

THE RELATIONS OF THE ANDRENINE BEES TO THE ENTOMOPHILOUS FLORA OF MILWAUKEE COUNTY

S. GRAENICHER.

Owing to their large number of species, as also to the close relations of many of the species to certain flowers, the bees of the family *Andreninae* occupy a prominent position among the flower-visiting insects of our neighborhood. This paper deals with 47 species, representing about one-fifth of the entire bee-fauna of our region. Several species make their appearance quite early in the spring, and from this time on the family is represented throughout the floral season, although not a single one of the species extends its time of flight over two months and a half. Some are of rather common occurrence, while others are extremely rare, and are only occasionally met with. For several years past I have given much attention to the bees of this family, and have gradually come across 17 new species of *Andrena* from Milwaukee county, which have been named and described as follows:

Andrena subcommoda
Andrena sigmundi
Andrena multiplicata
Andrena radiatula
Andrena rufosignata
Andrena clypeonitens } T. D. A. Cockerell, Canadian Entomologist,
1902, p. 45.

Andrena graenicheri
Andrena parnassiae
Andrena peckhami } T. D. A. Cockerell, Annals and Magazine of
Natural History, 1902, p. 101.

<i>Andrena thaspis</i>	}	S. Graenicher, Canadian Entomologist, 1903, p. 162.
<i>Andrena cockerelli</i>		
<i>Andrena milwaukeeensis</i>		
<i>Andrena viburnella</i>		
<i>Andrena albofoveata</i>		

<i>Andrena fragariana</i>	}	S. Graenicher, Entomological News, 1904, p. 64.
<i>Andrena wheeleri</i>		
<i>Andrena persimilis</i>		

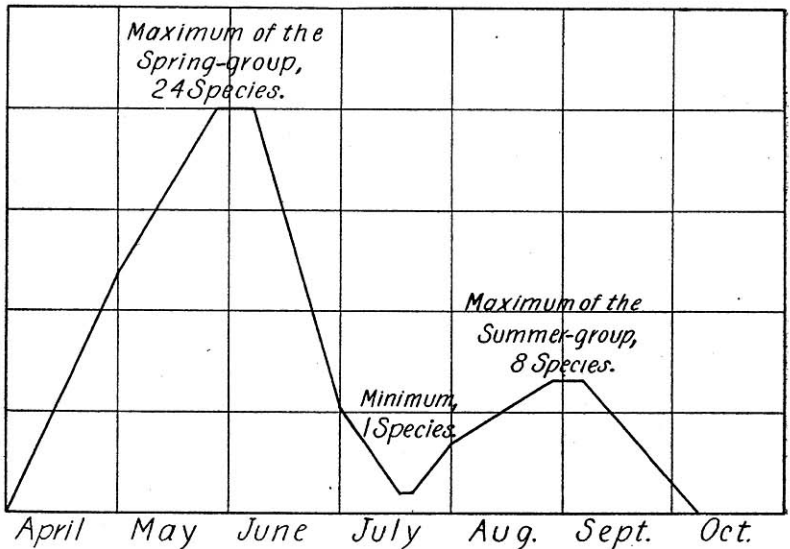
Polytropic and oligotropic bees. Some bees are in the habit of visiting a great variety of flowers, while others may be observed on the flowers of a single or those of a few species only. *Loew*¹ called the former polytropic and the latter oligotropic. *Robertson*² states that "in the economy of the host-bees (those not inquiline) the most important flowers are those from which the female gets the pollen upon which her brood is fed." Accordingly he proposes to use the term oligotropic for a species of bee, of which the female obtains her pollen-supply from a single species, or several closely related species of plants, i. e., plants belonging to the same genus, or the same natural family, and on the other hand to call those bees polytropic that collect pollen from plants of different families. In considering the relations of our *Andrena* species to our flowers, I make use of the terms oligotropic and polytropic in the same sense as *Robertson*. In the following table the time of flight, or in the case of insufficient observation the date of capture of each species is given, as also the names of the plants visited for pollen. When the bee has been recognized as oligotropic this is stated, otherwise the species is considered polytropic. Following *Robertson's* example, I consider in the case of an oligotropic bee the latter adapted to the genus if found collecting pollen from more than one species of that genus, and to the family if it obtains pollen from plants belonging to different genera of that family.

