Banisteria 59: 92–101

RESEARCH ARTICLE

NEW OCCURRENCE RECORDS FOR THE SOUTHERN PLAINS BUMBLEBEE, *BOMBUS FRATERNUS* SMITH, 1854 (HYMENOPTERA: APIDAE: APINAE), IN VIRGINIA

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Editor: T. Fredericksen | Received 16 January 2025 | Accepted 20 February 2025 | Published 6 March 2025

https://virginianaturalhistorysociety.com/2025/01/08/number-59-2025/

Citation: Weber, J. M., V. R. Emrick III, and T. A. Coates. 2025. New occurrence records for the Southern Plains Bumblebee, *Bombus fraternus* Smith, 1854 (Hymenoptera: Apidae: Apinae), in Virginia. Banisteria 59: 92–101.

ABSTRACT

The Southern Plains Bumblebee (*Bombus fraternus* Smith, 1854) is a bumblebee species that commonly occurs in grassland and open habitats in the Southeastern and Great Plains regions of the United States. The species is thought to be in decline due to habitat loss/alteration, widespread pesticide use, and other factors. This bumblebee species was originally assumed to be restricted to the southeastern portion of Virginia in recent times, though historically was found along the eastern coast of the United States. Here we report the collections of individuals from two locations with no previous records of the species with descriptions of the characters used to identify the specimens.

Keywords: *Bombus fraternus*, grasslands, military lands, native bees, Southern Plains Bumblebee, wildland fire.

INTRODUCTION

The Southern Plains Bumblebee (*Bombus fraternus,* Smith 1854*)* is a bumblebee species associated with prairies, savannas, and other similar grassland conditions (Williams et al., 2014). Historically, the species was distributed throughout the eastern United States, from the Coastal Plain of New Jersey south to central Florida, and throughout the Great Plains (Williams et al., 2014). Records of the species are absent from the Appalachian Mountains and Interior Low Plateau, as well as from the Rocky Mountains west to the Pacific Coast (Williams et al., 2014). However, this species has declined in range size and relative abundance in its historic range in the

last 10 years (Colla et al., 2012). The International Union for Conservation of Nature Red List classifies the Southern Plains Bumblebee as Endangered, and a petition was filed with U.S. Fish and Wildlife Service to list the species under the auspices of the Endangered Species Act (Hatfield et al., 2014; U.S. Fish and Wildlife, 2024).

Most bumblebees are generalists that gather nectar and pollen from a variety of plant species (Michener, 2000; Goulson, 2010). Grassland ecosystems, such as prairies and savannas, typically host high levels of flowering plant diversity and abundance that have species that flower throughout growing season (Augustine et al., 2021). These abundant resources make grasslands important habitats for bumblebee species, regardless of whether the species is a floral generalist or specializes on a few plant species (Rosenberger & Conforti, 2020). Due to the short length of their tongue relative to other bee species, the Southern Plains Bumblebee forages most effectively from flowers with compact shapes, such as those plant species in the genera *Asclepias*, *Cirsium*, *Liatris*, *Rudbeckia*, *Solidago*, and *Verbena* (Williams et al., 2014). The preferred flowers thrive in open habitats, making the Southern Plains Bumblebee especially reliant on grasslands. This species has also been documented in urban and suburban gardens, potentially due to the composition of flowers chosen by the gardeners, providing floral resources that might otherwise be scarce or unavailable in the immediate area (Majewska & Altizer, 2019; Palmersheim et al., 2022).

Similar to other bumblebee species, Southern Plains Bumblebees build their nests below ground and often take advantage of abandoned rodent nests and other similar cavities when available (Michener, 2000; Williams et al., 2014). Males are somewhat territorial and will chase conspecifics and other intruders away from the area around the nest (Williams et al., 2014). Currently, there are no documented parasitic species that target Southern Plains Bumblebee nests (Williams et al., 2014).

