

Healthy Forests: Proactive Strategies for Managing Threats and Promoting Conservation in the Chesapeake Bay Watershed



**STAC Workshop Report
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About the Scientific and Technical Advisory Committee

The Scientific and Technical Advisory Committee (STAC) provides scientific and technical guidance to the Chesapeake Bay Program (CBP) on measures to restore and protect the Chesapeake Bay. Since its creation in December 1984, STAC has worked to enhance scientific communication and outreach throughout the Chesapeake Bay watershed and beyond. STAC provides scientific and technical advice in various ways, including (1) technical reports and papers, (2) discussion groups, (3) assistance in organizing merit reviews of CBP programs and projects, (4) technical workshops, and (5) interaction between STAC members and the CBP. Through professional and academic contacts and organizational networks of its members, STAC ensures close cooperation among and between the various research institutions and management agencies represented in the watershed. For additional information about STAC, please visit the STAC website at www.chesapeake.org/stac.

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Executive Summary

Healthy, resilient forests are foundational to the Chesapeake Bay watershed restoration effort. This two-day programmatic Scientific and Technical Advisory Committee (STAC) Workshop was designed to provide the Chesapeake Bay Program (CBP) and its partners with actionable recommendations on how to achieve meaningful forest conservation outcomes through active forest management and stewardship.

Major Findings

Several insights emerged during the two-day workshop across presentations and breakout group discussions. The workshop was organized around three objectives (1) Identify the major stressors affecting forest health in the Chesapeake Bay watershed, (2) Evaluate how those stressors influence forest resilience and water quality, and (3) Develop management and stewardship strategies needed to address priority stressors. High-level findings from the workshop include:

1. Major stressors to forest health:

- Current forest conditions are a legacy of previous disturbance and often inadequate forest management. Current conditions influence how resilient forests will be to emerging stressors.
- Multiple biotic and abiotic stressors pose major threats to forest health, conservation and water quality in the Chesapeake Bay and its watershed. These stressors include invasive species, insect pests, disease, deer overpopulation, and changing environmental conditions.

2. Stressor impacts on forest resilience and water quality:

- A healthy forest is a resilient forest. Healthy, resilient forests are critical for maintaining clean water in the Chesapeake Bay and its local waterways and provide multiple other benefits for communities.
- Although some stressors cannot be directly influenced through management (for example, changing precipitation and temperature regimes), forests are most resilient to the stressors we cannot control when we actively manage forests for the stressors we can control.

3. Management and stewardship strategies:

- Robust markets are foundational to support sustainable forest management and rural economies. Forest product markets and supporting infrastructure, particularly for low-grade lumber and woody biomass, are currently inadequate to support forest management at scale in the Chesapeake Bay watershed.
- There is significant demand among private landowners for funding and technical assistance to support forest stewardship, but demand is outpacing available resources. In addition, many private landowners own relatively small parcels where the costs of management exceed the potential profits from selling the harvested wood products.

Key Recommendations

Recognizing that improved water quality in the Chesapeake Bay depends on sustaining the health of existing forests, to address the workshop's third objective, participants identified the following strategies for the Forestry Workgroup to advance in collaboration with partners to promote forest conservation in the Chesapeake Bay watershed. These high-level recommendations are coupled with more detailed specific actions in the report.

- Collaborate with the Bay Program's Strategic Engagement Team to develop and deploy a unified, positive, and compelling forest conservation communication strategy that positions healthy, resilient working forests as essential to Bay restoration and rural economies, using consistent messaging amplified through partners and credible messengers.
- Strengthen and connect local and regional forestry networks across the watershed, leveraging existing collaborative structures to support shared learning, rapid response, and more coordinated stewardship.
- Identify policy and enabling conditions that may remove barriers to forest management, reduce perverse incentives, and support active, sustainable forest management across jurisdictions.
- Support development of diverse and sustainable forest product markets as a foundational driver of forest health, rural economies, and Bay restoration, including new market pathways for low-value woody material.
- Build long-term, cross-sector capacity for forest management by expanding the regional forestry workforce, increasing the availability of technical assistance, and sharing expertise to effectively scale forest management and restoration in the watershed.
- Develop diversified, accessible, and scalable funding models that enable forest conservation and management—especially for small-acreage landowners—and support long-term stewardship, maintenance, and innovation.
- Invest in targeted research that improves understanding of forest condition, ecological processes, and management options and impacts to better guide Chesapeake Bay Program decisions.
- Adopt an adaptive, landscape-scale forest management approach that focuses on resilience, long-term planning, species diversity, and connectivity, paired with consistent maintenance and invasive species control.

Introduction

Forests make up about two-thirds of the land in the Chesapeake Bay watershed, and the Chesapeake Bay Program (CBP) has long recognized the importance of healthy forests for water quality and ecosystem health. The Forestry Workgroup has been emphasizing the importance of conservation since publishing the *Conserving the Forests of the Chesapeake* report in 1996 (Cooksey and Todd 1996). Since then, changing physical, biological, and social landscapes have continued to exert pressure on Chesapeake Bay watershed forests. Recent Land Use/Land Cover data have shown that despite major increases in tree plantings, these accomplishments have been overshadowed by very high rates of forest loss. The [State of Chesapeake Forests Report](#) showed that from 2013/14–2021/22, the Chesapeake Bay watershed had a net loss of 104,000 acres of tree cover on developed and developing lands (Brownson et al. 2025). To put this in context, over the same period, less than 9,000 acres of trees were planted in communities (Chesapeake Bay Program 2026; [Chesapeake Data](#)). This loss of tree cover has resulted in an estimated reduction of over \$331 million in benefits from air pollution removal, reduced stormwater runoff, and carbon sequestration (Brownson et al. 2025). Once mature forests are lost, it can take 100 years or more to restore to ecosystem function. It is essential and urgent to identify and address barriers to protecting and managing existing forests (Sprague et al. 2006). Ongoing pressures and forest loss will undermine the work accomplished by the partnership and the important ecosystem services that forests provide and will threaten our ability to meet many of the Chesapeake Bay Program’s water quality and habitat goals (Chesapeake Bay Program 2025).

Forest health is a multifaceted concept that encompasses both the ecological condition of forests and their capacity to provide benefits to humans through time. The U.S. Department of Agriculture Forest Service has defined forest health as the production of forest conditions that directly satisfy human needs and the resilience, recurrence, persistence, and biophysical processes that lead to sustainable ecological conditions (Kolb et al. 1995). Healthy forests provide numerous ecosystem services, including protecting water quality, regulating hydrologic processes, storing carbon, providing habitat to support biodiversity, and enhancing the well-being of communities (Millennium Ecosystem Assessment 2005; Robertson et al. 2011).

In the Chesapeake Bay watershed, forests are increasingly affected by interacting stressors including land conversion, fragmentation, invasive species, altered disturbance regimes, and changing environmental conditions (Batiuk et al. 2023; Brownson et al. 2025). Healthy forests are more likely to be resilient to these stressors and recover quickly from disturbances, sustaining ecosystem structure and function over the long term. Healthy, resilient forests are characterized by attributes such as diverse species composition and age classes, successful regeneration, structural complexity, and high connectivity to other forest patches to support their ability to resist, recover from, and adapt to disturbance and changing environmental conditions (Thompson et al. 2009; Messier et al. 2015). Long-term monitoring programs such as the U. S. Department of Agriculture (USDA) Forest Service Forest Inventory and Analysis program (FIA; USDA Forest Service n.d.) and existing Land Use/Land Cover products (e.g. Claggett et al. 2025) provide important information on forest presence and condition, but no single framework integrates these indicators across the diverse urban, rural, upland, and tidal forest ecosystems of

the Chesapeake Bay watershed. Comprehensive, multi-scale assessments of forest health and resilience are therefore needed to support forest conservation and management decisions under changing environmental conditions (Yan et al. 2025).

The revised [2025 Chesapeake Bay Watershed Agreement](#) reinforces the urgency to address forest loss and declining forest health through the new Healthy Forests & Trees Outcome, which calls on the partnership to conserve, manage, and restore forests and tree cover to maximize benefits for water quality, habitat, and people, particularly in riparian areas and communities (Chesapeake Bay Program 2025). The Healthy Forests & Trees Outcome also establishes a set of numeric targets for community tree canopy, riparian forest buffers and forest conservation. The Healthy Forests & Trees Outcome is included as a part of a new Healthy Landscapes Goal, which aims to “Conserve, protect, restore and enhance landscapes of ecological, economic, recreational and cultural value to improve water quality, provide habitat for wildlife and increase resilience.” The focus on conservation and protection under the Healthy Landscapes Goal and the Healthy Forests & Trees Outcome aligns with the Protection Goal of EPA’s 2022–2032 Vision for the Clean Water Act Section 303(d) Program). This Program goal encourages states to develop various forms of protection plans to prevent waterbody impairments and maintain high-quality waters through multiple mechanisms, including developing watershed-based plans, protection Total Maximum Daily Loads (TMDLs) and antidegradation protections (Environmental Protection Agency 2026). Forest conservation could be a foundational element of these planning efforts.

In response to the revised Watershed Agreement, and building on past CBP and the Scientific and Technical Advisory Committee (STAC) efforts (Cooksey and Todd 1996; Sprague et al. 2006; Batiuk et al. 2023; Curkendall et al. 2004), this STAC workshop convened researchers, practitioners, and decision-makers from across the watershed to take a more systematic look at the stressors affecting Chesapeake forests, how those stressors influence forest structure, function, and resilience, and implications for downstream water-quality outcomes. The workshop was guided by three core objectives: (1) Identify the major stressors to forest health in the Chesapeake Bay watershed, and how they interact and compound across different landscapes and forest types; (2) Evaluate how these stressors affect forest resilience and the ecosystem services forests provide, especially those linked to water quality; and (3) Develop proactive management and stewardship strategies that can be implemented and scaled to address priority stressors, distinguishing near-term actions from longer-term needs. The workshop integrated insights from scientific research, expert testimony, and case studies, and used structured breakout discussions to advance practical, actionable recommendations for the partnership.

Panel and Lightning Talks Summaries

This section summarizes presentations at the workshop. Slides for the presentations are available on the STAC *Healthy Forests: Proactive Strategies for Managing Threats and Promoting Conservation* workshop webpage, accessible using the [following link](#).

Conceptual Model Discussion – Matt Baker (UMBC), Michelle Katoski (USGS)

To lay the foundation for discussions at the workshop, the Steering Committee developed an initial conceptual model of the ways in which forest health can impact water quality, people, and ecosystems; the stressors that impact forest health; and influencing factors that mediate various impact pathways. The conceptual model evolved during steering committee discussions prior to the workshop and drew from earlier versions using a DPSIR-style framework (drivers, pressures, state, impact, and response model of intervention; Smeets and Weterings 1999). The model was designed to be clear and flexible for multiple uses and audiences, communicating both high-level connections and more detailed ecological mechanisms.

The initial conceptual model focused on water-quality degradation as a focal outcome that results from multiple stressors, while keeping impacts to people visible alongside the mechanistic pathways (Figure 1). The model was presented as a working draft with the expectation that workshop participants would refine key terms and linkages through discussion.

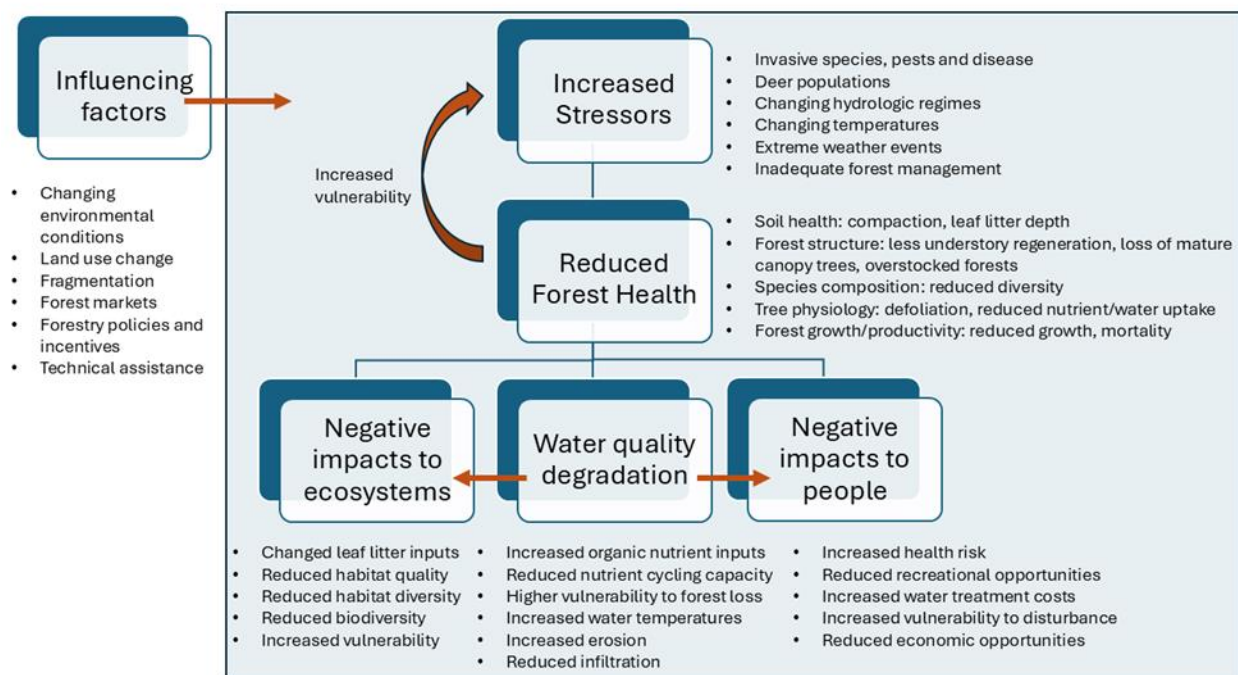


Figure 1. Original conceptual model used to frame the workshop discussion, illustrating how increasing stressors can contribute to reduced forest health, subsequent water quality degradation, and negative impacts to people.

The diagram also served as a boundary object throughout the workshop. Participants interacted with the diagram early in the agenda to align on shared assumptions and identify missing pathways and feedback and then returned to it during structured activities (e.g., sticky-note

annotations, voting/ranking, and breakout discussions). Pictures from the interactive activity on Day 2 can be found in Appendix E. Breakout prompts asked participants to consider compounding stressor interactions, knowledge gaps, and points of leverage, which were used to further populate the detailed processes and pathways tiered to the model (refer to the Final Conceptual Model section and Appendix F).

Level-Setting Plenary: Major Ecological Stressors to Forest Health

- Chris Hayes (USDA FS)

Major forest health stressors within the Chesapeake Bay watershed include insects, diseases, invasive plants, and management impacts. Significant threats include hemlock woolly adelgid (*Adelges tsugae*), beech leaf disease caused by *Litylenchus crenatae mccannii*, emerald ash borer (*Agrilus planipennis*), streamside invasive plant infestations, and early-season insect defoliation events from spongy moths (*Lymantria dispar*) and other early-season defoliators. Defoliating insect outbreaks can destabilize ecosystem processes—altering nutrient cycling, increasing water and nutrient runoff, and shifting biomass from living to detrital pools. Examples of mapped damage were shown from within the Chesapeake Bay watershed showing extensive defoliation, including hundreds of thousands of acres of spongy moth defoliation and a recent outbreak of fall cankerworm (*Alsophila pometaria*) contribute to increased water and nutrient discharge from these areas.

Forest damage monitoring efforts include annual insect and disease surveys. The United States Department of Agriculture Forest Service conducts an annual forest damage survey that is carried out mostly through an aerial survey with additional data collection through other remote sensing techniques and ground surveys. Maps of saltwater intrusion–related forest mortality observed along the Chesapeake Bay and defoliator damage in Pennsylvania collected through the annual survey were presented. Management tools were touched on briefly, such as aerial suppression programs for spongy moth, and impacts of forest management were also mentioned. Although timber harvests can temporarily increase water yield, poor practices—particularly road and skid trail issues, inadequate closures, and excessive bare soil exposure—are the primary drivers of water-quality problems due to forest management.

- Matt Hurd (MD DNR FS)

Forest management has always had challenges. Major ecological stressors generally fall into two categories: those that can be controlled and those that cannot. When management focuses on the stressors that can be controlled, like invasive species, wildlife and their habitat, and forest age/density, forests are more resilient to the stressors that cannot be controlled, like flooding, saltwater intrusion, precipitation extremes, and temperature extremes. Healthy, working forests are resilient forests. Maximizing partnerships, managing resources, and working with the forest product industry leads to more active management on the landscape and benefits everyone ecologically and economically.

- Jill Rose (PA DCNR)

Oak (*Quercus* sp.) decline is a slow-acting, stress-mediated disease complex. As illustrated by the Manion Decline Spiral (Figure 2), long-term predisposing factors (like poor soil and advanced age) weaken trees, leaving them vulnerable to short-term inciting events (such as

drought or defoliation). Ultimately, contributing factors like *Armillaria* root disease and wood borers kill the weakened oaks. Crucially, while aboveground stressors initiate this decline, tree resilience is heavily influenced by the soil microbiome. Examining how shifts in rhizosphere microbial communities alter these decline trajectories is the focus of ongoing soil sampling and analysis across Pennsylvania.

Regional vulnerability is further compounded by a critical demographic imbalance, shown in the “Oak Sustainability Bottleneck” chart (Figure 3). Most regional oak forests are physiologically mature (70–100 years old) with critically low regeneration rates, leaving insufficient young growth to replace declining oaks. To mitigate this legacy-driven bottleneck, managers must adopt a proactive, climate-informed framework assessing early decline signals, intervening with targeted thinning or supplemental regeneration, and continually adapting strategies to bolster overall ecosystem resilience.

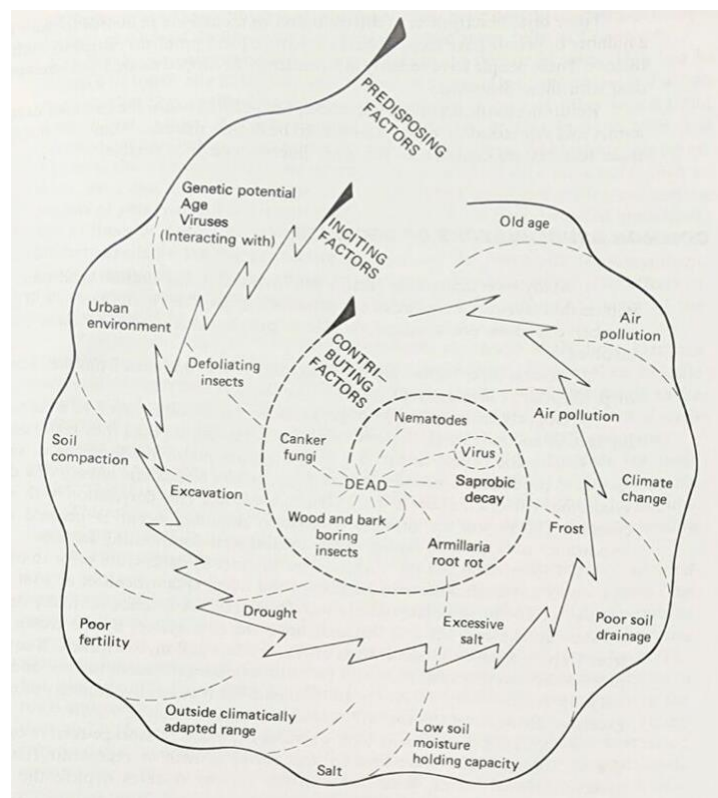


Figure 2. Tree disease decline spiral (Manion 1991). *Tree Disease Concepts*, 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall. 402 pp.

