** |
| **Strategy 4**: Prioritize remaining multi-modal corridors and public access sites (other than roads addressed in Strategy 1) on the ANF. Utilize a risk assessment matrix flow chart that includes forest health conditions, scenery implementation guide and other strategies. Consider motorized trails, developed campgrounds facilities, trailheads, boat and canoe launches and other public assess sites as high priority and other pedestrian trails as a lower, but important areas for treatment. Various work areas at least 100 feet from modal- corridor or site will be considered. Techniques for planting recommended native trees and shrubs for both aesthetics and wildlife habitat will be explored. Adapted techniques to control Non-native invasive plants will also be utilized in conjunction with strategy. **See also Strategy 1**. |

## Threats Template Matrix - Safety and aesthetics along multi-modal corridors

**When**: Consider in USFS FY 2018 program of work and 3-Year Strategic Plan. Explore the use of NEPA types to accelerate treatment for safety concerns. Consider on-going trail and campground maintenance, use of the Categorical Exclusions and NEPA documents that can be used repeatedly on a more programmatic or annual basis.

**Who**: USFS in cooperation with partners, volunteers, and landowners. Adopt-a-trail and Plant-a-Tree programs could be utilized if applicable.

**Cost**: **See Strategy 1** for implementation costs. Costs to produce additional NEPA would need to be considered. On-going maintenance costs of trails and facilities would be dependent on partnerships, volunteer groups, and other contractual costs.

**Strategy 5**: Provide aid and education to private landowners for hazard tree removal on private property within the ANF proclamation boundary along multi-modal corridors that are link to public land.

**When**: Implement with strategies above. Further research is needed to see if there are programs at other agencies or jurisdiction levels that could be applied and implemented

**Who**: Consult other agencies for application. USFS in conjunction with state and private entities. Utilize Cooperative Extension Offices

**Cost**: A funding avenue will need to be researched based on any program adopted. Will include cost for education, tree removal, and any replanting efforts.

**6. Monitoring Strategies**

**Strategy 1:** Utilize the information from the citizen reporting app to increase the monitoring of hazardous trees in developed recreation sites and trails in highly affected areas of the forest. Explore the opportunity for volunteer groups to increase their contributions to keeping the dead and dying trees cleared. Cameras could be considered to monitor some key site conditions in applicable areas that consider privacy etc… An example is Penndot's use of cameras for road and weather conditions.

**When/Frequency**: The current frequency is once every five years for developed campgrounds. Annual heavy and light maintenance for motorized trails currently in place. Apps and websites will supplement current program.

**Who**: ANF and citizen reporting app

**Cost**: Personnel workload and associated costs. Potential costs for equipment (cameras), maintenance/updating of computer apps, signing etc…

## Threats Template Matrix - Safety and aesthetics along multi-modal corridors

**7. Additional Information Needs:**

1. Costs associated with NEPA document development
2. Costs associated with App and Facebook, and public website development and maintenance
3. Agreement and partnership flexibility with other agencies and landowners and copies of agreements or authorities.

**8. Other:**

## Threats Template Matrix - Diversity

**1. Threat: *Loss of Diversity***

- Forest Health-diseases, etc.
- Invasive pests, plants and animals
- Habitat loss-development, etc.
  - Loss of food resources for wildlife
  - Loss of nesting habitat for birds and mammals
- Sedimentation/erosion of stream banks
- Loss of seed-bank

Causes of loss of diversity

- Changes in soil affecting micro-communities
- Changes in leaf litter composition impacting macroinvertebrates and salamanders
- Poor response to drought and flood conditions
- Loss of habitat connectivity

Results of loss of diversity

2. **Location:** Allegheny National Forest (in entirety) and adjacent landowners

3. **Impact or Severity:** Significant and ongoing

**4. Desired Outcome:** High-functioning ecosystems that support a wide diversity of plant and animal life and are resilient to change

**5. Strategies to Achieve the Desired Outcome**

**Strategy 1**: **Supplemental planting research (similar benefits)** species to replace ash and in long-term beech that will provide similar benefits for wildlife and ecosystem as a whole. *Research needed. Look for in the research literature. (Look at TNC high Allegheny plateau project*). Ash only 2.4% BA on the ANF – Beech a double-edge sword – both trying to keep it and address beech brush to retain diversity Cherry – stress factors, declining crown, declining seed, big puzzle – are we going to lose it, return to historical values?

**When:** ongoing

**Who:** partnership with Northern Research Station (NRS) and Penn state, Morgantown office, etc.

**Cost:** minimal to moderate cost, possibly include some travel costs, dependent on partners and level of plantings needed

## Threats Template Matrix - Diversity

**Strategy 2: Manage for Younger Forests (attract wildlife)** creating age diversity and its attendant structural diversity. Using appropriate silvicultural practices to allow for fostering young forest. Pay attention to adjacent invasive plant species that could impact the outcomes of management activities.

- Mapping and observation.
- Match management and site.
- Set goals for what wildlife to attract (e.g., game species, RTE species, habitat specialists)

**When:**

**Who:** NWTF, RGS, other wildlife interest groups to do active management

**Cost:**

**Strategy 3: Determine Ecosystem Services** Ecosystem services - assign value to see productivity, diversity of services, across the ANF. Find common denominator ($?) for valuation - demonstrate to the public and stakeholders the values the ANF provides, why these environments are so important - future action item. Listen to what the values are between partners and communities in order to share concise message.

**When:** ongoing

**Who:** NRS, ANF and other partners

**Cost:**

**Strategy 4: Create and Maintain Resilience** Adaptation Goals (from VT publication)

- Maintain a continuous forest resource
- Focus on regeneration requirements
- Manage for high forest carbon storage
- Identify areas suitable as climate change refugia
- Understand tree silvics and climate adaptability
- Prevent extinction of rare, threatened, and endangered (RTE) species
- Support low-impact harvest operations
- Manage to limit impacts of increased water flow
- Monitor during and after management operations
- Monitor silvicultural outcomes and plan for adaptive management
- Carefully manage invasive plants

## Threats Template Matrix - Diversity

- Implement integrated pest management
- Identify goals for species shifts
- Consider species shifts; allow recruitment of "new", more southern species as ranges shift.

**When:** ongoing, dependent upon forest health matter (react to sudden decline, etc.)

**Who:** ANF
**Cost:** dependent on tools used

**Strategy 5: Hire specific forest health biologists that can be efficient and committed to such issues to be better prepared for future unknown risks etc. and identify other possible partners.**

- Create a full-time position on the ANF focused on forest health threats
- Assist with citizen scientist monitoring program, reporting, and translating into action on the forest.
- Assist public affairs position to do public notice and education
- Continue partnership with Morgantown Field Office Forest Health office

**When:**

**Who:**

**Cost:**

**6. Monitoring Strategies**

**Strategy 1:** Promote use of iMap Invasives and iNaturalist to encourage citizen scientists to assist with tracking invasive plant species locations and unique species habitats. Create other opportunities to link citizen science data with existing ANF data resources to identify areas of risk, opportunity, engagement… Adjacent landowners must be pulled into monitoring programs. *Look to other programs elsewhere that work well and could be used here as well*

**When/Frequency:** ongoing

**Who:** Create partnership with adjacent landowners and interested naturalist groups to assist with monitoring. (MN has great examples of citizen scientists monitoring invasive species.)

**Cost:** Volunteer based, but may require some Forest Service personnel time to provide training to volunteers (at least to get program started-can do train the trainer workshops, etc.)

## Threats Template Matrix - Diversity

**Strategy 2:** Sharing of data across the permanent study plots that exist on the ANF (over 100) – FIA, Morgantown Field Office, Northern Research Station, DCNR Bureau of Forestry

**When/Frequency:** Need to determine if that number is sufficient

**Who:** Forest Service – across groups within the USFS (e.g., state and private, national forest system, research) and across agency – DCNR BOF

**Cost:** Determined by number of personnel needed

**7. Additional Information Needs:**

**8. Other: (Notes)**

- We know things are changing. How do we want to manage so that we retain diversity? What else can we support as well?
- What does the ANF want regenerating - how does that fit with current (and projected future) environmental conditions?
- Ecosystem services - assign value to see productivity, diversity of services, across the ANF. Find common denominator ($?) for valuation - demonstrate to the public and stakeholders that the values the ANF provide, why these environments are so important - future action item.

