University of New Hampshire
University of New Hampshire Scholars' Repository

Faculty Publications

6-16-2023

New Records of Southern Pine Beetle (Dendroctonus frontalis Zimmermann; Coleoptera: Curculionidae) in New York, New Hampshire, and Maine, USA Indicate Northward Range Expansion

Caroline R. Kanaskie
University of New Hampshire, Durham

Thomas C. Schmeelk
Maine Forest Service

Jessica A. Cancelliere
New York State Department of Environmental Conservation

Jeff R. Garnas
University of New Hampshire, Durham

Follow this and additional works at: https://scholars.unh.edu/faculty_pubs

Comments
This is an article published by BioOne in Coleopterists Bulletin in 2023, available online: https://doi.org/10.1649/0010-065X-77.2.248

Recommended Citation
Caroline R. Kanaskie, Thomas C. Schmeelk, Jessica A. Cancelliere, and Jeff R. Garnas "New Records of Southern Pine Beetle (Dendroctonus frontalis Zimmermann; Coleoptera: Curculionidae) in New York, New Hampshire, and Maine, USA Indicate Northward Range Expansion," The Coleopterists Bulletin 77(2), 248-251, (16 June 2023). https://doi.org/10.1649/0010-065X-77.2.248

This Article is brought to you for free and open access by University of New Hampshire Scholars' Repository. It has been accepted for inclusion in Faculty Publications by an authorized administrator of University of New Hampshire Scholars' Repository. For more information, please contact Scholarly.Communication@unh.edu.

BioOne COMPLETE

New Records of Southern Pine Beetle (Dendroctonus frontalis Zimmermann; Coleoptera: Curculionidae) in New York, New Hampshire, and Maine, USA Indicate Northward Range Expansion

Authors: Kanaskie, Caroline R., Schmeelk, Thomas C., Cancelliere, Jessica A., and Garnas, Jeff R.

Source: The Coleopterists Bulletin, 77(2) : 248-251

Published By: The Coleopterists Society

URL: https://doi.org/10.1649/0010-065X-77.2.248

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://bioone.org/journals/The-Coleopterists-Bulletin on 28 Jun 2023
Terms of Use: https://bioone.org/terms-of-use Access provided by The Coleopterists Society

The Coleopterists Bulletin 77(2): 248–251. 2023.

SCIENTIFIC NOTE

New Records of Southern Pine Beetle (*Dendroctonus frontalis* Zimmermann; Coleoptera: Curculionidae) in New York, New Hampshire, and Maine, USA Indicate Northward Range Expansion

Caroline R. Kanaskie*
Department of Natural Resources, University of New Hampshire
56 College Road, Durham, NH 03824, USA
caroline.kanaskie@unh.edu
https://orcid.org/0000-0002-4091-9607
*Corresponding author

Thomas C. Schmeelk
Department of Agriculture, Conservation and Forestry, Maine Forest Service
90 Blossom Lane, Augusta, ME 04333-0168, USA

Jessica A. Cancelliere
Bureau of Invasive Species & Ecosystem Health
New York State Department of Environmental Conservation
108 Game Farm Road, Delmar, NY 12054, USA

and

Jeff R. Garnas
Department of Natural Resources, University of New Hampshire
56 College Road, Durham, NH 03824, USA
jeff.garnas@unh.edu
https://orcid.org/0000-0002-9956-9875

DOI.org/10.1649/0010-065X-77.2.248

The southern pine beetle (SPB) (*Dendroctonus frontalis* Zimmermann, 1868; Coleoptera: Curculionidae: Scolytinae) is a tree-killing bark beetle native to North and Central America. When populations are small, SPB adults attack stressed or dying pines, such as those struck by lightning (Coulson *et al.* 1983; Hodges and Pickard 1971), where their larvae subsequently develop. During outbreaks, SPB initiate mass attack of healthy pines via pheromone communication, including the aggregation pheromone frontalin (Renwick and Vité 1969). Adult beetles bore into the outer bark of the tree and into the phloem layer, where female beetles construct serpentine galleries and males remove boring materials (Hain *et al*. 2011). Females deposit eggs on both sides of the gallery in small, excavated egg niches. Females also carry one or two beneficial fungi in the mycangia, which they introduce into the gallery. Upon hatching, larvae feed on phloem inoculated with the mycangial fungi as they move away from the parental galleries and eventually into the outer bark to pupate. Adults emerge from the bark and either attack nearby trees, resulting in local "spot" expansion, or disperse to create new infestations.

