

The Social Wasps in Indiana (Hymenoptera: Vespidae)

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The family Vespidae includes a relatively large number of species which may be identified as adults by the following set of morphological characters; pronotum reaching the tegulae; wings capable of being folded longitudinally; and length of the first discoidal cell greatly exceeding that of the submedian cell. Seven subfamilies are recognized in North America (Bohart, 4), four of which occur in Indiana. Only the subfamilies Vespinae and Polistinae contain social species and it is with these groups that this paper is concerned.

Key to the Subfamilies of Vespidae Occurring in Indiana

1. Middle tibiae each with one apical spur; tarsal claws with teeth or bifid; solitary species which typically use mud for nest construction and/or cell partitions2
- 1'. Middle tibiae each with two apical spurs; tarsal claws without teeth and not bifid; social (or rarely, parasitic) species which construct nests of "paper"3
2. Mandibles short and broad; first abdominal segment petiolate; clypeus wider than longZethinae
- 2'. Mandibles elongate, relatively slender, often crossing over one another; first abdominal segment petiolate (in which case clypeus is longer than wide) or truncateEumeninae
3. First abdominal segment truncate basally; hind wings without an anal lobe; nest of multiple brood combs enclosed in an envelopeVespinae
- 3'. First abdominal segment tapering basally; hind wings with an anal lobe; nest a single, exposed brood comb.....Polistinae

The biology of the species of Vespidae is a panorama of diversity. Within the family are species that are solitary, semisocial, subsocial, social or socially parasitoid. Occasionally, certain species will fall into two of the above habit categories, depending upon environmental conditions. Excellent general accounts of vespid biology are those of Fichener and Michener (14), Richards (20), and Wheeler (23). Evans (9, 10) has presented two brilliant analyses of evolutionary behavioral patterns which include considerations of the vespids.

This paper is presented in the hope that the records of Indiana species and aids in their identification will provide a basis for studies by others. The social vespids are especially good subjects for behavioral, life history, social development or population ecology studies. Evans (9) has stated that *Polistes* is something of a "key genus" in understanding the origins of social life in wasps.

Literature citations have been minimized. The keys are modified from those published previously by Bequaert (1, 2) and Miller (16). Extensive bibliographies are to be found in most papers cited here.

Vespinae

Six species, belonging to the genus *Vespa*, are known to occur in Indiana. Of the six species, four are commonly called yellow-jackets and placed in the subgenus *Vespula*; the remaining two species are hornets and are placed in the subgenus *Dolichovespula*. The genus *Vespa*, containing one species, *V. crabro germana*, has been included for reasons given under that species.

The biology of the species of Vespinae has been treated by Duncan (7) in a most comprehensive fashion. Briefly, the nests of *Vespa* are usually constructed in hollow trees or other interspaces; those of *Vespula* (*s.s.*) are typically subterranean; whereas, those of *Dolichovespula* are aerial. The larvae are fed primarily on foodstuffs of animal origin, flies constituting a large proportion of the food. The adults are omnivorous, feeding on the nectar and pollen of flowers, the pulp and juices of ripe fruits and animal fluids from prey or carrion.

There is no intergradation in size of females so that queens and workers are distinct as castes. The species overwinter as fecundated queens which are found especially beneath logs. The queens, in hibernation, hold their wings beneath the body.

Because of their predaceous habits, the species are generally regarded as beneficial. However, the aggressiveness of the females in defense of the nest is well-known. Yellow-jackets pose the greatest problem because of their well-concealed, subterranean nests. In general, when nests of vespids occur in areas of human occupation, these nests and their populations should be destroyed because they constitute a definite hazard. The European hornet (*V. crabro germana*) does additional damage by stripping the bark from trees and shrubs to secure nesting materials.

Bequaert (1) and/or Miller (15, 16) have recorded all of the species from Indiana with the exception of *V. arenaria*.