## Threats Template Matrix -- Hemlock

1. **Threat**: Non-native species threats to Eastern hemlock, including hemlock woolly adelgid (HWA) and elongate hemlock scale (EHS), jeopardizing the ability of hemlock forests to protect riparian areas & water quality, provide wildlife habitat/thermal cover, and recreational opportunities. A native pathogen, Fabrella tsugae needle blight, can also add stress to hemlock particularly during drought; however this has not been detected on the ANF. Scirococcus tip blight, another pathogen, has been identified on the ANF, but has not normally cause high levels of stress or decline. The combination of all these stressors may produce faster decline and mortality rates than previously seen in other areas of northern and central PA.

2. **Location**: Hemlock is widespread throughout the ANF, and is dense in many locations (Figure 1), especially higher gradient stream corridors. Hemlock woolly adelgid has been identified in various locations at low population levels both on the ANF and adjacent to ANF land, including at Cook Forest State Park and Millstone township to the south, Tionesta centrally located (HWA has not been found since cold winters of 13-14 and 14-15), and along the Allegheny River near the Kinzua Dam and at Webbs Ferry (though the Webbs Ferry infestation was not located again following cold winters). Elongate hemlock scale has not been found yet in any county that contains ANF land, the furthest point west that it has been positively identified thus far is around Clinton County directly west and in the Pittsburgh area to the south. High priority hemlock conservation areas have already been identified on the ANF (Figure 2).

3. **Impact or Severity:** The impact of HWA, and HWA in conjunction with EHS, could be severe to the ANF's hemlocks. In other parts of hemlock's range, especially to the east and south, mortality has been very high, and occurs on a time scale anywhere from about 5 to about 20 years with HWA alone. Hemlock on the ANF have more "climatic protection" at this point, since very cold winters keep the adelgid in check, however the impacts of climate change and potential HWA adaptation are unknown. It can be speculated that climate will not be a significant check on the population indefinitely into the future, and therefore once HWA and EHS are widespread, it is possible that a very high percentage of the ANF's hemlock will experience mortality within the next 2 decades.

4. **Desired Outcome:** Protect at least some populations of eastern hemlock in priority areas from the impacts of non-native insects into the future, so as to protect riparian areas and old-growth forest ecosystems, maintain recreational opportunities (provide aesthetics) and to serve as future seed sources. Ecosystem function in priority riparian areas should be maintained, through treatment of hemlock to protect against pests, or mitigation of the impacts of hemlock mortality by enhancing resiliency of understory responses to disturbance by promoting natural regeneration, preventing or controlling invasive plants, and/or re-planting.

## Threats Template Matrix -- Hemlock

5. **Strategies to Achieve the Desired Outcome**

**Strategy 1**: Preventative chemical treatment of priority hemlock conservation areas (see Figure 2); and EDRR/rapid response treatments in other critical habitat or recreation areas where a small outbreak may be detected (see Monitoring section)

**When**: Once HWA is detected in a priority area/stand/management unit, treatments could begin. Spring is the best time for treatment, but Fall is also possible and especially desirable if flowering understory plants are present in Spring and treatments would pose a risk to pollinators. Treatments are technically possible any time of year as long as adequate soil moisture is present. Imidacloprid is very cost-effective for HWA, but once EHS shows up, dinotefuran (Safari) will be necessary. Figure 3 shows treatment areas for 2016-2017.

**Who**: Contractual crews and/or Forest Service employees potentially with volunteer assistance (volunteers have been used with many hemlock treatment programs, in PA and other states)

**Cost**: Anywhere from probably $0.75 to $1.50 per diameter inch treated for imidacloprid contract, and at least ~$2/inch for dinotefuran, maybe more. Can be as low at ~$0.50 per inch for imidacloprid materials with in-house labor.

**Strategy 2:** Use of biocontrols may be another treatment option. This could be done in the same areas as chemical treatments, or other places.

May be useful in priority areas where the beetles are easy to release, collect, and where small hemlocks (planted as a hedgerow) could serve as "future insectaries". *Sasajiscymnus tsugae* was released widely in PA and other states. State and federal agencies are no longer releasing this beetle in PA though, because it is not as well-adapted to the climate conditions as other predatory beetle species (and one species of silver fly, collected in the Pacific NW; currently has been released and is being tested in the Finger Lakes area of NY by Dr. Mark Whitmore). There are two species of *Laricobius* that are more appropriate in PA, *L. nigrinus* and *L. osakensis*. Ln is capable of being reared in field insectaries (although also knocked back by cold winters), and Ln and Lo are also both available in small numbers for release on public lands from Forest Service-funded rearing labs.

The numbers of insects (thousands) and the amount of time needed for success may make this option more prohibitive. This is a long-term solution, as it may take as much as 2 or more decades for biocontrols alone to "save" hemlock trees.

**When**: Biocontrols may be released once there is a suitable amount of HWA present for them to feed on. Thus far only one location on the ANF is known to have enough HWA for a release, near the Kinzua Dam along the Allegheny River. Biocontrols have also been released in Cook Forest State Park. Biocontrols should be released as often as possible in a limited number of locations, to allow populations to build.

**Who**: Forest service employees and PA DCNR Bureau of Forestry employees

**Cost**: Cost for lab-reared beetles already covered by federal funding for those labs, and beetles from field insectaries require the staff time spent to collect, transport and release.

## Threats Template Matrix -- Hemlock

**Strategy 3:** Maintaining/enhancing resiliency of understory to HWA disturbance: including monitoring and control of invasive plants and re-planting/underplanting in priority stands with a mix of native or eastern hemlock, evergreen shrubs such as rhododendron and mountain laurel, and "surrogate conifer species," depending on what regeneration is already present at a given site and the site characteristics. Priority areas would include along a headwater drainage, where gaps are created in the overstory by HWA or some other natural or human disturbance- particularly near riparian corridors, or areas where HWA treatment isn't practical. Replanting of eastern hemlock, especially resistant hemlock, would be preferred. Potential surrogate species include native conifers such as tamarack, red and white spruces, balsam firs, cedars (appropriate for larger headwaters), and possibly white pine. Riparian hardwoods such as red maple, yellow birch, serviceberry, or tulip poplar are other choices. Group consensus is that Norway spruce not recommended. For some species, seedling protective measures from browsing, such as fencing or cribs, will be needed.

**When:** Planting could begin now in openings where there is no natural regeneration of hemlock, but should be deferred in areas where there is adequate hemlock regeneration or where shade is prohibitive to seedling establishment (see Monitoring strategy 4 to determine where these locations exist within the priority hemlock conservation areas).

**Who**: Forest Service staff and volunteers (would be good activity for school and youth groups)

**Cost**: DCNR can provide free hemlock seedlings, other seedling costs; fencing costs?

**Considerations/ Information needed**: Debate exists about whether replanting should be limited to just eastern hemlock. More testing needs to be done to develop resistant hemlock. Western hemlock has been proposed for evaluation as a species to replant. It is more resistant to the adelgid but may not be adapted to the region. Selection of replacement species might also consider potential climate change and range shifts for some species.