In the United States, SPB has historically been observed in Alabama, Arizona, Arkansas, Washington DC, Florida, Georgia, Louisiana, North Carolina, New Jersey, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and West Virginia (St. George and Beal 1929; Wood 1982). The beetle can attack any pine (Pinaceae) within its range, including *Pinus echinata* Mill., *Pinus engelmannii* Carrière, *Pinus glabra* Walter, *Pinus oocarpa* Schiede ex Schltdl., *Pinus palustris* Mill., *Pinus ponderosa* P. Lawson & C. Lawson, *Pinus rigida* Mill., *Pinus strobus* L., *Pinus taeda* L., and *Pinus virginiana* Mill. (Wood 1982), though successful reproduction appears to be favored in the hard pine group (subgenus *Pinus*). Infestations of SPB have caused significant economic losses in the southern US forest industry, where hard pine plantations are common (Clarke *et al.* 2016).

Downloaded From: https://bioone.org/journals/The-Coleopterists-Bulletin on 28 Jun 2023
Terms of Use: https://bioone.org/terms-of-use Access provided by The Coleopterists Society

During fall 2014, dying pitch pines (*P. rigida*) were observed on Long Island, New York. SPB was identified in these trees, which represented the northernmost collections of SPB at that time (Dodds *et al*. 2018). The finding of SPB on Long Island motivated pheromone-baited trapping efforts in New York and in New England, using standard methodology that has been developed in the southern US to monitor for SPB (Sullivan and Clarke 2021). As of 2016, SPB was collected from frontalin-baited Lindgren funnel traps in low numbers in Connecticut, Rhode Island, Massachusetts, and New York, with the furthest north detections in west-central Massachusetts (Dodds *et al.* 2018). Since then, monitoring efforts have continued every spring in New England, using the same pheromone-baited funnel traps in similar locations in every participating state. Traps as far north as Massachusetts consistently yield SPB, suggesting that small, persistent populations of SPB are present there. While Long Island, NY remains the northernmost known SPB outbreak to date, scattered attacked trees have been detected in the Hudson River Valley of New York and on Cape Cod. In Maine and New Hampshire, frontalin-baited funnel traps have been deployed for spring detection sampling since 2016 and 2015, respectively, but SPB had not been captured (J. A. Cancelliere and T. C. Schmeelk, personal observation) until 2021, as reported herein.

The northward range expansion of SPB is attributed to an increase in minimum temperatures in the literature (Dodds *et al*. 2018; Lesk *et al*. 2017). Southern pine beetle is freeze-intolerant in all life stages (Ungerer *et al*. 1999), which overwinter in the phloem (larvae and adults) or in outer bark (pupae). Pine bark provides moderate buffering against short-duration low temperatures, and this has been included in calculations of lower lethal temperatures. Air temperatures of −16 °C (3.2 °F) have been identified as a threshold below which mortality of > 90% of SPB is predicted to occur, as per Ungerer *et al*. (1999). Later work that accounted for greater thermal buffering by bark estimated the 90% mortality threshold at −21.7 °C (−7.1 °F) (Trần *et al*. 2007). Climate models predict that with warming winters, SPB will continue its northward range expansion (Lesk *et al*. 2017).

Here we report continued northward range expansion of SPB into upstate New York, New Hampshire, and Maine (Table 1). In New York, SPB has been collected in frontalin-baited funnel traps on Long Island since 2014, and in the lower Hudson River Valley since 2015. New records in New York have come from frontalin-baited funnel traps in Albany, Saratoga, and Warren counties, located in the upper Hudson River Valley. The SPB captures we report from Maine (York County) and New Hampshire (Carroll and Strafford counties) occurred during a frontalin-baited funnel trapping study designed to test insect community response to SPB pheromones outside the SPB range (Kanaskie, unpublished data).

All of our positive trap catches for SPB occurred during fall sampling. Spring trapping at these same locations has not captured SPB in the same year, despite the fact that spring dispersal typically corresponds to maximum trap yield in southern states (Thomason *et al*. 2021). Our traps were deployed in late spring and monitored bi-weekly through early November. Lures were replaced every six weeks. On Long Island, SPB activity has been observed into fall and even winter, raising the

Table 1. New SPB records from Maine (ME), New Hampshire (NH), and New York (NY). All SPB were collected in frontalin-baited Lindgren 12-funnel traps. New Hampshire and Maine specimens were identified by author CRK and confirmed by Marc DiGirolomo (US Forest Service, Durham, NH). Voucher specimens were placed at the US Forest Service Durham Field Office Forest Insect Collection (DFOC), Durham, NH. New York specimens were identified by Liam Somers and Erica Culbert (New York Department of Environmental Conservation, Delmar, NY) and are stored at the New York DEC Forest Health Diagnostic Lab, Delmar, NY.