Since the majority of the Southern Plains Bumblebee range overlaps with areas of high agricultural activity, the most significant threats for the Southern Plains Bumblebee are believed to be: 1. Habitat degradation due to grassland conversion for agriculture and urban development, 2. An increased use of pesticides for crop production, 3. Disruption of the natural disturbance regimes including fire, and 4. Loss of large grazer populations, such as the American Bison (*Bison bison* L., 1758) that historically helped maintain early successional habitats (Matson et al., 1997; National Research Council, 2007; Winfree et al., 2011; Cameron et al., 2011; Wright & Wimberly, 2013; Hatfield et al., 2014). The suppression of fire and other disturbances needed to create and maintain grassland habitats has also led to a scarcity of suitable areas for populations to persist (Campbell et al., 2018; Moylett et al., 2020; Simmons & Bossart, 2020). Without continued disturbance, woody species begin to invade grassland communities and shift the community away from the flowering plant species that provide nectar and pollen resources to bumblebees and other pollinators (Pickett & White, 1985). In addition to habitat loss, Southern Plains Bumblebees are also threatened by pathogens and parasites carried by managed bumblebee and honeybee hives and competition with non-native bees for limited floral resources (Goulson et al., 2015; Evans et al., 2023).

In Virginia, documented occurrences of the Southern Plains Bumblebee's range were previously limited to the southeastern portion of the state in the Coastal Plain and Piedmont regions, with the James River serving as the northern boundary (GBIF.org, 2023) (Fig. 1). North of these occurrences, the species seems to have been extirpated from most areas east of the Appalachian Mountains.

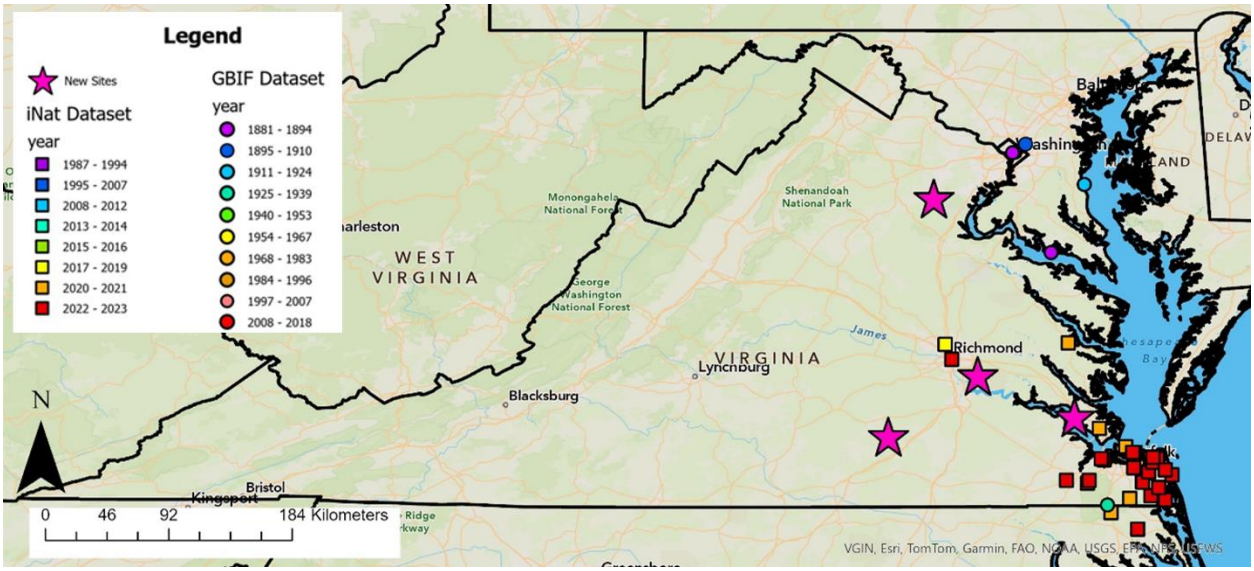

Figure 1. Map of recorded Southern Plains Bumblebee occurrences in Virginia, Maryland, and Washington D.C. from 1881 to 2023. The coloration of the point corresponds to the year of the collection. The pink stars indicate the two new collection areas. Data was collected from the Global Biodiversity Information Facility (GBIF), Symbiota Collections of Arthropods Network (SCAN), and iNaturalist records.