**6. Monitoring Strategies**

**Strategy 1:** Volunteers in adopted priority areas

**When/Frequency**: Nov – March during "wool-up," once yearly

**Who**: Volunteers – examples include Friends of Allegheny Wilderness members, Kinzua Fish & Wildlife Association, concerned citizens. Also train school and youth groups to help with monitoring

**Cost**: Administrative hours for someone to send reminders to volunteers, collect reports, and possibly provide training

| Threats Template Matrix -- Hemlock |
| --- |
| **Strategy 2:** State/federal personnel in priority areas<br>**When/Frequency**: Nov – March during "wool-up" once yearly<br>**Who**: DCNR BOF employees, ANF staff/interns<br>**Cost:** Hourly wage for interns/salary & benefits for BOF Forest Health staff (not covered by ANF), estimated one week for each of 2 or 3 BOF staff? |
| **Strategy 3:** Permanent Hemlock Condition Monitoring plot re-measurement<br>**When/Frequency**: Plots are established (2016), could be re-measured every other year<br>**Who**: Contract crew (initially established and measured by Forecon, Inc.)<br>**Cost**: Estimated at ~$15,000 |
| **Strategy 4:** Monitoring should begin now to indicate the need for underplanting in: 1) high priority hemlock conservation areas, 2) in other areas where there is a lack of regeneration, and 3) where there are openings already in critical riparian areas.<br>**When/Frequency**: Do simultaneously with HWA monitoring<br>**Who**: ANF<br>**Cost**: |

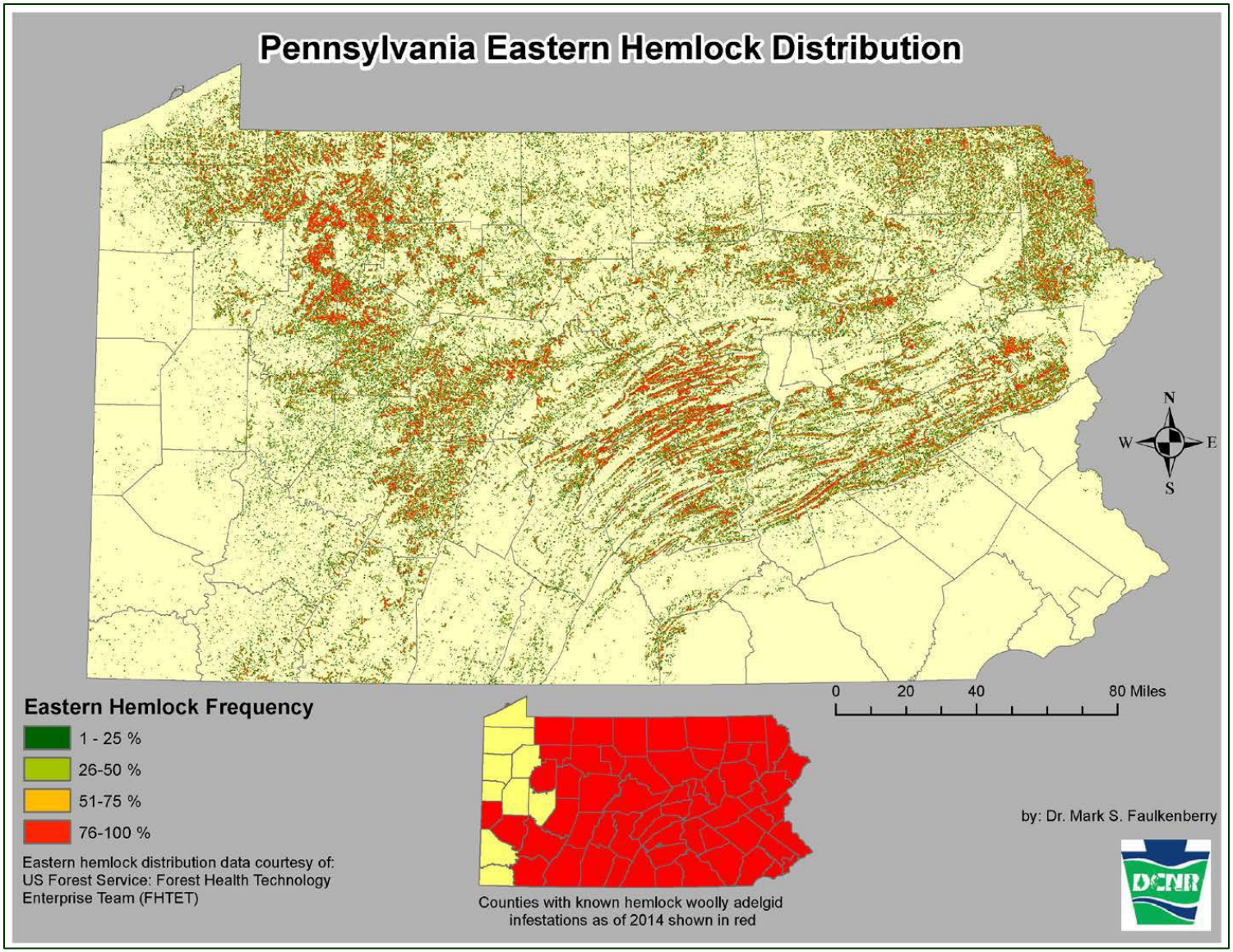


Figure 1. Hemlock distribution throughout Pennsylvania

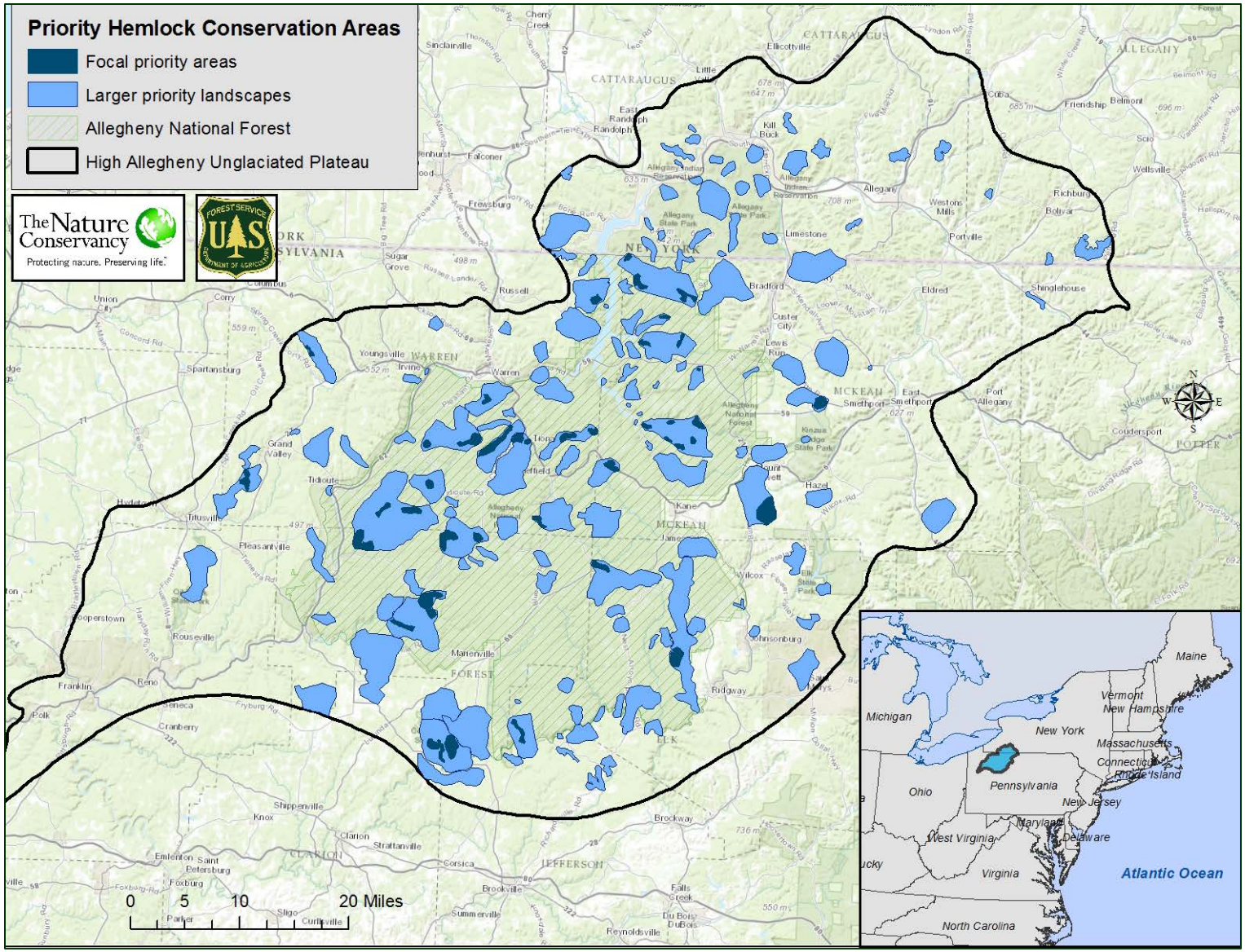


Figure 2. Priority areas for Hemlock conservation.

