Monitoring and Managing Ash in the Catskills: A Platform for Citizen Science and Land Manager Engagement and a Source of Hope in the Fight Against Emerald Ash Borer: 2022

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Overview

This document constitutes the final report by the Ecological Research Institute, on its 2022 project ***"Monitoring and Managing Ash in the Catskills: A Platform for Citizen Science and Land Manager Engagement and a Source of Hope in the Fight Against Emerald Ash Borer"***. In it, we describe the project's activities and outcomes and make recommendations for future work to build on what has already been accomplished.

Project achievements include, among others, managing data from 12 MaMA Monitoring Plots Network plots in the CRISP region; collecting data from one of the four network plots that serve as a demonstration plot (the one at the Catskills Visitor Center); preparing an updated Catskills MaMA Action Map showing the ash conservation actions prioritized for each location in the CRISP region based upon its EAB detection history and ash health and mortality status; extensively updating the Catskills MaMA webpage (www.monitoringash.org/catskills/) to include not only the new action map, but also an overview of the MaMA program in the region that brings attention to MaMA's increased capabilities that will be brought to bear to conserve ash in the region, and a detailed exploration of the lessons that the four demonstration plots can teach us about the progression of the invasion of EAB in the region over space and time.

Background: *Monitoring and Managing Ash (MaMA)*

The Ecological Research Institute's program *Monitoring and Managing Ash (MaMA)* provides an innovative framework that promotes undertaking particular tasks at each stage of emerald ash borer (EAB) invasion in order to achieve EAB mitigation and, even more importantly, to advance long-term conservation of native ash. Such conservation can be advanced by locating "lingering ash", i.e., rare naturally occurring trees (of each native species) that remain healthy at least two years after virtually all the rest of the nearby trees have been killed by EAB; the USFS has shown such trees to have heritable EAB resistance, and through a relatively rapid propagation and selective breeding approach, scion from them can yield locally adapted, native lines to be used in ash restoration. The hope provided by lingering ash provides the basis for MaMA's positive message, that everyone can still take important steps to help conserve ash, no matter what stage EAB infestation has reached in their area (and even before infestation has occurred).

ERI's MaMA program has been developed in close consultation with two of the USFS scientists leading the efforts for ash conservation, Dr. Kathleen Knight and Dr. Jennifer Koch, who together have pioneered methods to identify lingering ash and propagate EAB-resistant lines. In particular, it has taken their methods for lingering ash detection and modified them to make them accessible for citizen scientists while still retaining their rigor. This close cooperation and coordination is maintained on an ongoing basis. Moreover, ERI, analyzes the relevant data contributed to its citizen science projects to determine, in collaboration with the USFS, which areas are ready to be searched (based on reaching particular mortality thresholds) for lingering ash.

MaMA's framework provides the foundation for locating and protecting lingering ash trees while integrating this into an overall program that takes account of various land management goals and constraints (see Fig. 1).

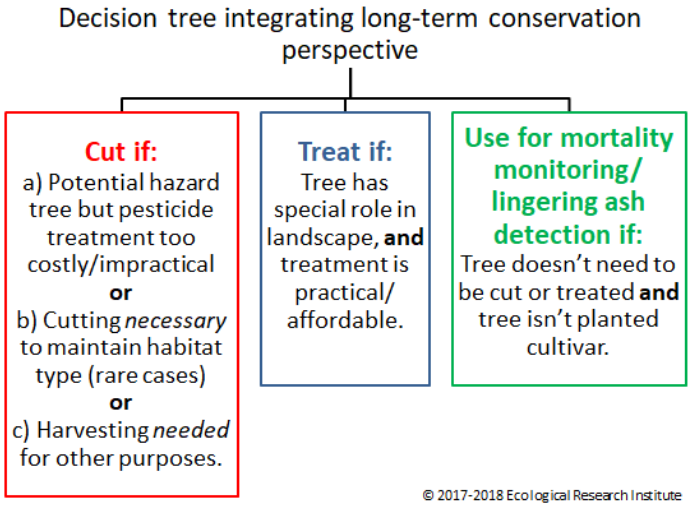

Fig. 1. MaMA's management approach takes into account local needs as well as actions needed to ensure long-term conservation and restoration