MATERIALS AND METHODS

We observed Southern Plains Bumblebee individuals during bee surveys at two military installations in Virginia. Multiple individuals were collected from Fort Barfoot (known as Fort Pickett until 2023) in Nottoway and Dinwiddie counties and a single individual was collected from Marine Corps Base Quantico in Prince William County. Individuals were encountered during active surveys and captured either in aerial butterfly nets or recorded via photograph.

The initial observation, from Fort Barfoot, was recorded as a photograph (Fig. 2). The photo was initially misidentified due to the absence of previous records from that area and the distance (approximately 96 km) from the closest known area of occurrence at that time. The photographed individual was incorrectly identified as a worn American Bumblebee (*Bombus pensylvanicus*, De Geer, 1773) individual. The species are similar in body size and habitat preference and can have the same black region on the thorax between the wings. The major differences between the species are the cheek length and some coloration on the metasomal segments of the abdomen. In the American Bumblebee, the T1 metasomal segment is usually partially black, the T3 metasomal segment is yellow, and the cheek length is longer than it is wide. The Southern Plains Bumblebee has cheek that is shorter than it is wide, a fully yellow T1 metasomal segment, and a black T3 metasomal segment. The cheek length is difficult to decern from the photograph, and hairs can be worn away by everyday activities. The identification was corrected with help from Dr. Leif Richardson at the Xerces Society for Invertebrate Conservation. The collections from subsequent bee surveys carried out on Fort Barfoot were checked, yielding five additional specimens that matched the individual in the photograph. The collections from other installations were also checked, yielding a single specimen from surveys conducted at Marine Corps Base Quantico from 2021. The specimens were sent to Sam Droege at USGS Patuxent River for independent confirmation of identification. Subsequently, all six specimens were confirmed to be Southern Plains Bumblebees.

Figure 2. The 2019 observation of a Southern Plains Bumblebee on a milkweed plant from Fort Barfoot used in the Marine Corps Base Quantico report. The picture was originally misidentified due to a lack of records in the surrounding area.

The sites where the specimens were collected are grassland habitats, with all having some form of fire (prescribed or accidental ignition) in the past 5 years. The plant communities therein supported flowering plant species that are often associated with Eastern grassland ecosystems, such as milkweeds (*Ascelpias* spp.), goldenrods (*Solidago* spp.), blazingstars (*Liatris* spp.), and thistles (*Cirsium* spp.). The Barfoot photograph (Fig. 2) shows an individual foraging on a stalk of Green Comet Milkweed (*Ascelpias viridiflora* Raf.), and two additional individuals were netted as they foraged on Spotted Knapweed (*Centaurea stoebe* L.). The remaining two Barfoot individuals and the Quantico individual were collected from pan traps, so no floral associations could be made.

Identification/Diagnostic Characters

Identifications were made using the dichotomous key from The Bumblebees of North America: An Identification Guide by Williams et al., 2014. Figures 3, 4, 5, and 6 show selected in-hand diagnostic characters. Photographs were taken using a Nikon D7500 camera with an AF-S Micro NIKKOR 40 mm f/2.8G lens.

Notable characters include: 1. The body is large, with size ranges from 21 to 27 mm for queens, 13 to 19 mm for workers, and 19 to 25 mm for males. 2. The head is very short, with the oculo-malar area (cheek) much shorter than it is broad (Fig. 3). 3. The hair is very short and even on all parts (Fig. 4). 4. Thorax is yellow with a band of black between the wings, except in some males (Figs. 4 and 6). The black band can extend down onto the side of the thorax but may also be absent. 5. Metasomal segments T1 and T2 are always entirely yellow while T3 is always entirely black (Fig. 4). The hair on metasomal segment T3 lies completely flat to the body (Fig. 4).