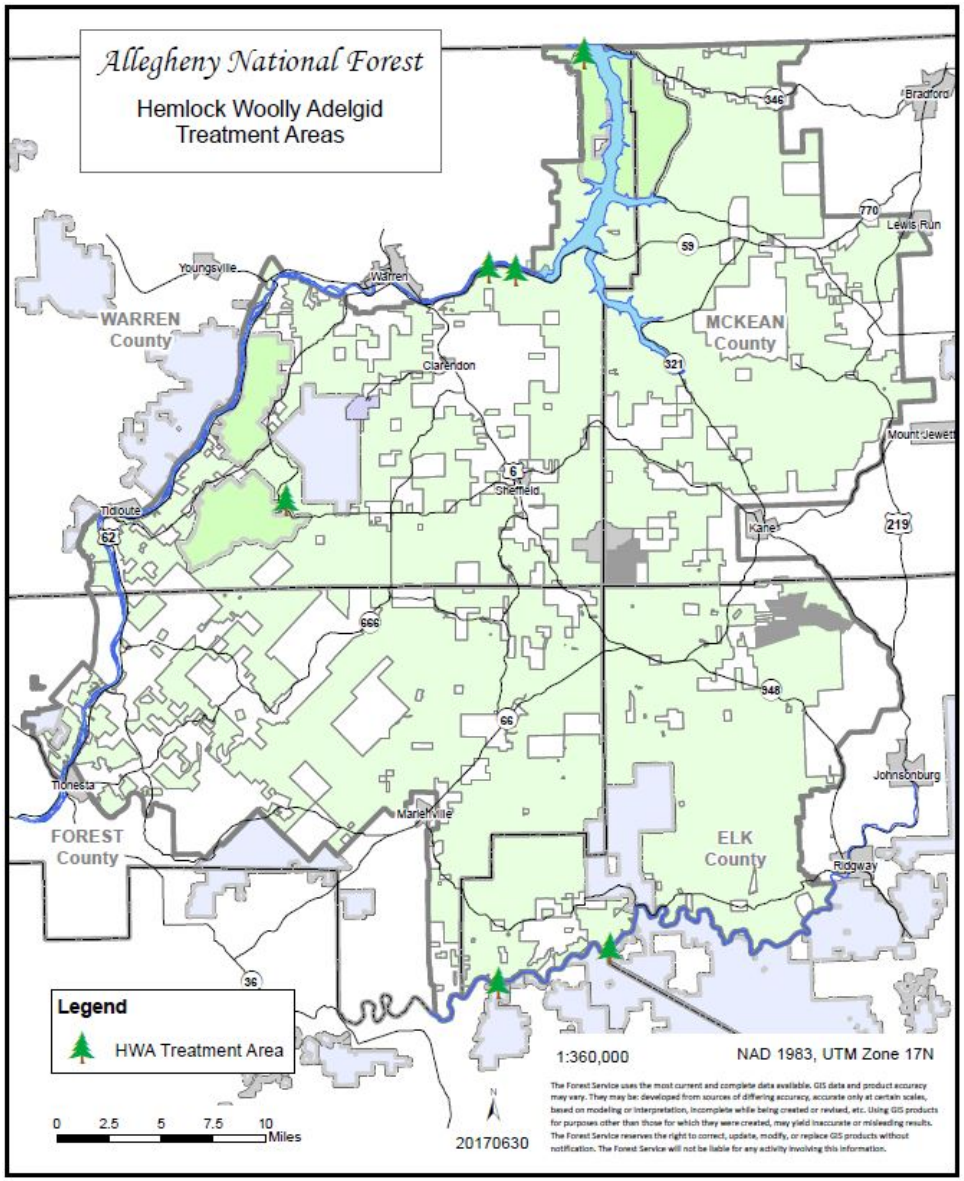


Figure 3. HWA treatment areas for 2016-2017

Table 1. **Species Considerations for Conifer Planting on the ANF**[i]

| Species | Habitat Characteristics | Present Distribution* | Site Requirements | Shade Tolerance/ Growth | Deer Palatability/ Browse Tolerance | Pest / Disease/ Pollution Considerations | Other Considerations/Climate Change Projections |
|---|---|---|---|---|---|---|---|
| Red Spruce *Picea rubens* | Lacking lower limb structure and thermal characteristics of hemlock. Best replacement species for northern flying squirrel, as it supports lichens (bryoria fremontii) required by northern flying squirrel for food and nesting material. | North of PA, and higher elevations in northern Appalachian mountains. Specimens in McKean County | Higher elevation, good moisture regime. Grows well on poor sites, acidic and shallow soils preferred. | Tolerant-Very Tolerant. Long-lived (350-400 years), slow growing. | Browsing occurs, but not preferred browse. | Spruce budworm, eastern spruce beetle, eastern dwarf mistletoe. Potentially sensitive to pollution (sulphur dioxide, nitrogen oxides and ozone). | Suitable habitat projected to occur north of ANF region in climate change models. |
| White Spruce *Picea glauca* | Retains lower limbs. | North of PA with specimens in a few counties south of the ANF. Planted on the ANF in the past. | Tolerant of wide range of sites in northern North America, from moist to dry, alkaline and acidic. | Intermediate shade tolerance. Long lived (250-300 years) | Not preferred as browse. | Can be susceptible to frost heaving. Seedlings can be damaged by rodents. Spruce budworm. European spruce needleminer. Tomentosus root disease. Various bark and wood boring beetles. | Considered a hardy tree. Strong affinity to local environments. Suitable habitat projected to occur in northern New York state and New England in climate change models. |

| Species | Habitat Characteristics | Present Distribution* | Site Requirements | Shade Tolerance/ Growth | Deer Palatability/ Browse Tolerance | Pest / Disease/ Pollution Considerations | Other Considerations/Climate Change Projections |
|---|---|---|---|---|---|---|---|
| Black Spruce *Picea mariana* | Small dbh at maturity, retains lower limbs, shallow rooting. | North of PA with specimens in Tioga County | Moisture regime important, prefers dark brown peat, boggy areas and wet organic soils. Common in swamps or bogs. Pioneer species. | Tolerant. 200 year lifespan typical. | Not preferred as browse. | Eastern dwarf mistletoe, spruce budworm, bud and needle rusts. | Not a large tree, usually planted in pure stands. Suitable habitat projected to occur north of Canadian border in climate change models. |
| Balsam Fir *Abies balsamea* | Retains Lower Limbs, Fairly small crown area. Provides food and cover for wildlife. Second best species for northern flying squirrel. | Generally north of PA, and higher elevations in Appalachian mountains. Specimens in Warren County | Abundant moisture required, slightly acidic sites. | Very Tolerant. Slow growing, 80 year lifespan typical. | Browsing occurs, but not preferred browse. | Balsam wooly adelgid. Intermediate sensitivity to sulphur dioxide and tolerant of ozone. | Suitable habitat projected to occur north of ANF region in climate change models. |
| Pitch Pine *Pinus rigida* | Lacking lower limb structure and thermal characteristics of hemlock. | Native to ANF and surrounding counties. | Dry, low quality sites- poor sandy soils. Mineral soil seedbed essential for regeneration. Pioneer species. | Intolerant. 200 year lifespan typical. | Limited to seedlings and sprouts. | Syrix wood wasp and various wood boring bark beetles. | Very good at surviving injury, has the ability to "green up" after fire or pests. Suited habitat not projected to migrate northward as much as other species in climate change models. |