Graenicher—Andrenine Bees and Entomophilous Flora. 91

Name of Species.	Time of Flight.	Flowers Visited for Pollen.
1. <i>Andrena cockerelli</i> , Graen ..	Mar. 31—May 4	<i>Oligotropic, Salix.</i>
2. <i>Andrena illinoensis</i> , Rob ...	Apr. 6—May 7	<i>Oligotropic, Salix.</i>
3. <i>Andrena radiatula</i> , Ckll....	Apr. 8—June 16	Species of <i>Salix</i> and <i>Thaspium</i> .
4. <i>Andrena bipunctata</i> , Cress..	Apr. 8—June 17	Species of <i>Salix, Prunus, Claytonia, Cornus, Crataegus, Viburnum, Angelica, Symphoricarpos, etc.</i>
5. <i>Andrena mariae</i> , Rob	Apr. 9—June 6	<i>Oligotropic, Salix.</i>
6. <i>Andrena erythrogastra</i> , Ashm.	Apr. 17—June 6	<i>Oligotropic, Salix.</i>
7. <i>Andrena carlini</i> , Ckll.....	Apr. 18—June 10	Species of <i>Salix, Claytonia</i> and <i>Crataegus.</i>
8. <i>Andrena vicina</i> , Sm	Apr. 20—June 15	Species of <i>Salix, Sanguinaria, Erythronium, Calla, Ribes, Rosa, etc.</i>
9. <i>Andrena hypotes</i> , Rob.....	Apr. 25—June 26	Species of <i>Salix, Prunus, Viburnum, Angelica, Spiraea, Celastrus, etc.</i>
10. <i>Andrena cressonii</i> , Rob	Apr. 28—June 28	Species of <i>Acer, Salix, Claytonia, Cornus, Vagnera, Hydrophyllum, Geranium, etc.</i>
11. <i>Andrena dubia</i> , Rob	Apr. 28—May 21	This species is known in the male sex only.
12. <i>Andrena erigeniae</i> , Rob.....	Apr. 28—May 7	<i>Oligotropic, Claytonia Virginica.</i>
13. <i>Andrena dunningi</i> , Ckll ...	Apr. 30—May 12	Species of <i>Calla</i> and <i>Lonicera.</i>
14. <i>Andrena macgillivrayi</i> , Ckll.	May 2—May 7	Species of <i>Salix.</i>
15. <i>Andrena milwaukeeensis</i> , Graen.	May 4—June 26	Species of <i>Claytonia, Ribes, Strep-topus, Symphoricarpos, Angelica, Spiraea, Celastrus, Diervilla, etc.</i>
16. <i>Parandrena andreoides</i> , Cress.	May 8—May 28	<i>Oligotropic, Salix.</i>
17. <i>Andrena rugosa</i> , Rob.....	May 9—June 12	Species of <i>Salix, Taraxacum</i> and <i>Rubus.</i>
18. <i>Andrena hartfordensis</i> , Ckll.	May 9—June 2	Species of <i>Taraxacum, Vagnera, Thaspium, Angelica, Viburnum, Symphoricarpos, etc.</i>
19. <i>Andrena nivalis</i> , Sm	May 9—June 27	Species of <i>Ribes, Vagnera, Thaspium, Geracleum, Cornus, Rubus, Geranium, etc.</i>
20. <i>Andrena forbesti</i> , Rob.....	May 9—June 26	Species of <i>Salix, Taraxacum, Viburnum, Geranium, Crataegus, Cornus, Thaspium, Sanicula, etc. Claytonia Virginica.</i>
21. <i>Andrena claytoniae</i> , Rob.....	May 10—May 14	
22. <i>Andrena fragariana</i> , Graen.	May 15—June 15	<i>Oligotropic, Fragaria Virginiana.</i>
23. <i>Andrena platyparia</i> , Rob ..	May 16—July 4	Species of <i>Salix, Thaspium, Angelica, Cornus, Viburnum, Rhus, etc.</i>
24. <i>Andrena ziziae</i> , Rob	May 18—June 26	<i>Oligotropic, Umbelliferae.</i>
25. <i>Andrena geranii</i> , Rob.....	May 18—July 1	<i>Oligotropic, Hydrophyllum.</i>
26. <i>Andrena rufosignata</i> , Ckll..	May 19	<i>Uvularia grandiflora.</i>
27. <i>Andrena geranii maculati</i> , Rob.	May 20—June 25	<i>Oligotropic, Geranium maculatum.</i>
28. <i>Andrena sigmundi</i> , Ckll....	May 26—June 6	Species of <i>Vagnera</i> and <i>Crataegus.</i>
29. <i>Andrena subcommoda</i> , Ckll	May 27—July 3	Species of <i>Thaspium, Viburnum, Crataegus, Symphoricarpos, Rosa, Spiraea, Rhus, etc.</i>
30. <i>Andrena corni</i> , Rob	May 27—July 9	Species of <i>Viburnum, Sanicula, Angelica, Cornus, Rubus, Rhus, Rosa, etc.</i>
31. <i>Andrena multiplicata</i> , Ckll..	May 29—July 30	Species of <i>Thaspium, Cornus, Spiraea, Symphoricarpos, Rhus, Ceanothus, Veronica, etc.</i>
32. <i>Andrena thaspii</i> , Graen.....	May 29—June 23	<i>Oligotropic, Umbelliferae.</i>

