PREPARING A PROCEEDINGS PAPER
Author Guidelines

Overview

- Proceedings include full papers and extended abstracts. A full paper includes an abstract, introduction, methods, results, analyses, and summary/conclusions (or similar subheads). An extended abstract (1,000 words or more) that outlines work in progress or preliminary results can be published but must include similar subheadings.
- The compiler coordinates the review process and sets page limits.
- Please use the following guidelines and any additional instructions provided by the compiler to streamline the publication process. See also the sample paper on pages 7–11.

Naming Files

- Name files using the last name of the first author and second author (if any).
- For figure and table files, add F1, F2, Table, and so on after author names.

General Format

- Submit files in Microsoft Word saved as a .docx or .doc file.
- Use Times New Roman 11 pt or similar.
- Use a minimal formatting (i.e., avoid bold, underline, italics).

Manuscript Sections and Organization

The manuscript should cover the research discussed during your presentation and should be assembled in the following order.

Title

Use title case, capitalizing all significant words.

Author Information

- For all authors, give the first name, middle initial, and last name, job title, and organization or affiliation. .
- For the corresponding author, provide job title, organization or affiliation, and contact information (email or phone is sufficient).

Abstract

- Full papers require an abstract; extended abstracts do not.
- Emphasize the purpose of the study, results, and conclusions in approximately 150 words.

Body

- Include an introduction, methods, results, analyses, and summary/conclusions (or similar sections).
- Make head levels distinct. Adding codes [H1], [H2], [H3] helps avoid errors.

FIRST-LEVEL HEADING [H1]

Second-Leveling Heading [H2]

Third-Level Heading [H3]

Acknowledgments

- Place acknowledgments before the literature cited.
- Acknowledge sources of funding by grant number and agency and technicians or others who helped with the research.

Sources: In-text References and Literature Cited

- Put in-text references in alphabetical order by author: (Ambrose et al. 2012, Smith and Jones 2008, Zhang 2009).
- Arrange literature cited entries in alphabetical order, including multiple citations by the same author(s).
- Use semicolons between authors' names in the literature cited.
- Give journal titles in full; do not abbreviate.
- Include the digital object identifier (DOI) if available at the end of the entry.
- Use footnotes for unpublished sources and personal communication.

Example: Journal Article in NRS Citation Style

Pagliai, M.; Vignozzi, N.; Pellegrini, S. 2004. **Soil structure and the effect of management practices.** Soil and Tillage Research. 79(2): 131–143. https://doi.org/10.1016/j.still.2004.07.002.

Appendix

- Appendixes are uncommon but can be used for explanations not essential to the text, lists of common and scientific names of species, questionnaires, or forms that will be helpful to readers.
- Number appendixes using Arabic numerals only if there is more than one appendix and give each appendix a descriptive title.

Tables

Files—Submit tables as Microsoft Word or Excel files; do not submit tables as image files.

Title—Place titles directly above each table, numbering tables in the order they are referred to in the text: **Table 1.—**Title of Table.

Table body—Present data as simply and clearly as possible.

- Avoid headings that span multiple columns if possible.
- Do not use spaces or hard returns in cells. The layout person will determine the table format and align data as needed.

Footnotes—Use superscript lowercase letters (a, b, c) unless letters are used to designate statistical significance; then use symbols.

References in the text—Number tables in the order they are referred to in the text, and check that all tables are referenced in the text (Table 1) or Table 1.

Figures and Captions

Figures include charts, graphs, maps, photographs, diagrams, and other illustrations.

General Guidelines

Files—Submit a separate file for each figure.

References in the text—Number figures in the order they are referred to the text, and check that all figures are referenced in the text (Fig. 1) or Figure 1.

Captions and alternative text (alt text)—Provide a separate manuscript for captions, credit lines, and alternative text.