State	County	Municipality	Site	Coordinates	Collection dates	Number of SPB
ME	York	Shapleigh	Waterboro Barrens Preserve	43.601, −70.811	4–20 Oct 2021	21
ME	York	Lyman	Massabesic Experimental Forest	43.562, −70.633	4–20 Oct 2021	4
NH	Carroll	Ossipee	Pine River State Forest	43.711, −71.088	6–23 Oct 2021	7
NH	Carroll	Madison	Ossipee Pine Barrens Preserve	43.842, −71.182	6–23 Oct 2021	23
NH	Carroll	Tamworth	White Lake State Park	43.833, −71.229	6–23 Oct 2021	1
NH	Strafford	Madbury	Kingman Farm	43.173, −70.929	8–22 Oct 2021	7
NY	Columbia	Copake	Taconic State Park	42.135, −73.493	13–27 Sept 2021	383
NY	Albany	Albany	Albany Pine Bush Preserve	42.712, −73.894	12–26 Oct 2021	78
NY	Albany	Albany	Albany Pine Bush Preserve	42.716, −73.868	12–26 Oct 2021	87
NY	Saratoga	Gansevoort	Saratoga Sandplains Wildlife Management Area	43.141, −73.681	13–27 Sept 2021	11
NY	Warren	Queensbury	Queensbury Land Conservancy	43.303, −73.702	17–31 Oct 2022	2

Downloaded From: https://bioone.org/journals/The-Coleopterists-Bulletin on 28 Jun 2023
Terms of Use: https://bioone.org/terms-of-use Access provided by The Coleopterists Society

possibility of a shift toward later emergence phenology, perhaps indicative of climate mismatching. This pattern could also reflect high overwintering mortality followed by population buildup through the growing season. In all of the sites we report on here, winter minima have been below the > 90% mortality threshold established by Ungerer *et al*. (1999) since 2002 (Menne *et al*. 2012a, b). Trần *et al*. (2007) models predicted SPB mortality ranging from 58.7% (Madbury, NH) to 99.8% (Queensbury, NY) in the winter before our 2021 sampling season (Garnas 2022). Interestingly, based on weather station data from Hollis, ME (12 km ENE of our Waterboro site), over 99% overwintering mortality was predicted during 15 of the 22 years prior to our sampling (2000–2021), with a mean of 97.4 ± 2.5% overwintering mortality predicted from 2019–2021 (Garnas 2022; Menne *et al*. 2012a, b). Even at low minimum winter temperatures, a small proportion of SPB populations are likely to survive due to individual variation in freeze tolerance or thermal refugia (*i.e.*, thick bark).

To date, no SPB-attacked trees have been found in Maine or New Hampshire. It is possible that SPB captured in these states originated from populations further south. Maximum flight distance for SPB has been estimated to range from 1 km (based on marked-recapture; Turchin and Thoeny 1993) to 2.6 km (based on tethered flight mill studies; Kinn 1986). Wind-aided dispersal has not yet been studied in SPB, though other *Dendroctonus* species can move 30–110 km per day with prevailing winds (Jackson *et al*. 2008). Alternatively, trapped beetles in Maine and New Hampshire may have originated locally, though confirmation of local establishment awaits the detection of live beetles in trees, particularly in early spring. Local persistence in these states might also indicate changes in the lower lethal temperature of SPB in northern latitudes, potentially due to adaptive evolution or acclimatization. To further elucidate SPB's northern distribution, we recommend extending SPB sampling outside of the traditional spring trapping window, with a particular focus on fall sampling.

Acknowledgments

We thank the many people who collected and sorted through trap catch, including Liam Somers, Erica Culbert, Juliet Linzmeier, Amanda Dillon, Nathan Hudson, Adam Clark, and Isabella Barbini. These collections would not have been possible without those who aided in obtaining site access and permitting, much of which was done during the particularly challenging spring of 2020. We thank Marc DiGirolomo (US Forest Service, Durham, NH) for confirmation of identifications made by CRK.

References Cited

Clarke, S. R., J. J. Riggins, and F. M. Stephen. 2016. Forest management and southern pine beetle outbreaks: A historical perspective. Forest Science 62: 166–180.

Coulson, R. N., P. B. Hennier, R. O. Flamm, E. J. Rykiel, L. C. Hu, and T. L. Payne. 1983. The role of lightning in the epidemiology of the southern pine beetle. Zeitschrift für Angewandte Entomologie 96: 182–193.

Dodds, K. J., C. F. Aoki, A. Arango-Velez, J. Cancelliere, A. W. D'Amato, M. F. DiGirolomo, and R. J. Rabaglia. 2018. Expansion of southern pine beetle into northeastern forests: Management and impact of a primary bark beetle in a new region. Journal of Forestry 116: 178–191.