Name of Species.	Time of Flight.	Flowers Visited for Pollen.
33. <i>Andrena viburnella</i> , Graen.	May 29—June 20	Species of <i>Viburnum</i> and <i>Rubus</i> .
34. <i>Andrena wheeleri</i> , Graen .	June 8—June 18	<i>Oligotropic</i> , <i>Umbelliferae</i> .
35. <i>Andrena albofoveata</i> , Graen.	June 9—June 16	<i>Oligotropic</i> , <i>Umbelliferae</i> .
36. <i>Andrena robertsonii</i> , D. T...	June 26—July 16	Species of <i>Krigia</i> , <i>Ceanothus</i> and <i>Rhus</i> .
37. <i>Andrena peckhami</i> , Ckll....	July 21—Aug. 8	<i>Oligotropic</i> , <i>Compositae</i> .
38. <i>Andrena clypeonitens</i> , Ckll.	July 26—Aug. 20	<i>Oligotropic</i> , <i>Compositae</i> .
39. <i>Andrena nubecula</i> , Sm.	July 26—Sept. 20	<i>Oligotropic</i> , <i>Compositae</i> .
40. <i>Andrena aliciae</i> , Rob	July 27—Sept. 4	<i>Oligotropic</i> , <i>Compositae</i> .
41. <i>Andrena helianthi</i> , Rob ...	Aug. 8—Sept. 12	<i>Oligotropic</i> , <i>Compositae</i> .
42. <i>Andrena americana</i> , D. T...	Aug. 17—Sept. 27	<i>Oligotropic</i> , <i>Compositae</i> .
43. <i>Andrena solidaginis</i> , Rob...	Aug. 22	<i>Oligotropic</i> , <i>Compositae</i> .
44. <i>Andrena asteris</i> , Rob.....	Aug. 24—Oct. 8	<i>Oligotropic</i> , <i>Compositae</i> .
45. <i>Andrena persimilis</i> , Graen..	Aug. 24—Sept. 12	<i>Oligotropic</i> , <i>Compositae</i> .
46. <i>Andrena parnassiae</i> , Ckll...	Aug. 25—Sept. 26	<i>Oligotropic</i> , <i>Parnassia Caroliniana</i> .
47. <i>Andrena graenicheri</i> , Ckll.	Aug. 28—Sept. 23	<i>Oligotropic</i> , <i>Compositae</i> .