- Style captions as follows: **Figure X.—**Caption.
- Label multipanel figures left to right with capital letters (A, B, C, D) and refer to the letters in the caption and alt text (see example).
- Include a credit line with photographs and with figures created by someone other than the authors.
- To be compliant with Section 508 of the Rehabilitation Act, all figures must have alt text. Assistive technology can read text and captions aloud; in alt text, writers should include information readers need to know that is not included in the text or caption.

Example

Fig	Caption/Credit Line	Alt Text
1	**Figure 1.—**Life stages of *Lymantria dispar:* (A) late instar caterpillars, (B) male and female pupae (note the smaller male pupa), (C) adult male and female mating, (D) females laying egg masses) of *Lymantria dispar* collected in the United States. USDA Forest Service photos by T.W. Coleman.	Four photographs. A: Two caterpillars, male and female, on a partially eaten leaf. B: About six pupae on a tree trunk. C: Two moths mating. D: Two female moths laying egg masses on a tree trunk.

2	**Figure 2.**—Frequency distribution of drop sizes of aerially applied SPLAT GM in 2009 and SPLAT GM-Organic in 2018 and 2020.	Bar graph. Y axis is labeled percent of drops with values from zero to 45. X axis is labeled drop size, microns, with four values: 300 to 700, 800 to 1000, 1100 to 1400, and greater than 1500. Three bars per value represent SPLAT GM, 2009; SPLAT GM-Organic, 2018; and SPLAT GM-Organic, 2020.

Charts and Graphs

Files—Submit a separate file for each figure and follow these guidelines:

- Microsoft Excel files with original data are preferred.
- Put multiple figures in the same Excel file, and number each tab with the figure number.
- If R or another program is used, please be attentive to the following guidelines for titles, labels, and legends and submit PNG, JPG, or TIFF files.

Titles, labels, and legends—Use these guidelines to style these elements:

- For axis and legend titles, use title case, bold, minimum 10 pt. Arial or a similar sans serif font.
- For labels subordinate to titles, use sentence case, lightface, minimum 9 pt. Arial or a similar sans serif font.
- For words in parentheses after a title or label, use lowercase, matching font and size.
- To express a percentage, add language to the axis title; do not add "%" after numbers on the axis.
- Place the legend on the top or the right side of the figure, and place the legend elements in the same order as the graph elements, whether horizontal or vertical.
- Use axis lines and all type, use black (not gray or color) *unless* black type is on top of a dark color. In that case, use white type for contrast.

Color and contrast—The following can help readers with colorblindness or low vision to distinguish figure elements:

- Use high-contrast, accessible colors.
- Use patterns or textures such as cross hatches, lines, and dots to distinguish segments when colors are similar in grayscale.
- Add thin black lines between color segments to distinguish segments in grayscale.
- Use black for axis lines and all type (not gray or color) *unless* black type is on top of a dark color or background. In that case, use white type for contrast.
- Test contrast by viewing the screen in grayscale.

Maps

Files—Submit a separate file for each map and follow these guidelines:

- Export maps to EPS files if possible; if not submit high-quality PDF, TIFF, or JPG files.
- File size should be 1-2 MB if possible for good resolution.

Titles, labels, legends, and projection—Use these guidelines to style these elements:

- For legend titles, use title case, bold, Arial or a similar sans serif font.
- For labels subordinate to titles, use sentence case, lightface, Arial or a similar sans serif font.
- For words in parentheses after a title or label, use lowercase, matching font and size.
- To express a percentage, add language to the legend title; do not add "%" after numbers in labels.
- Within the figure, include a statement about projection (mapping tool), the data source, and the cartographer (if different from the author):

  Projection: Web Mercator WGS 1984. Source: USDA Forest Service, Forest Inventory and Analysis program, 2019. Geographic base data are provided by the National Atlas of the USA. FIA data and tools are available online at https://www.fs.usda.gov/research/products/dataandtools/forestinventorydata. Cartography: T.A. Albright, USDA Forest Service, December 2020.