Segments T4 through T6/T7 are black (Fig. 4). 6. Ocelli are large and located in front of a line between the back edges of the eyes. 7. Females have a very shallow notch in front of the back tooth on mandible.

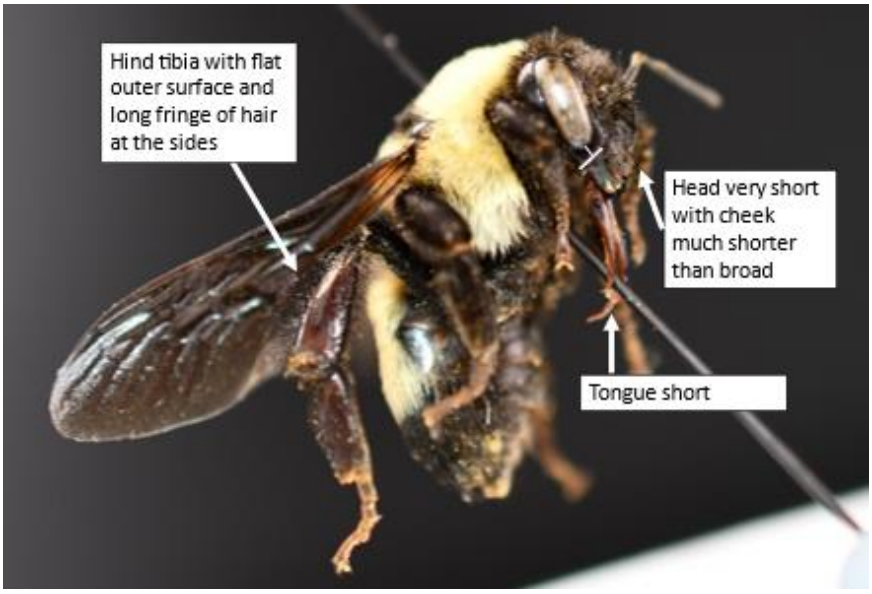

Figure 3. Female worker collected from Fort Barfoot.

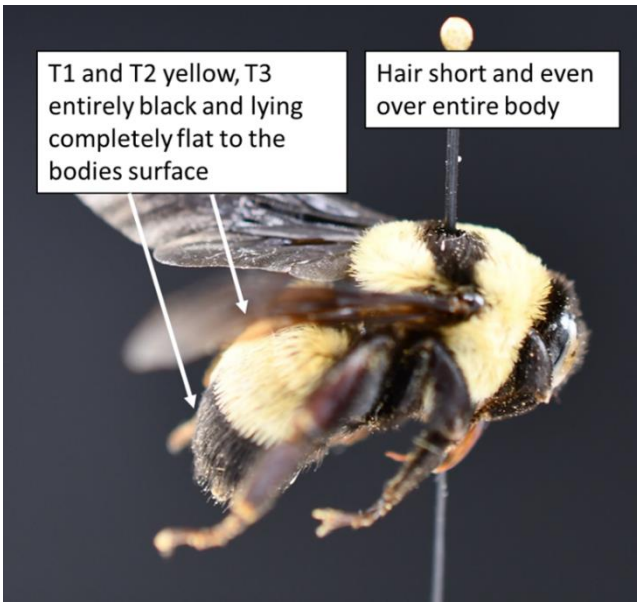

Figure 4. Female worker from Marine Corps Base Quantico.

Figure 5. Male (left) and Female (right) facial differences.

Figure 6. Three Southern Plains Bumblebee specimens collected from Fort Barfoot and Marine Corps Base Quantico. Left, male from Fort Barfoot; Middle, Female (worker) from Fort Barfoot; Right, Female (worker) from Marine Corps Base Quantico.