The data relating to the time of flight, as contained in this table, enable us to construct a flight-curve for the family *Andreninae* as follows:



With us the blossoming of the first catkins of our earliest species of willow, *Salix discolor* falls together with the appearance of our earliest species of *Andrena*, *A. cockerelli*, an oligotropic visitor of the willows. In a certain locality in the Menomonee valley numerous specimens of *Salix discolor* occur, and among these a large specimen, bearing pistillate catkins opens its blossoms regularly in advance of all the other specimens. This particular plant was kept under observation in the early days of spring for 2 successive seasons, with the result, that on the first warm and bright day bringing out its blossoms the presence of the bee *Andrena cockerelli* in both sexes was noticed. This was the case on April 6th, 1902, and again on March 31st in the exceptionally early spring of 1903. I have never succeeded in coming across a species of *Andrena* before our willow-blossoms appear, although two species of entomophilous plants, *Erigenia bulbosa* and *Hepatica acuta* open up their flowers earlier than this willow. As the willow-blossoms become more abundant additional species of *Andrena* arrive on the scene, so that at the end of the third week in April 8 species are on the wing, 4 of which are oligotropic, depending for pollen on the willows exclusively, although they also visit other flowers for nectar. These facts point to the importance of the willows in the economy of our first arrivals among the Andrenine bees. As the season advances several other flowers attractive to insects open up, among them being *Claytonia Virginica* which usually appears towards the end of April, and also has an oligotropic visitor *Andrena erigeniae*. At the beginning of May 13 species of *Andrena* are present, and this number is gradually increased during the month until a maximum with 24 species is reached in the latter part of May, and lasting throughout the first week in June. This is the maximum of our spring-group of *Andreninae*, and it corresponds with the blooming period of a great variety of flowers, representing different families. Seven of these bees are oligotropic, two of which collect pollen from the late species of willows, one from *Fragaria Virginiana*, one from *Hydrophyllum Virginicum*, one from *Geranium maculatum*, and the two remaining ones from umbelliferous plants. Two species of Umbelliferae *Thaspium trifoliatum aureum* and *Taenidia in-*

tegerrima produce flowers in great abundance, and are very attractive to many species of *Andrena* besides the two oligotropic species of the family flying during the maximum. In addition to the plants mentioned in connection with the oligotropic visitors various species of *Viburnum*, *Crataegus*, *Cornus*, *Ribes*, *Rubus*, etc., supply many of the species forming the spring-maximum with pollen and nectar. From this maximum on there is a gradual decline of the curve until a minimum is reached, extending from about July 17 to July 20, and represented by a single species. At the end of the third week in July a renewed increase sets in, culminating in a maximum of the summer-group of *Andreninae*, with 8 species in evidence at the end of August and the beginning of September. This summer-group comprises altogether 11 species, and these are with but one exception oligotropic bees of the family *Compositae*. The plants of this family with the numerous species of *Solidago*, *Aster*, *Helianthus*, *Rudbeckia*, *Eupatorium* and many other genera are dominant factors in the make-up of the flora of the late summer months. The earliest species of goldenrod begins its blooming period about the middle of July, around the 20th of the month the first aster appears, and mostly a trifle later the first sunflower. Corresponding with the appearance of these composite flowers the earliest *Andrena* of the summer-group *A. peckhami* begins to fly about July 21, and before the end of the month 3 additional oligotropic visitors are present on these flowers. From the first week in September on there is a falling off in the number of these bees, and around October 8th *Andrena asteris*, the last one of the *Andreninae* disappears. Although any one of these visitors of the *Compositae* may collect pollen from flowers belonging to different genera of the family, they still show a decided preference for certain genera. *A. peckhami*, *A. clypeonitens*, *A. aliciae* and *A. helianthi* favor the sunflowers, *A. nubecula*, *A. americana*, *A. solidaginis* and *A. persimilis* the goldenrods, *A. asteris* and *A. graenicheri* the asters.

