

# Finding the Lights: Analyzing the Distribution of Firefly Species *Photinus carolinus*

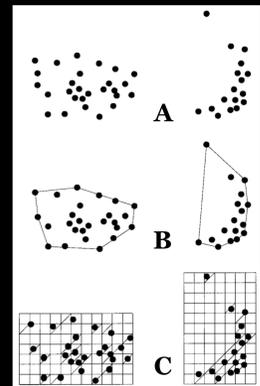
## Background

*Photinus carolinus*, better known as lightning-bugs or synchronous fireflies, are known to put on mating displays that attract and fascinate scientists and tourists alike. However, with incredible flashes of alternative synchronized bright lights, the awe-inspiring event may be attracting its decline. In addition to other anthropogenic causes of decline such as habitat loss, increased tourism to see these incredible mating displays may be perpetuating decline. This risk is what has sparked the need to map the distribution of the known locations of the species. Additional to mapping the distribution, following the International Union for Conservation of Nature, the leading international organization that categorizes risk levels for species, analysis of the distribution was conducted to determine the current threat level for *Photinus carolinus*.



## Methods

*Photinus carolinus* observation coordinate data points were collected and compiled to create a species distribution map. Following the IUCN Red List Categories and Criteria Version 3.1, analysis for extent of occurrence and area of occupancy were calculated.



(A) is the known species distribution.  
 (B) is the extent of occurrence measured as the area in kilometers of a minimum convex polygon around the distribution.  
 (C) is the area of occupancy measured as the area in kilometers of grid squares occupied by the species.

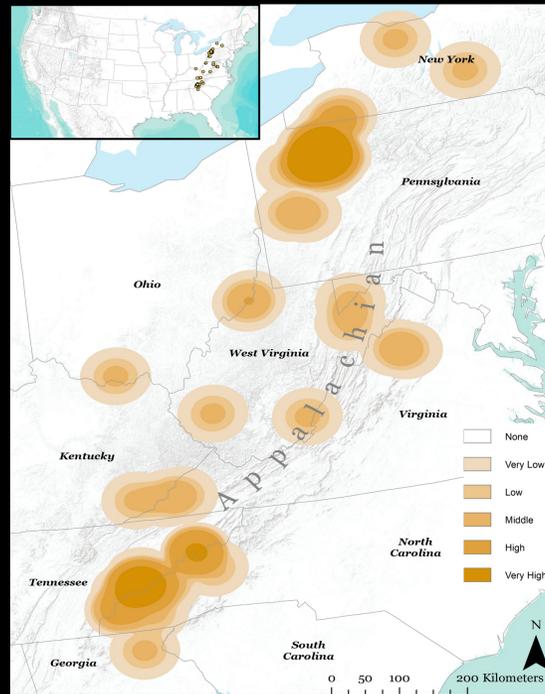
According to the IUCN Red List Categories and Criteria Version 3.1

## References

Data sources: Sara Lewis, Michael Reed, Lynn Faust, Sunny Fleming, Avalon Owens, Annie Nguyen, PAFF, GBIF.org.  
 Information sources: IUCN Red List Categories and Criteria: Version 3.1, Scaling Range Sizes to Threats for Robust Predictions of Risks to Biodiversity by Keith et al.  
 Image sources: Trevor Williams, Paige Brown Jarreau, Todd Amacker, Firefly.org.  
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 Acknowledgments: A large thanks to Sara Lewis and Michael Reed for project advice. To Lynn for your extensive data and incredible passion. To Sunny and Avalon for sharing your data. To Annie for your graphic design assistance.

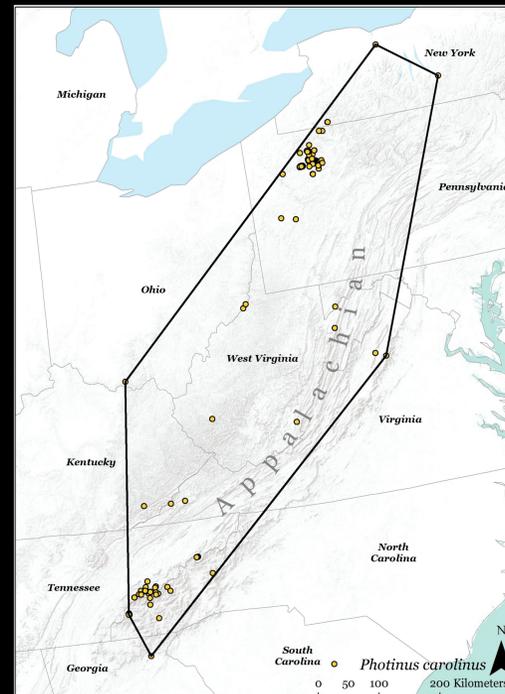


## Species Distribution



Map of the species distribution of *Photinus carolinus* in the eastern United States.