Photographs

Files—Submit a separate file for each photo:

- Submit JPG or TIFF files.
- File size should be 1-2 MB for good resolution (300 dpi at desired picture size).

Permission for use—Photos in the public domain do not require permission, but all photos require a credit line. Follow these guidelines:

- Photos by federal employees as part of their employment are in the public domain and do not require permission.
- Check whether a photo on a website such as Bugwood.org, Flickr, or Adobe Stock requires permission.
- Permission is required for photos not in the public domain or that include children. Contact the compiler for the photo release form.

Credit lines—Every photo needs a credit line in the caption.

Photo by government employee; public domain:

Figure 4.—Common buckthorn with fruit. USDA Forest Service photo by Cassandra Kurtz.

Figure 9.— Trees infested with Asian longhorned beetles are felled and destroyed. USDA Animal and Plant Health Inspection Service photo by Amanda Green.

Photo licensed, purchased, or used under a creative commons license:

Figure 12.—Fall colors by Elkhart Lake, Wisconsin. Licensed photo by csillamaroti/Shutterstock.

Figure 13.—Adult Asian longhorned beetles feed on the bark of twigs and on the midribs and petioles of leaves. Licensed photo by Dean Morewood, Health Canada/Bugwood.org.

Donated photo; permission on file:

Figure 15.—Northern long-eared myotis bat (*Myotis septentrionalis*). Courtesy photo by Tim Carter/Ball State University.

Style Notes

Acronyms

- Write out the full name or term the first time it appears followed by the acronym in parentheses.

Scientific Names

- Give the scientific name after the common name the first time the name appears in the abstract and in the text.
- Include the naming authority if it is commonly used (e.g., *Quercus rubrus* L.); otherwise omit it.
- Genus, species, and variety are italicized.
- If many species are referred in the document, scientific names can be included in a table or appendix rather than in the main text.

Numbers and Units of Measure

- Spell out the numbers one through nine except when used with a unit of measure or time.
- Use numerals for 10 through 999,999 except when the number is the first word of the sentence.
- Spell out million, using decimals where appropriate (1 million trees; 2.45 million people).
- Do not use an apostrophe with years: 1990s (not 1990's).
- Use either English or metric units consistently.
- For temperature, the space goes after the number: 100 °C (*not* 100° C).

Equations and Symbols

- For compliance with Section 508 of the Rehabilitation Act, use Word's equation editor or official symbols in equations rather than keyboard keys. For example, a screen reader will read "x" as "ex," not "multiplied by." A reader will ignore a hyphen in "5-3" and read "five three," not "minus."
- Display an equation on its own line, numbered at the right margin, with a blank line above and below and followed by a list of the components and their meanings.
- Spell out the word "percent" in the text and captions. The symbol (%) can be used in tables, figures, parenthetical comments, or when space is tight.

IMPACTS OF A HICKORY DECLINE EVENT AND IMPLICATIONS FOR BITTERNUT HICKORY

Kelsey A. Bakken, Jodi A. Forrester, David J. Mladenoff, Zakiya Leggett, Jennifer Juzwik, and Robert M. Jetton[1]

Abstract.—Between 2010 and 2016, rapid and extensive mortality of bitternut hickory (i.e., 35 percent year^{-1}) was observed within a long-term experimental site in Wisconsin. The purpose of this study was to document and quantify the mortality, investigate stem-density impacts on mortality, and assess remaining hickory regeneration. Similar mortality has been reported in the midwestern and northeastern United States, and a pathogenic fungus (*Ceratocystis smalleyi* Johnson and Harrington) and hickory bark beetle (*Scolytus quadrispinosus* Say) were identified as the causal agents, herein investigated via a post hoc analysis. Larger hickory stems (i.e., ≥20 cm d.b.h.) experienced higher mortality rates than smaller stems (i.e., 10 to <20 cm d.b.h.). Density (i.e., percent hickory), crown class, and diameter were statistically important in predicting hickory mortality. Maintaining this species is increasingly important, especially as other dominant species, such as ash, are also decreasing. Management actions such as selective thinning will be important in mitigating these rapid hickory declines.

