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Bumble Bees, *Bombus* Latreille (Hymenoptera: Apidae), in State Wildlife Action Plans: New Opportunities for Conservation

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Abstract: We report significant growth in interest and available resources for the conservation of bumble bees, *Bombus* Latreille (Hymenoptera: Apidae), in the USA, as measured by the inclusion of these species in the 56 U.S. State Wildlife Action Plans. In the first editions of these plans, completed in 2005, only three states included a total of three species of the genus *Bombus* in their plans. In the second editions of these plans, completed in 2015–2016, 26 states and the District of Columbia included 25 species of the genus *Bombus* in their plans as "Species of Greatest Conservation Need." The species most frequently identified by states as "Species of Greatest Conservation Need" included *Bombus affinis* Cresson (17 states and the District of Columbia), *B. pensylvanicus* (De Geer) (17 states), *B. terricola* Kirby (15 states), and *B. fervidus* (Fabricius) (11 states). A complete list of the *Bombus* species included in these plans and a map showing the associated states are provided. Inclusion of these species in these plans will increase the available funding for bumble bee conservation and provide new opportunities for interstate and regional partnerships to conserve these species.

Keywords: Apidae, Apoidea, *Bombus*, bumble bee, conservation, Hymenoptera, pollinator

Significant declines have been reported in populations of many North American species of bumble bees, *Bombus* Latreille (Hymenoptera: Apidae; Figure 1) (Brown 2011, Cameron et al. 2011, The Xerces Society for Invertebrate Conservation 2019), and multiple species in this genus have been formally proposed for listing under the U.S. Endangered Species Act (The Xerces Society for Invertebrate Conservation 2010, 2013). Reports of bumble bee population declines in the USA have generated considerable interest among conservation biologists (Brown 2011) and wildlife managers (Learn 2016). Here we document the growth of interest and enhanced opportunities for bumble

bee conservation in the USA between 2005 and 2016, as reflected by increased inclusion of *Bombus* species in the 56 U.S. State Wildlife Action Plans.

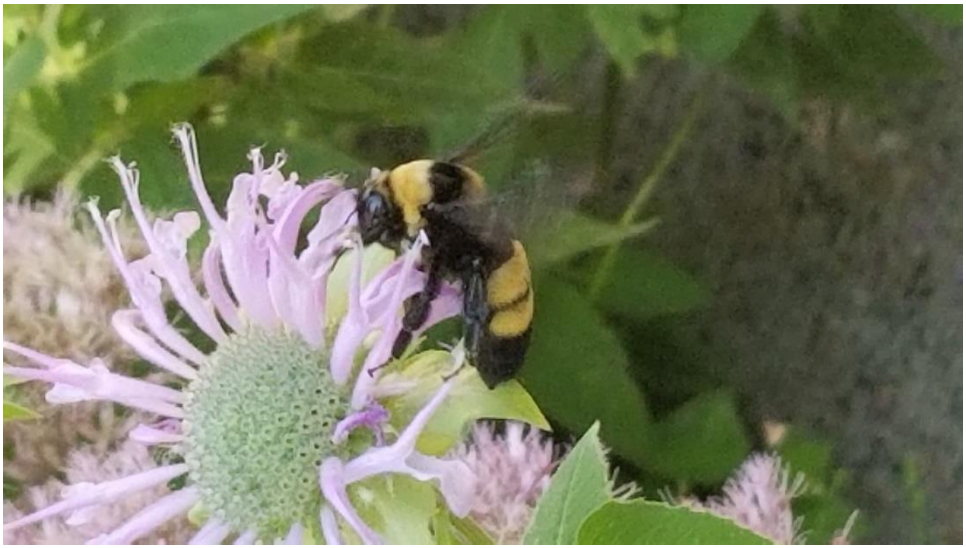

Figure 1: *Bombus auricomus* (Robertson) visiting wild bergamot, *Monarda fistulosa* L. (Lamiaceae), on the National Mall in Washington, DC, USA. This bumble bee species has been identified as a "Species of Greatest Conservation Need" in Delaware and Maryland.