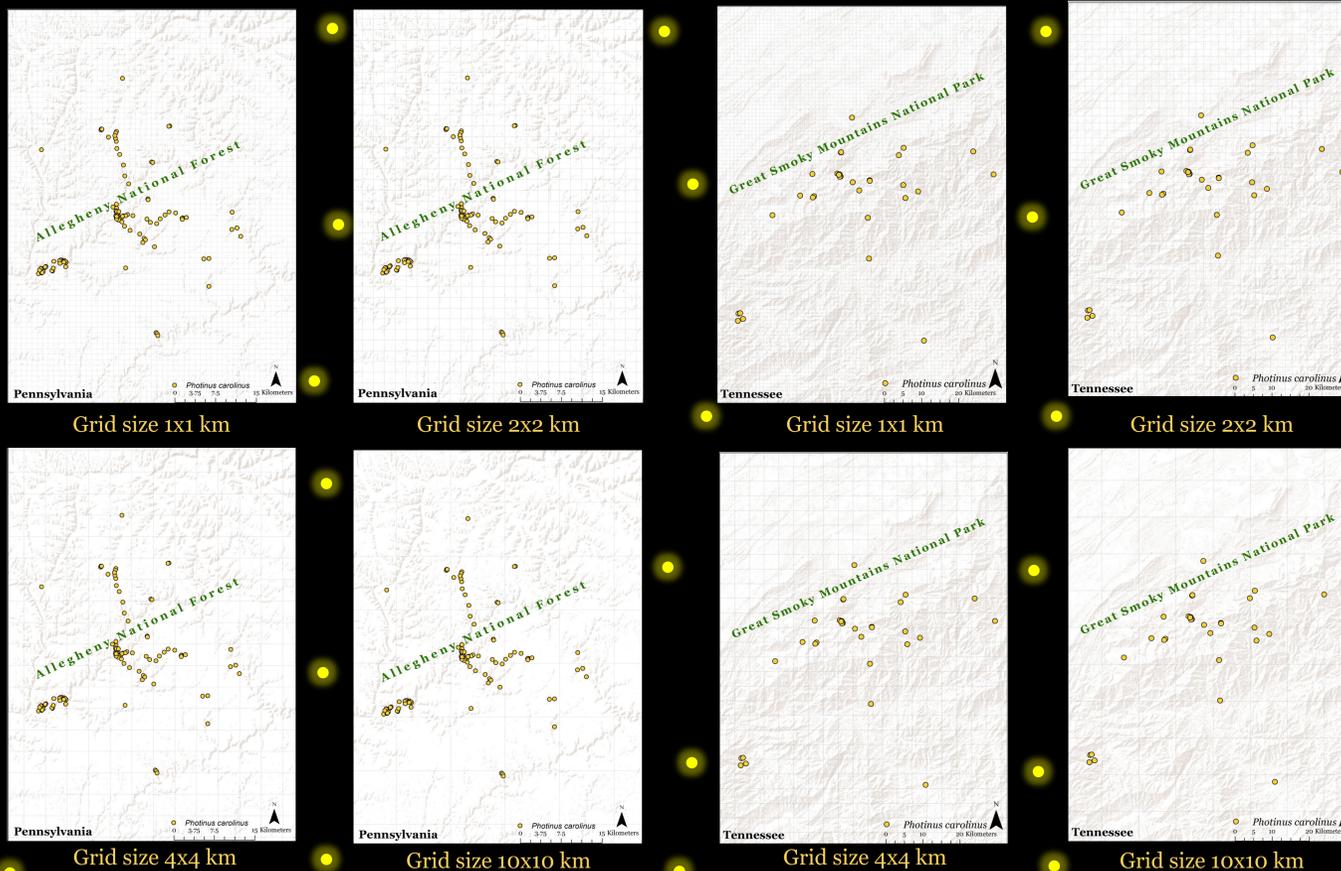
## Extent of Occurrence



Map of the extent of occurrence *Photinus carolinus*. Area of the minimum convex polygon is 241136 km<sup>2</sup>.

## Area of Occupancy

Maps of the area of occupancy for the largest clusters of *Photinus carolinus*, Allegheny National Forest in Pennsylvania and the Great Smoky National Park in Tennessee. Area of occupancy is dependent on the area of grid squares in which the species is found. Four different grid sizes were tested and analyzed, 1x1 km, 2x2 km, 4x4 km, and 10x10 km. The most commonly used is 2x2 km followed by 1x1 and 4x4 km. 10x10 km is commonly used for ecosystems.



## Results

Extent of Occurrence (km <sup>2</sup> )	241136			
Grid Size (km)	1x1	2x2	4x4	10x10
Area of Occupancy (km <sup>2</sup> )	108	360	1072	5000

## Discussion

The species distribution of *Photinus carolinus* has a long range in the United States along the eastern side of the following the Appalachian mountain range. Distribution points seem to be centered at two national park sites, Allegheny National Forest and the Great Smoky National Park. This may be due to the higher levels of sampling at those locations mixed with habitat loss in other non-protected regions.



Following the IUCN Red List Categories and Criteria: Version 3.1:

IUCN Category	Critically Endangered	Endangered	Vulnerable
Extent of Occurrence (km <sup>2</sup> )	<100 km <sup>2</sup>	<5,000 km <sup>2</sup>	<20,000 km <sup>2</sup>
Area of Occupancy (km <sup>2</sup> )	<10 km <sup>2</sup>	<500 km <sup>2</sup>	<2,000 km <sup>2</sup>

The extent of occurrence area found of 241136 km<sup>2</sup> does not place *Photinus carolinus* within levels of vulnerability.

The area of occupancy, however, places *Photinus carolinus* under either endangered, vulnerable, or not vulnerable depending on the grid size used for analysis. There was a positive linear rate between higher area of occupancy and larger grid size. Using the IUCN recommended 2x2 km grid size for most species, *Photinus carolinus* is endangered, at 360<500 km<sup>2</sup>. However, there are clear implications about the importance grid size. While the rating of endangered is the same for both 1x1 and 2x2 km, a grid size of 4x4 km would have placed *Photinus carolinus* in only vulnerable. 10x10 km would have not placed the species under any level of vulnerability.

Future studies that attempt to fill in missing data on the species distribution of *Photinus carolinus* to get more accurate assessments of the extent of occurrence and the area of occupancy would be beneficial. Additionally, studies that analyze the current distribution in the context of habitat type would be advantageous towards the predicting of additional locations of other populations for future data collection.



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