| Species | Habitat Characteristics | Present Distribution* | Site Requirements | Shade Tolerance/ Growth | Deer Palatability/ Browse Tolerance | Pest / Disease/ Pollution Considerations | Other Considerations/Climate Change Projections |
|---|---|---|---|---|---|---|---|
| Virginia Pine *Pinus virginiana* | Lacking lower limb structure and thermal characteristics of hemlock. | Generally south of ANF and northern PA. Specimens in Potter County. | Requires well drained sites, prefers poor sandy soils. Mineral soil seedbed essential for regeneration. | Intolerant. 100 year lifespan typical. | Not preferred as browse. | Syrix wood wasp and various wood boring bark beetles. Sensitive to air pollution (ozone). Meadow mouse girdling. | Grows well in old fields, pioneer species, successful competitor. Suitable habitat projected to migrate northward into ANF region in climate change models. |
| Eastern Redcedar *Juniperus virginiana* | General Bush-like appearance, may lose lower limbs in forest grown areas. | Widely distributed through eastern and Midwestern U.S. Specimens in Forest County, but separate from ANF. | Can grow on a wide variety of conditions, prefers deep, moist, well drained sites. Prefers calacareous soils. | Intolerant-Very Intolerant. 150 year lifespan typical. | Intermediate preference/ Tolerant | Cedar gall. Tolerant of air pollution (sulphur dioxide and hydrogen fluoride). | Pioneer species. Can tolerate drought and temperature extremes. Suitable habitat projected to migrate northward into ANF region in climate change models. |
| Red Pine *Pinus resinosa* | Lacking lower limb structure and thermal characteristics of hemlock. | Planted already on ANF, McKean County population. Generally native to counties east of ANF. | Dry sites but will grow on wetter sites. | Intolerant to very-intolerant. 200 year lifespan typical. | Not preferred/ Tolerant | Syrix wood wasp and various wood boring bark beetles. Sensitive to sulphur dioxide but tolerant of ozone. | Pioneer. Usually planted in pure stands. Suitable habitat projected to occur north of ANF region in climate change models. |

| Species | Habitat Characteristics | Present Distribution* | Site Requirements | Shade Tolerance/ Growth | Deer Palatability/ Browse Tolerance | Pest / Disease/ Pollution Considerations | Other Considerations/Climate Change Projections |
|---|---|---|---|---|---|---|---|
| Northern white-cedar *Thuja occidentalis* | General Bush-like appearance, may lose lower limbs in forest grown areas. Provides an abundance of food in cover for wildlife, especially in winter. | North of PA, mostly into Canada and Northern New England area. | Moist, nutrient rich sites, such as those along streams. Prefers calacareous soils. | Tolerant. Slow-growing, persistent. 300 year lifespan typical. | Preferred/ \ Not Tolerant | Carpenter ants/ Leafminers. Tolerant of sulphur dioxide and ozone. | Can withstand suppression for long time periods. Suitable habitat projected to occur north of Canadian border in climate change models. |
| Eastern White Pine *Pinus strobus* | Lacking lower limb structure and thermal characteristics of hemlock. | Native to ANF and surrounding states. | Well drained, drier sites, with coarse textured soils. | Intermediate. 200 year lifespan typical, but can be long-lived (450 years). | Preferred/ Not tolerant. | White pine weevil, syrix wood wasp, white pine blister rust. Sensitive to ozone and sulphur dioxide. | Grows rapidly and is considered an excellent tree for reforestation projects. Suitable habitat projected to migrate northward but still remain ANF region in climate change models (could consider more southerly genotypes). |
| Shortleaf pine *Pinus echinata* | Lacking lower limb structure and thermal characteristics of hemlock. | South of ANF. Native to ridge and valley region of southeastern PA. | Wide range of sites from dry sites to deep well-drained soils. | Intolerant. 200 year lifespan typical. | Limited to seedlings and sprouts | Syrix wood wasp and various wood boring bark beetles. Intermediate air pollution sensitivity. | Pioneer- competes better on dry sites. Suitable habitat projected to migrate northward into ANF region in climate change models. |

| Species | Habitat Characteristics | Present Distribution* | Site Requirements | Shade Tolerance/ Growth | Deer Palatability/ Browse Tolerance | Pest / Disease/ Pollution Considerations | Other Considerations/Climate Change Projections |
|---|---|---|---|---|---|---|---|
| Norway spruce<br>*Picea abies* | Conical crown in young trees changing over to a columnar shape with age. Drooping, pendulous branches.<br>Its drooping branching structure make it a potential candidate for planting in areas where the maintenance of shade is highly important such as excellent value streams, riparian areas, and known brook trout streams. | Not considered native to the United States, but widely distributed through plantings across the Eastern and Midwestern United States. | Grows best in cool, humid climates on rich soils but grows well on almost all types of soils. Not suited for dry or nutrient deficient soils or those that are permanently waterlogged | Tolerant. 200 year lifespan but can live up to 300 - 400 years | Not preferred | | Can withstand suppression for long time periods. Widely used in reforestation programs in the eastern US.<br>Has shallow rooting system similar to eastern hemlock.<br>Norway spruce needle litter has a similar decay rate to eastern hemlock, possibly preserving some of the ecosystem function of the site. |

*Note: Distribution column requires further work to separate indigenous from naturalized species.

[i] References include:

Burns, Russell M., and Barbara H. Honkala, tech. cords. 1990. Silvics of North America: 1. Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. Vol. 1, 675 p (website: http://www.na.fs.fed.us/spfo/pubs/silvics_manual/Volume_1/vol1_Table_of_contents.htm)

Latham RE, Beyea J, Benner M, Dunn CA, Fajvan MA, Freed RR, Grund M, Horsley SB, Rhoads AF, Shissler BP. 2005. Managing white-tailed deer in forest habitat from an ecosystem perspective: Pennsylvania Case Study. Report by the Deer Management Forum for Audubon Pennsylvania and Pennsylvania Habitat Alliance. Harrisburg, PA. pp. 53-58

USDA Natural Resources Conservation Service Plants Database (website: http://plants.usda.gov/java/)

USDA Forest Service Climate Change Tree Atlas. Anantha M Prasad, Louis R Iverson, Steve Matthews, Matt Peters. NRS-4151, USDA Forest Service, Northern Research Station, Delaware, Ohio (website: http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)

## Threats Template Matrix – BLACK CHERRY DECLINE

1. **Threat:** Black cherry health and regeneration in the Allegheny Plateau ecoregion have undergone dramatic changes in the 21st century. Black Cherry is highly valued for its economic and ecological values. It is a significant portion of area tree cover, comprising around 25 percent of the overall basal area on the ANF, for example, and important on the surrounding landscape as well.

   **Overstory mortality** has increased much more in this species than in all other species combined, and many surviving trees have thinning crowns. Hypothesized causes include defoliation by native insects (cherry scallop shell moth and fall webworm), sometimes repeatedly, as well as changes in nutrient inputs from the atmosphere. While not demonstrated, there is reason to be concerned that declining cherry will become increasingly vulnerable to peach bark beetle infestation and associated quality degrade and value loss.

   - **Seed production** has become irregular and infrequent, seedling establishment less common, and the health and competitiveness of seedlings has also declined. Hypothesized factors include spotted wing drosophila and pollinator asynchrony affecting seed production, pythium (a root rotting fungus demonstrated to limit cherry seedling establishment near overstory cherry), cherry leaf spot fungal disease of seedlings, changes in nutrient inputs from the atmosphere, and potentially changes in climatic factors.
   - The result is that areas with a high proportion of black cherry in the overstory are at risk of **value loss and regeneration failure**. This is especially significant where other overstory species, like ash and beech, are themselves declining. These stands are at risk of very poor regeneration outcomes unless regeneration processes are begun while there is still adequate seed source available.
   - Black Cherry from the Allegheny Plateau has historically been recognized as the best cherry in the world and demanded high prices. Since 2010, the values of cherry have declined. **Without strong domestic and international markets** for black cherry, it becomes harder to support the cost of forest management. Improving markets for cherry and all Pennsylvania hardwoods would financially improve options for forest management on the ANF and support a stronger forest products industry in the region as well as improve local communities through the 25% fund.

