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of some large crabronid wasps in Arkansas
(Hymenoptera: Crabronidae)

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Internet-based data platforms re-define the distributions of some large crabronid wasps in Arkansas (Hymenoptera: Crabronidae)

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Abstract. The geographic distributions of three large wasps, *Sphecius speciosus* (Drury), *Stictia carolina* Fabricius and *Stizus brevipennis* Walsh (Hymenoptera: Crabronidae), occurring in Arkansas are defined using museum specimens and three internet-based data platforms. The internet-based data platforms generally provided more county location records than museum records. Using data from internet sources for easily identified species can better serve to illustrate the known distributions for some species thus making for a powerful tool elucidating distributional patterns and conservation planning.

Key words. Cicada killer, horse guard wasp, eastern Stizus, conservation planning.

ZooBank registration. urn:lsid:zoobank.org:pub:DCAE9192-1765-40CD-952B-0A094F413991

Introduction

Internet-based data platforms (IDPs) that allow for posting natural history photographs and locality data (e.g., iNaturalist and BugGuide), or other platforms that aggregate such data, including Symbiota2 Collections of Arthropods Network (SCAN), and Global Biodiversity Information Facility (GBIF), are becoming increasingly popular among both amateur naturalists and professional scientists. Such biodiversity platforms are proving useful for scientists who seek to better define the distributions of some species (Bowles et al. 2015; Bowles 2018; Sumner et al. 2019). These IDPs are particularly useful for such purposes when the species is readily identifiable based on a photograph.

Wasps in the family Crabronidae (subfamily Bembicinae, tribe Bembicini; square-headed and sand wasps) are large in size (up to 5 cm long) and visually striking with black and yellow markings. Members of this group are predatory ground-dwellers that typically excavate nests in friable soils (Evans and O'Neill 2007). The black and yellow coloration of most crabronids coupled with simple characters to distinguish them, makes them prime targets to secure distributional data using photographs. Three such crabronid wasps occurring in Arkansas include the cicada killer, *Sphecius speciosus* (Drury, 1773), the horse guard wasp, *Stictia carolina* (Fabricius, 1793), and the eastern stizus, *Stizus brevipennis* Walsh, 1869. Moreover, the distributions of these species in Arkansas have not been previously reported.

This paper describes the known geographic distributions of these species in Arkansas using specimen data from the University of Arkansas Arthropod Museum in addition to several IDPs to assess the importance of citizen collected data for re-defining distributional patterns for conservation planning purposes.

Materials and Methods

Distributional data for species included here were obtained from specimens I collected, the University of Arkansas Arthropod Museum, Fayetteville Arkansas (UAAM), as well as Symbiota2 Collections of Arthropods Network (SCAN; scan-all-bugs.org), Bugguide.net, and iNaturalist.org. I did not include Global Biodiversity Information Facility (GBIF, <https://www.gbif.org/>) records in the analysis since those aggregated records overlap extensively with those of iNaturalist and BugGuide. Although some of the records in SCAN also overlap with iNaturalist and

BugGuide, that database included more museum records than did GBIF and was included in the analysis. Photographs of each specimen posted to those sites were carefully examined to ensure the proper identification. I did not physically examine the specimens listed for on-line sources, and I could not determine if all specimens were deposited in museums or if they still exist. Because the emphasis of this study is on county-level distributions, specific collection data are not presented. Photographs are by the author unless otherwise indicated.