The State Wildlife Action Plans (SWAPs) are documents that describe approaches for the conservation of wildlife species and ecological communities in each of the 50 U.S. states, the District of Columbia, and five U.S. territories (Riexinger and Williamson 2009, Stoms et al. 2010, Meretsky et al. 2012). Under the U.S. federal system, the governments of these individual states and territories have legal responsibility for managing much of the nation's biodiversity, including many of the animal pollinator species which are not listed under the federal Endangered Species Act (Association of Fish & Wildlife Agencies 2012, The Heinz Center 2013, Mawdsley et al. 2016).

Each of the 56 SWAPs is intended to present a comprehensive blueprint for the conservation of aquatic and terrestrial biodiversity within a particular state or territory. Each plan, developed in collaboration with multiple conservation partners, contains a set of common elements: a list of species of conservation interest, called "Species of Greatest Conservation Need" (SGCN); descriptions of the habitats occupied by these wildlife species; descriptions of threats to species and their habitats; identification of monitoring approaches, including both status and effectiveness measures; provisions for public engagement; and provisions for review and revision of the plans (Riexinger and Williamson 2009, Stoms et al. 2010, Fontaine 2011, Meretsky et al. 2012). The first set of SWAPs was completed in 2005 (Association of Fish & Wildlife Agencies 2012), and a

second, revised, set of plans has now been completed by states and territories and published online in 2015–2016 (Mawdsley et al. 2016).

Although pollinators were not specifically identified as a priority for inclusion in the original SWAPs, many states did include taxa from insect pollinator groups in their first plans. According to an analysis and review published by The Heinz Center (2013), 127 species of butterflies (Lepidoptera: Papilionoidea) and 103 species of skippers (Lepidoptera: Hesperioidea) were mentioned in 40 of the 56 original plans; 24 plans mentioned one or more native moth species (Lepidoptera); 11 plans included flies (Diptera); and 10 plans mentioned social or solitary bees (Hymenoptera: Apoidea), including a total of 31 bee taxa. Three states (Alaska, California, and Illinois) included three species of the genus *Bombus* as SGCN (*Bombus franklini* (Frison), *B. fraternus* (Smith) and *B. occidentalis* Greene) in their original State Wildlife Action Plans (The Heinz Center 2013, Mawdsley and Humpert 2016).

A revised set of SWAPs was prepared and released by the individual U.S. state fish and wildlife agencies in 2015–2016 (Mawdsley et al. 2016). Preliminary data collected from state wildlife agency staff before the final completion of these plans indicated that many of the revised plans were likely to include bumble bees and other pollinator taxa as SGCN (Mawdsley and Humpert 2016). Because these plans are directly associated with dedicated funding from federal and regional grants programs, the inclusion of species of the genus *Bombus* in these plans will create important new opportunities for bumble bee conservation efforts in North America.

METHODS

Staff from the Association of Fish & Wildlife Agencies conducted annual or semi-annual web-based surveys of the 56 SWAP coordinators between 2013 and 2016, in order to learn more about the progress of the individual plan revisions, as well as the plant and animal taxa that were likely going to be included in the revised plans. The online "Survey Monkey" platform (www.surveymonkey.com) was used to collect this information from the SWAP coordinators. Surveys conducted in May 2015 and May 2016 specifically asked about the possible inclusion in the revised plans of representatives from animal taxa that included known or likely pollinator species. The May 2015 survey asked states and territories whether they were planning to include native bees (Hymenoptera: Apoidea) in their revised plans, while the May 2016 survey asked specifically whether the individual states and territories were including bumble bees, *Bombus* spp., in the revised plans. In four cases of non-response to this question (i.e., either the state representative did not complete the survey, or left the question about bumble bees blank), the authors followed up directly with the SWAP coordinator in the non-responsive state in order to obtain information about the inclusion of bumble bees in the revised plan.