Key for the Identification of Species
of Vespinae Occurring in Indiana

1. Head very large, swollen behind the eyes; vertex long; posterior ocelli on a line connecting the upper lobes of the eyes and 4 to 6 times as far from the occiput as from each other*Vespa crabro germana*
- 1.' Head not unusually large, not swollen behind the eyes; vertex short; posterior ocelli on a line connecting the tops of the eyes and subequally distant from the occiput as from each other (*Vespula*, *s.l.*) 2
2. Space between eye and base of mandible (oculomalar space) very short in queens and workers, less than half the length of the penultimate antennal segment in the male. (Yellow-jackets, subgenus *Vespula*)3
- 2.' Space between eye and base of mandible as long as, or longer than, the penultimate antennal segment in the queen, worker and male. (Hornets, subgenus *Dolichovespula*)6
3. Mesonotum with 2 complete, longitudinal, yellow lines or stripes*Vespula* (*V.*) *squamosa*

- 3'. Mesonotum without longitudinal lines (occasionally some individuals will have 2 short lines or dash-like marks but these never extend full length of the mesonotum)4
4. First abdominal segment narrowed basally, the tergite somewhat depressed immediately behind the anterior margin; occipital carina obsolete ventrally, not reaching the bases of the mandibles; erect hairs on first metasomal tergite black*Vespula* (V.) *vidua*
- 4'. First abdominal segment not narrowed basally, the tergite not depressed; occipital carina complete, reaching mandibular bases; erect hairs on first metasomal tergite gray5
5. Females: Yellow hind margin of pronotum gradually widened; yellow band of first abdominal tergite extensive, enclosing a transverse, median, black area; black clypeal marks usually in the form of separated spots arranged as a triangle, or these may be absent. Males: Seventh abdominal tergite abruptly depressed at its basal third, forming a distinct angle or notch with the distal portion; apical edge of last tergite without a median notch*Vespula* (V.) *maculifrons*
- 5'. Females: Yellow hind margin of pronotum parallel-sided; yellow band of first abdominal tergite restricted as apical border, notched medially and without any tendency to enclosed the black area; black clypeal marks usually united into an anchor-shaped spot. Males: Seventh abdominal tergite evenly convex, not abruptly depressed; apical edge of last tergite with a distinct median notch*Vespula* (V.) *vulgaris*
6. Pale markings yellow*Vespula* (D.) *arenaria*
- 6'. Pale markings white or ivory*Vespula* (D.) *maculata*

Vespa crabro germana Christ

This is the introduced European hornet. The species is extending its range in North America and has reached the Mississippi River in Tennessee (Mullet, 17). It is included here not only because the possibility exists that it may eventually become established in the state, but also for the following reasons: 1) the species has been reported from the Chicago area by Bromley (6) but this report has been generally disregarded; 2) In July, 1951, two large wasps, fitting the description of this species, were observed stripping bark from lilac in a yard near Friendship (Ripley County); and, 3) In February, 1962, the aerial nest of a hornet with a specimen of *V. crabro germana* mounted at the entrance was seen in a local home. The nest was collected along the Wabash River near Granville Bridge (Tippecanoe County). The association of the specimen with the nest, which appeared to be that of *Vespula maculata*, could not be satisfactorily confirmed.

Vespula (V.) *squamosa* (Drury)

V. squamosa is the second most common yellow-jacket in Indiana, occurring throughout the state. Both sexes are readily recognized by the longitudinal yellow lines on the mesonotum. The species differs in several ways from other species in the *Vespinæ*. In coloration and in

color pattern, the workers and males are alike. The queens differ by being more orange than yellow, and in being marked more extensively by that color. The range of *V. squamosa* extends southward into Guatemala (Miller, 16), exceeding by far the southern range limits of other species.

Taylor (22) reported a queen of *V. squamosa* from a nest of *V. vidua*. This observation, and others cited by Michener and Michener (14), indicate that *V. squamosa* may occasionally be a social parasitoid.

Vespula (*V.*) *vidua* (Saussure)

Since *V. squamosa* was "run out in the key" on the basis of distinctive color pattern, the relationship of *V. squamosa* and *V. vidua* was not obvious. The species are related, however, as both have the basal tergite narrowed and depressed basally and the occipital carina becomes obsolete ventrally in both species. The inferred parasitoid-host relationship is, therefore, in keeping with the theory that social parasitoids are derivatives of related nest-building species.

Both Bequaert (1) and Miller (16) reported *V. vidua* from Indiana (without locality), but the Indiana distribution indicated by Bohart and Bechtel (5) is too extensive (throughout the state). We have taken *V. vidua* in Fulton, LaPorte, Starke and Tippecanoe counties. It probably occurs throughout the northern third of the state. In the Christmas tree plantings in the sandy areas of LaPorte County, it is the most commonly collected species.