Oak Sustainability “Bottleneck” – Regional Scale

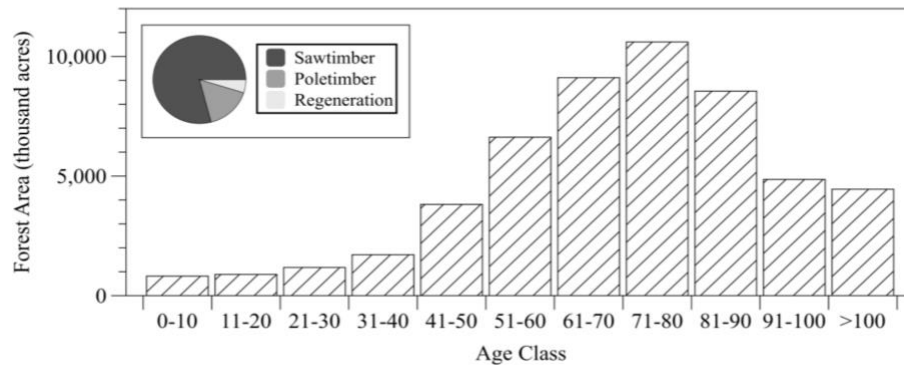


Figure 3. Oak Sustainability “Bottleneck”-Regional Scale (via Adaptive Silviculture for Climate Change, 2022). Data collected from Forest Inventory and Analysis (FIA) plot network within AL, AR, DE, GA, IL, IN, IA, KY, MA, MI, MN, MO, MS, NC, NJ, OH, PA, SC, TN, VA, WI, WV for 2019 (USDA Forest Service n.d.).

Panel: People and Forests

- Allyson Brownlee Muth (James C Finley Center for Private Forests, PSU)

Four of the six bay states are predominantly forested. Across all states, the majority of that forest is privately-owned by families, individuals, private businesses and other entities, in other words, not owned by federal, state, or local government. Of the almost 2 million private owners of woodlands in the Bay states, very few take advantage of cost share programs, have management plans, or own woods that are currently protected with easements or other conservation restrictions. Barriers to getting help include: locating and navigating help – they do not know that resources exist or the burden of accessing them is too great; personal investment – many woodland owners are land rich and cash poor, leaving little liquid financial resources available to invest in caring for their land; uncertainty about what to do – they lack knowledge about forest ecosystems and options for tending it, or do not feel confident that they know enough to care well or do not feel that their land is worth asking for help. Other barriers include their relationship with professionals – how that professional behaves, if they meet expectation; the boundedness of their ownership – few landowners consider their property within a landscape scale; and importantly to our work, many woodland owners express a general skepticism towards the whole of the forestry professional community. Overcoming these barriers to move more woodland owners into active engagement with their land to promote forest health and resilience will be an important aspect of work.

- Isaac Hametz (The Nature Conservancy), Michele Romolini (Loyola Marymount University)

Maryland’s [5 Million Tree Initiative](#) (5MT) includes planting 500,000 trees in urban and underserved areas by 2031, but planting rates in urban areas are currently insufficient to meet that goal. Existing research identifies that trusted, local community groups can help overcome barriers to urban forestry participation through culturally responsive approaches and existing social ties. In Baltimore, community groups may not have the resources or capacity to access

5MT’s annual tree planting grant programs, and alone, these groups are unable to implement at scale. The Nature Conservancy (TNC) developed a strategy in Baltimore centered on network science. Rather than acting as a direct community group, TNC adopted the role of a network broker and boundary organization, actively facilitating relationships and knowledge coproduction related to the implementation of 5MT. To bridge the distance between state agencies and community groups, TNC partnered with trusted intermediary “connector” organizations to lead outreach and recruitment of groups interested in planting trees in their neighborhoods. Through a series of engagements designed to learn participants’ priorities and place-based expertise, TNC worked to create technical resources reflecting the local context. Then, in community design workshops, participants utilized these co-created resources to develop tree planting plans and proposals for 5MT grants. Early evidence suggests that this networked approach successfully facilitated relationships and made urban forestry more accessible. The process of engagement, capacity building, and technical assistance allowed for new community groups to prepare grant applications for projects collectively benefiting over 30,000 people in Baltimore. Interviews with partner organizations indicate that meeting residents “where they are” and prioritizing storytelling alongside technical data builds essential trust and local capacity. This work has broader implications for how strategic network brokers can catalyze policy implementation by increasing the two-way flow of knowledge between public agencies, research, and practice.

- Jenny Willoughby (City of Frederick)

People can be one of the best assets to effective forest management when stewardship is built directly into public use and management of forested spaces. In the City of Frederick watershed, management has evolved since 2014 through a management plan, recreation planning, established rules, road controls and gates, enforcement, trail repairs and closures, signs and kiosks, and ongoing maintenance. These actions help protect the watershed’s core values, including water supply, rare, threatened, and endangered species, recreation space, positive health outcomes, and community building.

Stewardship was presented as a practical management strategy, not just a public engagement goal. Volunteer trail teams, annual cleanups, volunteer meetups, trail work days, trainings, hikes, rides, and regular communication with the public can help build a community of users who care for the resource and report issues before they become unmanageable. Key challenges include people and funding, making education, persistence, and consistent public communication especially important.

- Jon Geyer (Hardwood Development Council)

Healthy, resilient forests depend on strong, diverse markets that can utilize the full range of material they produce—from high-value sawtimber to low-value, small-diameter wood generated. Historically, markets like the paper industry provided a critical outlet for this lower-value material, helping landowners keep forests economically viable and sustainably managed, but as the economy has shifted into a more digital era, those markets have significantly declined, leaving a gap that must be filled to maintain the balance of working forests. Expanding opportunities through emerging uses—such as renewable fuels supported by a hopeful modernization of the Renewable Fuel Standard, biochar, molded fiber, mass timber, and other innovative wood-based products—can help restore this demand, all while expanded markets,

both domestic and internationally, remain essential for high-value hardwood products.

Working forests are more resilient forests, and active management helps address growing stressors facing regions like the Chesapeake Bay watershed, including parcelization, fragmentation, invasive insects and plants, aging and underutilized forests, and shifting climate conditions. In this region, healthy working forests play a critical role in protecting water quality by filtering runoff, stabilizing soils, and reducing nutrient and sediment pollution, while also providing wildlife habitat, carbon storage, and recreation. Without markets for both high- and low-value material, forests lose economic value and are far more likely to be converted to non-forest uses, making it essential to sustain and grow these markets to keep forests as forests and ensure they remain resilient and productive for generations to come.

Panel: Lessons from Practice

- Kyle Myers (PA DCNR), Roy Brubaker (PA DCNR)

Located in south-central Pennsylvania on South Mountain, Michaux State Forest comprises nearly 90,000 acres of public land. Over the last 10 plus years, Michaux State Forest managers and foresters have taken large strides towards establishing watershed level monitoring protocols in order to better understand ecological and human impacts on the landscape. The goal of these watershed level approaches is to establish monitoring protocols that help to engineer resilience in ecosystems, maintain diversity and function of watersheds, and strengthen public trust in land managers. As public land, Michaux faces several challenges in the implementation of this work including diverging objectives of target conditions, opposing objectives amongst taxa, balancing recreation opportunities within high value ecological areas, and implementing modeling results with public feedback.

The Mountain Creek Trail System began as a dynamic user-driven collection of trails totaling around 125 miles. In order to formalize and understand the ecological impacts of this informal trail system, Michaux State Forest and partners at Shippensburg University undertook a comprehensive inventory and suitability analysis of the existing trail system. Following this initial study, Michaux State Forest staff held public meetings and allowed for the collection of public comments using a service called Social Pinpoint (now Social Point). Currently, Michaux staff are working to develop signage, kiosks, and parking lots to support the newly designed trail system. This transition from informal collection of trails to a designated trail system has been key in developing understanding of successful approaches to balancing modeling results with public feedback.

In partnership with the American Bird Conservancy, the U.S. Army Corps of Engineers, the University of Kentucky, and Indiana University of Pennsylvania, and funded by the National Fish and Wildlife Foundation, the Michaux State Forest Watershed Monitoring Protocol aims to pair aquatic and terrestrial habitat improvement work with ongoing ecological monitoring. Prior to the start of the study, the area of interest had been subject to prescribed (RX) burning and some large woody debris additions. During the study, Michaux State Forest staff have completed more large woody debris additions, forestry mowing, and native plantings. This work is paired with a multi-modal set of ecological monitoring methods including environmental DNA (eDNA), Autonomous Recording Units, and traditional macroinvertebrate sampling. These methods are deployed across three different upper tributary streams, which have received

different treatments over time. The goal of this monitoring is to better understand the impact of habitat work on nutrient flow and ecological transition in upper tributary watersheds.

- Nancy Baker (Land steward, landowner)

Forest stewardship on private lands was framed as a long-term and evolving process shaped by changing ecological conditions, landowner objectives, economic realities, and social values. Examples from a multigenerational family property in northern Pennsylvania illustrated how management priorities shifted over time from timber harvesting and subsistence farming to climate-informed stewardship focused on ecological integrity, resilience, wildlife habitat, invasive species management, and assisted migration. Active management practices included erosion control, regeneration treatments, expansion of wildlife corridors, invasive species treatment, white-tailed deer (*Odocoileus virginianus*) management, and planting of more climate-adapted and disease-resistant tree species. Forests were described as dynamic systems requiring continual adaptation rather than restoration to a single historical condition.

Many private landowners are motivated less by timber production and more by privacy, recreation, conservation, legacy, and long-term stewardship values. Stewardship decisions were described as highly personal and shaped by individual experiences, cultural values, and intuitive “cognitive maps” of the land. A broader shift from extractive management toward stewardship-oriented and “put back in” approaches was also noted. Barriers to active management include assumptions that passive management is preferable, the idea that one management approach can apply across ownerships, and challenges associated with framing stewardship investments as long-term benefits rather than short-term costs.

Peer-to-peer stewardship networks and volunteer-based outreach programs were identified as important mechanisms for increasing management capacity and supporting implementation on private lands. Woodland owner associations, stewardship training programs, and landowner outreach networks help translate management concepts into on-the-ground action while extending the reach of traditional technical assistance programs through workshops, demonstrations, trainings, and landowner-to-landowner communication. Effective stewardship outreach was described as collaborative and relationship-based, emphasizing listening, interpretation, and landowners as equal partners in management decisions.

- Matt Pienkowski (Woodland Stewardship Network, the Alliance)

In the Chesapeake Bay watershed, over 70% of forestland is owned by non-industrial private landowners and the majority of those properties are smaller in scale, which can often present substantial barriers to management. Non-commercial treatments like controlling invasive species or pre-commercial thinning can be investments in future forest health that do not pay off for decades. On their own, small-to-medium acre properties may not hold enough potential for a natural resources contractor to conduct intermediate or commercial management. These barriers pose a risk to the future of the region’s ecosystems. A general lack of sustainable management leads to a forested landscape that is less diverse, less healthy, and less usable to wildlife and humans alike.

The [Woodland Stewardship Network](#) model counters these issues by coordinating landowners’ timelines as they work towards their own management goals, thereby increasing management

success across the network. The approach does not involve pooling resources, sharing profits, or necessarily working across property lines. Simply by pushing toward sustainable forest management at the same time, neighboring landowners increase their ability to attract forestry contractors at reasonable rates. This coordination can increase the health of the forest ecosystem at a landscape level, address instances of invasive species more effectively, and provide habitat for wildlife. Species that require young forests, like golden-winged warblers (*Vermivora chrysoptera*), American woodcock (*Scolopax minor*), and ruffed grouse (*Bonasa umbellus*), or mature forests with vigorous understory growth, like cerulean warblers (*Setophaga cerulea*), benefit from the closer proximity of these patches of quality habitat, which can help promote population growth.

In the Alliance's program, Woodland Stewardship Networks are assembled by an initial "keystone" landowner who involves at least 2 additional adjacent or nearby neighbors (within 0.5 miles) each with at least 10 acres of forested property, for a network total of at least 100 acres. The Alliance for the Chesapeake Bay then funds the writing of forest management plans for members of the network that do not already have one, generally in collaboration with a consulting forester chosen with input from the landowners. The plans are written for compatibility with other forestry cost-shares, such as the U.S. Department of Agriculture (USDA) [Environmental Quality Incentives Program](#) (EQIP), and landowners are assisted in applying for management implementation funding. The Alliance can also reimburse landowners for some costs associated with beginning to actively manage forests, in amounts dependent on current program parameters and geographies. Woodland Stewardship Networks are an effective and efficient way to help stewardship-minded landowners manage their privately owned forests, which will eventually result in a healthier forest landscape that is more resilient and usable for all.

- Dave Mausel (USFS)

Invasive species management across forest landscapes presents persistent challenges. The current situation can be characterized as a "wicked problem," a term from Rittel and Webber (1973) describing complex, ill-defined issues resistant to resolution due to incomplete, contradictory, and evolving circumstances. Like wildfire and climate change, the cascading succession of invasive plants, insects, pathogens, and earthworms cannot be solved but must be continuously adapted to and addressed. Compounding this is the practical difficulty of managing across many fronts simultaneously with limited staff and resources. Additional barriers include the absence of actionable on-the-ground management plans (often because applied research remains ongoing) as well as inconsistent integrated pest management (IPM) options, poor timber markets, a shrinking number of mills and logging contractors, and the tendency of multi-agency, multi-ownership contexts to keep plans high-level rather than driving implementation. Even well-executed forest management can be reset by a new invasive pest or a major weather event.

Several approaches have demonstrated consistent value. Collaboration across interdisciplinary teams using iterative processes to support management has been foundational, as has long-term, sustainable funding tied to sustainable forest management objectives. Maintaining diversity in forest age, structure, and species composition contributes meaningfully to resilience. Proactive forest management, such as oak (*Quercus* sp.) silviculture paired with prescribed fire, and hemlock (*Tsuga* sp.) conservation through canopy release cuts within a broader IPM framework, have shown effectiveness when applied consistently. Robust inventory systems, including

continuous forest inventory (CFI) plots, [Forest Inventory Analysis](#) (FIA) data, aerial detection surveys, and drone technology, have been essential for tracking both the positive and negative impacts of management over time and for guiding strategic adjustments as conditions change.

The greatest opportunity for scaling impact is moving from planning to implementation—specifically, executing forest management plans that incorporate up-to-date, practical, and effective IPM options alongside silviculture, prescribed fire, and timber harvest. Tribal perspectives on timber harvesting offer a particularly transferable lesson, noting that Indigenous frameworks provide a model for integrating sustainable resource use with deeply held values around water and ecological integrity, demonstrating that economic and ecological goals need not be in conflict. CFI or FIA analyses can rigorously monitor management outcomes and support adaptive decision-making. A Chesapeake Bay Program FIA analysis or CFI plot network could provide a foundation for building a regional forest conservation strategy grounded in data, sustained by interdisciplinary collaboration, and guided by practical IPM plans with consistent monitoring and evaluation.

Lightning Talks/Panel: Tools and Approaches for Scaling Forest Management

- Guy Dunkle (Foundation for Sustainable Forests)

Forest management on small private properties in northwestern Pennsylvania focuses on increasing resilience through active, low-intensity management. Rather than responding to each stressor individually, the approach manages for tree age diversity, plant species diversity, habitat diversity, high tree vigor, and dense native understories. Maintaining a vigorous understory through uneven-aged management helps limit invasive plant establishment and reduce white-tailed deer browse impacts.

Management activities center on high-frequency, low-intensity harvests that incrementally improve forest condition over time. A “worst-first” single-tree selection process is paired with group selection openings to support regeneration and create uneven-aged patch forests. Horse logging supports this system because it has lower mobilization costs and reduces impacts to soils and residual vegetation. The model depends on strong local forest economies and wood products markets, particularly for low-grade material such as pallet wood and railroad ties. Revenue from harvested products helps support stewardship activities like invasive species management. Outcome-based compensation, trusted contractors, and efficient local permitting can also help make smaller, lower-intensity harvests financially feasible.

- Jeff Larkin (IUP/ABC)

There exists substantial scientific evidence that the ecology of eastern North American forest birds is strongly tied to landscape context, composition, and within-stand structural complexity. Long-term population declines of eastern forest birds have been fueled, in part, by a predominance of homogeneous middle-aged forests that resulted from large-scale forest clearing in the early 1900s. This lack of structural complexity is further exacerbated by excessive browsing by white-tailed deer, unsustainable timbering methods on private lands, invasive species, and lack of timber markets. Collectively, two overarching themes emerged: 1) the health, resilience, and economic value of eastern forests are in jeopardy and 2) forest management activities that fail to consider the entire reproductive period of forest birds are at risk of being less effective.

In 2017, the Dynamic Forest Restoration Block (DFRB) program was initiated to address factors that threaten forest resilience while implementing a more comprehensive approach to eastern forest bird conservation. To date, the program has incorporated 35 forest blocks totaling more than 146,400 hectares (ha) into the DFRB and implemented management on more than 8,300 ha, with additional projects underway. Monitoring of avian and vegetation communities has also been conducted at more than 4,000 unique survey locations across 29 forest blocks. Analyses of these data indicate positive outcomes for forest bird communities, with more diversified forest landscapes supporting significantly higher avian conservation values. These results indicate that collaborative, well-funded, and sustained partnerships can help overcome constraints that often inhibit large-scale wildlife conservation.

- Sabina Dhungana (VA DOF)

A healthy, sustainable forest landscape is not possible without a strong and thriving forest industry. Forest-based businesses are essential partners in implementing effective forest management, providing the revenue streams that allow landowners to carry out the ongoing work needed to maintain forest, soil, and water health. These industries create markets for low-value material generated from thinning, restoration, and wood-manufacturing by-products—material that would otherwise accumulate and increase risks to forest health. Yet, across the United States, many forest-based industries are struggling due to declining demand, global competition, and policy challenges. Biomass-to-energy markets, in particular, are often misunderstood despite being the only commercially available technology capable of utilizing the large volumes of woody biomass produced through responsible management. Without viable markets, forests face mill closures, weakened rural economies, and declining forest health.

Collaboration with the forest industry is essential. Nearly every state has a forest utilization or marketing program designed to support these businesses and connect them with partners. Collaboration among industry, landowners, environmental organizations, policymakers, and community stakeholders can create solutions that advance ecological, economic, and social goals simultaneously. Healthy forests require healthy forest industries, strengthened partnerships, and collective work to ensure forests remain forests and continue providing ecological, economic, and social benefits.

- Amy Shields (Allegheny Hardwoods Utilization Group, Allegheny Forest Health Collaborative)

Collaborative forest health work on the Allegheny Plateau provides a landscape-scale model for addressing threats that cross ownership boundaries. The [Allegheny Forest Health Collaborative](#), co-led by the Allegheny Hardwood Utilization Group (AHUG) and the Allegheny National Forest (ANF), brings together agencies, nongovernmental organizations, industry partners, researchers, and landowners to coordinate management priorities, share information, and support cross-boundary stewardship. Working groups have focused on silviculture, invasive species, monitoring, communications, and forest health research needs, including hemlock woolly adelgid, emerald ash borer, sweet birch (*Betula lenta*) proliferation, black cherry (*Prunus serotina*) health, Japanese knotweed (*Fallopia japonica*), and Japanese stiltgrass (*Microstegium vimineum*).

Glossy buckthorn (*Rhamnus frangula*) management provides an example of coordinated regional response to an emerging invasive species. Initially identified as an early detection and rapid response species in [Pennsylvania's State Forest Action Plan](#), glossy buckthorn expanded from an approximately 5,000-acre outbreak to 50,000 acres by 2022. The species impedes regeneration and succession, alters soil chemistry and hydrology, reduces wildlife habitat quality, and spreads rapidly across ownership boundaries. Coordinated efforts included mapping and inventory work, outreach to rural landowners, contracted treatment activities, and post-treatment monitoring.