Results

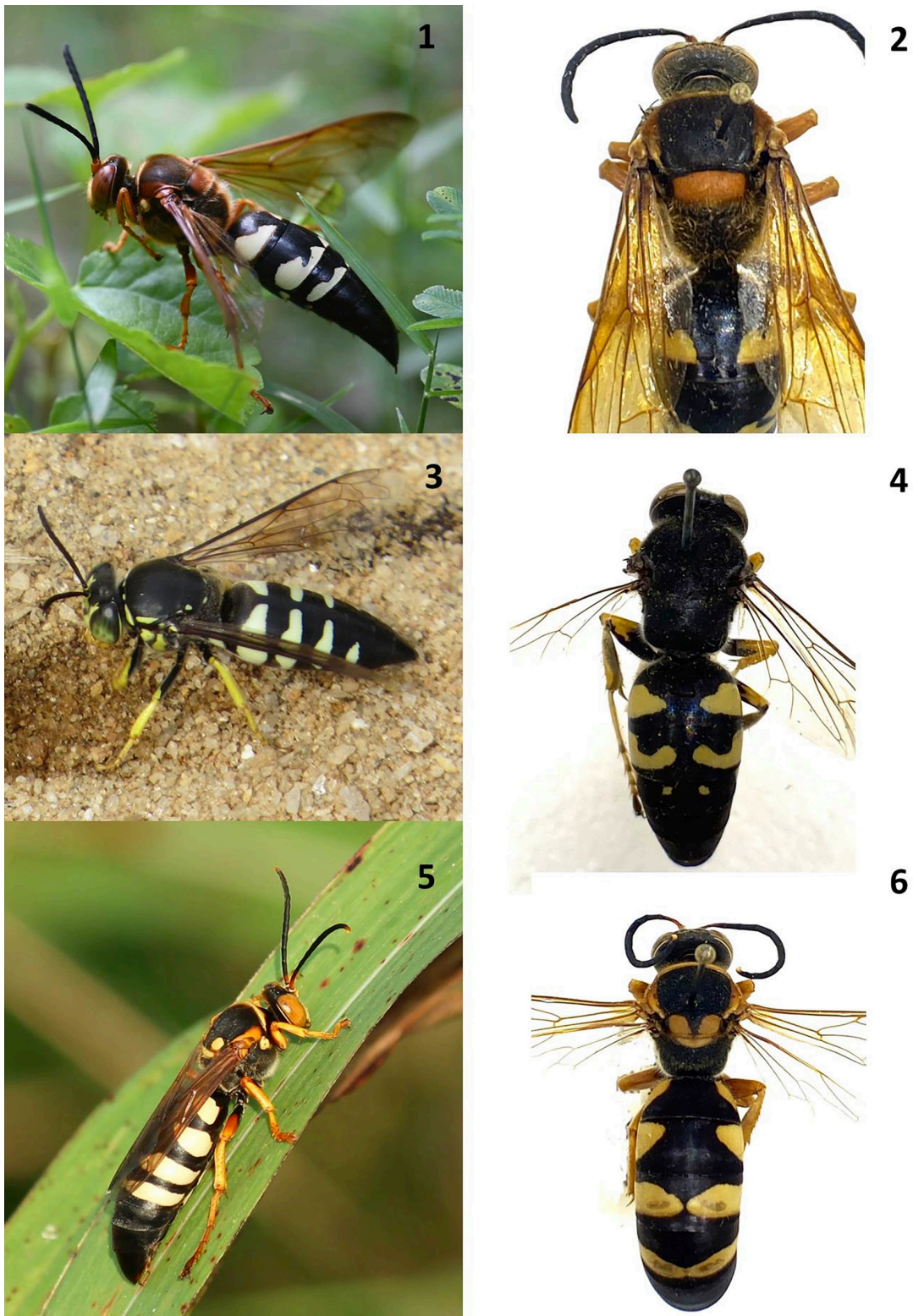
The three species included in this study have a superficially similar appearance in that the body coloration is largely black with yellowish markings on the abdomen. They can be readily distinguished using eye coloration and shape and coloration of marks on the metanotum (Fig. 1–6). For example, *Sphecius speciosus* has light brown eyes, and the metanotum has a brown oval-shaped marking (Fig. 1–2). *Stictia carolina* (Horse guard wasp) has black eyes and the metanotum is entirely black (Fig. 3–4). *Stizus brevipennis* also has light brown eyes, but the metanotum has a distinct, yellow, V-shaped marking (Fig. 5–6). All three species are easily separated using photographs.

Among the 75 counties in Arkansas, the UAAM collection has specimens of *S. speciosus* from only five counties (6.7%, Table 1). Distributional data from iNaturalist, BugGuide and SCAN produced 26 additional county records thereby increasing statewide coverage to 31 counties (41.3%) (Fig. 7, Table 1). For *S. carolina*, there were 10 county records in the UAAM collection or 13.3% of Arkansas counties represented (Fig. 7, Table 1). Six additional county records were found among the IDPs, thus increasing its state-wide county coverage to 21.3%. *Stizus brevipennis* was the rarest of the three species presented here being represented by only four counties in the UAAM (5.3%) (Fig. 7, Table 1). Records of this species from nine additional counties were found among BugGuide, iNaturalist and SCAN. The total known statewide coverage for this species in Arkansas is 13 counties or 13.3%.

Generally, more county level records were obtained from the IDPs compared to the holdings in the UAAM (Fig. 8). The only exception was for *S. carolina* where a few more records were found in the UAAM compared to the IDPs. Among the internet databases, iNaturalist provided the most records (Fig. 8). There was some modest overlap in occurrences among the IDPs (not further analyzed here), including the same specimen photographs and records in some instances.

Table 1. Counties of occurrence for three species of Crabronid wasps in Arkansas found in the University of Arkansas Arthropod Museum (UAAM), Symbiota2 Collections of Arthropods Network (SCAN), BugGuide, and iNaturalist.