Implementing the MaMA framework requires engagement by well-informed citizen-scientists, land managers, forestry professionals and natural resource agencies and organizations; this is made possible by its outreach activities and materials as well as its four distinct citizen-scientist/land manager-driven data reporting projects (hosted on the Anecdata.org citizen science platform). Information on these projects; other materials (e.g., decision tree) we have designed to guide ash management; background materials on relevant topics (e.g., ash identification, EAB-resistance breeding); and links to tools (e.g., cost calculators) are available at our MaMA program website www.MonitoringAsh.org. Here, we shall very briefly describe the four citizen-science projects we have constructed on the Anecdata.org platform.

MaMA Ash/EAB Surveys (https://www.anecdata.org/projects/view/316). In this project, the observer documents the presence/absence of evidence of EAB infestation and EAB-induced mortality at a site having ash trees. Its purpose is to fill information gaps regarding the distribution of EAB.

MaMA Monitoring Plots Network (www.anecdata.org/projects/view/319). To assess EAB-induced ash mortality levels, which is necessary for appropriately timing the local search for lingering ash, ERI has developed this network of plots, each of which must cover at least 0.5 acres, and have at least 40 native ash that have not been chemically treated against EAB, are at least 10 cm dbh and are unlikely to be cut down while living (even if dying). This network extends through much of NY and beyond into Vermont and New Jersey, with further expansion to occur in 2019. While establishing a plot (which can only be done during the June-September field season), data are collected on tree location, crown health and whether or not each tree has evidence of EAB infestation. Living trees (which get tagged) are included along with trees that have been killed by EAB. Data has to be collected and reported once yearly until either the 50% mortality level is reached (for relatively recently invaded sites) or the 95% threshold has been reached (for long invaded sites). Reaching the 50% threshold triggers the onset of a four-year waiting period until the search for lingering ash in the nearby area; the 95% threshold triggers such a

search two years after it has been attained. These thresholds and waiting periods were developed by the USFS (95% + 2 years) and ERI using USFS data (50% + 4 years) based on ash mortality trajectories.

MaMA Lingering Ash Search (www.anecdata.org/projects/view/320). Participants can submit reports for this project only after an area has been determined to be eligible based upon its having reached one of the mortality thresholds and completed its associated waiting period. Trees that are still healthy before these criteria have been satisfied may not truly be lingering ash (and therefore would not have significant heritable EAB resistance). Locations of healthy, untreated ash in such areas are reported along with other information needed to document their status.

History of implementation of Monitoring and Managing Ash in the Catskills

The Catskills comprise an ideal region to implement the MaMA program, because the EAB invasion status runs the full gamut there, from areas where EAB has not yet been detected to areas where virtually 100% mortality has been reached. Thus, it can be used to demonstrate the roles that the various stage-specific tasks of the MaMA framework play in promoting EAB mitigation and enabling long-term ash conservation. Indeed, we have featured the implementation of MaMA in the Catskills as a model system at many presentations both within and beyond the region's boundaries, highlighting the roles played by CRISP and our many project partners in making this implementation possible.

CRISP was in fact the first PRISM to contract with ERI to implement MaMA, back in 2018 (and has since been joined by the Lower Hudson PRISM, SLELO, and the Finger Lakes PRISM). Thus, MaMA is already well established in the region, with numerous partners already involved in its efforts. However, in both 2020 and 2021, although ERI's proposals for MaMA implementation were approved, contracts were not ultimately finalized, due first to the COVID-19 outbreak and then to unfortunate administrative complications. This resulted in ERI not having the funding to support its activities in the region for these two years, with the lack of engagement undoubtedly leading to some attrition in participation in the program. However, because implementation of MaMA was contracted by the adjacent Lower Hudson PRISM for both of this years, it still allowed the program to maintain a nearby presence, including ongoing collection of data right along the border between the two regions. We therefore draw on some insights obtained in that PRISM in describing the outlook for MaMA in CRISP.