Long-term capacity building is essential for sustaining collaborative forest health management. Capacity building efforts include workforce development, summer internships, contractor training, mapping technologies, monitoring protocols, landowner engagement, and research into emerging treatment approaches such as drone applications and seasonal invasive species treatments. These investments can build a scalable framework for addressing future forest health priorities while strengthening regional coordination and implementation capacity.

- Phyllis Joris (NeighborSpace)

[NeighborSpace](#) is a nonprofit land trust working with communities in urban Baltimore County to protect, restore, and steward land for small parks, gardens, trails, and natural areas. NeighborSpace currently conserves 100 acres across 21 sites, of which more than 80% is forested. The biggest threats to the health of these urban forests are invasive pressure and white-tailed deer pressure; erosion and littering are also significant concerns at some sites. NeighborSpace has recently begun implementing a range of stewardship activities and restoration projects to improve and maintain forest health, including performing forest health assessments, removing invasives, planting trees, seeding perennials, and installing dense layered native plantings.

Projects are planned and executed in partnership with community leaders, and NeighborSpace offers educational programs, community science opportunities, and hands-on activities to engage residents and volunteers. These activities have noticeably improved forest health in portions of five NeighborSpace sites. Barriers to more widespread and sustained implementation include inconsistent funding, limited staff capacity, and lack of volunteer engagement. Obtaining permission from Baltimore County government to remove invasives and/or plant natives in forest conservation or stream buffer easements has also been difficult or impossible in some cases.

Mentimeter Prioritization Exercise

Before moving into breakout groups, participants used Mentimeter to complete an individual ranking exercise for the stressors identified in the initial conceptual model. One question asked participants to rank each stressor based on both the urgency of addressing it due to potential impacts on forest health and the degree to which management actions could influence the stressor.

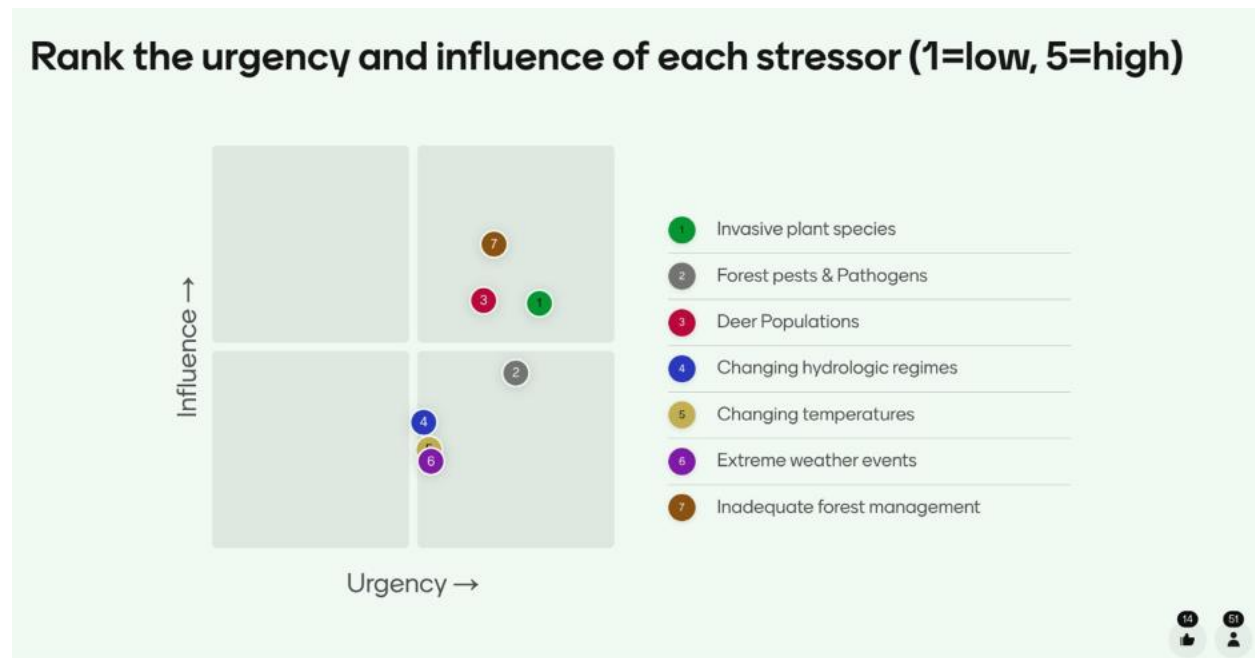


Figure 4. Participant ranking of forest stressors by urgency and management influence.

Stressors ranked in the upper-right quadrant of the urgency/influence matrix were identified as higher priorities because they were viewed as both urgent and actionable. These included invasive plant species, deer populations, and inadequate forest management.

A second question asked participants to rank the same stressors based on urgency and current understanding of the stressor and its impacts.

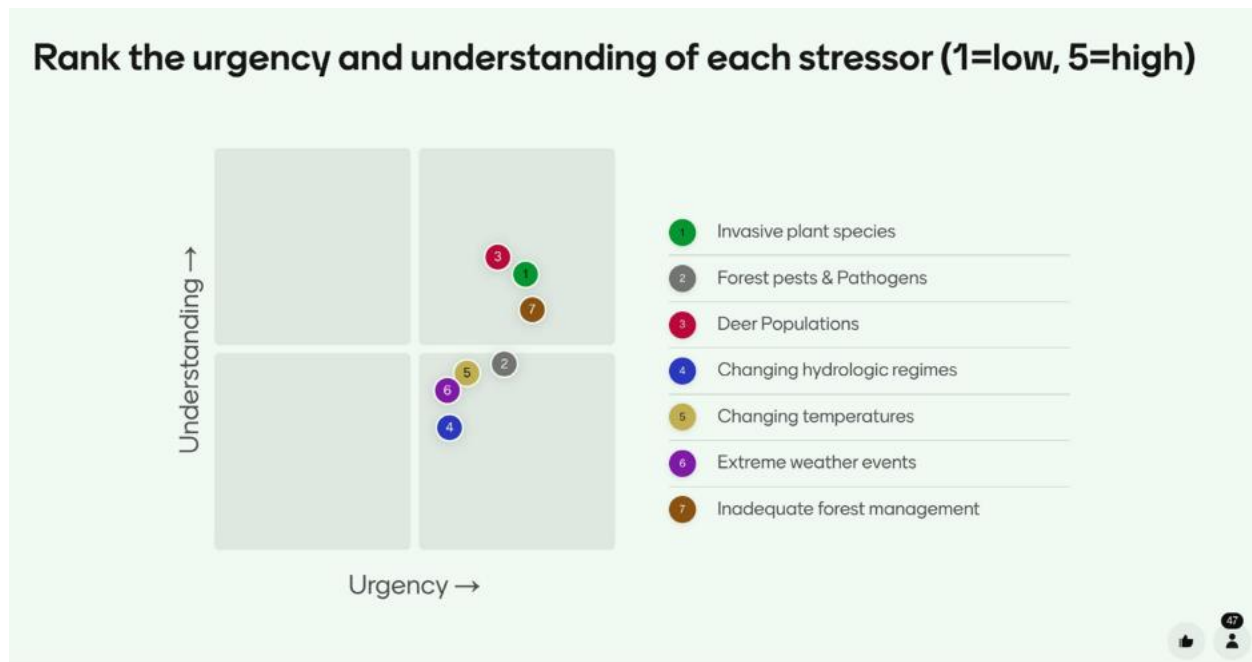


Figure 5. Participant ranking of forest stressors by urgency and current level of understanding

For the second question, the same set of stressors were ranked in the upper-right quadrant of the urgency/understanding matrix, indicating that invasive plant species, deer populations, and inadequate forest management were viewed as both urgent and relatively well understood. Together, the two figures show that these stressors were considered both actionable and supported by a stronger current knowledge base, making them clear priorities for follow-up discussion.

Breakout Groups

Breakout discussions were held on both days of the workshop and informed the findings and recommendations in this report. These sessions built on the conceptual model discussion, plenary presentations, panel discussions, and case examples presented earlier in the agenda. On Day 1, participants focused on priority stressors affecting forest health and water quality in the Chesapeake Bay watershed. On Day 2, participants focused on strategies for addressing those threats and promoting conservation. Additional breakout materials are provided in the appendices.

Day 1. Prioritizing Threats to Forest Health and Water Quality

The Day 1 breakout discussions focused on the stressors that participants viewed as most important for forest health and downstream water quality. Participants were placed in topical groups based on their areas of expertise where appropriate and were asked to identify priority stressors, consider how those stressors interact across landscapes and ownerships, and highlight key knowledge gaps that limit management and action. Summarized responses from the Day 1 breakout report-out and workshop recording are included in Appendix D.

Forest Conservation Research

Participants in the forest conservation research breakout emphasized several gaps in how stressors were conceptualized in the proposed conceptual model and suggested refinements to better support regional-scale application. Conceptual models specific to physiographic regions may better represent landscape-specific stressor regimes (e.g., salinization was not included as a stressor in the conceptual model and would be a coastal-specific stressor). The discussion also highlighted the importance of representing stressor intensity and scale, noting contrasts between localized disturbances, such as American beaver (*Castor canadensis*) activity, and widespread, high-impact pests such as spongy moths. Additionally, forest age and land-use history were noted as critical drivers of forest resilience that were not included in the conceptual model. Across discussions, regeneration failure emerged as a central forest health concern, with deer browsing and pest pressures identified as primary drivers. There was a clear call to focus on forest resilience mechanisms, particularly regeneration dynamics under pressures from climate change, herbivory, and pests.

Research and monitoring priorities demonstrated the group's strong expertise in landscape-scale analysis and geospatial tools. Participants called for improved mapping of stressors and management activities to better target interventions and identify implementation gaps. It was noted that there may be potential to integrate forest stressors, structural condition (e.g., forest age and land use history), and forest management tracking into Chesapeake Bay watershed mapping programs, such as Chesapeake Bay High Resolution Land Use and Land Cover (LULC) database 2024 Edition (Claggett et al. 2025). Participants noted that increasing the availability (and possibly mandating) the collection of pre- and post-restoration reference data would be essential for better understanding the effects of restoration treatments because some restoration sites may decline in condition without sustained management and evaluation. For water quality, priority research needs centered on how climate-driven shifts in hydrologic regimes, including changes in evapotranspiration and growing season dynamics, affect forest function.

While the group held strong expertise and interest in leveraging emerging technologies such as artificial intelligence/machine learning (AI/ML) modeling, drones, Light Detection and Ranging (LiDAR), and high-resolution canopy mapping, field-based monitoring of forest function in response to restoration and stressors still remains a major gap. The group underscored that knowledge gaps around multiple stressor interactions, especially related to forest condition and function, were “not a gap, but a canyon,” and also stressed the importance of embedding rigorous outcome-based monitoring and evaluation into management and funding frameworks.

Urban Forest Conservation

Urban forest health in this breakout was framed less as a purely ecological challenge and more as a coupled land-use, governance, and capacity problem. Whereas familiar stressors (e.g., invasive plants, white-tailed deer browsing, fragmentation) remain important, participants returned to the idea that dominant drivers in urban contexts are structural: development pressure, misaligned incentives, and limited ability to manage forests consistently at scale.

A central concern included ongoing degradation and loss of existing forests, particularly mature stands, as relics from bygone eras. Development pressures, typically justified through “highest and best use” frameworks, continually favor land conversion, whereas infrastructure maintenance, dumping, and new access corridors incrementally fragment remaining woodlots. Participants highlighted potential tensions within restoration paradigms: some stream restoration and stormwater (MS4) programs incentivize clearing mature forests to achieve regulatory credit (e.g., linear feet of restored stream), raising concerns about whether short-term compliance gains may come at the expense of long-term forest or water quality outcomes.

Across both forest health and water quality, resource constraints and disjointed governance emerged as urgent and pervasive stressors. Responsibility for urban forests is distributed across jurisdictions and agencies that often operate in silos, limiting coordinated action. At the same time, there is insufficient capacity, both in public agencies and among contractors, to implement and sustain management at the required scale. Governance fragmentation and limited capacity reinforce one another, where connectivity of organizational networks can act either as a multiplier (when collaboration is strong) or an additional stressor (when coordination is weak). Procurement processes further constrain access to skilled urban forestry work. These factors interact to create a reinforcing loop: even well-designed programs struggle to achieve durable outcomes without alignment and sustained investment.

Participants emphasized that management effectiveness, not just knowledge, is a key gap. Research priorities therefore should focus on moving beyond information sharing toward models of coordinated, cross-jurisdictional management, and improving effectiveness of specific interventions. There was particular interest in developing targeted and coordinated invasive plant control strategies, rather than diffuse efforts, to produce measurable ecological improvements.

Monitoring and management were viewed as both technical and social opportunities. Urban forests provide a highly visible platform to engage residents and build public and political support, while also enabling targeted monitoring to test whether management actions (e.g., invasive control) are achieving desired results. However, participants noted that to be effective, monitoring must be explicitly linked to decision-making. For example, white-tailed deer population management was viewed as relatively tractable in principle, though outcomes remain

uncertain and delayed. Climate-adaptive planting and diversification strategies were discussed as promising but still under-evaluated.

Urban forest outcomes are being shaped less by a lack of ecological understanding than by misaligned incentives, fragmented governance, and insufficient management capacity. Addressing structural constraints, while rigorously evaluating tradeoffs in restoration and improving targeted interventions, was considered essential to sustaining both forest health and water quality in urban landscapes.

Invasive Pests

Much of the Chesapeake Bay watershed is privately owned, but there are multiple types of forest landowners, including federal, state, municipal, private, and non-governmental organization (NGO) landowners. Given that some existing infrastructure supports education, funding, and landowner assistance for good land management, the breakout group identified increasing landowner awareness as a high priority for addressing inadequate forest management. Landowners want to be good stewards of their land but need increased knowledge and resources.

In addition to discussing the importance of landowner awareness, the breakout group discussed managing forests for resiliency and diversity. There were also discussions of challenges to good forest management that included the lack of forest product markets, poor information being disseminated by social media influencers, and the lack of funding for non-commercial type treatments (e.g., invasive plant treatments). Other discussion points of stressor prioritization follow below.

The most urgent stressors to address:

- Animals (early season defoliating insects and white-tailed deer)
- Preparedness for extreme weather events (e.g., interactions of extreme weather with roads and culverts)
- Land use change
- Lack of diversity in species, landscape, mosaic structure, genetics

Stressors that should be prioritized for additional research on impacts to forest health and water quality:

- Species loss and decline cycles (hemlock loss, oak decline) and broader ecosystem consequences
- Effects of invasive insects, diseases and earthworms on soils
- Stream temperature, chemistry, and flow changes in response to invasive insects and forest declines (hemlock, oak) and broader ecosystem consequences
- Developing predictive modeling & mitigation strategies for oak decline

Public Lands

Considering public lands, breakout group participants highlighted multiple anthropogenic stressors that were not initially included in the conceptual model, including trash, poaching, direct effects of recreational activities like mountain biking, and the increased spread of invasives. Participants also discussed the need to include constraints on management in the model. Resource and capacity limitations shape what stressors can be addressed and can magnify the effects of stressors over time if they are not addressed in a timely manner. Negative public

perception of active forest management stemming from inadequate knowledge about the purpose of management can also effectively limit management on public lands. Invasive species, degraded riparian conditions, and soil acidification in some areas were also highlighted as urgent stressors to address for improving or sustaining water quality.

Compared with private lands, breakout group participants highlighted that on public lands, managers have much more control to implement management actions, so there is significant opportunity to develop long-term plans to restore ecosystems using all appropriate management tools. For example, public land managers can ensure invasive species removal is paired with sustained follow-up and management. In significantly degraded systems, long-term restoration planning may include reconsidering the ecosystems managers are trying to restore. Restoring novel or replacement ecosystems that are easier to manage in the short-term may be effective for starting to restore ecosystem function and address potential water quality impacts while working to build diversity over the longer-term. This may include planting warm season grasses that can be effectively managed with fire at scale before trying to restore forested ecosystems. Public lands managers can also play an important role in public education by demonstrating the role and the benefits of management for popular uses of public lands, like hunting and fishing.

Key knowledge gaps identified include understanding how multiple stressors interact to support actionable and adaptive forest management and better understanding the impacts of management under changing environmental conditions. With changing conditions, the same management activities are generating different or unexpected results. Effectively addressing these knowledge gaps will require watershed-scale research that pairs interventions with long-term monitoring, baseline data collection and reference watersheds to better understand the impacts of management and restoration on water quality over time. Public lands can provide a good opportunity for conducting this research. Beyond water quality, on public lands there are also opportunities to monitor and evaluate the effectiveness of management for habitat restoration leveraging monitoring of threatened and endangered species. Applied research could support a better understanding of mechanisms and approaches that can influence the ecosystem enough to generate measurable improvements in a cost-effective way.

Forest conservation

Forest conservation is a new target in Healthy Forests and Trees Outcome to address forestland conversion stressors. During initial discussions in this breakout group, it was recognized that forestland conservation has different connotations depending on the entity engaged in the work. Land trust organizations, for instance, often perceive that forest conservation is achieved only when permanent protection encumbers the parcel, whereas a natural resources agency or organization may perceive forest conservation through less constraining mechanisms like forestland tax abatement programs or other conservation initiatives that might have limited-term easements or protections. The group discussed the merits of perpetual easements in protecting forests with the highest ecological and economic value but also acknowledged the fiscal and capacity constraints that limit this tool. Often private landowners, even those that are conservation minded, are leery or hesitant about potential constraints of these perpetual agreements.

It was also recognized during this group's discussion that there is often a disconnect between conserved forestlands and forestlands that are well managed to address the stressors introduced in this workshop. A forestland under permanent protection is often assumed to be a resilient landscape that will persist into perpetuity despite lack of management or recognition of various stressors current and future impacts. Often the terms set in easements can inhibit management actions. Discussion then shifted to various public land ownerships, which are essentially conserved land, as an example of how perceived objections to management affect how stressors are addressed. State forestland is managed differently than state parkland in most of the Chesapeake Bay watershed. While state forests typically have a forest management plan and are managed for a variety of goals like timber production, wildlife, and recreation, state park lands often lack any management. State parks undoubtedly receive more visitors, and resources are understandably allocated to recreation and park facilities as priorities. There is also likely a public perception and lack of knowledge about forest management that prohibits necessary or efficient silvicultural practices from being implemented.

The last part of the discussion was prompted by the need to address public perceptions of forest management in improving forest health and resiliency. The group came to a consensus that the term "healthy forests" needs to be clearly defined. Although deriving a general, overarching definition of healthy forests is difficult due to the complexities and variances of the region's forests and the myriad of current and future stressors, this group agreed that this is an essential step to move the Healthy Forest and Trees Outcome forward.

Forest Markets

Within the breakout session on forest markets, there was initial broad agreement that the conceptual model was missing many key human dimensions concepts and related potential indicators. For key stressors, there were three key missing concepts, in order of importance: 1) economic drivers and conditions such as interest rates, markets, and trade that set system constraints, 2) public perception of active forest management, and 3) economy of scale constraints that limit possible management approaches. Related research priorities were also related to scale, specifically a need to downscale climate research (i.e., hydrodynamics, weather, temperature) to the property scale to make that research operational within functioning forest markets. Specifically for water quality, participants recognized that the importance of forests for protecting water quality is well established while also identifying a need to better understand how forest condition, degradation, and specific stressors influence water-quality outcomes and how that knowledge can be operationalized for management.

In terms of monitoring progress toward Agreement Outcomes, the forest market breakout stressed the need to figure out how to count nontraditional contributions to forest-related outcomes. These indicators also need to be relevant to property-scale decision-making (made possible by new technology) and different actors and objectives throughout the system. Markets have the opportunity to provide some of these indicators because they quantify dynamics related to many actors in the system. These monitoring programs also need to create time series to capture effects of management decisions, restoration, natural hazards, and other acute events.