INTRODUCTION

Bitternut hickory (*Carya cordiformis*) is an important component of many hardwood forests, including sugar maple-basswood forests in northern Wisconsin. The range extends from Quebec to Minnesota, and south to Georgia and Texas. Periodic and severe mortality has occurred historically throughout its range, and more recently within the northeast and midwest United States. Mortality was attributed to the hickory bark beetle (*Scolytus quadrispinosus* Say) and an associated canker pathogen (*Ceratocystis smalleyi* J.A. Johnson and Harrington) (Park et al. 2010, 2013; Park and Juzwik 2014). Extensive mortality of bitternut hickory occurred between 2010 and 2016 within a long-term research site in the Flambeau River State Forest in northern Wisconsin. The objectives of this study were to (1) quantify and characterize the bitternut hickory tree mortality, (2) investigate impacts of stem density on mortality patterns, and (3) assess hickory-regeneration persistence. Post hoc sampling for the hickory bark beetle and *C. smalleyi* was conducted to support the hypothesis that hickory decline was the cause of the extensive mortality.

[1] Kelsey A. Bakken is a graduate research assistant, Jodi A. Forrester is an associate professor, Zakiya Leggett is an assistant professor, and Robert M. Jetton is an associate professor and forest health specialist, North Carolina State University, Department of Forestry and Environmental Resources; Jennifer Juzwik is a research plant pathologist, USDA Forest Service, Northern Research Station; David J. Mlandenoff is professor emeritus, University of Wisconsin-Madison, Department of Forest and Wildlife Ecology. Corresponding author: Kelsey A. Bakken, kabakken@ncsu.edu.

METHODS

Site Description

The long-term experimental study site is in a second-growth northern hardwood forest dominated by sugar maple, in the southern edge of the Flambeau River State Forest in northern Wisconsin. The "Flambeau Experiment" includes thirty-five 80 m × 80 m (i.e., 0.64 ha) permanent plots to test seven treatment levels, with five replicates. Treatments are woody debris addition, gap creation, gap creation and woody debris addition, gap creation with deer exclusion, deer exclusion, mechanical disturbance from harvest equipment, and control (Forrester et al. 2013).

Stem Inventory

All trees (stems $\geq$10 cm diameter at breast height [d.b.h.]) in plots were tagged, identified, and mapped. D.b.h., crown class, and status (i.e., live or dead) were measured annually in fall from 2005 to 2010 and in 2016. Saplings (i.e., 0.5 to <10 cm, d.b.h. >1.4 m in height) were measured (i.e., height and d.b.h.) in subplots in 2005, 2010, 2013, and 2016. Woody understory plants were measured in 2010, 2013, and 2016. Species and counts were recorded by height class.

Statistical Analysis

Mortality rates were calculated for the trees in 5 cm diameter classes with the following equation (from Lorimer et al. 2001):

$$mortality = \left(1 - \left(\frac{N_t}{N_0}\right)^{\left(\frac{1}{t}\right)}\right) \cdot 100 \qquad (1)$$

Where

N_o = number of trees at first measurement,

N_t = number of surviving trees at next measurement, and

t = time between measurements.

An analysis of variance (ANOVA) with a Tukey's test was used to test for difference in mortality rates by diameter class. Hickory regeneration was assessed with an ANOVA followed by least squares means comparisons to test the significance of the interaction of year by height class.