MaMA Monitoring Plots Network in the Catskills: 2022 data collection coordination, data management, and synthesis

We received 2022 data from 12 plots in the CRISP region, submitted by a broad range of program partners, including private landowners, coordinating this data collection, and managing and validating these data. Additionally, we collected data from one plot (the demonstration plot at the Catskills Visitor Center) for which we have been conducting the monitoring. Table 1 shows the name, GPS coordinates, and responsible entity for each plot. The cumulative EAB-induced mortality percentages for each plot are shown on the Catskills MaMA Action Map available at http://www.monitoringash.org/wp-content/uploads/2023/01/2022-CRISP-MaMA-action-map-w-demonstration-plots.pdf (see below).

Table 1.

Lat	Long	Plot name	Land Manager	Contact	Year established
42.027198	-74.270399	Catskills Visitor Center	Catskills Visitor Center	ERI	2018
42.42445	-74.569733	Cola Young Green waste facility	The Clark Foundation	devmerkley@gmail.com	2020
42.088035	-75.236506	DEP - Apex	DEP	MeTaylor@dep.nyc.gov	2018
41.999741	-74.168907	DEP - Kenozia Lake	DEP	MeTaylor@dep.nyc.gov	2018
42.09805	-74.798955	DEP - Perch Lake	DEP	MeTaylor@dep.nyc.gov	2018
42.30534	-74.781952	DEP - Scutt Mountain Road	DEP	MeTaylor@dep.nyc.gov	2020
42.091877	-74.820633	DEP - Shavertown	DEP	MeTaylor@dep.nyc.gov	2018
42.244099	-74.956902	Lenox Model Forest	Watershed Agricultural Council	kbrown@nycwatershed.org	2018
42.398678	-74.605456	MKNHP	M. Kudish Natural History Preserve	mkudish@catskill.net	2018
42.800834	-74.903328	Mohican 1	Otsego County Conservation Association and Mohican Farms	devmerkley@gmail.com	2018
42.2894	-74.57275	Shephard Hills Golf Course	Private	catbert749@gmail.com	2019
42.323431	-74.095812	Siuslaw Model Forest	Watershed Agricultural Council	tet35@cornell.edu	2018

Updated MaMA in the Catskills web page, including updated Catskills MaMA Action Map
We expanded and updated the dedicated MaMA in the Catskills webpage (http://www.monitoringash.org/catskills/) on ERI's MaMA program website (www.MonitoringAsh.org) in the following ways:

1. We added extensive material describing the 2022 data from the four Catskills MaMA demonstration plots (http://www.monitoringash.org/demonstration-plots/), comparing these results from those obtained in 2018, when the plots were first established and explaining what these numbers tell us about not only the state of the monitored ash themselves, but the areas around the plots and the situation in the CRISP region more generally. The results from each of these plots are presented graphically and described in text that should give non-technical visitors to the web page a clear sense of the very important stories that the plots have to tell when considered individually as well as all together.

2. We updated the Catskills MaMA Action Map to reflect the latest data that we have from the MaMA Monitoring Plots Network in the CRISP region (including all the plots listed in Table 1 as well as mortality levels from plots from which data collection has stopped because the 95% mortality threshold was already reached in a previous year), as well as EAB detection history data from iMapInvasives and before that from the NYS DEC Forest Health Protection databases. We there were not any new data reported through either the MaMA Ash/EAB Surveys project or the MaMA Lingering Ash Search project on the Anecdata platform, but this is not surprising, because in the case of the former project, it was not

promoted in the region since 2019 and in the case of the latter, the time when sizeable areas of the CRISP region are ready to be searched has arrived only recently.

We did, however, incorporate data from three Ash Mortality Rapid Assessments that we performed in the CRISP region. These assessments represent a new, stripped-down method that we have been piloting in CRISP and in the Lower Hudson PRISM as a way to quickly get a sense of EAB-induced ash mortality in areas that are not in close proximity to existing monitoring plots, without the long-term time commitment involved in establishing these plots. The time savings are possible because the rapid assessments do not require tagging individual trees (thus obviating permission issues), precisely measuring their DBH (instead recording DBH in several categories), or recording GPS coordinates for each tree (instead just recording coordinates for one location in the stand being assessed). Although some precision is sacrificed with this approach, broad application of it by program participants can likely go a long way to fill data gaps that would otherwise remain empty. The locations of the three rapid assessments that we performed in 2022 in CRISP are shown in Table 2, and the data from them, as mentioned above, is shown in the Catskills MaMA Action Map. In addition to these rapid assessments, when conducting one of them (at Ashokan Rail Trail), we also performed a lingering ash search, for which we recorded our search track in CALTOPO map that we designed for systematic lingering ash searches (https://caltopo.com/m/088U/0JFG5F15B0L5BJB0). Although this search did not reveal any lingering ash, recording and reporting such systematic searches in areas that are indeed ready to be searched are still very useful, because this information eliminates the need to search the area again in the future, thus enabling more efficient allocation of search resources.