2. **Location:** Black cherry has been declining across the High Allegheny Plateau, which includes the ANF and a variety of other ownerships. The areas of highest modeled risk are in the central eastern part of the Forest, which is also where the most recent cherry scallop shell moth defoliations have been most severe.

## Threats Template Matrix – BLACK CHERRY DECLINE

3. **Impact or Severity**: The most recent estimates of mortality in black cherry are more than twice as high as the average mortality in all other species combined (22.5% standing dead trees in black cherry vs. 10.0% in other species based on remeasurements of 92 plots sampled 3 times since 1998). Monitoring on other ownerships has indicated similar results, with continuous forest inventory data collected on the Pennsylvania High Plateau (ANF region) by the Pennsylvania DCNR Bureau of Forestry indicating more than 30 percent of dead black cherry stems were dead in the most recent remeasurement cycle, compared with 17% dead for other species.

   According to the 2016 USDA Forest Inventory Analysis, black cherry represents 11.4% of the standing sawtimber in Pennsylvania – third highest after soft maple (15.2%) and northern red oak (12.8%). With a higher concentration of cherry in northwestern Pennsylvania, cherry decline threatens to become a major financial loss to the local communities, the region, and the state.

   Black cherry seed production has also decreased in regularity and abundance, based on assessments of stands sampled in the 70s and at present. While evidence about seedling survival, growth, and competitiveness is more anecdotal, these all appear to sharply decline as well.

4. **Desired Outcome:** Sustain high value, diverse, resilient, and well stocked forests on the Allegheny Plateau, that continue to contain a cherry component.

   Regenerate stands with abundant declining black cherry (and other species such as American beech and ash) in the overstory to a mix of species, featuring red maple, tulip polar, cucumber tree, oaks, hemlock, pine, and birch, while recovering optimal value from black cherry wood for community and industry benefit. Strive to regenerate a black cherry component to the extent possible.

5. **Strategies to Achieve the Desired Outcome**

   **Strategy 1**: As ANF focuses on achieving better age class balance in suited Management Areas, prioritize stands with either declining overstory black cherry or abundant healthy black cherry advance regeneration for creating younger age classes with a diversity of high quality hardwood species, while recouping value of existing black cherry value and regenerating black cherry to the extent that is possible.

   Apply the following definitions for successful regeneration:
   - Desirable Outcome = >70% stocking with “preferred” species; cherry, oaks, maples, tulip, cucumber, hemlock, pine, etc.
   - Acceptable Outcome = >70% stocking with “commercial” species; this adds birch into the mix.

   The amount of birch that is acceptable can be analyzed by the site quality, and the pre-existing conditions of the mature overstory when the regeneration process began.
   **When:** As soon as possible
   **Who:** ANF and collaborative participants
   **Cost:** If completed while majority of black cherry is alive, should be profitable, even at lower cherry prices

## Threats Template Matrix – BLACK CHERRY DECLINE

**Strategy 2**: Develop adaptive silvicultural Decision Guides for more effectively regenerating forest stands with declining overstories. Emphasize retaining a component of black cherry in the regen to the extent feasible through adaptive management**.** While it is notoriously difficult to project future timber values, that of black cherry has been consistently high and it is the signature species of our region and our commonwealth. Black cherry also has very high wildlife values.

- Develop adaptive regeneration strategies for various forest types/overstory conditions- decision charts with trigger points/range of conditions for treatment selection.
- Incorporate strategic approach to packaging herbicide treatments and overstory removals to optimize contractor participation and reduce overall costs
- Implement structured program to monitor (adaptive) prescription effectiveness in achieving broad forest plan desired conditions, sustaining healthy forests, and achieving stand level objectives.
- Collaborate with partners in the forest health collaborative on this task.

Current strategies for adaptive management to retain black cherry in regenerating stands include NPK fertilization of stands with a significant cherry component after overstory removal and lower residual densities after shelterwood seed cuts. Develop a communication strategy for regularly sharing success stories.

**When:** Begin immediately
**Who:** ANF, collaborative participants (especially PA DCNR Bureau of Forestry), and research scientists.
**Cost:** $50,000/year for 5 years; includes regular meetings of cooperating foresters and scientists; formal and informal research studies.

**Strategy 3:** Develop adaptive, innovative strategies for understory treatment (weight-scaled biomass sales, for example, where an understory of beech and or birch is interfering with mixed species regeneration establishment and growth) and develop management guidelines for various proportions of birch in regenerated stands where other seed source is not available.

**When:** Begin immediately
**Who:** May require partnerships with industry and state to certify weight-scaling and implement some test stands. ANF collaboratively develop management guidelines with NRS scientists, State agency, and industry staff.
**Cost:**

## Threats Template Matrix – BLACK CHERRY DECLINE

**Strategy 4:** Work with the Northern Research Station, State and Private Forestry, and university cooperators to sustain a research-management partnership to understand black cherry stressors and test adaptive management strategies. Develop short and long term research strategies focused on understanding current black cherry health and regeneration challenges on the Allegheny Plateau.

These could include collaborative approaches to better understand black cherry interaction with pythium fungus, cherry leaf spot, and spotted wing drosophila. There is a need to better understand the impact and relative abundance of fungal pathogens (cherry leaf spot, Pythium) in stands with different overstory cherry densities and differing environmental and soil chemical conditions.

Continue the dominance probability study initiated by NRS in 2013 to follow competitive status of different species of seedlings; Install several new blocks of that study with smaller seedlings.

**When:** Begin immediately

**Who:** ANF, collaborative participants (especially PA DCNR Bureau of Forestry), Northern Research Station, Northeastern Area State & Private Forestry, university cooperators, granting agencies

**Cost:** From multiple partners (not just ANF) $3 million/year

**Strategy 5**: Develop a flexible planning/NEPA process that allows rapid response when new hot spots of decline or mortality occur, or when abundant healthy advance regeneration is found. Options may include categorical exclusions and newer Farm Bill categorical exclusions (for insect and disease treatment and regeneration), or perhaps more programmatic approaches.

**When:** Within six months.

**Who:** ANF

**Cost:**

**Strategy 6**: Develop a marketing program for black cherry at the regional, state, national, and international levels that includes participation in consumer based trade shows, home builder shows, and architect/design shows or seminars. With increased consumer demand for cherry domestically and internationally, the values of cherry will improve.

**When:** Immediately

**Who:** Pennsylvania Hardwoods Development Council, Allegheny Hardwood Utilization Group, Keystone Wood Products Association, Northern Tier Hardwood Association, and Regional and state forest product companies

**Cost:**

## Threats Template Matrix – BLACK CHERRY DECLINE

6. **Monitoring Strategies**

**Strategy 1:** Continue to monitor Forest Health Plots with high proportions of black cherry, including monitoring of crown health, peach bark beetle, and regeneration.

**When/Frequency**: Five-year intervals would imply next cycle of remeasurement to begin in 2019

**Who:** University partners with State and Private Forestry Forest Health Program funding. There is a need to identify a new principle investigator for this work to continue, starting in 2018.

**Cost:** $25,000 year for three years.

**Strategy 2:** Develop systematic monitoring approach on the Allegheny Plateau for more closely monitoring insect and disease trends (more intensive than FHM plot network), including monitoring of defoliation events. Include analyses to detect correlations among stressors and relationships to predict vulnerability and sustainability, such as age of stands, site factors, etc.

Establish all lands network for monitoring and consider development of drone technology for aerial surveillance.