Private Lands

Within the Private Lands breakout group, there was consensus around the missing key stressors on private lands of recognizing how individual landowner decisions and actions are driving

fragmentation and resource impacts within the watershed. With these millions of individual actors, there is great need for more human dimensions research and understanding of these decisions as drivers of stewardship and land use change. These landowners' decisions and actions are often framed by invasive species and deer as landscape- and property-scale stressors that many owners observe and act on. The interactions among fragmentation, landowner decision-making, deer browsing pressure, and invasive species were implied as a core system needing better intervention design. In the space of the wooded resource, this breakout group also recognized that human infrastructure and impacts outside the woodlands could potentially outmatch forest-based gains. Research priorities included applied research to remove barriers to action and increase implementation, longer timelines for research and post-intervention assessment to understand outcomes from decisions, and work that clarifies where forest interventions can meaningfully affect water outcomes versus where broader human-system changes are required.

Day 2. Strategies for Managing Threats and Promoting Conservation

Following the Day 2 lightning talks on tools and approaches for scaling forest management, participants met in a second set of breakout groups to discuss management and conservation strategies for addressing priority stressors. Discussion focused on actions that may be feasible in the near term, longer-term needs, the scale at which different approaches may be most effective, and the policy, funding, capacity, and decision support needs that may affect implementation. Images of the Day 2 post-it responses are included in Appendix E.

Forest Policies and Incentives

Understanding barriers to adoption of sustainable practices and active and appropriate management, and where policy can help or hinder, is critical to gaining support and traction for land conservation and increasing forest resilience in the Bay watershed. The breakout group focused on increasing communication with consistent and standardized messaging across partners and increasing technical support providers and funding for conservation programs. The group also stressed how current funding programs can diversify how funds are allocated and utilized to support unique and non-traditional projects (such as non-native insect and disease treatment, urban and agroforestry projects). There are also instances where programs that are available are not aligned with regulations. For example, regulatory barriers to working effectively in streams and wetlands, and programs that provide perverse incentives to remove forested habitat. Addressing these disconnects will require intervention by many partners at the regulatory level, and input from the Chesapeake Bay Program could help advance these discussions.

The Chesapeake Bay Program is also in a unique position to support the important role of forest markets in driving active management. Key initiatives supported by the Chesapeake Bay Program could help modernize the Renewable Fuels Standard to increase the range of feed stocks that are covered under the U.S. Environmental Protection Agency (EPA) Renewable Identification Number (RIN) credit program (Environmental Protection Agency 2025), and supporting and working with the U.S. Forest Service's [Wood Innovations Grant program](#) and other partners (e.g., [Hardwood Development Council](#)) to direct funding to projects in the Chesapeake Bay watershed that support the utilization of low-grade wood products. The Wood Innovations Grant program has a limited range of qualifying activities for which the funding can

be used; updating the program to include equipment modernization and more innovative techniques could help better inform applicants. Illustrating the declining health of the watershed's forests could be undertaken by utilizing the U.S. Department of Agriculture's [Forest Inventory and Analysis](#) (FIA) data for a Forest Condition Assessment, to highlight the need for active management to steer the region's forests onto a more positive trajectory for greater resilience. The results of such an analysis could be used by all partners to communicate with one voice to landowners that the Chesapeake Bay watershed forests could benefit from intervention, and markets are building to help address the need for more active and appropriate management ("Healthy Markets = Healthy Forests = Healthy Bay").

Changing Environmental Conditions

The group identified challenges associated with restoring and maintaining healthy forests in the context of changing environmental conditions. Understanding that conditions are becoming more extreme and not changing linearly, climate-adapted species selection can be challenging. Additional knowledge sharing around recent research on climate-adapted reforestation efforts could help guide this work and increase understanding of where particular species are going to do well. Assisted species migration may be appropriate in some cases where there are likely to be big changes in environmental conditions. In these cases, species could be slowly introduced as part of broader forest management plans and efforts to reduce fragmentation to allow for natural migration across the landscape.

Participants highlighted that there can be substantial variability in microclimates and habitat suitability, with floodplains and ridgetops being particularly vulnerable to the more extreme conditions and weather events that stress forests and trees. Considering this variability, it is critical to maintain and increase multiple forms of diversity, including diverse species mixes, ecotypes and age classes. Dynamic Forest Restoration Blocks (DFRBs) were noted as an effective approach for encouraging landscape-level diversity, but a diversity of management models would be needed to manage and restore diverse landscape conditions. Additional strategies would also be needed to better address the interactive effects between changing environmental conditions and other stressors on the landscape, including additional management and long-term maintenance for invasives and emerging pests.

However, as phenology and productivity change with environmental conditions, there is still significant uncertainty around how these changes will impact hydrology and nutrient dynamics. With changing conditions, the implications of ecosystem changes like earlier green up or forest die back should be accounted for and are likely to significantly affect interception, infiltration, and water quality. There is an urgent need to better understand the impact of forest degradation on water quality. This includes better understanding the impacts of invasives on soil processes, functions and nutrient cycling, both below-ground in the buffer zone and in the stream. Additional knowledge is also needed on the relationship between forest successional stage and water quality, accounting for changes in productivity and leaf fall. An initial meta-analysis could establish a foundation and should be a near-term priority to inform the Chesapeake Bay Program about opportunities to improve the Chesapeake Bay Watershed Model (Chesapeake Bay Program 2020). Improvements could include better incorporating ecosystem models and distinguishing between healthy and degraded forests or stands in various successional stages.

Finally, the group followed up on a high priority need identified by workshop participants to define a healthy forest. The group established a draft definition that a healthy forest is a resilient forest, while also acknowledging that a healthy, well-managed and functioning forest will look different in different places.

Fragmentation

Forest fragmentation was framed as both a biophysical process and a management challenge, with impacts including increased invasive species pressure, greater vulnerability to pests and stress, reduced interior habitat, and constraints on effective forest management due to edge effects. Participants emphasized that fragmentation is not a single event but a progressive sequence, often beginning with parcelization and subdivision, followed by physical forest breakup and long-term degradation. Accordingly, strategies were organized along this continuum: prevention, intervention, and response.

Early in the process, participants stressed the importance of getting ahead of parcelization. This includes maintaining existing ownership and management regimes, limiting subdivision or permitting in priority areas, and strengthening local markets for low-value forest products to help keep working forests economically viable. A primary goal is to reduce pressures that lead landowners to subdivide or convert forestland in the first place.

In the intervention phase, focus should shift to slowing or redirecting fragmentation as it emerges. Key strategies include expanding and distributing local wood markets to reduce transport costs, and importantly, building networks among landowners because neglect and land sales were deemed key pre-fragmentation processes. Participants highlighted the need for collective approaches, such as cost-share programs, tiered incentives, and cooperative management frameworks that make it more feasible for smaller landowners to participate and thus maintain healthy forests through active management rather than neglect. Reducing minimum acreage thresholds for program eligibility and actively engaging small parcel owners (0–10 acres) were considered critical given their growing influence on landscape outcomes.

For areas where fragmentation has already occurred, response strategies center on coordination and reconnection. This includes cooperative efforts across private, tribal, and public lands, use of tools like [U.S. Forest Service Forest Legacy Program](#), and targeted reforestation to reconnect forest blocks and restore functional landscape connectivity. A recurring theme was that economic and social structures are as important as ecological ones. Markets, incentives, and landowner networks can either accelerate or help counteract fragmentation depending on how they are designed.

Participants also noted an important technical consideration: commonly used definitions and datasets may misclassify certain management practices, such as uneven-aged forestry, as fragmentation in high-resolution analyses. This highlights a need to refine how fragmentation is defined and measured to better align with on-the-ground conditions and management goals. Addressing fragmentation requires acting early in the parcelization process, strengthening economic and social incentives for keeping forests intact, and coordinating across ownerships to restore connectivity, while also improving how fragmentation itself is defined and monitored.

Land use Change

The land use change breakout focused on strategies to reduce forest loss while aligning conservation with development pressures and economic priorities. Participants emphasized that conserving existing forests is more effective than relying on reforestation alone, highlighting tools such as easements, tax credits, and land conversion payments to incentivize protection. Expanding incentives for low-impact development, particularly on commercial properties through preservation and replanting at scale, was also identified as a near-term opportunity. Several participants suggested formally recognizing forest conservation as a best management practice within the Chesapeake Bay Program modeling framework, though this would require establishing baseline pollutant loads for conserved forests. In addition, there was a strong emphasis on engaging private landowners through education, targeted tax programs (especially for small parcel owners), and financial incentives that make conservation and “green” development an economically competitive option for corporations and viable for landowners.

Implementation challenges were closely tied to governance, coordination, and social constraints. Participants noted that inconsistent policies and government structures across states complicate regional approaches and called for stronger coordination among state-level agencies (e.g., energy, transportation, planning, and environment) to better align land use decisions. Where policy levers are limited, working directly with industry sectors, such as energy, data centers, and solar, was identified as a pragmatic pathway, although this approach can be constrained by local opposition (e.g., Not In My Back Yard (“NIMBY”) dynamics) and competing economic and population growth goals. Participants also highlighted the need for increased understanding of land use change drivers to inform more targeted interventions. Overall, the discussion underscored that effective land conservation will require coordinated policy frameworks, cross-sector engagement, and incentives that reconcile environmental goals with development pressures.

Forest Markets

The breakout group focused on ways markets could positively impact the health, resilience, and sustainability of forests within the Chesapeake Bay watershed, with deeper discussion occurring around Bay-focused messaging in support of these markets. Initial discussion emphasized the need for baseline metrics within the watershed from which to assess programmatic and intervention impact. Recent studies in New England and Pennsylvania may provide a model at the Bay watershed scale to delve more deeply into forest condition using USDA Forest Service Forest Inventory and Analysis data (USDA Forest Service n.d.).

Specific opportunities for support of markets from partners within the Chesapeake Bay watershed include messaging linking forest management and forest products to the Bay, highlighting local economies and jobs benefiting from management activities, and partner-led common messaging to improve forest health through increased demand for sustainably managed wood products, as well as linking to less traditional wood products supply chains such as drawing from urban tree removals. Recognizing the numerous market opportunities that exist, convening around common messaging and shared branding presents a great opportunity to demonstrate support of good management and derived products. Through demonstrated support of Bay partners, there is opportunity for collective endorsement for programs and markets that utilize low-grade, small-diameter wood, such as biochar, endorsement of wood products industry recruitment by individual Bay states, recognizing that the procurement regions cross state lines,

and support for the modernization of policies affecting source material for products like renewable fuel. The group also suggested opportunities to add weight to proposals to the Wood Innovations Grants program for those occurring within the Chesapeake Bay watershed.

Technical Assistance

There was unanimous agreement within the group about the essential role various technical service providers, like natural resources agencies, consulting foresters, and private sector natural resources providers and businesses, will provide in achieving the Healthy Forests and Trees Outcome targets. It was recognized that there are likely not enough technical service providers across each sector to take on the amount of work needed to achieve the targets. It was further recognized that the opportunity for technical assistance providers to increase capacity to assume the work is highly dependent on the forest products market. A vibrant forest products market infuses necessary financial resources to scale up technical services well beyond what public funding could provide.

The group discussed the need for the forest products industry to be part of this strategy and to help communicate services needed for changing and emerging markets. The PA Hardwood Council, for instance, already offers training programs for technical resources providers in the northern part of the state that are relevant for the services needed in that market. This could be replicated in other regions as it pertains to other specific markets. The various university Cooperative Extension systems provide and should continue to provide a role in training and educating technical resource providers for current markets and natural resources opportunities, while also supporting research on new and emerging forest markets and landowner outreach. The breakout group also discussed opportunities to incentivize other green industry professionals like landscapers and arboricultural service providers to offer woodland management services like invasive plant management and timber stand improvement practices on smaller acreage parcels that are not taken on by most forest technical providers.

The last item discussed to increase technical capacity was assurances of steady work through longer-term contracts or projects that compile multiple projects in the same region. There is reluctance to scale up equipment and train additional workforce without knowing there is consistent work demand.

Keynote Presentation and Discussion

Ethan Tapper, a Vermont-based forester, ecologist, author, and digital storyteller, presented a lunchtime keynote on the emotional, practical, and long-term work of forest stewardship. Tapper is the author of *How to Love a Forest: The Bittersweet Work of Tending a Changing World*, published by Broadleaf Books in 2024 (Tapper 2024) and named the 2025 New England Book Award winner for nonfiction. He framed his talk around the idea that loving forests does not always mean leaving them alone. Instead, true care often requires difficult, nuanced, and ongoing work. As Tapper explained, “the deepest and most profound form of love” is not found in simple choices between action and inaction, but in loving ecosystems enough “to do what’s necessary to care for them.” Tapper used the concept of stewardship to describe an ongoing responsibility to forests, ecosystems, and future generations. He emphasized that stewardship is not a one-time act, but a continuing process of care.

Reflecting on his own work tending an orchard at Bear Island, his 175-acre working forest in Vermont, Tapper said: “planting the tree was the easiest part. The most radical acts of care and compassion are not when we just conserve this forest, protect it, or plant this tree, but everything that comes after that.” He connected this directly to conservation work, noting that there are “no finish lines” in ecosystem stewardship, and that the difficult work is often the ongoing maintenance, adaptation, and care that follows protection, restoration, and/or planting.

Tapper also described his own path into forestry as a process of “deepening.” He did not begin as someone who always knew he would work in forests, but through wilderness guiding, forestry coursework, dendrology, birding, and close observation, he came to see forests as layered, dynamic, and full of interrelated stories; that shift changed his understanding of forests from something pristine and separate from people to ecosystems shaped by history, recovery, climate change, invasive species, deer overpopulation, fragmentation, and other pressures. For Tapper, inviting others into that deeper understanding is a key part of stewardship. He argued that public support does not come only from explaining management actions, but from helping people see the beauty, complexity, and interdependence of the living world. As he put it, “all we got to do to get people to understand how beautiful they are is to get them to come a little deeper.”



Figure 6. Ethan Tapper, forester, author, and digital storyteller, delivered the lunchtime keynote on forest stewardship during the workshop. Photo courtesy of Ethan Tapper; used with permission.

A major theme of Tapper's talk was communication, trust, and the need to reach people through shared values as well as sound science. He noted that conservation professionals often have to ask the public to accept complex or actions that seem counterintuitive, such as cutting trees, controlling invasive plants, using herbicides, or managing deer populations. Because most people do not have the same level of technical understanding as the people doing this work, Tapper argued that trust is essential to the success of managing our forests. "The way that we build that trust, I think, most powerfully, is not through beating them over the head with a bunch of facts... it's through showing them who we are." Tapper encouraged conservation professionals to tell the public why they care, how they came to the work, and what values guide their decisions.

Tapper closed with a hopeful message about the language of restoration. He encouraged participants to describe stewardship not only in terms of loss, prevention, or what must be removed, but in terms of what can be built. "It can be about creating abundance, creating a better world," he said. Even when describing forest management actions such as cutting trees, Tapper said he tries to focus on the forest being created: one that is more abundant, more full of life, more reflective of long-standing ecological communities, and more able to thrive in the future. His closing message was that hope is more powerful than fear. Rather than only telling people what has been lost, Tapper encouraged conservation professionals to show them "how much is still here," how much remains, and overall, how much better the future can be if people are invited into the work of stewardship.

Final Conceptual Model Integrating Participant Feedback

The Steering Committee used the conceptual model to synthesize workshop findings for the first two workshop objectives: to identify major stressors to forest health in the Chesapeake Bay watershed and evaluate how the stressors affect forest resilience and water quality. Workshop participants suggested both relatively minor additions and modifications, as well as larger structural revisions to the original conceptual model throughout the workshop. Minor suggestions included adding stressors, more clearly illustrating how social and economic factors influence forest health and removing “inadequate forest management” as a stressor to improve clarity. Additional stressors referenced during the discussions and breakouts included changing fire regimes, trash dumping and high-impact recreation on public lands, salinization in coastal areas, and the current and historical impacts of acid deposition, which has impacted forest soils, tree growth/survival and water quality. Several of these modifications were incorporated into the conceptual model during the workshop and shared with participants (Figure 7).

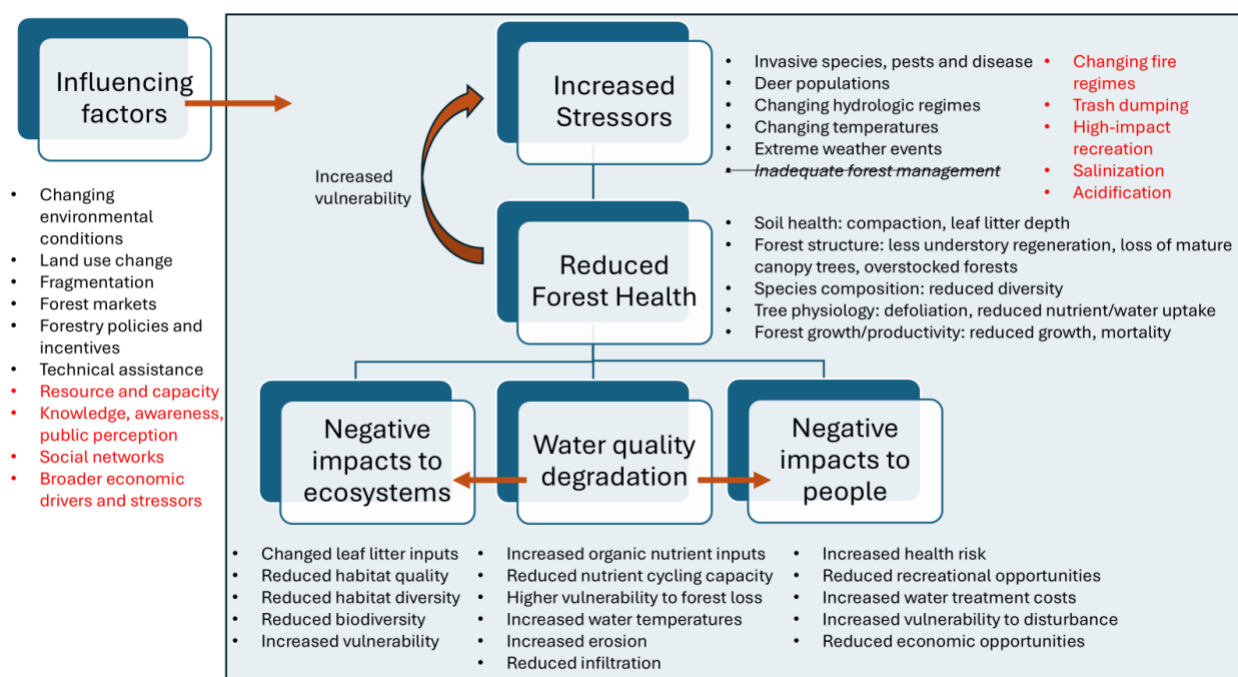


Figure 7. Initial revised conceptual model. Additions suggested by workshop participants are shown in red.

However, several more substantive revisions could not be incorporated during the workshop, including separating influencing factors outside the sphere of management control from enabling conditions or management actions that could be supported through targeted strategies. Participants also suggested reframing the conceptual model in a more positive way. Rather than emphasizing how increasing stressors reduce forest health and degrade water quality, the model could instead highlight how reducing stressors and supporting active management improve forest health, resilience, and water quality outcomes. The keynote presentation reinforced this idea, emphasizing that positive framing can be more effective in encouraging public engagement and stewardship.