Using geographic information systems (GIS), four circular areas (i.e., 4, 8, 11, 25 m radii) were delineated around each mapped hickory tree to estimate if density influenced mortality and at what scale. Stem density (percentage hickory) was calculated for each area. Logistic regression was used to model the likelihood of hickory stem mortality testing predictor variables including d.b.h., crown class (canopy or subcanopy), and percentage hickory. All statistical analyses were completed in Statistical Analysis System (SAS) statistical software (i.e., SAS version 9.0, SAS institute, Cary, NC), and significance was determined using an $\alpha \leq 0.05$.

Biotic Agent Identification

In July 2019, three actively dying hickory trees were felled, surveyed, and sampled for biotic agent confirmation. Wood samples were cut and brought back to the laboratory for pathogen identification confirmation using DNA sequencing.

RESULTS

There was an 84 percent reduction of bitternut hickory trees (i.e., $\geq$10 cm d.b.h.) from 2010 to 2016. Mortality rates were higher for hickory compared to other important species (i.e., sugar maple [*Acer saccharum*], American basswood [*Tilia americana*], and ash species [*Fraxinus* spp.]) at the site, at 35 percent $year^{-1}$ vs. 1 percent $year^{-1}$. Bitternut hickory trees declined in all size classes, and mortality rates were higher in larger stems compared to smaller stems (Fig. 1).

All variables in the logistic regression used to predict likelihood of mortality were significant for each radius modeled (Table 1). All models show that likelihood of mortality increases with increasing d.b.h., a higher (i.e., canopy) crown class, and higher percentage of hickory stems near to the host-hickory stem.

Hickory regeneration density in the <30 cm height class decreased significantly from 2010 to 2016 (i.e., $p = .0012$, F-value = 10.86). Investigation of densities from earlier years revealed that density has been extremely variable, so the decrease cannot be attributed to the same decrease in overstory tree density.

Debarking of sampled hickory trees confirmed the presence of the hickory bark beetle, based on entrance holes and larval galleries. Presence of *C. smalleyi* was confirmed with DNA sequencing.

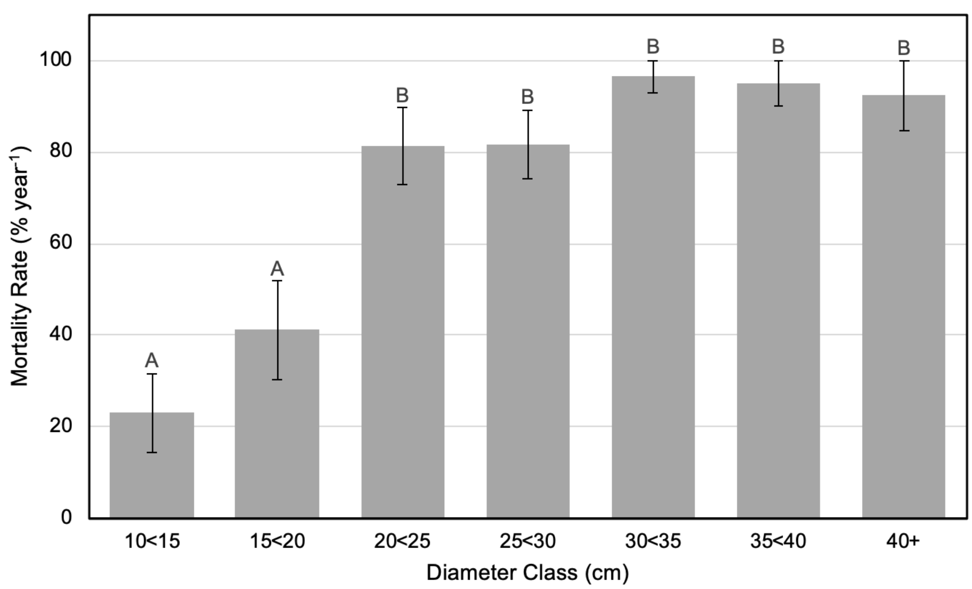

Figure 1.—Mean hickory tree mortality rates from 2010 to 2016. The analysis of variance (ANOVA) of mortality by diameter class resulted in a $p < .0001$, F-value = 15.79, and letters A and B indicate results from a Tukey's test to compare diameter classes ($\alpha = 0.05$ level). Error bars indicate ±1 standard error.

