

**Conserving Bumble Bee Biodiversity in the North Atlantic – Appalachian Region:
Identifying Priority Landscapes, Conservation Measures, Communication
Structure and Science; A summary of 2021 Bumble Bee Surveys in the
Appalachian Range of *Bombus affinis*.**

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Re: Creation of a bumble bee geographic conservation area within the central Appalachian Mountains; Detailed survey of *Bombus affinis* abundance and patterns of occurrence in its isolated range in Appalachia.

A geographic conservation area for bumble bees (*Bombus*) was created in the central Appalachian Mountains using the most recent known locations of rusty patched bumble bee (*Bombus affinis*) (RPBB) and local landscape knowledge and expertise (Figure 1). The conservation area was identified as having the potential of RPBB presence, including areas of eastern West Virginia, western Virginia, western Maryland, and southern Pennsylvania. A repeatable and quantitative roadside survey using non-lethal techniques was created to document *Bombus* species in the conservation area. A grid was created that extended across the entire conservation area; random points were generated within each grid cell. The randomly generated points were manually moved to the closest public road, now referred to as a route starting point. For each route starting point a direction (North, South, East, West) to travel from the starting point was generated using a random number table. A total of 167 route starting points were generated representing five separate sets. A set is a group of route starting points distributed across the entire conservation area. A route consists of an unspecified number of survey points spaced two miles apart or safest stopping point after two miles in the randomly generated direction. At each survey point a hand net is used to continuously capture all *Bombus* species observed for 10-minutes and time of day, weather, and GPS location are recorded. Captured bees are transferred from the hand net to a large zip-lock style plastic bag, photographed, counted, identified to species (if possible) and caste, photographed again, and released. The floral resources bees are captured from are recorded as well as the floral resources available but not used. Local habitat features are also recorded such as road type, mowing regime, and landscape setting.

In 2021, a trial *Bombus* monitoring survey (BMS) was initiated in the created conservation area within the central Appalachian Mountains and was successful at locating RPBB. The BMS in 2021 was conducted by one surveyor and consisted of the 34 routes of set 1 and one randomly selected survey point located along a route with abundant floral resources but not at a BMS survey point. Surveys were conducted from July 5 through September 6 between 0930 to 1700 on days of sunny or cloudy skies while not raining or heavy dew with no wind to light wind and temperatures at least 60°F.

A total of 355 survey points were completed, recording 3,503 *Bombus* representing 10 species including RPBB. No *Bombus* were captured at 46 survey points. A RPBB was captured during the BMS at two survey points, a worker from unknown floral resource in Bath County, Virginia and a male from common

milkweed (*Asclepias syriaca*) in Highland County, Virginia (Figure 2). Other *Bombus* species and number of individuals (n) included *B. impatiens* (n=2,802), *B. vagans/sandersoni* (n=430), *B. bimaculatus* (n=163), *B. griseocollis* (n=57), *B. flavidus* (n=21), *B. perplexus* (n=15), *B. fervidus* (n=7), and *B. auricomus* (n=6) (data from these surveys are available from the author). Additionally, five RPBB were located along BMS routes in areas of abundant floral resources but not at a BMS survey point. The locations included a right-of-way adjacent to a road in Pendleton County, West Virginia with two male RPBB on common milkweed (Figure 3) and a wetland adjacent to a road in Pocahontas County, West Virginia with three male RPBB on hollow Joe Pye weed (*Eutrochium fistulosum*). The author is a U.S. Fish and Wildlife Service *Bombus affinis* Recovery Permit holder, permitted to conduct these surveys and collect non-lethal genetic, pollen, and pathogen samples. A genetic sample was collected from all seven RPBB found during the BMS. A separate survey conducted by the author in 2021, specifically to find new RPBB locations and collect non-lethal samples, found 46 RPBB in the region. Combined these surveys found 53 RPBB and collected 46 genetic and 14 pollen samples. During these surveys RPBB was observed foraging on 14 different flowering plant species (Table 1) in the central Appalachian Mountains from June 28 through September 19, 2021.

The 2021 data show the BMS was successful at surveying the *Bombus* community within the created conservation area using non-lethal techniques and locating RPBB. The remaining four sets are anticipated to be completed in 2022 and/or modified in highest probability areas within the central Appalachian Mountains (Figure 1). The highest probability areas were created using the most current known RPBB locations and landscape characteristics (i.e., elevation, topography, hydrology) along with local landscape knowledge and expertise.