For those states that had indicated in the surveys that they would be including bumble bees in their revised plans, the authors then reviewed final copies of their revised plan documents in 2016 as posted on official state government websites (links to all 56 plans are available at: https://www.fishwildlife.org/afwa-informs/state-wildlife-action-plans). For each plan, the authors downloaded the relevant portion(s) of the document which

contained the lists of SGCN in .pdf or .docx or .xlsx formats. The authors then performed a comprehensive word search for the following strings of text characters: "bumble," "bumblebee," "bee," and "*Bombus*." All species of *Bombus* that had been included as SGCN in the revised plans were then listed in a Microsoft Excel spreadsheet, along with a comprehensive list of the individual states that had included each of these species as SGCN.

RESULTS

Twenty-seven of the revised SWAP documents included at least one species of the genus *Bombus* as an SGCN. One additional state (Colorado) did not include bumble bees as SGCN, but did mention The Xerces Society for Invertebrate Conservation and collaborators' "Bumble Bee Watch" citizen science program (www.bumblebeewatch.org) in the revised plan's chapter on monitoring of wildlife species. Twenty-five species of *Bombus* were included in total across all of the revised plans. Lists of these species with the associated states are presented in Table 1. Species most frequently identified by states as SGCN included *Bombus affinis* Cresson (17 states and the District of Columbia), *B. pensylvanicus* (De Geer) (17 states), *B. terricola* Kirby (15 states), and *B. fervidus* (Fabricius) (11 states).

Table 1: *Bombus* Latreille species included in the 2015–2016 revised U.S. State Wildlife Action Plans. States are designated by their postal abbreviations.

Species	States including the species as a "Species of Greatest Conservation Need"
B. affinis Cresson	CT, DC, DE, GA, MA, MD, ME, MI, MN, NC, NH, NJ, NY, PA, RI, VA, VT, WI
B. ashtoni (Cresson)	CT, DE, MD, ME, NJ, NY, PA, VT
B. auricomus (Robertson)	DE, MD
B. bohemicus (Seidl)	MN, VA
B. borealis Kirby	GA, NY
B. citrinus (Smith)	MD, ME, VT
B. fernaldae (Franklin)	ME, VT
B. fervidus (Fabricius)	ID, MA, ME, MN, NC, NH, NJ, NY, VA, VT, WI
B. franklini (Frison)	CA, OR
B. fraternus (Smith)	DE, IL, NC, NJ, OK, VA
B. frigidus Smith	WI
B. griseocollis (De Geer)	ME
B. huntii Greene	ID
B. insularis (Smith)	ID, WA
B. morrisoni Cresson	ID, WA
B. occidentalis Greene	AK, CA, ID, OR, WA
B. pensylvanicus (De Geer)	CT, DE, ID, LA, MA, MD, ME, MN, NC, NH, NJ, NY, OK, TX, VA, VT, WI
B. perplexus Cresson	VT, WI
B. rufocinctus Cresson	VT
B. sandersoni Franklin	MD, ME, NJ, WI
B. sonorus Say	TX
B. suckleyi Greene	ID, WA
B. terricola Kirby	CT, MA, MD, ME, MI, MN, NC, NH, NJ, NY, PA, RI, VA, VT, WI
B. vagans Smith	DE, MD, NC
B. variabilis (Cresson)	DE, MD, NC, NJ, TX, VA

Figure 2 shows states with at least one species of Bombus in their revised SWAP. As can be seen from Figure 2, these states include much of the northeastern United States, the entire west coast, and separate clusters of states in the upper Midwest and lower central portion of the country.