Vespula (*V.*) *maculifrons* (Buysson)

This species is the most common yellow-jacket in Indiana and is found throughout the state. *V. maculifrons* is related to *V. vulgaris*, and the two have overlapping ranges in northern Indiana. The two species are rather easily separated by color patterns in the females; by the characters of the last abdominal tergite in the males. Miller (16) has recorded intergradations of color pattern in the area of sympatry and has interpreted this as indicating hybridization.

Vespula (*V.*) *vulgaris* (L.)

This is a Holarctic species and is the rarest of Indiana yellow-jackets. Miller (16) recorded it from the Shades State Park (Montgomery County) where it must certainly be a boreal relict. Our only record is based upon a single male from Fort Wayne (Allen County).

Vespula (*D.*) *arenaria* (Fab.)

On the basis of coloration, this species would be called a yellow-jacket. Morphologically (long malar space) and biologically (aerial nests), the species is a hornet. It is apparently rare in Indiana. Our records are based upon two workers taken from *Melilotus alba*, north of Medaryville (Pulaski County) by Earle Cross and myself.

The record by Blatchley (3) for Vigo County is undoubtedly erroneous. Bequaert (1) tentatively assigned the record to *V. (V.) rufa* var. *consobrina* (Sauss.). On the basis of existing data, the specimens were probably *V. maculifrons*.

Vespula (D.) maculata (L.)

This is the common and widespread bald-faced hornet. It occurs throughout the state. The aerial nests are familiar sights to most persons and they are commonly displayed. The distinctive color and stable color pattern readily identifies the species.

Polistinae

The so-called single-comb wasps are represented in Indiana by five species, one of these with two recognized subspecies. The species belong in the genus *Polistes*.

The biology of polistine wasps is less well-known than that of the vespines and appears to be more variable. The species overwinter as fecundated females (there is a question as to whether these are queens or workers or both). Overwintering quarters are more diverse in this genus with crevices in rocks and in walls of buildings being likely sites. The colonies are very much smaller than those of *Vespula* and, while the females are aggressive in defense of the nest, they are less so than species of *Vespula*.

The value of *Polistes* spp. as predators is probably of greater importance than has been recognized. The works of Lawson (12, 13), Rabb (18) and Whitcomb and Bell (24) are significant here. The larval food is predominantly the larvae of Lepidoptera which are malaxed into pellets. Since many of these larvae are those of pest species, polistine wasps exert a significant pressure on the pest populations.

Bequaert (2) has recorded the following species from Indiana: *P. annularis*, *P. f. fuscatus*, *P. f. pallipes*, *P. F. variatus*, *P. metricus*, *P. rubiginosus*, The record of *P. exclamans* appears to be new.

Key to the Species of *Polistes*
Occurring in Indiana

1. Females: (as viewed from the side) First abdominal tergite slightly convex, gradually sloping toward the base; second abdominal sternite convex but not bulging; (as viewed from above) first abdominal segment somewhat longer than its apical width. Males: Apical sternite without a median tubercle2
- 1'. Females: (as viewed from the side) First abdominal tergite strongly convex and sloping abruptly toward the base; second abdominal sternite strongly convex, bulging; (as viewed from above) length of first abdominal segment less than, or equal to, its apical width. Males: Apical sternite with a median tubercle 3
2. First abdominal tergite mahogany or black, but always with a yellow apical margin, remainder of abdomen black; thorax uniformly mahogany or dark brown. Wings extremely dark. Large individuals*P. annularis*
- 2'. Thorax and abdomen extensively yellow, usually with light brown ground color; most tergites with yellow apical bands. Wings light. Small individuals*P. exclamans*
3. Head, thorax and abdomen almost wholly unicolorous, ferruginous. Wings purplish-black, Large individuals.
..... *P. rubiginosus*