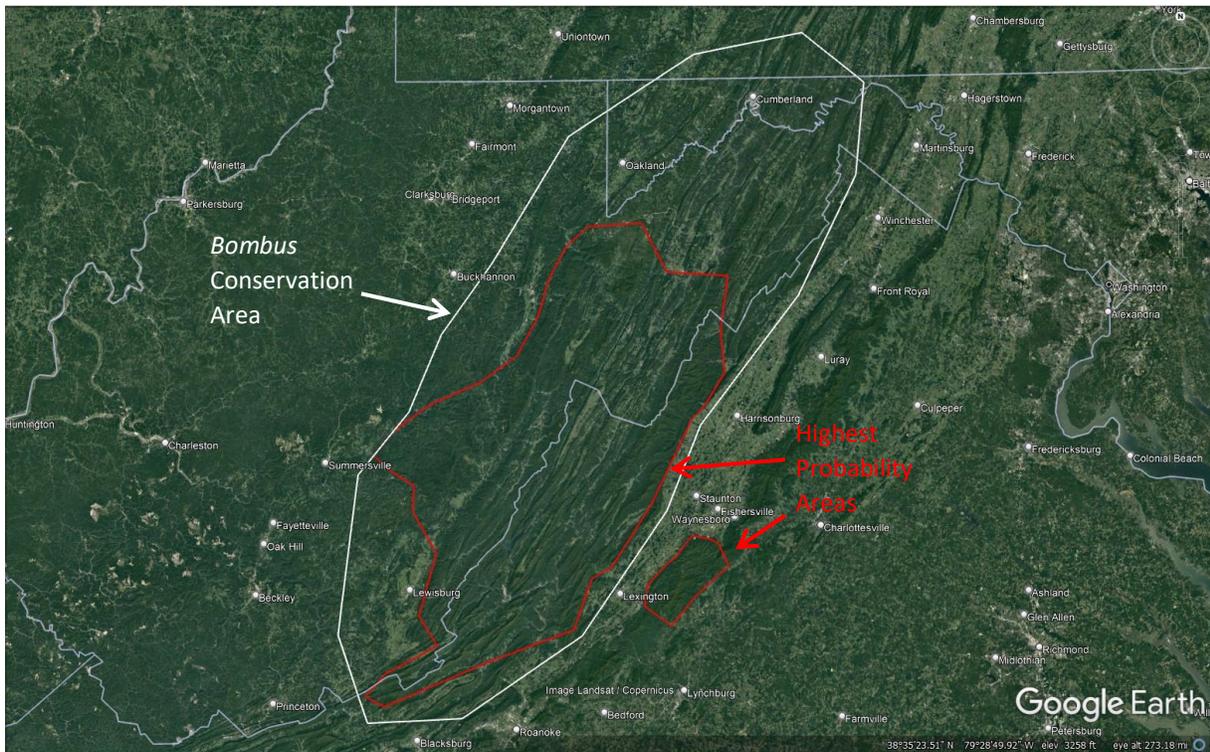


Figure 1. A map showing the created *Bombus* conservation area within the central Appalachian Mountains and created highest probability areas of rusty patched bumble bee (*Bombus affinis*) (RPBB).¹



Figure 2. A photograph of *Bombus* captured, including a male rusty patched bumble bee (*Bombus affinis*) (RPBB), at a *Bombus* monitoring survey point in Highland County, Virginia. Photo taken on July 27, 2021 by Mark J. Hepner.



Figure 3. A photograph of a male rusty patched bumble bee (*Bombus affinis*) (RPBB) on common milkweed (*Asclepias syriaca*) found along a survey route but not at a *Bombus* monitoring survey point in Pendleton County, West Virginia. Photo taken on July 20, 2021 by Mark J. Hepner.

Table 1. A list of flowering plant species rusty patched bumble bee (*Bombus affinis*) (RPBB) was observed foraging on during the 2021 *Bombus* monitoring survey and author’s RPBB specific survey within the central Appalachian Mountains.

Common Name (Scientific Name)
Common Burdock (<i>Arctium minus</i>)
Common Milkweed (<i>Asclepias syriaca</i>)
Early Goldenrod (<i>Solidago juncea</i>)
Field Thistle (<i>Cirsium discolor</i>)
Grass-Leaved Goldenrod (<i>Euthamia graminifolia</i>)
Hollow Joe Pye Weed (<i>Eutrochium fistulosum</i>)
Queen Anne’s Lace (<i>Daucus carota</i>)
Spiny Plumeless Thistle (<i>Carduus acanthoides</i>)
Spotted Knapweed (<i>Centaurea stoebe</i>)
Sunflower (<i>Helianthus</i> sp.)
Sweet Joe Pye Weed (<i>Eutrochium purpureum</i>)
Tall Meadow-Rue (<i>Thalictrum pubescens</i>)
Wild Hydrangea (<i>Hydrangea arborescens</i>)
Wingstem (<i>Verbesina alternifolia</i>)

ⁱ Google Earth Pro. (n.d.) Central Appalachian Mountains, U.S.A. 38° 35' 23.51"N, 79 28' 49.92"W, Eye alt 273.18 mi. Borders and labels; terrain. Landsat/Copernicus. <<https://www.google.com/earth/>> (Accessed October 28, 2021).