Garnas, J. G. 2022. SPB winter mortality by temperature estimator. https://foresthealth.shinyapps.io/SPBWinterTemp (accessed 9 March 2023).

Hain, F. P., A. J. Duehl, M. J. Gardner, and T. L. Payne. 2011. Natural history of the southern pine beetle [pp. 13–24]. *In*: Southern Pine Beetle II: General Technical Report SRS-140 (R. N. Coulson and K. D. Klepzig, editors). US Department of Agriculture Forest Service, Southeastern Forest Experiment Station, Asheville, NC, vi + 512 pp.

Hodges, J. D., and L. S. Pickard. 1971. Lightning in the ecology of the southern pine beetle, *Dendroctonus frontalis* (Coleoptera: Scolytidae). The Canadian Entomologist 103: 44–51.

Jackson, P. L., D. Straussfogel, B. S. Lindgren, S. Mitchell, and B. Murphy. 2008. Radar observation and aerial capture of mountain pine beetle, *Dendroctonus ponderosae* Hopk. (Coleoptera: Scolytidae) in flight above the forest canopy. Canadian Journal of Forest Research 38: 2313–2327.

Kinn, D. N. 1986. Studies on the flight capabilities of *Dendroctonus frontalis* and *Ips calligraphus*: Preliminary findings using tethered beetles. Research Note, June 1986, so-314, U.S. Dept. of Agriculture, Forest Service, Southern Forest Experiment Station, New Orleans, LA, 1–3.

Lesk, C., E. Coffel, A. W. D'Amato, K. Dodds, and R. Horton. 2017. Threats to North American forests from southern pine beetle with warming winters. Nature Climate Change 7: 713–717.

Menne, M. J., I. Durre, B. Korzeniewski, S. McNeal, K. Thomas, X. Yin, S. Anthony, R. Ray, R. S. Vose, B. E. Gleason, and T. G. Houston. 2012a. Global Historical Climatology Network - Daily (GHCN-Daily), Version 3. doi.org/10.7289/V5D21VHZ (accessed 11 Feb 2023).

Menne, M. J., I. Durre, R. S. Vose, B. E. Gleason, and T. G. Houston. 2012b. An overview of the Global Historical Climatology Network-Daily Database. Journal of Atmospheric and Oceanic Technology 29: 897–910.

Renwick, J. A. A., and J. P. Vité. 1969. Bark beetle attractants: Mechanism of colonization by *Dendroctonus frontalis*. Nature 224: 1222–1223.

St. George, R. A., and J. A. Beal. 1929. The Southern Pine Beetle: A Serious Enemy of Pines in the South.

Downloaded From: https://bioone.org/journals/The-Coleopterists-Bulletin on 28 Jun 2023
Terms of Use: https://bioone.org/terms-of-use Access provided by The Coleopterists Society

Farmers' Bulletin No. 1586, US Department of Agriculture, 18 pp.

Sullivan, B. T., and S. R. Clarke. 2021. Semiochemicals for management of the southern pine beetle (Coleoptera: Curculionidae: Scolytinae): Successes, failures, and obstacles to progress. The Canadian Entomologist 153: 36–61.

Thomason, J. W., S. Clarke, and J. J. Riggins. 2021. Evaluation of phenological indicators for optimizing spring southern pine beetle (Coleoptera: Curculionidae: Scolytinae) trapping surveys. Florida Entomologist 103: 444–451.

Trần, J. K., T. Ylioja, R. F. Billings, J. Régnière, and M. P. Ayres. 2007. Impact of minimum winter temperatures on the population dynamics of *Dendroctonus frontalis.* Ecological Applications 17: 882–899.

Turchin, P., and W. T. Thoeny. 1993. Quantifying dispersal of southern pine beetles with mark-recapture experiments and a diffusion model. Ecological Applications 3: 187–198.

Ungerer, M. J., M. P. Ayres, and M. J. Lombardero. 1999. Climate and the northern distribution limits of *Dendroctonus frontalis* Zimmermann (Coleoptera: Scolytidae). Journal of Biogeography 26: 1133–1145.

Wood, S. L. 1982. The Bark and Ambrosia Beetles of North and Central America (Coleoptera: Scolytidae), a Taxonomic Monograph. Great Basin Naturalist Memoirs, No. 6. Brigham Young University, Provo, UT, 1,359 pp.

(Received 29 November 2022; accepted 25 April 2023. Publication date 16 June 2023.)

Downloaded From: https://bioone.org/journals/The-Coleopterists-Bulletin on 28 Jun 2023
Terms of Use: https://bioone.org/terms-of-use Access provided by The Coleopterists Society