Continue collaboration with the U.S. Forest Service Forest Health Technology Enterprise Team (FHTET) on use of satellite imagery and remote sensing (e.g. FORWARN and Forest Disturbance Mapper) for monitoring forest canopy health and disturbances.

**When/Frequency:** Annually and as needed during defoliator outbreaks

**Who:** ANF, NRS, S&PF, State and larger landowner partners.

**Cost:** $15,000 per year for one monitoring technician and 15,000 per year for traditional aerial surveillance.

7. **Additional Information Needs:** Continued monitoring of dominance probability study initiated by NRS in 2013 to follow competitive status of different species of seedlings; Installation of several new blocks of that study with smaller seedlings. Also need study to understand the impact and relative abundance of fungal pathogens (cherry leaf spot, Pythium) in stands with different overstory cherry densities and differing environmental and soil chemical conditions.

8. **Other:**

## Threats Template Matrix -- Non-native invasive insects and diseases

1. **Threat**: Non-native invasive (and some native) insects and diseases impacting native trees, causing decline and mortality and leading to undesirable successional trajectories and loss of biodiversity.

2. **Location**: Throughout Allegheny National Forest and region

3. **Impact or Severity**: Severity has been and can be very high, but ranges depending on host/damage casual agent relationship

4. **Desired Outcome:** Maintenance of native biodiversity and resilience by protection of native trees, breeding resistant native trees, and accomplishing diverse and vigorous regeneration through silvicultural operations.

5. Strategies to Achieve the Desired Outcome

   **Strategy 1: Chemical –** Chemical control is possible/desirous as far as we know for the following:

   - Hemlock woolly adelgid
   - Elongate hemlock scale
   - Gypsy moth – also treat hemlocks when egg mass densities warrant, as GM can cause hemlock mortality quickly at high densities (Bt and Mimic, treat hemlocks with Mimic or Gypcheck?)
   - Emerald ash borer – Triage, although treatment should be started in advance of infestation if at all possible so this may not be feasible on vast majority of ANF any longer
   - Asian longhorned beetle
   - Spotted wing drosophila???

   **When**:

   **Who**:

   **Cost**:

## Threats Template Matrix -- Non-native invasive insects and diseases

**Strategy 2: Biological –** Biological control is possible/desirous as far as we know for the following:

- Hemlock woolly adelgid – see hemlock threat matrix
- Elongate hemlock scale (*Cybocephalus nipponicus*) but these predators are less readily available
- Emerald ash borer – sites need to be entered into mapbiocontrol.org, approved by APHIS. APHIS looking for more release sites and many locations on/near the ANF have suitable conditions (high ash density, variety of sixes, moderate EAB densities), but EAB densities increasing/tree health rapidly declining
- Spotted wing drosophila???

**Naturalized/native controls:**

- Cherry scallopshell moth, although virulence of populations of CSSM is combined with apparently declining overstory cherry health, making impact a concern despite native controls
- Gypsy moth fungus and virus

**When**:

**Who**:

**Cost**:

**Considerations/ Information needed:**

**Strategy 3: Finding, Cataloging and Breeding Resistant Trees or Possibly Resistant Trees or "Lingering Trees"**
**Species:**

- American beech
- Eastern hemlock
- White, green and black ash on the ANF
- Butternut? Already have plantings/orchards

**When**:

**Who**:

**Cost**:

**Considerations/ Information needed:** Locations of possibly resistant or lingering trees, appropriate reporting and/or seed collection methods once resistant or lingering tree identified

## Threats Template Matrix -- Non-native invasive insects and diseases

**Strategy 4: Timely removal of affected tree(s) and other silvicultural operations considering residual species and regeneration diversity**
Oaks with oak wilt or stands with oak decline/mortality
White pine in key locations showing decline and mortality from multiple fungal pathogens identified?

**When**:

**Who**:

**Cost**:

**Considerations/ Information needed:**

**Strategy 5: Seed collection and storage (USDA, National Repository, Camcore)** Hemlock, Ash; any native tree

**When**:

**Who**:

**Cost**:

**Considerations/ Information needed**

### 6. Monitoring Strategies

**Strategy 1: Early Detection/Rapid Response for species:**

- Winter moth
- Asian longhorned beetle
- Spotted lanternfly

***if any of these are detected, immediate action for tree removal/chemical control for eradication should be triggered

**When/Frequency**: Yearly

**Who**:

**Cost**:
**Considerations/ Information needed:**

## Threats Template Matrix -- Non-native invasive insects and diseases

**Strategy 2: Longer term monitoring in priority locations once an invasive insect or disease is detected across the ANF but still low densities**

Hemlock in HCAs and BOF General Hemlock Survey locations/along roads; these surveys will check for EHS as well
Spotted wing drosophila??

**When/Frequency**: Yearly

**Who**: Forest Service staff, BOF staff, volunteers

**Cost**:

**Considerations/ Information needed:**

**Strategy 3: Permanent plot network(s)**

- Northern Research Station/ANF ash research plots
- Permanent Hemlock Condition Monitoring Plots

**When/Frequency**: visitation frequency depends on protocols (for example, Permanent Hemlock Condition Monitoring Plots need only be visited once every other year or so)

**Who**: NRS, ANF, contractual

**Cost**:

**Considerations/ Information needed**

**7. Additional Information Needs:**

**Don't recommend any more permanent plot networks for any invasive insect pests identified at this time – too intensive??

**8. Other:** Developing some kind of scheme that could be applied to any non-native invasive insect or disease to determine best course of action, or best location to take what action among the available strategies – some list of questions or something that could be asked anytime a new invasive is faced. E.g., How much of the host is there ANF-wide and in what configuration; How much mortality is expected in the next 10 years ANF-wide; How much ecological value; How much social/economic value; Effective chemical available; Effective biocontrol available; Resistance. And each question would lead to "do something in the short term" or "wait and monitor" option or something. For example with EAB and ash: ash is patchy locations on ANF, low percentage of overall BA but significant in specific areas = I don't know if it's because I already know what I think about this as far as ash, but I think that this conclusion about any host would lead me to think that an

| Threats Template Matrix -- Non-native invasive insects and diseases |
| --- |
| in-depth prioritization analysis wouldn't be very necessary. Very significant mortality expected in next decade = do something in short term (??). How much ecological value = relatively moderate and other associated tree species may fulfill niche gap created. How much economic value = high, so it will be important to salvage some of this value. Effective chemical available = at this point on the ANF I'd say not really. Effective biocontrol available = as far as we know right now biocontrols are a decent option. Resistance = potential for lingering ash. This combination of factors leads to salvaging a good portion of the BA, developing a biocontrol program, and looking for lingering ash after most ash BA is dead. Seed collection would be efficacious with any host of a non-native invasive insect or disease, and hazard trees have to be dealt with no matter what the host/agent. Of course it's never this cut and dried, but even attempting to reach some kind of consensus with each of these questions would be a good way to outline reasonable actions.<br><br>Tie in with other groups – Age class diversity group concerned with increasing stand resilience, diversity group concerned with increasing native diversity; these actions, using identified strategies (silvicultural, management of invasive plants, etc.), will possibly protect against future unknown invasives. Diversity is the best buffer against adversity in the face of uncertainty.<br><br>Aerial survey for cherry scallopshell moth defoliation; native parasitoid, what's it doing, how much is it taking care of, is population crashing?<br><br>Other natives like forest tent caterpillar during outbreak conditions – no funding support for treating a native, even though it may cause significant dieback and mortality<br><br>Don't know yet what to do about new beech leaf disease, seems to only be affecting understory beech (i.e., root sprouts)<br><br>Not sure what is done about winter moth in New England where it's an issue |

**Don's list from 6-23-2017 email to Maureen:**

- Hemlock woolly adelgid - invasive
- Elongate hemlock scale – invasive; not yet present in NW PA, but it is moving westward in PA
- Emerald ash borer – invasive
- Ash yellows
- Gypsy moth - invasive
- Oak wilt – considered to be an invasive and has been present in PA a long time but is now expanding its range.
- Oak decline
- Forest tent caterpillar – native insect
- Beech bark disease and beech bark scale insect
- Beech leaf disease (new to PA – pathogen(s) not known; found in Ohio and western PA)
- Cherry scallop shell moth – native insect
- White pine decline and rapid mortality (multiple pathogens and stress factors involved)
- Winter moth - invasive (not in PA yet, but is a big problem in New England)
- Spotted lanternfly - invasive
- Sugar maple decline
- Asian longhorned beetle – invasive
- Thousand cankers disease and the vector walnut twig beetle – native to SW U.S. but is not native to the eastern U.S.