Source	<i>Sphecius speciosus</i>	<i>Stictia carolina</i>	<i>Stizus brevipennis</i>
UAAM	Crawford, Jefferson, Logan, Miller, Washington	Crawford, Crittenden, Desha, Hempstead, Howard, Lee, Little River, Mississippi, Montgomery, Nevada	Benton, Crawford, Prairie, Washington
SCAN	Baxter, Garland, Pulaski, Searcy, Sebastian	Pope, Sebastian	Benton, Cleburne, Johnson, Pulaski, Washington
BugGuide	Baxter, Sebastian, Hot Spring, Searcy	Pope, Sebastian	Johnson, Washington
iNaturalist	Ashley, Benton, Boone, Carroll, Cleburne, Columbia, Craighead, Crawford, Crittenden, Faulkner, Garland, Grant, Johnson, Lafayette, Lonoke, Newton, Poinsett, Polk, Pope, Pulaski, Saline, Sebastian, Stone, Van Buren, Washington	Craighead, Lawrence, Pope, Sebastian, Yell	Benton, Cleburne, Craighead, Faulkner, Johnson, Pope, Pulaski, Washington



Figures 1–6. Photographs of three species of crabronid wasps occurring in Arkansas. 1–2) *Sphecus speciosus*. 1) Lateral (Andy Reago and Chrissy McClarren_Flickr 50202938888_CC BY 2.0 DEED). 2) Dorsal. 3–4) *Stictia carolina*. 3) Lateral (Gordon C. Snelling_iNaturalist_43558725_CC by 4.0 DEED). 4) Dorsal. 5–6. *Stizus brevipennis*. 5) Lateral (Cara Flinn_ used with permission). 6) Dorsal.

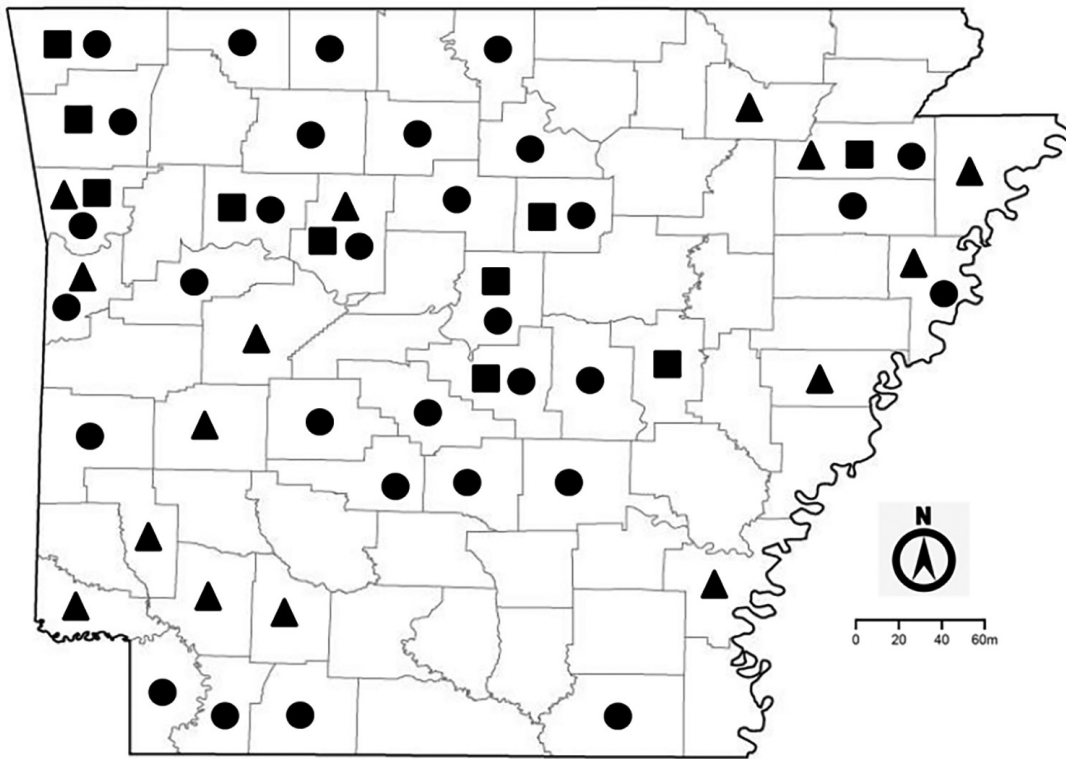


Figure 7. Map of the known geographic distributions for *Sphecius speciosus* (circle), *Stictia carolina* (triangle), *Stizus brevipennis* (square) in Arkansas.