- 3'. Head, thorax and abdomen not unicolorous, or if appearing so, dark in color, not ferruginous. Wings light or dark, but not purplish. Medium to small individuals4
4. Head, mesonotum and lateral blotches on first and second tergites mahogany (mesonotum, if at all black, always with longitudinal mahogany lines); pleura usually mahogany but occasionally with black confined to sutures and their margins; yellow, if present, confined to apical margin of first tergite and rarely to reduced propodeal lines; remainder of abdomen black or dark mahogany. Colors of head and thorax usually contrasting with darker colored abdomen. Wings very dark
.....*P. metricus*
- 4'. Color combination not as above. **Either extensively** marked with yellow, including two lines on the propodeum; or mesonotum black; pleura entirely black or nearly so; colors of head and thorax not contrasting with abdomen. Wings lighter in color than above5
5. Mesonotum and pleura largely black; yellow, if present, restricted to apical margin of first tergite and occasionally reduced propodeal lines. Legs dark except tarsi which are white
.....*P. fuscatus pallipes*
- 5'. Thorax marked with yellow, including two propodeal lines; several tergites usually with yellow apical margins and lateral blotches on first and second tergites with yellow. Legs dark, gradually becoming lighter in color toward the tarsi which, though white or yellowish, do not contrast conspicuously
.....*P. fuscatus fuscatus*

Polistes annularis (L.)

This large polistine wasp is undoubtedly more common in Indiana than our records indicate. *P. annularis* is easily identified by its dark mahogany and black body and the yellow apical band on the first tergite. *P. annularis* and *P. exclamans* are representative of two related groups as indicated by their placement in the key. Additionally, the apical antennal segments are reddened in both, a condition not found among other species.

P. annularis has been collected in Clark, LaPorte, Montgomery, Perry and Tippecanoe counties. It has also been observed in large numbers at Turkey Run State Park (Parke County). In all instances, except the unknown LaPorte site, the species has been collected in areas having steep, rocky bluffs.

Polistes exclamans Viereck

P. exclamans is the smallest of the Indiana polistine wasps and also the least common. It has been collected thus far only in Posey and Perry counties. It probably occurs in those counties along the Ohio River westward from Harrison County and may occur northward along the Wabash River.

Polistes rubiginosus Lep.

This species has been collected in Clark, Dearborn, Harrison, Knox, Lawrence, Monroe, Posey, Ripley, Spencer and Vanderburgh counties.

Its range is limited to the southern part of the state where it is relatively common. The large size, ferruginous or reddish unicolorous body, and dark wings with purplish reflections, mark it as a striking wasp. Occasional specimens will show a suffusion of black on the thorax.

Polistes metricus Say

P. metricus was described by Say (21) from specimens collected in Indiana, where it was reported to occur abundantly, and in Louisiana. This is one of our most common species; however, it is misidentified so often as *P. fuscatus pallipes* that much of the information concerning it is confused.

At the one extreme of coloration, the head, thorax and first two abdominal segments are mahogany, the remainder of the abdomen being black. Individuals so-colored are similar in appearance to *P. annularis* (Say, 21; Bequaert, 2). At the other extreme, the mesonotum is black, but always with mahogany lines; the pleurae have black along the sutures; and the first abdominal tergite has a yellow apical band. This color form is often mistaken for *P. fuscatus pallipes*.

The wings of *P. metricus* are much darker than those of *P. fuscatus pallipes* and, when observed in series, the difference is readily apparent. Likewise, while the tarsi of both species are light in color, those of *P. fuscatus pallipes* contrast markedly with the darker tibiae.

The distribution of *P. metricus* extends over much of the state. We have no records north of a line drawn from Tippecanoe to Allen counties. Moving southward from this line, *P. metricus* becomes increasingly abundant.

Polistes fuscatus (Fab.)

P. fuscatus is a polytypic species with eight recognized subspecies (Bohart, 4; Krombein, 11). The criteria for subspecific recognition are geographic distribution of color forms. Of the currently accepted subspecies, three have been recorded from Indiana (Bequaert, 2). These are *P. f. fuscatus* (Fab.) (from Bloomington), *P. f. pallipes* Lep. (from Winona Lake), and *P. f. variatus* Cresson (Indiana, without locality). In this paper, only two of the subspecies, *P. f. fuscatus* and *P. f. pallipes*, are recognized as occurring in the state. Previous state records for *P. f. variatus* are assigned to *P. f. fuscatus*. *P. f. variatus* is a valid subspecies but is of more western distribution (4).

Both subspecies occur abundantly throughout the state. They are found together in typical color patterns as well as intergradations. Rau (18) recorded *P. pallipes* and *P. variatus* from the same nest. The number of individuals assignable to *P. f. fuscatus* increases from north to south; conversely, the number referable to *P. f. pallipes* increases from south to north. Such a distributional color pattern was plotted by Enteman (8).

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