Rapid mortality assessment locations:

Lat	Long	Location
42.10559	-74.47034	Lost Clove Trail
42.14517	-74.64888	Dry Brook Ridge Trail
41.99404	-74.09379	Ashokan Rail Trail

In addition to updating the Catskills MaMA Action Map to reflect the latest data, we featured the locations of the four demonstration monitoring plots (mortality of rates of other monitoring plot locations are also shown on the map, but the plots not named), so that users of the map can clearly see how the data from them influences the actions prioritized in their vicinity.

3. We added text explaining how the next few years will present a crucial opportunity to facilitate long-term native ash conservation and restoration in the Catskills based upon several factors. One of these is the fact that 120 square miles of the CRISP region is now ready to be searched for lingering ash, with this area to expand greatly in future years as more of the Catskills will have been invaded sufficiently long for the 95% mortality for at least two years threshold to have been reached. Additionally, by playing a major role in The Nature Conservancy's Trees in Peril collaborative initiative to counter the effects of invasive forest pests in the Northeast, we will have partnerships with institutions that can propagate and selectively breed ash from scion collected through the MaMA program, and we should also have other additional capabilities previously unavailable to us. Finally, in this new text on the website, we also called attention to other tools that will assist in the implementation of MaMA in the Catskills, including the development of the Rapid Ash Mortality Assessments (to be rolled out for widespread use in the 2023 field season) and the availability of recorded MaMA training webinars (originally produced for the

Lower Hudson PRISM, but useful for other regions as well). The new text incorporated into the MaMA in the Catskills website also mentioned the fact that over 20 lingering ash have been found by the MaMA in the Lower Hudson PRISM as proof of concept of the MaMA approach and to demonstrate that, with sufficient participation in the search effort, we should be able to have similar results in CRISP, especially as the search area expands

MaMA in the Catskills update email

In order to rally participation in MaMA in the CRISP region in 2023 and take advantage of all the opportunities described above, we also drafted and distributed a program update email to all MaMA program participants, comprising anyone who had attended one of our training workshops given under the auspices of CRISP. This email was thus sent to 79 recipients, and contained the same messages as those conveyed in the text incorporated into the Catskills MaMA webpage, as described above, while also thanking everyone for their participation in the program.

Future directions

We believe that the strategy to enable widespread participation in MaMA in the CRISP region, enabling us to find robust numbers of lingering trees to ultimately be used in selective breeding of native, locally adapted ash comprises the following:

- Messaging to highlight MaMA's success in detecting lingering ash in the neighboring Lower Hudson PRISM, the increasing opportunities to find such trees in the CRISP region as the search area expands, the availability of resources to help accomplish this, and the high profile that the MaMA program is attaining (as MaMA is now being considered as a model for approaches to conservation and restoration of other species). All of these themes can replace the hopelessness that EAB now inspires with hope.
- Messaging to call attention to all the tools that will be available to enable gathering the necessary data and messaging that highlights the importance of all of these data collection efforts (e.g., establishing monitoring plots, reporting EAB in areas in which it wasn't previously detected, conducting rapid assessments where necessary, in addition to conducting actual searches for lingering ash). In other words all of these are needed to provide the scaffolding upon which lingering ash detection is built.
- Messaging that acknowledges all of the work that people have already put into MaMA in the Catskills, in order to promote retention of participants.
- Providing all the institutional support to enable these ongoing efforts to continue without interruption.

Literature

Knight, K. S., J. P. Brown, and R. P. Long. 2012. Factors affecting the survival of ash (*Fraxinus* spp.) trees infested by emerald ash borer (*Agrilus planipennis*). Biological Invasions 15:371–38