DISCUSSION

The collection of these Southern Plains Bumblebee individuals from these installations is notable for multiple reasons. The Fort Barfoot records are approximately 80 km southwest of the nearest records from the city of Richmond along the James River. The Quantico individual is over 100 km north of the Richmond records. The typical foraging distance for a worker bumblebee is 1-5 km from the nest, so the individuals encountered were likely not foraging transients but residents (Osborne et al., 2007). In addition, there were no prior records of the Southern Plains Bumblebee in the area around Fort Barfoot. While records of the species do exist in regions closer to Marine Corps Base Quantico, these records date to the early 1900s (GBIF.org, 2023). The closest record is an individual collected in 1883 located approximately 35 miles northeast in Washington D.C., followed by a record from Riverdale, MD collected in 1902, approximately 41 miles northeast of the Quantico record (GBIF.org, 2023). The species has not been documented in these areas in recent years (GBIF.org, 2023).

In addition, with multiple specimens and photographs from multiple sites and across multiple years at Fort Barfoot, it is very likely that there is a resident population. The status at Quantico is less certain, since only one individual was collected, and has not been re-surveyed for that species since the initial collection. However, the individual was a female worker, thereby indicating that a nest was likely in the area near the collection site.

Furthermore, the presence of these individuals without attempts to manage specifically for their habitat indicates that the land management strategies and other non-management activities (i.e., training) implemented on these installations are effective at creating and maintaining suitable habitats for this species. A common theme amongst the collection sites appears to be relatively recent fire (either intentional or accidental). Prescribed fire is commonly used to create and maintain early successional habitat for a variety of plants and animals (Brockway et al., 2002). Prescribed fire is used widely at Fort Barfoot for management purposes (Environmental Branch-Fort Barfoot, 2021). Fire is less frequent at Marine Corps Base Quantico, but the historic old fields and regeneration units found throughout the installation may have been providing the necessary habitat (Natural Resources and Environmental Affairs Branch- MCBQ, 2015). The effects of fire on bee communities can vary depending on the community composition and the extent of alterations to the resident plant communities (Campbell et al., 2018; Moylett et al., 2020; Simmons & Bossart, 2020; Ulyshen et al., 2022; Burkle et al., 2019). Fire that is too frequent can reduce the availability of floral resources by preventing the recovery and growth of plants in burned areas (Simmons & Bossart, 2020). Infrequent disturbance of any type, fire included, allows for rapid woody invasion in the mesic eastern United States (Brockway et al., 2018). While most bumblebee species are considered habitat generalists and use a variety of habitats, Southern Plains Bumblebees prefer open, early successional habitats like prairies and savannas (Williams et al., 2014). The ideal fire frequency will prevent the community from advancing beyond the early successional phase, maintaining it as a grassland. Other types of disturbance, such as mowing, military vehicle maneuvers and herbicides, are also able to create and maintain early successional habitats and are likely also contributing to the maintenance of the grasslands the Southern Plains Bumblebee is inhabiting (Stein et al., 2008).

Finally, new collections in locations distant from the previously known range indicate that additional surveys of grasslands may be warranted to further elucidate species distribution in Virginia. Previous occurrence records of the species in Virginia were located within the Coastal Plains region, while our new records were from the Piedmont region. Prior to European colonization and expansion, much of the Coastal Plain and Piedmont were grassland ecosystems, which would have been suitable habitat for the Southern Plains Bumblebee (Sayler et al., 2016). While most of the land has been converted to various uses, remnant pockets of habitat similar to these historic grasslands remain. Other areas that are maintained as grasslands for recreation, education, and other purposes, may also be hosting populations of this species. Inspection of previous collections for misidentified specimens from grassland areas in the Piedmont and Coastal Plain regions outside of the previously known range may also be warranted.

ACKNOWLEDGEMENTS

The authors would like to thank the Natural Resource Office at Marine Corps Base Quantico and the Environmental Office at Fort Barfoot for providing funding and for their assistance with base access, Dr. Leif Richardson and Sam Droege for their assistance with photograph and specimen identification, and Dr. Roger Schürch for the use of his specimen

photography equipment. Dr. Margaret Couvillon and Dr. Mark Ford provided helpful comments on early drafts of the manuscript.

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B A N I S T E R I A

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

ISSN 1066-0712

Published by the Virginia Natural History Society

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