Following the workshop, the Steering Committee developed additional iterations of the conceptual model with varying levels of detail. Ultimately, the group converged on a model that simplifies the mechanistic pathways linking stressors, forest health, water quality, people, and ecosystems while providing additional detail on opportunities to advance forest conservation (Figure 8). The enabling conditions and land management actions detailed in the “action arena” align closely with the recommendations that emerged from the workshop. The enabling conditions influence the extent to which land management actions can be implemented on the landscape. A more detailed version of the conceptual model, including mechanistic pathways and influencing factors, is provided in Appendix F.

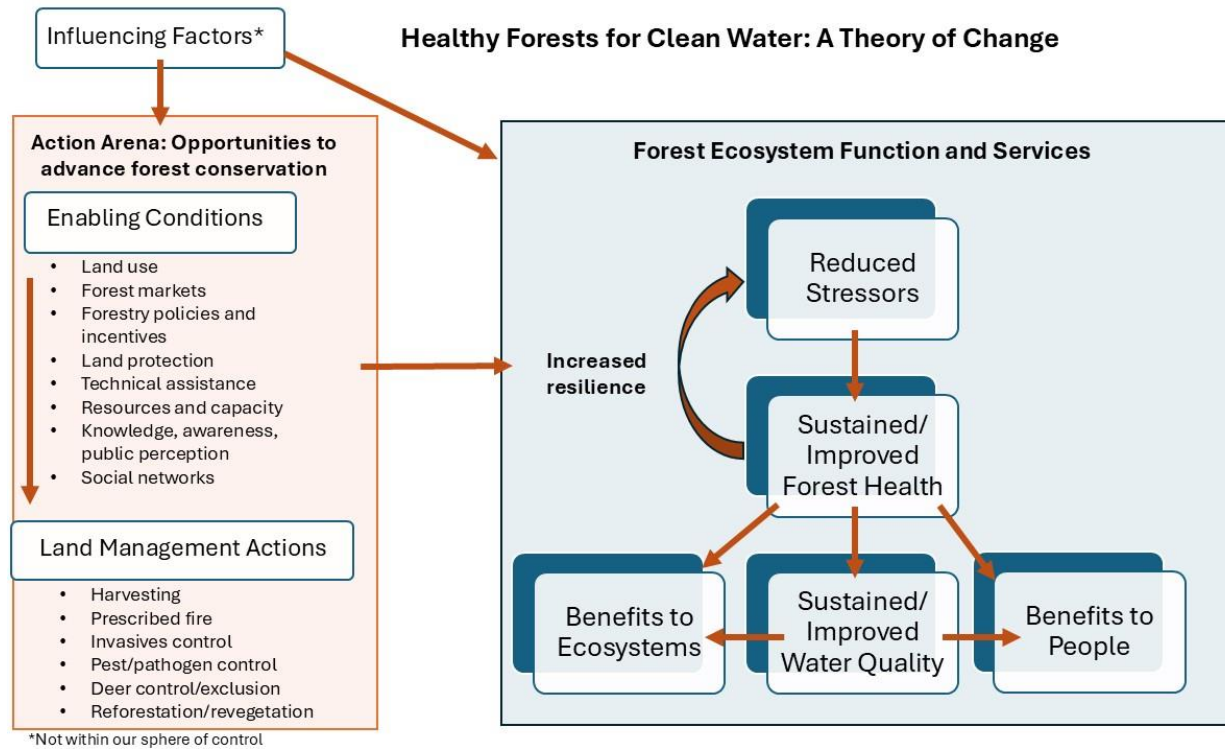


Figure 8. Final Conceptual Model.

Recommendations

The recommendations were developed through breakout discussions, report-outs, and a final synthesis discussion. To address the workshop's third objective, participants identified actionable strategies for managing priority stressors and promoting forest conservation, including key barriers and enabling conditions. During a break, participants used colored dots to mark priority recommendations (refer to Appendix E).

The steering committee developed a set of synthesized participant recommendations focusing on messaging & communication, networks, policy, capacity, markets, funding models, research needs, and land management actions. High-level recommendations are coupled with a set of specific actions that could be undertaken by the Forestry Workgroup and its partners, including state forestry agencies, non-profits, universities, federal agencies, and other partners. Recognizing that improved water quality in the Chesapeake Bay depends on sustaining the health of existing forests, the workshop participants identified the following strategies to strengthen forest resilience, manage threats, and promote forest conservation in the Chesapeake Bay watershed.

Messaging & Communication

Collaborate with the Chesapeake Bay Program's Strategic Engagement Team to develop and deploy a unified, positive, and compelling forest conservation communication strategy that positions healthy, resilient forests as essential to Bay restoration and rural economies, using consistent messaging amplified through partners and credible messengers.

Specific actions:

- Establish a positive and consistent definition of healthy forests as resilient forests.
- Strengthen the narrative linking forest markets and rural economies with environmental outcomes and Bay health ("Healthy Markets= Healthy Forests = Healthy Bay")
- Identify a small set of simple, memorable core messages (e.g., management and markets enable restoration and resilience) that will resonate with the public and educate people about the important role of forest management in Bay restoration.
- Use coordinated, partner-driven messaging and branding to increase demand for sustainable, regionally produced wood products.
- Invest in communications capacity, including trusted figures with reach beyond traditional forestry audiences.

Networks

Strengthen and connect local and regional forestry networks across the watershed, leveraging existing collaborative structures to support shared learning, rapid response, and more coordinated stewardship.

Specific actions:

- Map and visualize networks so local partners understand how their work fits into the broader, Bay-wide restoration mission.

- Support and elevate existing forestry networks rather than recreating them, including engaging existing urban and rural networks that have not historically engaged with the Chesapeake Bay Program.
- Grow regional/watershed-wide forest stewardship networks for communication, peer-to-peer learning, threat alerts, and joint action, leveraging an increasing focus on using collaborative restoration models through grant programs like the [Innovative Nutrient and Sediment Reduction](#) (INSR) grants administered through the National Fish and Wildlife Foundation (NFWF).
- Build on the Chesapeake Bay Program’s ability to serve as a convener for the “network of networks” to facilitate communication and strategic, watershed-wide coordination around forest conservation.

Policy

Identify policy and enabling conditions that may remove barriers to forest management, reduce perverse incentives, and support active, sustainable forest management across jurisdictions.

Specific actions:

- Identify perverse incentives in cost share programs and regulatory barriers that discourage desired management practices in favor of higher-intensity management, unintentionally incentivize forest conversion, or limit habitat restoration activities in riparian areas or floodplains.
- Engage municipal and county governments through Chesapeake Bay Program local government groups to identify local regulatory barriers to sustainable forest management, identify opportunities to limit further parcelization and fragmentation in priority areas, and workshop potential solutions.
- Leverage current federal emphasis on active management and rural jobs to pursue lowering administrative hurdles for participation in cost-share programs.
- Promote cross-agency coordination between state agencies (energy, planning, transportation, environment).
- Identify and share models of “good neighbor” setback policies that protect forest landowners from development liabilities along shared boundaries.
- Identify policy changes that will support the development of additional outlets for woody biomass, including working with EPA to adjust the Renewable Fuel Standard so woody biomass could be utilized.

Markets

Support development of diverse and sustainable forest product markets as a foundational driver of forest health, rural economies, and Bay restoration, including new market pathways for low-value woody material.

Specific actions:

- Reinforce the link between healthy markets, healthy forests, and a healthy Chesapeake Bay in the forest conservation communications strategy.
- Pursue opportunities for the Chesapeake Bay Program to work with the forest products industry to support market development as a key strategy for forest conservation in the Healthy Forests and Trees Management Strategy and Workplan.

- Identify marketing models, such as the “[Real American Hardwood](#)” and “[American Softwoods](#)” marketing campaigns, that would be suitable for adaptation for Chesapeake Bay forest products branding and marketing.
- Collaborate on multi-state endorsement for low-grade wood markets (e.g., biochar, renewable fuels, small-diameter wood) and nontraditional supply chains, including urban wood reuse.
- Revisit opportunities for the Chesapeake Bay Program to credit biochar for its water quality benefits as a mechanism for increasing demand for biochar production.

Capacity

Build long-term, cross-sector capacity for forest management by expanding the regional forestry workforce, increasing the availability of technical assistance, and sharing expertise to effectively scale forest management and restoration in the watershed.

Specific actions:

- Engage the forest products industry in developing a capacity building initiative targeting the services needed for changing and emerging markets.
- Increase contractor capacity by strengthening forest products markets and expanding the use of longer-term or bundled contracts to provide more certainty to contractors so they can scale their equipment and workforce.
- Expand technical service capacity across agencies, nongovernmental organizations (NGOs), consulting foresters, and industry by replicating successful technical training programs (e.g., those developed by the PA Hardwood Council), expanding peer-to-peer education models, and exploring development of watershed-wide forestry educational opportunities.
- Use the Chesapeake Bay Program’s Forestry Workgroup as a hub for knowledge and expertise sharing across government, nonprofits, and academia.
- Work with the Workforce Workgroup to better leverage existing capacity to support forest management activities, including incentivizing arborists, loggers and other green industry professionals to diversify their offerings, for example to support invasive plant management and timber stand improvement practices on smaller acreage parcels.

Funding Models

Develop diversified, accessible, and scalable funding models that enable forest conservation and management, especially for small acreage landowners, and support long-term stewardship, maintenance, and innovation.

Specific actions:

- Identify funding sources for Chesapeake Bay restoration that could be utilized for forest conservation under the Healthy Forests & Trees goals and work with funders to adapt their Request for Proposals (RFPs) or grant guidance as needed to clarify eligible practices.
- Improve cost-share programs to better engage small acreage woodland owners, reduce minimum acreage thresholds and simplify participation, reducing the number of required steps and waitlists for participation.

- Where possible, increase grant timelines to ensure funding is available for longer-term maintenance including invasive species control and for conducting pre- and post-treatment monitoring.
- Improve accessibility and utilization of U.S. Forest Service's [Wood Innovations Grant program](#) by enabling mobile equipment purchases and leases and prioritizing projects in the Chesapeake Bay watershed.
- Expand partnerships with environmental and natural resources groups and businesses to diversify funding streams and the activities that can be supported.
- Explore more collaborative approaches to ensure funding is being strategically utilized to support market development, networks, and capacity-building, in addition to on-the-ground implementation, bundling management activities across multiple properties where needed to achieve economies of scale.

Research Needs

Invest in targeted research that improves understanding of forest condition, ecological processes, and management impacts to better guide Chesapeake Bay Program decisions.

Specific actions

- Conduct a Chesapeake Forest Condition Assessment by leveraging [FIA data](#) to establish baselines, assess management impacts, and communicate results using the [Pennsylvania Forest Assessment Project](#) as a model.
- Study how shifting phenology and productivity affects hydrology and nutrient cycling to better understand how changing environmental conditions will influence water quality in forested ecosystems.
- Increase understanding of how forest degradation and different successional stages influence water quality including how invasive species impact soil processes and nutrient cycling in buffers and streams.
- Short-term action: Conduct a meta-analysis of existing research to determine whether there is sufficient evidence to recommend distinguishing between healthy and unhealthy forests as separate land uses with distinct loading rates in the Chesapeake Bay watershed model.

Land Management Actions

Adopt an adaptive, landscape-scale forest management approach that focuses on resilience, long-term planning, species diversity, and connectivity, paired with consistent maintenance and invasive species control.

Specific actions:

- Manage for the stressors we can control (including deer population management, invasive plant species, management of species composition, density and wildlife habitat) to increase resilience to the stressors we cannot control (including flooding, salt water intrusion, wet/dry extremes and temperature extremes).
- Conduct stewardship at ecologically meaningful scales, seeking to reduce fragmentation and maintain a diversity of age classes across the landscape (e.g., the Dynamic Forest Restoration Block approach described in Fiss et al. 2025).
- Use long-term restoration planning to ensure management is paired with the needed invasive species control and follow-up maintenance and consider where

novel/replacement ecosystems may effectively restore function in the short-term while building diversity for the long term.

- When selecting species for reforestation, consider adaptation to future conditions, species suitability for various microclimates, mixing ecotypes, and increasing diversity across the landscape.
- Incentivize reforestation between large forest blocks to improve connectivity.

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Appendix A: Workshop Agenda



Chesapeake Bay Program's (CBP)
Scientific and Technical Advisory Committee (STAC) Workshop
**Healthy Forests: Proactive Strategies for Managing
Threats and Promoting Conservation**
February 24-25th, 2026
The Delaplaine Arts Center
Frederick, Maryland

****Exact Times Are Subject to Change****

This meeting will be recorded to assure the accuracy of meeting notes.

Workshop Objective: Participants will identify and discuss major ecological stressors to forest health in the Chesapeake Bay watershed, with a focus on which stressors feel most urgent, how stressors interact, and where key knowledge gaps limit action. The discussion will also explicitly connect forest health to downstream water quality outcomes, including nutrient and sediment runoff, stream temperature, and the ability of forests and riparian buffers to protect and restore aquatic habitat.

- **Day 1 Objective:** Develop a shared picture of the major stressors affecting forest health, how they compound, and why they matter not only for forests but also for Chesapeake Bay water quality and living resources.
- **Day 2 Objective:** Develop and prioritize actionable recommendations for proactive forest management and stewardship, distinguishing short-term from long-term strategies.

Tuesday, February 24, 2026

- | | |
|-----------------|--|
| 8:45 am | Coffee & Light Breakfast (Provided) |
| 9:15 am | Welcome and Introductions – Katie Brownson (USFS), Craig Highfield (Alliance)
Workshop Co-Chairs will kick off the workshop with a welcome and introductions and outline the objectives of the workshop. Summary of the new Forestry goals in the <u>Bay Watershed Agreement</u> . |
| 9:45 am | Conceptual Model Discussion – Matt Baker (UMBC), Michelle Katoski (USGS)
Steering Committee members will introduce a draft model connecting stressors to forest health, water quality, and Bay outcomes. Participants are requested to provide feedback and refinement. |
| 10:00 am | Level-Setting Plenary: Major Ecological Stressors to Forest Health
<i>Facilitator: Katie Brownson (USFS).</i> Experts will present on important ecological stressors affecting forest health in the Chesapeake Bay watershed (e.g., climate change, land use, invasive species, pests/disease) and the management relevance of these stressors. <ul style="list-style-type: none">• <i>Chris Hayes (USDA FS)</i>• <i>Matt Hurd (MD DNR FS)</i>• <i>Jill Rose (PA DCNR)</i> |
| 11:00 am | 20-minute Break |

11:20 am	<p>Panel: People and Forests <i>Facilitator: Sarah Johnson (PA DCNR Bureau of Forestry).</i> Panelists will talk about the roles of people (e.g., landowners, community groups, stewardship programs, local governments) in forest management.</p> <ul style="list-style-type: none"> • <i>Allyson Brownlee Muth (Center for Private Forests, PSU)</i> • <i>Isaac Hametz (The Nature Conservancy), Michele Romolini (Loyola Marymount University)</i> • <i>Jenny Willoughby (City of Frederick)</i> • <i>Jon Geyer (Hardwood Development Council)</i>
12:20 pm	Lunch (provided)
1:20 pm	<p>Panel: Lessons from Practice <i>Facilitator: Craig Highfield (Alliance).</i> Case studies of proactive forest management that will help inform the strategy moving forward.</p> <ul style="list-style-type: none"> • <i>Kyle Myers (PA DCNR), Roy Brubaker (PA DCNR)</i> • <i>Nancy Baker (Land steward, landowner)</i> • <i>Matt Pienkowski (Woodland Stewardship Network, the Alliance)</i> • <i>Dave Mausel (USFS)</i>
2:20 pm	20-minute Break
2:40 pm	<p>Breakout Groups: Prioritizing threats to forest health and water quality Participants will identify priority stressors and discuss how stressors interact, with attention to implications for both forest health and downstream water quality. Participants will rank each stressor on a 1–5 scale for importance/urgency, current understanding, and ability to influence (tractability).</p> <ul style="list-style-type: none"> • Which stressors are most urgent for maintaining forest health and for maintaining water quality, and why • Where are key knowledge gaps, including around stressor interactions and water quality implications
4:00 pm	Breakout Groups Report-Out
4:30 pm	<p>Wrap-Up Discussion: Key Takeaways from Day 1 <i>Facilitated by the workshop steering committee.</i></p>
4:45 pm	Recess
5:40 pm	Optional Dinner (offsite)

Wednesday, February 25, 2026

8:45 am	Coffee & Light Breakfast (Provided)
9:00 am	Recap of Day 1 & Framing for Day 2 <i>Facilitated by the workshop steering committee.</i>
9:15 am	Lightning Talks / Panel: Tools and Approaches for Scaling Forest Management <i>Facilitator: Chris Hayes (USFS).</i> Lightning talks highlighting practical tools and policies that have supported proactive forest management. <ul style="list-style-type: none">• <i>Guy Dunkle (Foundation for Sustainable Forests)</i>• <i>Jeff Larkin (IUP/ABC)</i>• <i>Sabina Dhungana (VA DOF)</i>• <i>Amy Shields (Allegheny Hardwoods Utilization Group, Allegheny Forest Health Collaborative)</i>• <i>Phyllis Joris (Neighbor Space)</i>
10:30 am	Breakout Groups: Strategies for managing threats and promoting conservation Participants will discuss actionable strategies that address the priority stressors (and their water quality implications), including what can be implemented in the short term versus what requires longer-term effort. <ul style="list-style-type: none">• What proactive management strategies can address the priority stressors, and at what scale do they work (project/local/state/basin-wide)• What enables implementation (key implementers) and what barriers or gaps limit action (capacity, policy, funding, data, decision-support needs)
11:30 am	20-minute Break
11:50 am	Breakout Groups Report-Out
12:30 pm	Lunch Keynote: Inspiring Forest Futures – Ethan Tapper Ethan Tapper is a Vermont-based forester and the author of <i>How to Love a Forest: The Bittersweet Work of Tending a Changing World</i> . Drawing on years of on-the-ground forest stewardship, Ethan offers a practical and hopeful perspective on what it really means to care for forests in a time of change, including the hard, “bittersweet” decisions required to protect and restore resilient forest landscapes.
2:00 pm	Group Discussion: Synthesis and Next Steps <i>Facilitated by the Workshop Steering Committee.</i> This session will summarize key takeaways from both days and focus on identifying three priority areas for follow-up.
3:00 pm	Closing Remarks and Workshop Conclusion – Katie Brownson (USFS), Craig Highfield (Alliance)
3:15 pm	Adjourn

Appendix B: Workshop Participants

Name	Affiliation	Email
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Appendix D: Summary of Day 1 Breakout Group Responses

Missing key stressors

- Public lands and forest operations
 - Resource and capacity constraints as a limiting condition that shapes what stressors can be addressed and how quickly issues can escalate when deferred
 - Interactions between ecological stressors and implementation constraints (staffing/funding) as a key “systems” gap in translating knowledge into outcomes at scale.
- Urban forest conservation
 - Development pressure and the “highest and best use” framing that favors land conversion
 - Dumping in woodland areas and in newly cleared spaces; Infrastructure maintenance leading to clearing and new access/fragmentation into core woodlands
 - Deforestation tied to stream restoration approaches and MS4 credit incentives that reward linear feet and can encourage clearing mature forest for floodplain reconnection work
- Forest conservation research
 - Salinization raised as an underrepresented stressor
 - Forest age/tree age and land use history as key context drivers – forest mapping (USGS product)
 - Stressor gradients (varying intensity/cumulative burden) suggested as an organizing concept
 - Separate conceptual models by physiography proposed to better reflect different stressor regimes
 - Beaver
- Invasive plants, pests, and disease management
 - Landowner awareness and engagement surfaced as central (sometimes missing from ecological-only conceptualizations) – outreach, consistent messaging, markets, operators
 - *any stressor that causes a regression, crisis, is the most important
- Forest markets and products
 - Public perception of active forest management as a major barrier to action
 - Economy of scale constraints driven by parcelization and shrinking forest blocks
 - Broader economic conditions shaping feasibility (interest rates, markets, trade)
 - Inadequate management should be split into many categories
- Private lands, landowner assistance, stewardship
 - Human dimensions and individual landowner decisions as central drivers
 - Recreational pressure and trespassing/community change pressures
 - Fragmentation and land use change
- Land conservation
 - Forestland conversion highlighted as a major stressor
 - “Ignorance” or lack of understanding shaping decisions and priorities