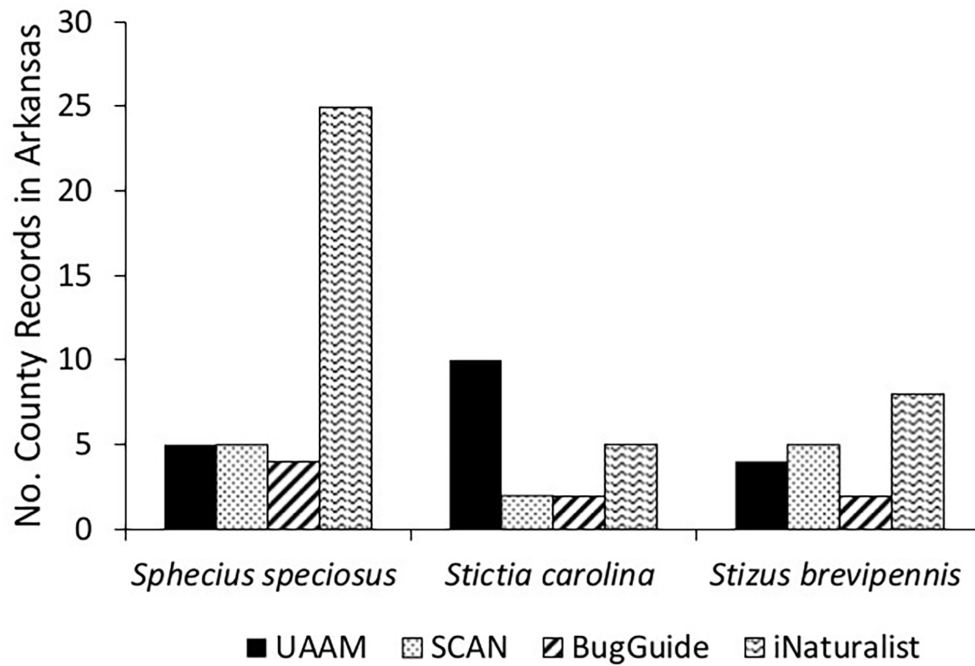


Figure 8. Number of county records for three species of wasps in the University of Arthropod Arthropod Museum (UAAM), and three internet-based data platforms.

Discussion

Collection data obtained from on-line sources expands the known ranges in Arkansas for the three species in this study. Using museum specimens alone would have grossly underestimated their distribution in the state and could produce misleading results, especially for the rare species. I recognize that I only physically examined specimens from one collection although most of the major collections in the United States are represented in the SCAN database. Moreover, the UAAM holds specimens of each species that were collected over several decades with most specimens dating from the 1950s and 1960s. It is unknown if those species still occur in those counties. In contrast, specimens photographed by amateur naturalists and uploaded to the IDPs add more recent collections.

The scant holdings of *S. carolina* and *S. brevipennis* in the UAAM, as well as the few records available from the IDPs, may be due to the rarity of these species and potentially represent their respective population declines in Arkansas. In contrast, *S. speciosus* is common and widespread in the state and specimens can be routinely observed during the warmer months. Given the introductions of other predatory wasps and hornets (Abbate et al. 2018; Skvarla et al. 2022), populations of the species included here potentially could be impacted by direct predation or through interspecific competition. The scarcity of *S. carolina* and *S. brevipennis* in Arkansas and the identified threats of introduced species and climate change, suggests those two species should be added as species of conservation concern in the state.

While IDPs cannot be practically used for visual identification of difficult to identify or cryptic species, they are a powerful tool for establishing the distributions of species that can be reliably identified using photographs. Among the IDPs I examined, iNaturalist produced the most novel distributional records, but using all the data platforms in addition to museum collections provided the most complete distribution maps for these species. It is noteworthy that iNaturalist and BugGuide do not include digital museum records in contrast to platforms such as GBIF and SCAN, which aggregate both of these record sources. Another limitation of iNaturalist is that it allows users to obscure location information and automatically obscures it for species of concern at state level. This means that a common and widespread species whose range barely includes Arkansas, potentially could be listed in iNaturalist but with its location obscured and with occurrences plotted incorrectly. Therefore, caution must be used when reviewing those data.

The data presented here clearly show that a body of amateur naturalists can, in some instances, provide a far greater number of observations and distributional coverage for some species compared to what a few professionals can provide. Data mining IDPs, where practical, can be a powerful conservation tool for understanding the distributions of some species. Based on these findings and those of Bowles et al. (2015), Bowles (2018) and Sumner et al. (2019), I encourage other researchers to use those sources in their studies.

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