Table 1.—Logistic regression model equation ($M = \ln [m/(1-m)] = \beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3$) and parameter estimates for predicting mortality of individual hickory stems using four differently sized circular buffers

Buffer size (radius)	β_o	β_1 (crown class)	β_2 (percent hickory)	β_3 (d.b.h.)	LR ChiSq[a]	H-L (df = 8)[b]	P > ChiSq for H-L
4 m	-1.1018	0.7813**	0.0176**	0.0920**	105.91	4.5695	0.8024
8 m	-1.2583*	0.8040**	0.0367**	0.0875**	112.09	11.2861	0.1860
11 m	-1.1695*	0.7821**	0.0345**	0.0862**	105.85	7.4211	0.4919
25 m	-1.4728**	0.7902**	0.0554**	0.0903**	110.14	5.7647	0.6736

Notes: Parameter estimate significance from Wald's chi-squared tests denoted using * ($\alpha = 0.05$) and ** ($\alpha = 0.01$). M is log-odds of the probability of mortality, β_i are coefficient estimates, X_1 is crown class (Canopy (D) = 1; Subcanopy (S) = −1); X_2 is percent hickory; and X_3 is d.b.h. (cm).

[a] LR ChiSq = Likelihood ratio chi-square statistic.
[b] H-L = Hosmer and Lemeshow statistic for testing model goodness of fit. P > ChiSq is statistical significance.

CONCLUSION

Rapid crown decline of hickory is the likely cause of the bitternut hickory mortality, which is supported by the presence of the biotic decline agents and the consistency of the observed- mortality patterns with other reports in the midwestern and northeastern United States in the same period. *C. smalleyi* is commonly associated with the hickory bark beetle and has been associated with beetle galleries (Juzwik et al. 2013), although the function of the beetle as a vector has not been proven. Mortality is ultimately caused by vascular dysfunction from multiple beetle attacks, and multiple stem cankers. Drought is known to be an inciting factor in decline diseases and was also observed in the area prior to this mortality event.

Bitternut hickory stems in dominant and codominant canopy positions were almost eliminated from the site following the mortality event, and only 20 percent of stems ≥10 cm d.b.h. survived. The likelihood of mortality increased with higher percentages of bitternut hickory within a defined area of a host hickory tree, the host tree d.b.h., and a higher crown class. Stem density is known as a stressor of trees, often increasing susceptibility to insect attacks. In this case, stem density did indeed increase that susceptibility. Hickory regeneration was variable through time, so the decrease in population cannot be attributed to the rapid crown decline of hickory. These results suggest that regeneration does persist shortly following overstory mortality.

Low mortality of the regeneration layer and surviving stems in the mature stem cohort suggest that bitternut hickory can be maintained at the site. The potential for more frequent and intense droughts with climate change could incite mortality events like this to occur more frequently. The loss of even a single species reduces the resilience of a site, especially if other species are under threat as well, such as ash trees facing future emerald ash borer (*Agrilus planipennis* Fairmaire) attack. Managing forests to reduce stress on trees and encourage resilience to insects and pathogens is important to address decline diseases because stressed trees are more likely to succumb to other inciting and contributing factors. The logistic regression model developed here can guide management to reduce stem density, which would minimize the effect of density as a predisposing factor. Mortality is likely in all diameter sizes and canopy positions; however smaller, subcanopy hickory stems are less susceptible to mortality when hickory is in lower proportions. Thinning or selective harvesting techniques can reduce stem density and the proportion of hickory trees, while also increasing biodiversity and heterogeneity in stand species and structure. This further reduces bark beetle populations and the potential for subsequent attacks (Fettig 2012, Knops et al. 1999).

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