## Threats Template Matrix—Invasive Plants

1. **Threat**: Non-native invasive plants pose threats to native plants, wildlife, and ecological function across the ANF. Invasive plants are a serious impediment to obtaining desirable tree regeneration and can compromise stream health along riparian areas. Large expanses of invasions may also impact recreational opportunities. The most pervasive invasive plants on the ANF include, but are not limited to, glossy buckthorn, multiflora rose and Japanese barberry in forest interiors; Japanese stiltgrass along trails/roadways, rights-of-ways, and other disturbed areas; and Japanese knotweed along streamsides. Additional species of concern in or on properties surrounding the ANF include bush honey suckles, crown vetch, canary reed grass, purple loosestrife, and goat's rue.

2. **Location**: Areas of high concentrations of invasive plants, and particularly glossy buckthorn, multiflora rose, and Japanese knotweed have been mapped (and prioritized ?) by ANF. Glossy buckthorn predominates across thousands of acres of the southeast portion of the forest (including the Marienville district), while multiflora rose predominates on the western portion of the forest. Japanese knotweed is pervasive along the Allegheny River and tributaries on the northern portion of the forest.

3. **Impact or Severity:** Non-native invasive plants are notably limiting recruitment of native plants and trees across the ANF. This is highly problematic in areas where gap openings from harvesting or natural disturbance, including mortality from non-native insects and pathogen, are occurring. Non-native invasive shrubs have also been documented to reduce nesting success of many bird species, and berries from non-native species are of lower nutritional value than native plants such as Rubus spp. Much of the riparian areas in the Allegheny River watershed, in and surrounding the ANF, are choked with knotweed and lack any other vegetative cover. Lack of management of non-native invasive plants in the last decade has led to major infestations (over thousands of acres) which will take coordinated effort to control and keep in check. Impacts are also likely to increase where human activity and disturbance will occur in the future.

4. **Desired Outcome:** The desired outcome for invasive plant management would be to reduce established populations significantly enough to allow for native herbaceous and woody plants to re-establish and thrive. Complete eradication is unlikely except at very small spatial scales or over a long time-frame. Several strategies should be employed to limit new introductions of non-native invasive in areas where they are not currently found.

## Threats Template Matrix—Invasive Plants

5. **Strategies to Achieve the Desired Outcome**:

**Strategy 1**: Herbicide treatments for large-scale infestations: Herbicides are likely to be the most effective treatment method, but can be used in conjunction with mechanical treatments, Generally, shrub species can be treated by foliar herbicide application, or 'hack and squirt' for individual stems, or by 'cut stump' treatments. For large acreages, foliar application with a mist blower may be most efficient, but directed sprays may be needed in areas where native plants or seedbank is present and should be maintained. Mechanical 'mowing' using a brush hog or Gyrotract, followed by herbicide to cut stumps, may also be appropriate on areas amenable to machinery. (See note below about using cut materials for chips if the market develops). Effective treatments for Japanese knotweed includes early season cutting followed by foliar herbicide treatment in late Summer, using herbicides with aquatic labeling. Pre-emergent herbicides are effective for stiltgrass seed bank.

**Note**: prioritization of treatment areas will be key to controlling invasive plants across the landscape. Areas with only moderate infestations may be easier to control than larger infestations, but require more time to move from site to site and may require more directed spray or individual stem treatment than a broadcast application or mechanical treatment.

**When:** 2017-2020? Priority treatment areas should be considered in conjunction with harvest operation schedules as well, to time understory vegetation management with promotion of desirable tree regeneration.

**Who**: ANF/ contract sprayers

**Cost**: $150-$250/ acre?

**Strategy 2:** Early Detection and Rapid Response: This strategy in combination with monitoring will be most effective in limiting the establishment of small populations of non-native invasive plants in new areas. Some suggestions include requiring natural resource contractors (natural gas and forestry) to monitor and treat roadways, rights of ways, well pads, or log landings, and to include this requirement as part of the contract to leasees. EDRR is a good approach for recreational areas as well to spot treat non-native plants as detected.

**When**: 2018?

**Who**: ANF staff, natural resource contractors

**Cost**:

## Threats Template Matrix—Invasive Plants

**Strategy 3:** Best Management Practices; Other strategies for limiting the introduction of non-native invasive plants to new areas is to clean equipment (and clothing) when moving from site to site, and using designated native seed mixes for reseeding ROW's, log landings, well pads, etc. As above, this may be considered a requirement by ANF and written into future contracts with natural resource companies.

**When**: 2018?

**Who**: ANF staff, natural resource contractors

**Cost**:

**Strategy 4:** Restoration: Once invasive plants have been controlled to suitable levels (see Additional information needs below), establishment of native plants need to occur rather quickly to prevent re-infestations or establishment of other non-native plants. For example, Japanese stiltgrass commonly invades barren areas where Japanese knotweed was treated and controlled. In forested areas, measures such as deer fencing, vegetation management of native problem plants and appropriate silvicultural methods to promote desirable tree regeneration should be used. In riparian areas and rights of ways, seeding in with native herbaceous seed mixes can be used to quickly establish vegetation.

**When**: Varies site to site, depending on level of control

**Who**: ANF staff, contractors?, possibly volunteer groups

**Cost**: (need cost per pound or per acre of native seed mixes)

**6. Monitoring Strategies:**

**Strategy 1:** Utilizing natural resource employees including staff foresters, as well tenders and ROW workers, to monitor areas used for natural resource development or extraction. Develop an easy checklist for top species of concern (this could be combined with monitoring for forest pests such as Hemlock Wooly Adelgid). Might be combined with EDRR if some workers also certified pesticide applicators.

**When/Frequency**: During routine inspections

**Who**: ANF Staff, Well tenders, line workers, and other contractors

**Cost**:

**Strategy 2: Utilizing volunteer groups and organizations for monitoring recreational areas and hiking trails**

**When/Frequency:** 2018-2019; 2-3 times through growing season

**Who**: Trail groups, hiking clubs, bird clubs, ATV/bike clubs, and volunteer citizens.

**Cost**:

| Threats Template Matrix—Invasive Plants |
| --- |
| 7. **Education and Outreach:** Utilize and work with Allegheny Plateau Invasive Plant Management Area (APIPMA) cooperative for education and training of volunteer network and natural resource workers to ID and map invasive plants on the ANF. APIPMA is currently applying for funding for volunteer training for 2018-2019. Also Consider signage, boot cleaning stations, etc. in recreational areas. |
| 8. **Additional Information Needs:** Complete eradication of invasive plants across the ANF is costly, labor intensive, and likely unachievable. Little research and scientific literature is available (?) to provide guidelines on when non-native invasive plant cover or densities are low enough that native plants may establish and outcompete invasives (though that threshold is likely very, very low). It will be important to understand the most effective timing for promoting native plant establishment (either naturally or by planting) following treatment of invasive species. |
| 9. **Other**: In other parts of the country, trials to incorporate invasive plant control with timber harvesting operations have occurred. This includes mechanically cutting shrubby and woody non-native invasive plants concurrently with overstory tree removals. Understory woody material is piled and chipped on site, and chips transported and used for fuel at nearby plants. This has worked well for privet in the Southeastern United States. This may be a consideration for the future with management of buckthorn and multi-flora rose. |