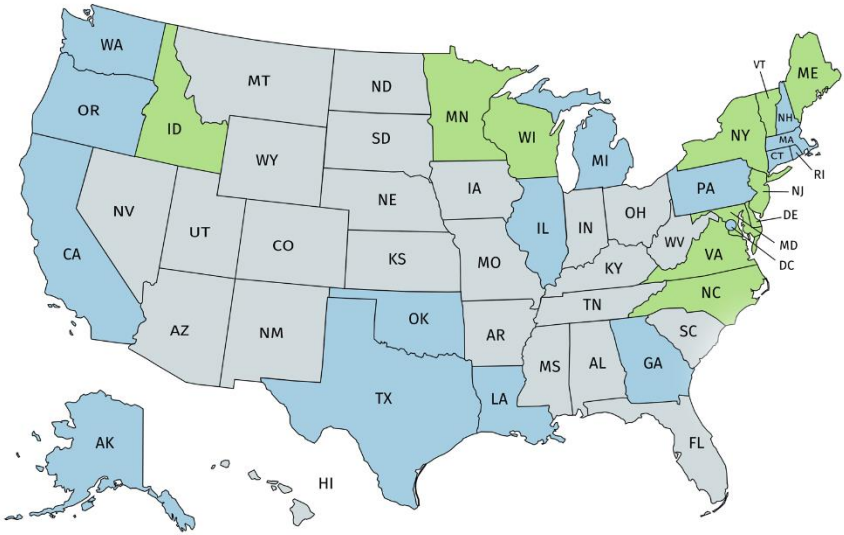

Figure 2: Map of the United States showing states with species of the genus *Bombus* as "Species of Greatest Conservation Need" (SGCN) in their most recent State Wildlife Action Plan (SWAP). States in blue have one to four species; states in green have five or more species.

The percentage increase in the number of bumble bee species included in the revised SWAPs is at least an order of magnitude greater than the increases observed in other groups of organisms. Overall, the number of bumble bee species included in the SWAPs increased from three in 2005 to 25 in 2015–2016, a percentage increase of 733%. The total number of taxa included in all 56 plans increased from 12,363 in 2005 to 17,200 in 2015–2016, a percentage increase of 39%, while the total number of insect taxa increased from 2,488 to 3,516, a percentage increase of 41% (United States Geological Survey 2019). Looking at other invertebrate groups, the number of mollusk taxa increased from 1,223 to 1,342, a percentage increase of 10%, while the number of crustacean taxa decreased from 842 to 746, a decrease of 11% (United States Geological Survey 2019).

DISCUSSION

The SWAPs are closely linked to important funding sources for wildlife conservation in the United States, particularly the State and Tribal Wildlife Grants Program which is administered by the U.S. Fish and Wildlife Service (Association of Fish & Wildlife Agencies 2011, 2012). This grant program provides each state with annual funding for the conservation of those wildlife species that are not the subject of active hunting or trapping programs (the so-called "non-game" species). Each state receives a direct apportionment of funding from this program each year, and funds are also available for competitive grant proposals to support projects that benefit multiple states. The financial support from this program is intended to benefit the conservation of species which are included as SGCN in the SWAPs (Association of Fish & Wildlife Agencies 2011, 2012).

By including bumble bees as SGCN in their revised SWAPs, 26 states and the District of Columbia now have expanded opportunities to conduct conservation activities to benefit these species. One of the most important sources of financial support for these conservation activities is the State and Tribal Wildlife Grants Program, which has contributed over one billion US$ towards the conservation of SGCN and their habitats since the program's inception in the year 2000 (Association of Fish & Wildlife Agencies 2012). Activities that could potentially be funded through these grants program include surveys and monitoring for rare bumble bee species, status reviews and the development of conservation plans for individual species or groups of species, and projects to restore and enhance bumble bee habitats. In addition, multiple states could work together to develop broader, cross-boundary conservation strategies for rare and declining bumble bee species using dedicated funding available through the competitive portion of the State and Tribal Wildlife Grants Program. Finally, funding may also be available to conserve these species from other grant programs, such as the Northeast Association of Fish and Wildlife Agencies' Regional Conservation Needs Grant Program (Northeast Fish and Wildlife Diversity Technical Committee 2015). Together, these resources offer significantly expanded opportunities for bumble bee conservation in the United States.

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