Most urgent stressors for forest health

- Public lands and forest operations
 - Invasive species, with the qualifier that they are only “addressable” with sustained follow-up and active management rather than one-time restoration.
 - “Inadequate forest management” as an umbrella issue, tied less to knowledge and more to capacity and ability to implement at scale
- Urban forest conservation
 - Resource allocation and ongoing management at scale as a primary constraint in urban contexts
 - Fragmented governance and siloing across jurisdictions (local/state/federal; agencies within local governments) limiting coordinated action
 - Contractor capacity and procurement challenges for skilled urban forestry work
- Forest conservation research
 - Regeneration failure framed as fundamental
 - Deer browsing highlighted as a primary driver
 - Pests also highlighted as a major driver
 - Where are particular pests causing regeneration?
- Invasive plants, pests, and disease management
 - Landowner engagement and ability to implement actions
 - Deer as an interacting amplifier in many systems
 - Lack of diversity in species, landscape, mosaic structure, genetics
- Forest markets and products (in order)
 - Economic stressors → lack of market growth and incentive
 - Economic drivers viewed as upstream constraints on feasible management
 - Public perception shaping whether active management can occur
 - Economy of scale constraints limiting management approaches
- Private lands, landowner assistance, stewardship
 - Invasive species management as a property-scale stressor that landowners can see and act on
 - Deer as a frequent interacting amplifier
 - Condition framing: stable versus unstable systems shaping which actions make sense (proactive versus reactive versus stabilization)
- Land conservation
 - Lack of forest management as a dominant concern, with emphasis on prioritizing opportunities on state/public lands where scale is possible

Most urgent stressors for water quality

- Public lands and forest operations
 - Invasive species and degraded riparian conditions implied as key concerns, but the emphasis remained on feasibility and scalability of management rather than ranking specific pollutants or pathways.
- Urban forest conservation
 - Urban management and restoration decisions that remove existing mature forest cover in the course of stormwater/stream projects (especially where incentives are misaligned)

- Ongoing maintenance constraints and governance fragmentation that impede consistent riparian and forest management
- Forest conservation research
 - Inadequate forest management; management on foreign lands
 - N leaching through spongey moth defoliation
 - Regeneration crisis – biodiversity, pests, deer browsing
- Invasive plants, pests, and disease management
 - Deer, insect defoliators, extreme weather, land use change, and land management quality (including Best Management Practice (BMP) effectiveness) as key linked factors
 - Extreme weather as a compounding driver
- Forest markets and products
 - Place-based framing: riparian buffers and bayside properties viewed as particularly influential, with strong geographic variability across the watershed
 - loss of a buffer, marsh migration squeezes forestry land
- Private lands, landowner assistance, stewardship
 - Human impacts and infrastructure pressures viewed as capable of outmatching forest-based gains
- Land conservation
 - Long-term management and protection decisions shaping forest cover and continuity, with implied importance of riparian protection and maintained forest condition (less explicit ranking than the management emphasis)

Research priorities for water quality

- Public lands and forest operations
 - Monitoring designed to detect whether forest management/restoration actions measurably affect downstream outcomes over time.
- Urban forest conservation
 - Better quantify tradeoffs and outcomes when mature forest is removed for stream restoration and stormwater compliance (including short- versus long-term water quality effects)
- Forest conservation research
 - Climate change impacts on the hydrologic effectiveness of forests – changing hydrodynamic regimes and discharge
 - growing season, plant physiology, evapotranspiration
- Invasive plants, pests, and disease management
 - Streamside vegetation and plant-community influence on water quality, including invasive plant impacts
 - Large Woody Debris conditions
 - Difference in outcomes when we implement them versus mother nature
 - Stream temperature changes
- Forest markets and products
 - Forest-to-water connection viewed as relatively well understood; additional research emphasis may depend on gaps emerging from new work or better translation/operationalization
- Private lands, landowner assistance, stewardship

- Work that clarifies where forest interventions can meaningfully affect water outcomes versus where broader human-system changes are required
- Land conservation
 - Evidence base and communication of water quality benefits of managed versus unmanaged forests (and how to package that for CBP use)
 - Long-term effects of invasives on hydrology and soil biota, and how warming affects invasive plants/pathogens

Monitoring capabilities and opportunities

- Public lands and forest operations
 - A recurring gap: interventions without baselines or long-term monitoring limit learning and adaptive management.
 - Build monitoring into projects as a standard pairing (intervention + evaluation).
- Urban forest conservation
 - Urban forests as a venue to engage many people and build public/political support for forest and water quality priorities
 - Potential use of targeted monitoring to evaluate whether invasive plant control is translating to desired ecological outcomes
- Forest conservation research
 - Strong interest in modern tools: AI-enabled approaches, Drones, LiDAR, High-resolution canopy mapping
 - Insufficient post-treatment monitoring
- Invasive plants, pests, and disease management
 - “managing for resilience,” a need for indicators that detect early declines and system shifts rather than only tracking single species
 - What does funding prioritize? The action? The research? Both are needed.
- Forest markets and products
 - Need to figure out how to count nontraditional contributions to outcomes (we understand how to measure easements but not other conservation plans)
 - Markets (commercial) have the potential to touch everyone (heavy hitters, philanthropic, financial markets)
 - need to have outcomes that capture both
 - Drones and modern monitoring tools suggested as a way to generate decision-relevant data at the property level
 - Need for diverse metrics aligned with different actors and objectives across supply chains
- Private lands, landowner assistance, stewardship
 - Should pair interventions with longer-term assessment, including social and ecological outcomes
- Land conservation
 - Implicit need for long-term tracking of managed versus unmanaged outcomes and invasive-driven changes to hydrology and soils
 - Should have a better understanding of the connection between forest management plans/estimating efficiencies of forest health. Envision the state management plans, including forest management plans, as an approved BMP credit. Similar to Nutrient Management Plans for Agricultural lands.

- Perceptual shift: managed forests provide more water quality benefits than un-managed forests

Multiple stressor interactions and knowledge gaps

- Urban forest conservation
 - Governance fragmentation interacting with limited capacity, creating a reinforcing loop where even good programs struggle to sustain management
 - Network connectivity as a determinant of success: cooperative networks function as multipliers; disconnected networks function as stressors
- Forest conservation research
 - Need to represent interactions differently by physiography and land use history, suggesting “one model for the watershed” may be too coarse
- Invasive plants, pests, and disease management
 - Interactions among deer pressure, pests/pathogens, and extreme weather implied as core compounding dynamics needing better predictive understanding
 - Predictive modeling – what proxy variable can measure to predict mortality
- Forest markets and products
 - Can we make a menu of stressors feeding into a big outcome?
 - Climate bundle – effects on the ground (parcel scale), predict changes, making results digestible to landowners; outcomes measured and understood by landowners
 - Monetary and trade policies affect other stressors and change possible adaptations
- Forest conservation research
 - “Not a gap, it’s a canyon”
- Private lands, landowner assistance, stewardship
 - Interactions among fragmentation, landowner decision-making, deer pressure, and invasive species implied as a core system needing better intervention design
- Land conservation
 - Long-term invasive impacts plus increasing temperatures as interacting drivers shaping pathogen and invasive plant dynamics
 - Incorporate Indigenous Environmental Knowledge and traditions

Additional themes captured

- Public lands and forest operations
 - Restoration realism and staging: long-term pathway thinking (e.g., stabilization/vegetation establishment as an intermediate step) and “seventh generation” framing.
 - A broader social/cultural thread (including individualism) surfaced but was not fully reported out.
- Urban forest conservation
 - Deer often viewed as tractable (e.g., sharpshooting/bow hunting), but time-lag and outcome uncertainty remain
 - Diversification/planting strategies discussed as possible climate and hydrology adaptation, with uncertainty about effectiveness
- Forest conservation research
 - Management effectiveness

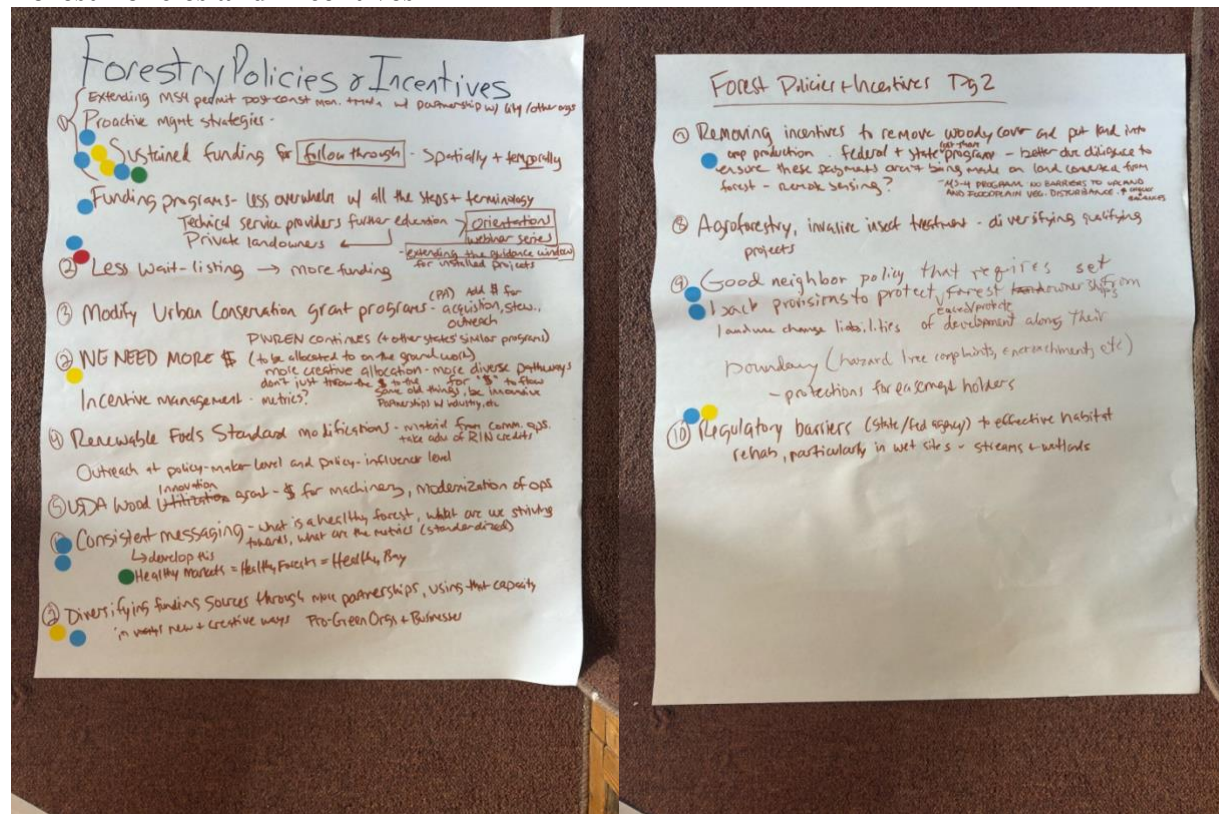
- real outcome assessments
- insufficient post-treatment monitoring, requires pre-treatment data – should be built into the grant process

Takeaways

- Scalability option to leverage the power of networks (urban to rural spaces)
- Manage what we can control to be more resilient for what we cannot control
 - What is within our control to influence?
- Elevating the human dimensions and people component
 - Conceptual model was more ecologically focused
 - People are stressors, but how can they be solutions?

Appendix E: Images of Prioritized Day 2 Breakout Responses

Forest Policies and Incentives



Changing Environmental Conditions

Changing Env. Conditions

long-term
Manage for invasives, maintenance
→ How to fund, incentivize?

How do you prepare for and mitigate extreme weather events?

Share experience w/ climate-adapted plantings 'ASCC (USFS) (USFS)

How does climate change interact w/ pest pressure?
- Role of nurseries in pest/invasive spread

Challenges in climate-adapted species selection -
climate change is not linear; increasing extremes
→ interaction w/ mesophication

Unknown impacts of phenology changes on hydrology +
nutrient dynamics

Need to integrate ecological modeling into Bay model? Can we
incorporate healthy vs. degraded forest into Bay model?

Research need: Impact of invasives → soil processes →
nutrients + hydrology

*Flesh this out, think about updating expert
panel lit review(s)

Changing Enviro Conditions

(2nd group) (Ecosystem Vulnerabilities)

Restore the Floodplain / Ridge Top

Stressor: late frost, wet

Strategy → diversity of species for hot weather; variable
micro-climates
→ age diversity

Utility of Defining "future" resilient forests?

Factor: big variability / micro-climates

Strategy → slow introduction, forest management plans
→ reduce fragmentation / allow for migration

Define Healthy Forest

Short-term strategy → outreach / communication

→ hear from landowners their priorities
- Follow up with Allison about Reentry Scorecard Project

change
challenge

Fragmentation

What is... Fragmentation

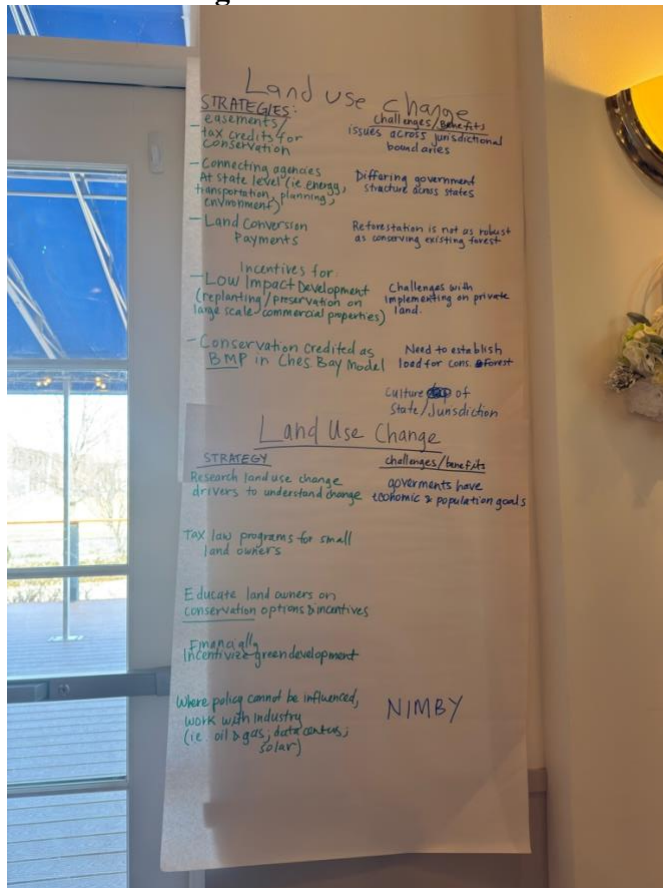
Risks include ↑ invasions, ↑ vulnerability to pests/stress, edge-limited forest mgmt area, interior habitat, overall degradation

1. Get ahead of parcelization + subdivision
 - maintain/support existing ownership ~~but~~ mgmt regimes
 - limit permitting in certain jurisdictions
 - expand local markets for forest products for low value timber

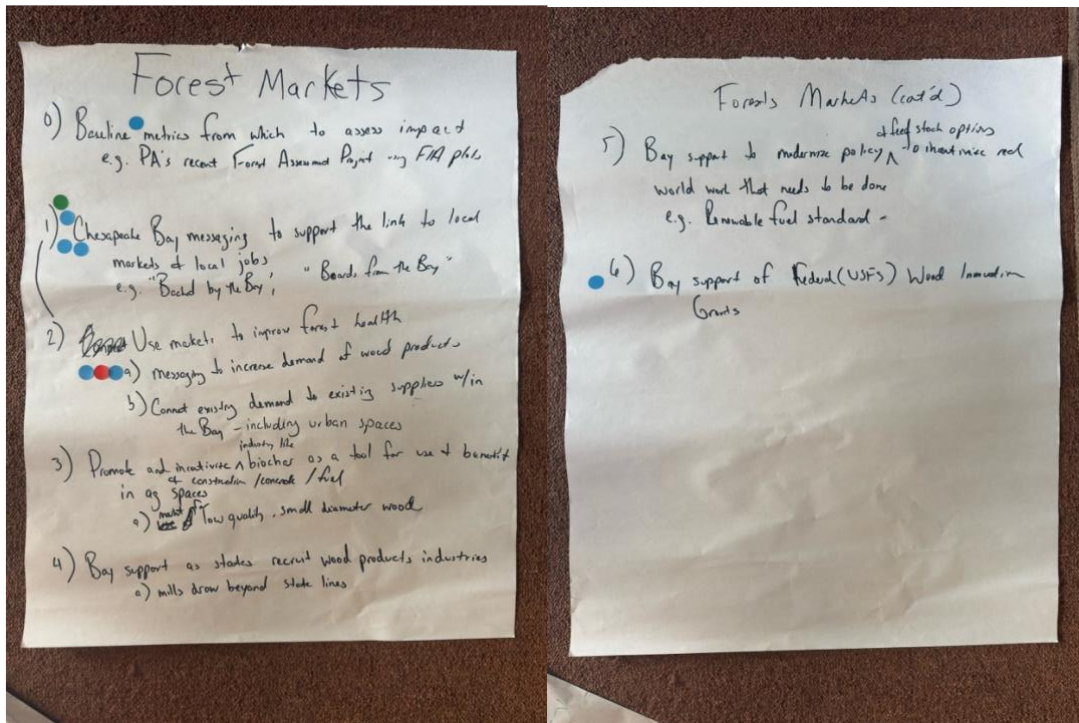
2. Get between parcelization + fragmentation
 - expand local markets
 - distributed markets (reduce transport costs)
 - grow networks of land owners
 - encourage collective payments/cost-share, tiered programs that encourage networking
 - remove/reduce floor for minimum acreage for management payments, provide info re: existing programs

3. Response to fragmentation
 - coop private + tribal, forest legacy plans
 - incentivize reforestation between large forest blocks

Land use Change



Forest Markets



Technical Assistance

Technical Assistance

Stressors:

- Capacity: skills / expertise
invasive management (contractors, academia)
- Solution: peer-to-peer education
 - e.g. Baltimore City
Weed Warriors course
 - Watershed-wide forestry course
 - Watershed/region-wide stewardship network
 - ✓ can be quickly activated in response to threats
 - like Nancy's Woodland Stewards but larger(?)
 - mobilize landowners

- Education (landowners)
- leadership + funding

Need Stewardship Network in place before "emergency".

- ~~share~~ notify members of threats
- collaborate to address threats

Models?

- PRISM
- Woodland Stewards Network
- Use of apps: OnX, iNat

- Capacity to monitor pre- & post-treatment

- longer grant timelines
- contribution agreements for technical assistance

NRCS

- processes exist (?) but are not implemented for long-time monitoring

Need more contractors.

- make it easier for contractors to work on cost-share / grant-funded programs
- lack of qualified professionals

- workforce development

Why are contractors not scaling up?

- liability
- cost
- unpredictability ~~seasonality~~
 - funding
- hard work

Solutions:

- get arborists / loggers to diversify (brush cutting)

↳ as part of Master Logger program

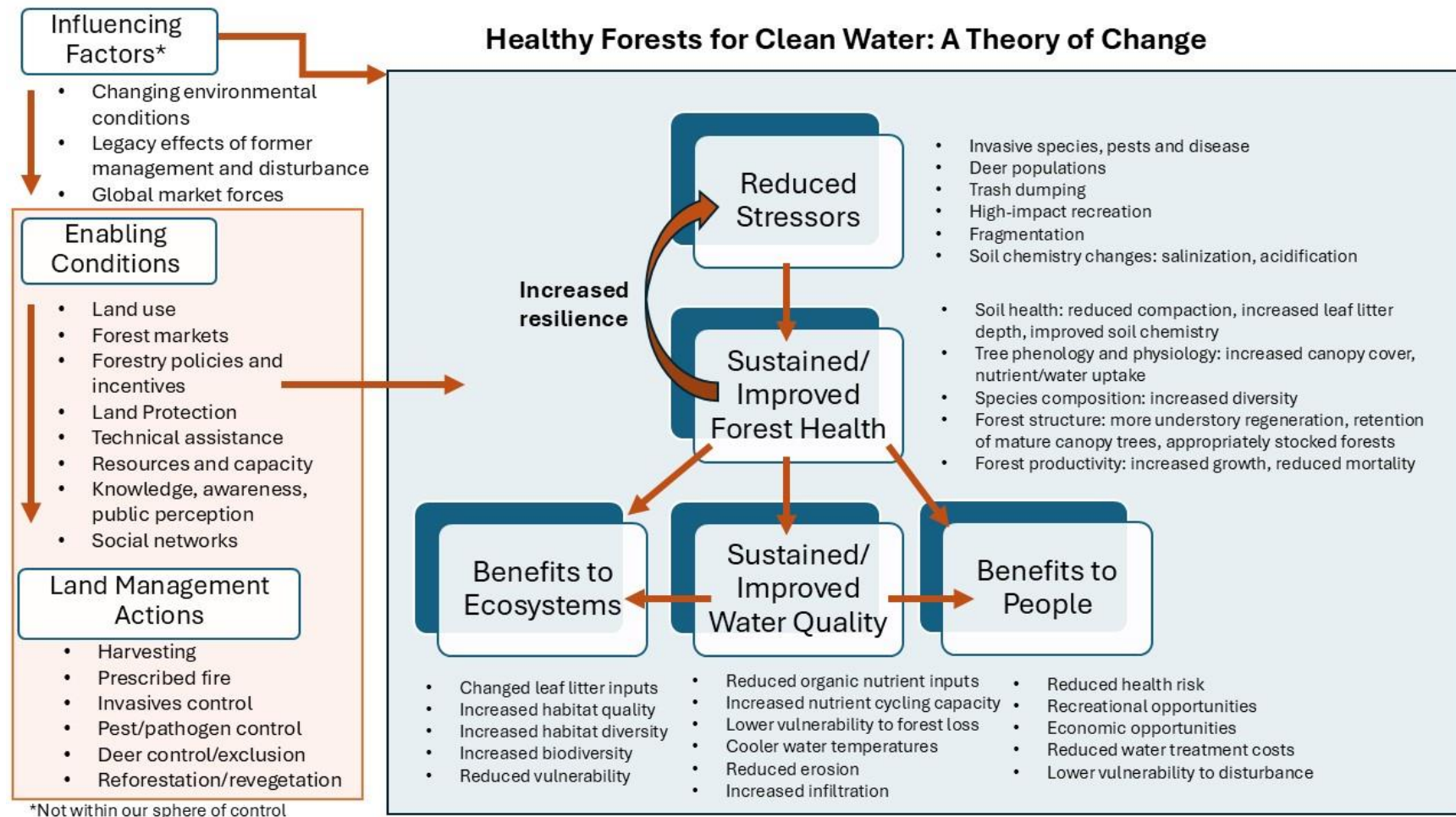
↳ Extension, AHUG, ... ~~may~~ needs to make connections

↓
AHUG packaged all info (equipment,
training \$, ~~SAME~~...) into 1 webinar
series = Continuing Education

→ younger loggers

Urban areas: ^{target} arborists,
landscape professionals

Appendix F: Fully Detailed Final Conceptual Model



Appendix G: Healthy Forests STAC Workshop Supporting Data and Resources

Resources Sheet

USFS Resources

[National Forest Health Conditions and Highlights](#)

[Annual National Forest Health Monitoring Reports](#)

[State Forest Health Highlight Reports](#)

[Insect and Disease Detection Survey](#)

[National Insect & Disease Risk and Hazard Mapping](#) ([Intercreative map for 2024](#))

[Hi-Form Timber Harvest BMP tool](#)

[Forest Resources of the United States, 2022](#) (Resource Planning Act Assessment; Oswalt et al. 2026)

[FIA Forest Snapshot Factsheets by state](#)

[Forests 2 Faucets 2.0](#)

Chesapeake Bay Program Resources

[2025 Chesapeake Bay Watershed Agreement](#)

[State of Chesapeake Forests Storymap](#)

[High-Resolution Land Use/Land Cover and Change Data](#)

[Chesapeake Bay Forest Fragmentation viewer](#)

[Chesapeake Healthy Watersheds Assessment](#)

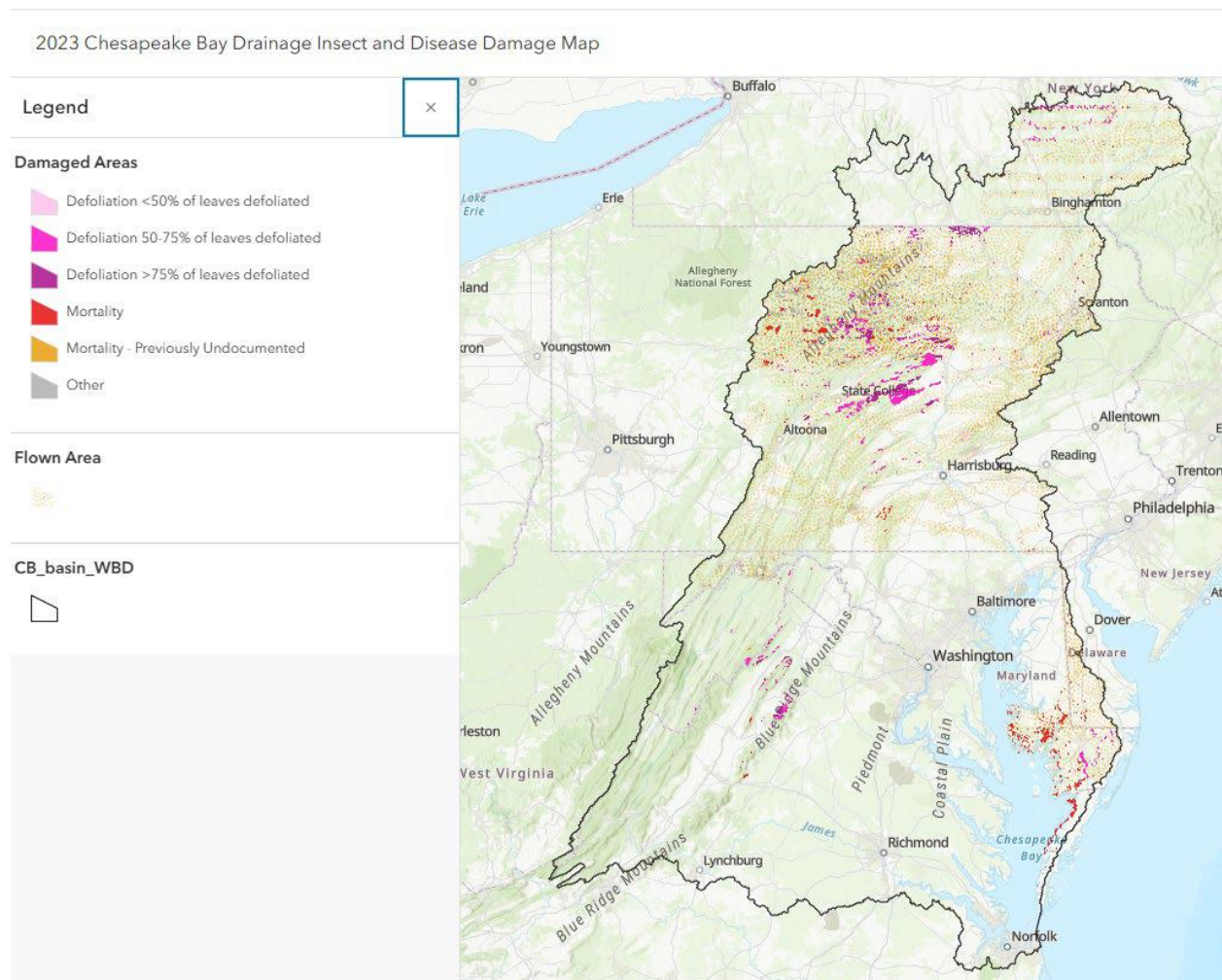
Other resources

<http://www.terrapulse.com/> (compiling a suite of satellite time series indices for CBW)

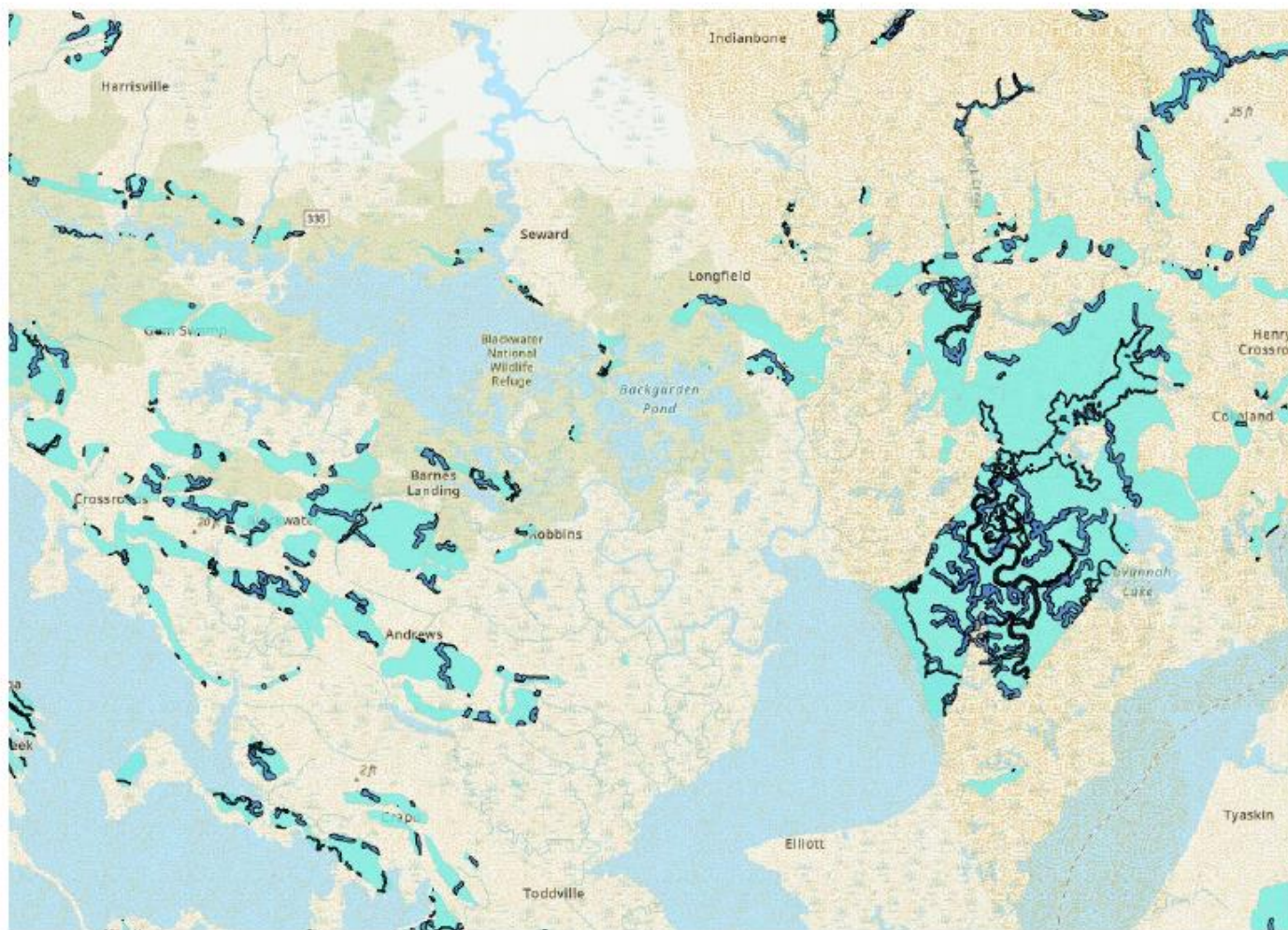
www.nomadiq.earth (option for public outreach and education)

USDA-FS insect and disease survey (IDS) forest damage web maps, Chesapeake Bay watershed (2023)

The USDA-FS in cooperation with states collects an annual survey of large-scale, forest damage. Most of the data are collected through aerial surveys (Aerial Survey Detection, ADS); however, data in some areas are collected through ground surveys that are informed by remote sensing tools (e.g., satellite imagery and change detection products). The USDA-FS does not collect damage data on every acre but does make a concerted effort to document all major disturbances of forested areas. Data from these surveys (final data are known as Insect and Disease Detection Survey, IDS) are available to the public and can be found at the [Insect and Disease Detection Survey website](#). The screenshot below captures a web map created by the USDA-FS to visualize IDS data for the Chesapeake Bay Watershed.

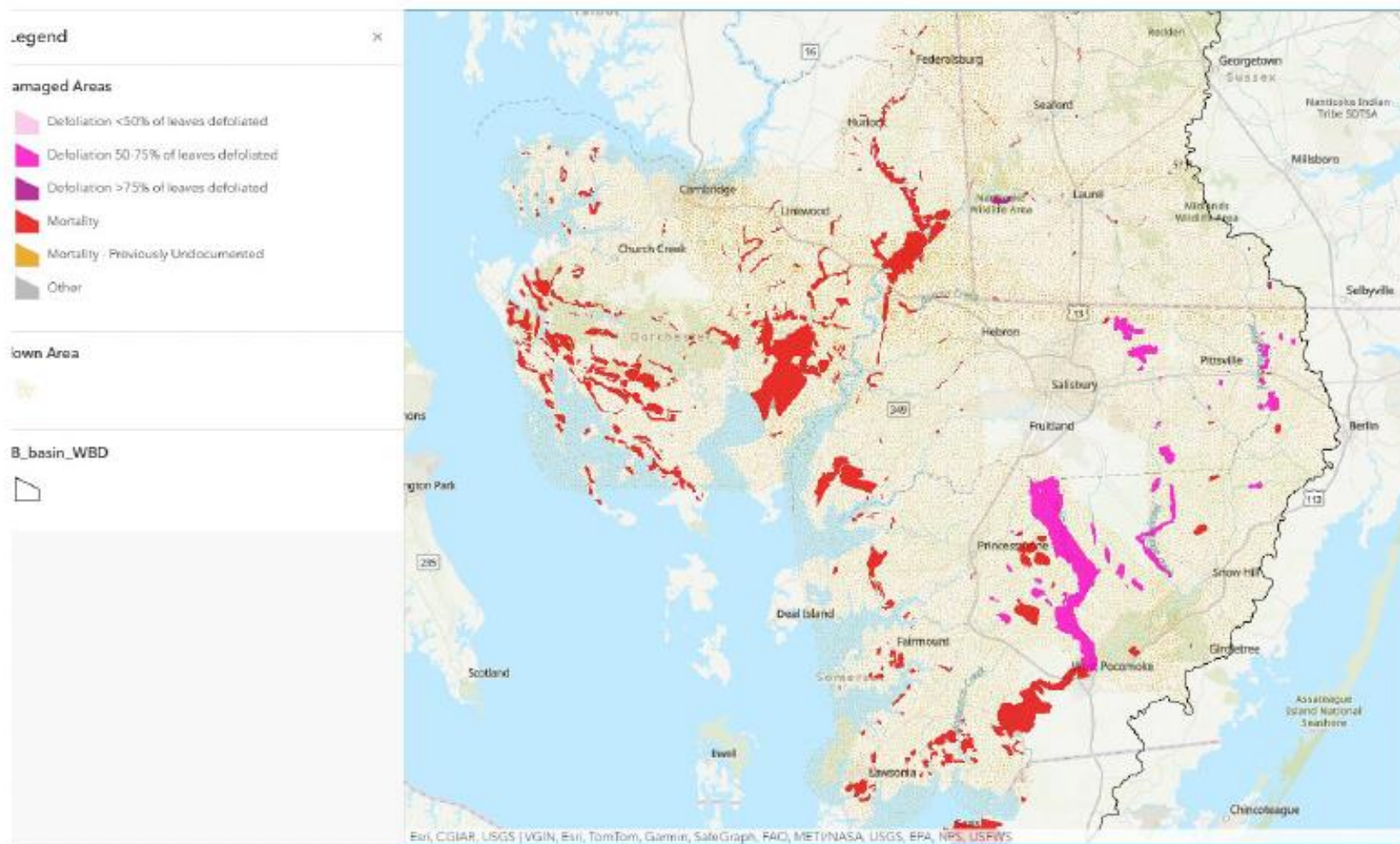


Screenshot of USDA-FS insect and disease survey (IDS) forest damage web map showing the 2023 top five damage types (mortality, defoliation, flagging, etc.) within the Chesapeake Bay watershed using data from the USDA-FS IDS. Base from Esri and its licensors, copyright 2026. Figure provided by Christopher Hayes, USDA-FS.



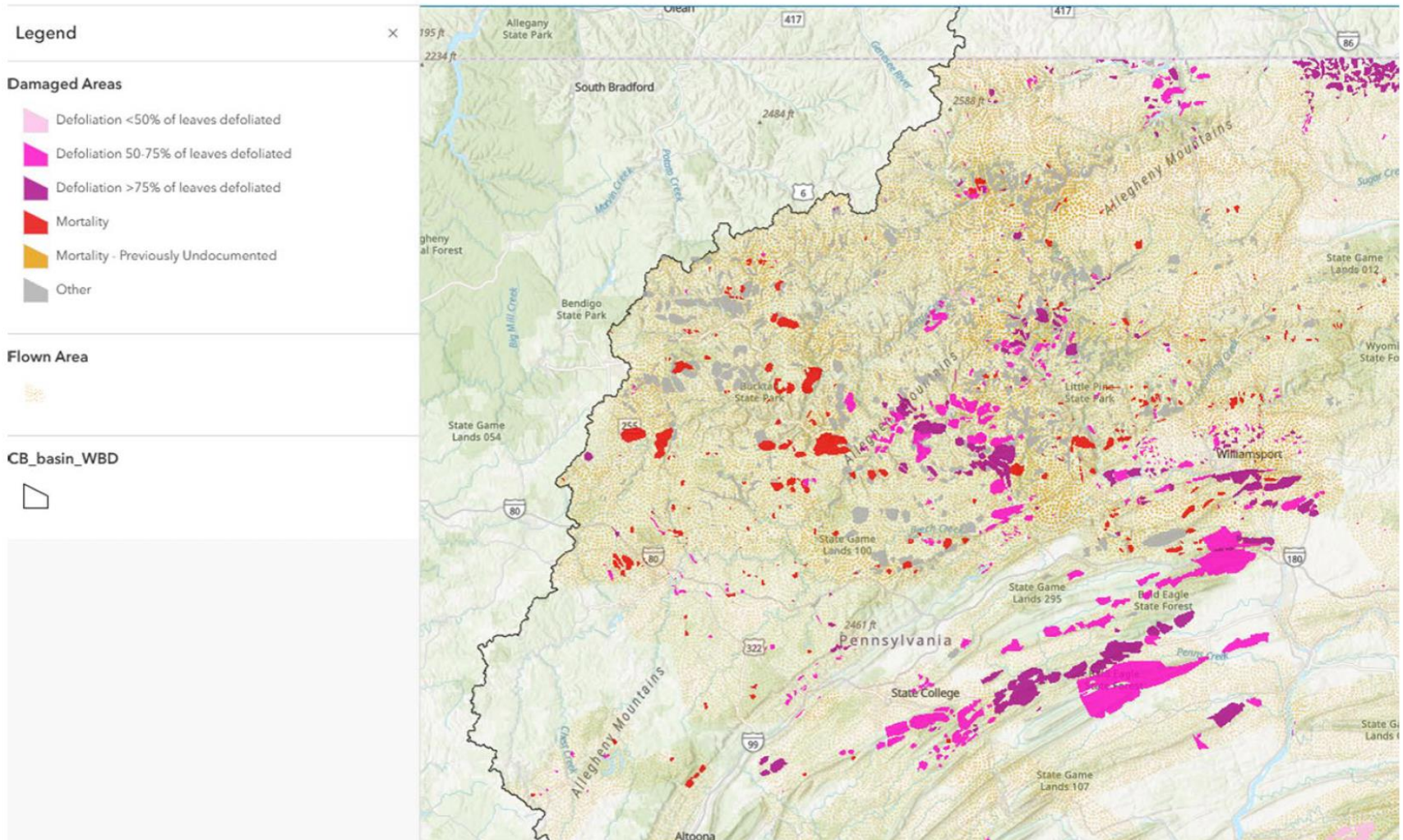
Screenshot of USDA-FS 2023 insect and disease survey (IDS) forest damage web map in areas around Blackwater National Wildlife Refuge. Teal polygons are areas with mortality due to saltwater intrusion and blue areas are a riparian buffers that overlapped with damage polygons. Estimates of percent tree mortality within damage areas is collected but not presented here. Base from Esri and its licensors, copyright 2026. Figure provided by Christopher Hayes, USDA-FS.

2023 Chesapeake Bay Drainage Insect and Disease Damage Map



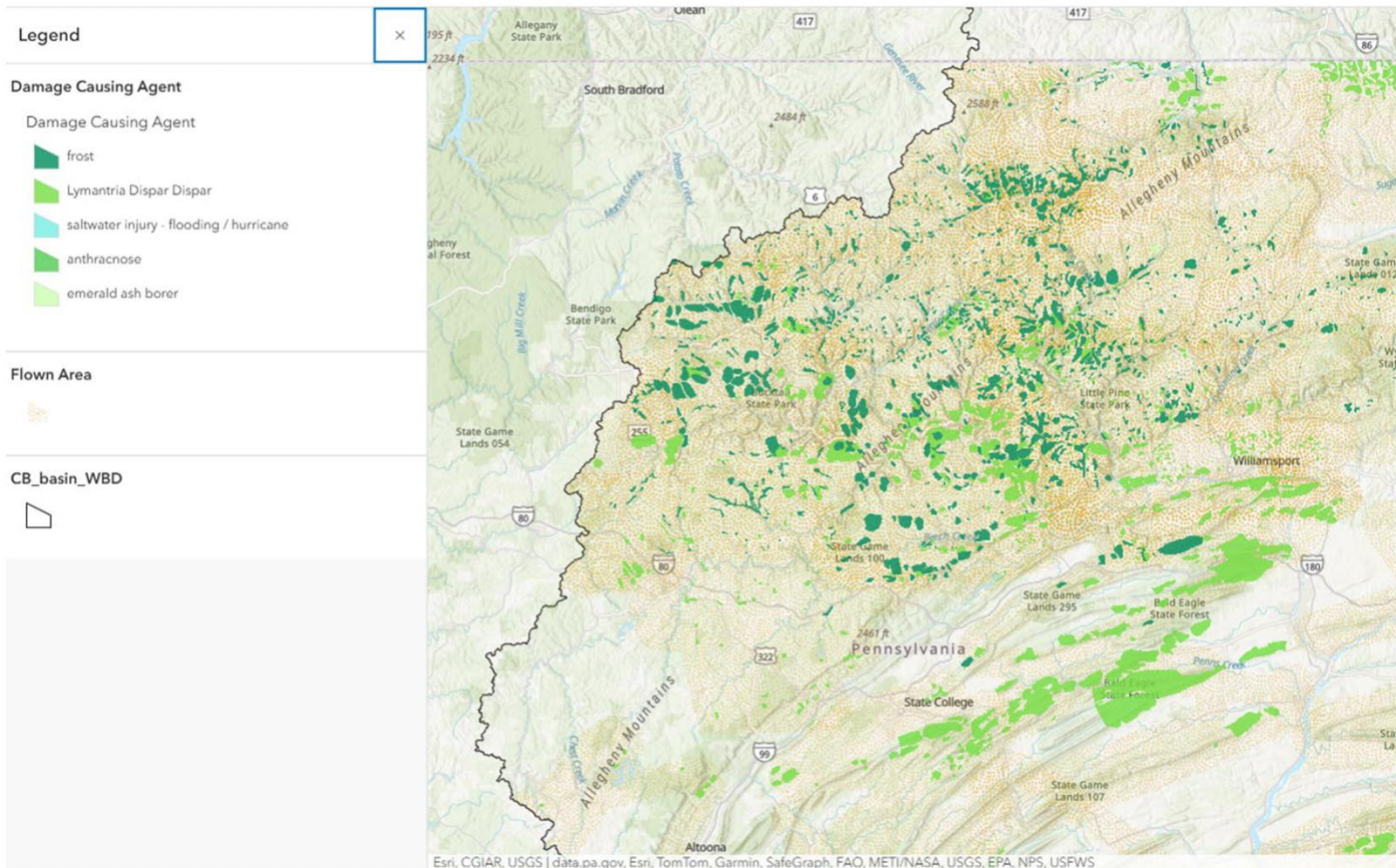
Screenshot of USDA-FS 2023 insect and disease survey (IDS) forest damage web map displaying damage areas projected by damage type. Damage polygons can be displayed and summarized by damage type, damage causing agent, tree species impacted, and/or percent of trees impacted. Most of the damage polygons pictured here were caused by saltwater intrusion (mortality polygons) or spongy moth (defoliation polygons). Base from Esri and its licensors, copyright 2026. Figure provided by Christopher Hayes, USDA-FS.

2023 Chesapeake Bay Drainage Insect and Disease Damage Map



Screenshot of USDA-FS 2023 insect and disease survey (IDS) forest damage web map displaying area with large amount of mapped damage in north-central PA projected by damage type. Base from Esri and its licensors, copyright 2026. Figure provided by Christopher Hayes, USDA-FS.

2023 Chesapeake Bay Drainage Insect and Disease Damage Map



Screenshot of USDA-FS 2023 insect and disease survey (IDS) forest damage web map displaying area with large amount of mapped damage in north-central PA shown by damage causing agent. Base from Esri and its licensors, copyright 2026. Figure provided by Christopher Hayes, USDA-FS.

Tree mortality by HUC8 watershed (Ash [*Fraxinus* sp.], Oak [*Quercus* sp.], Eastern Hemlock [*Tsuga canadensis*]), 2014–2024

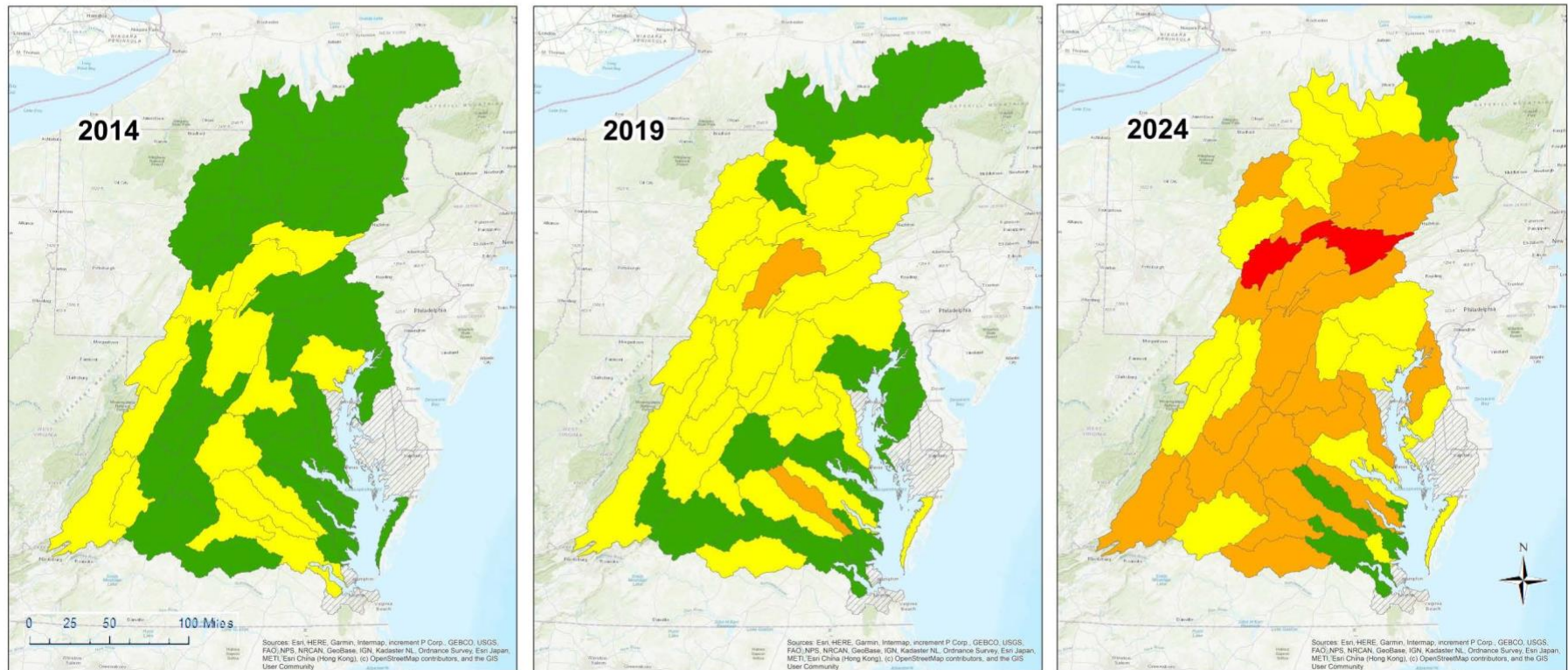
Percent Mortality



NoData (no Ash, or not included in output)

Ash Species Annual Mortality by HUC8 Watershed in the Chesapeake Bay Watershed

In 3 snapshot time periods: 2014, 2019 & 2024



Base from Esri and its licensors, copyright 2026. Map provided by Sarah Johnson, USDA-FS.

Percent Mortality

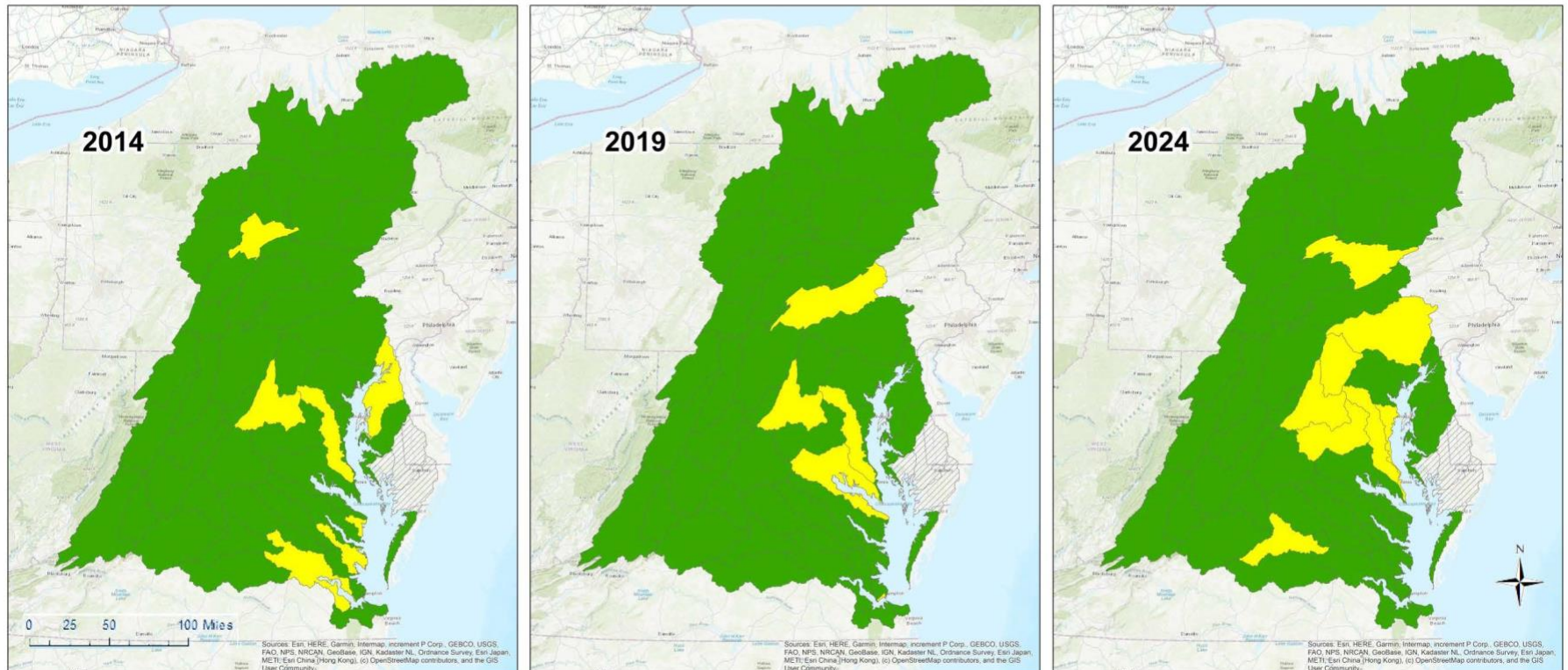
0 - 2

2 - 3.5

No Data (not included in output)

Oak Species Annual Mortality by HUC8 Watershed in the Chesapeake Bay Watershed

In 3 snapshot time periods: 2014, 2019 & 2024



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Percent Mortality

0 - 2

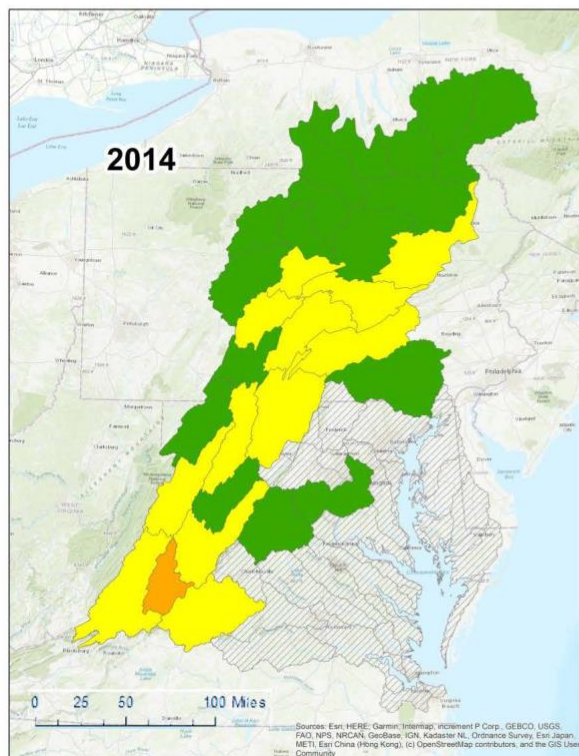
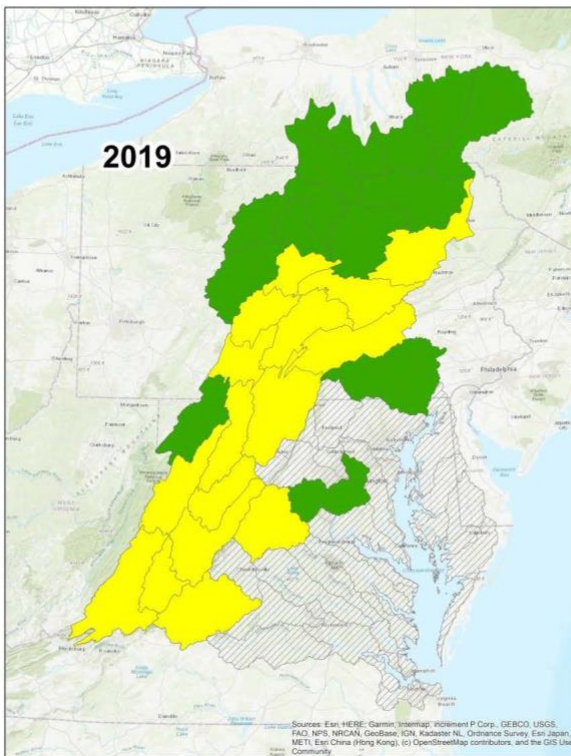
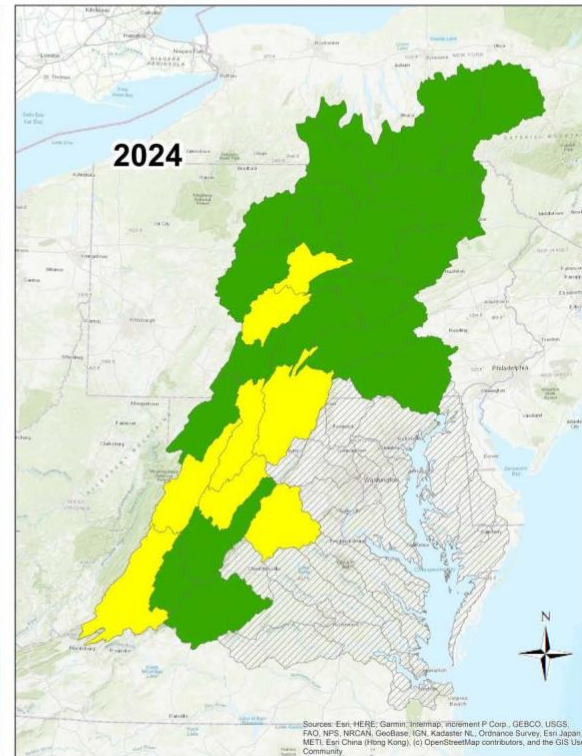
2 - 10

10 - 15.4

No Data (low or no Hemlock, or not included in output)

Eastern Hemlock Annual Mortality by HUC8 Watershed in the Chesapeake Bay Watershed

In 3 snapshot time periods: 2014, 2019 & 2024



Base from Esri and its licensors, copyright 2026. Map provided by Sarah Johnson, USDA-FS.

HUC8 level mortality data was obtained from the FIA EVALIDator application for 2014, 2019, and 2024 to show mortality that occurred in each of the intervening time windows (baseline year 2008). Mortality is reported as the average number of overstory trees (5" or greater diameter) that died annually over the 5 to 7-year inventory cycle. Annual Mortality Rate is calculated by dividing annual mortality (in number of trees) at an FIA measurement cycle end by the number of live trees present at the beginning of the cycle. Values of zero should represent a watershed where there were live trees but no mortality was observed. Values of No Data represent watersheds that were not included in the output (several HUCs in the Delmarva Peninsula), where no individuals of the target species were recorded at the beginning of the measurement period, or where individuals of the existing target species were removed from the inventory due to factors other than mortality, including the loss of access in order to remeasure a plot. The HUC8 watershed level is a relatively small scale at which to utilize FIA data, therefore in several watersheds the mortality rates are reported based on a very small number of trees, producing high error estimates.

Data extraction and manipulation credit: Thomas Albright, USFS