The exceptional position held by *Andrena parnassiae*, the oligotropic visitor of *Parnassia Caroliniana* has been referred to above. This is so closely related to *A. peckhami*, and the two resemble each other to such an extent as to leave no doubt regard-

ing their origin from a common ancestor. But while *A. peckhami*, a bee adapted to the *Compositae* appears together with the early flowers of *Helianthus*, *A. parnassiae* is adapted to a plant belonging to quite a different family, and it flies considerably later, from August 25th to September 26th, during the blooming period of *Parnassia*. The first specimens of this bee were taken in a certain locality south of Whitefish Bay on the bluffs bordering Lake Michigan, where the plant *Parnassia Caroliniana* occurs in large patches with an abundance of flowers. The latter are especially attractive to flies, 17 of the 25 recorded visitors belonging to this order, but the bee *Andrena parnassiae* may be observed regularly, season for season, although not a frequent insect. It has up to the present time not been met with at any other point within our County, nor has it been reported from elsewhere.

Oligotropic species of Andrena. In the foregoing several of our oligotropic species have been mentioned in connection with the flowers visited. For the sake of completeness a list of all of our oligotropic *Andreninae* is offered below.

Robertson² has published a list of the bees of Carlinville, Southern Illinois regarded by him as oligotropic, and 13 of the 20 species of oligotropic *Andreninae* of that locality occur also in our region. They are as follows:

Name of species.	Plants visited for pollen.
<i>Andrena illinoensis</i> , Rob.	<i>Salix</i> .
<i>Andrena mariae</i> , Rob.	<i>Salix</i> .
<i>Andrena erythrogastra</i> , Ashm.	<i>Salix</i> .
<i>Parandrena andrenoides</i> , Cress.	<i>Salix</i> .
<i>Andrena erigeniae</i> , Rob.	<i>Claytonia Virginica</i> .
<i>Andrena ziziae</i> , Rob.	<i>Umbelliferae</i> .
<i>Andrena geranii</i> , Rob.	<i>Hydrophyllum</i> .
<i>Andrena geranii maculati</i> , Rob.	<i>Geranium maculatum</i> .
<i>Andrena aliciae</i> , Rob.	<i>Compositae</i> .
<i>Andrena nubecula</i> , Sm.	<i>Compositae</i> .
<i>Andrena helianthi</i> , Rob.	<i>Compositae</i> .
<i>Andrena solidaginis</i> , Rob.	<i>Compositae</i> .
<i>Andrena asteris</i> , Rob.	<i>Compositae</i> .

To these I add 11 species recognized as oligotropic bees of our surroundings:

<i>Name of species.</i>	<i>Plants visited for pollen.</i>
<i>Andrena cockerelli</i> , Graen.	<i>Salix.</i>
<i>Andrena fragariana</i> , Graen.	<i>Fragaria Virginiana.</i>
<i>Andrena thaspisii</i> , Graen.	<i>Umbelliferae.</i>
<i>Andrena wheeleri</i> , Graen.	<i>Umbelliferae.</i>
<i>Andrena albofoveata</i> , Graen.	<i>Umbelliferae.</i>
<i>Andrena peckhami</i> , Ckll.	<i>Compositae.</i>
<i>Andrena clypeonitens</i> , Ckll.	<i>Compositae.</i>
<i>Andrena americana</i> , D. T.	<i>Compositae.</i>
<i>Andrena persimilis</i> , Graen.	<i>Compositae.</i>
<i>Andrena graenicheri</i> , Ckll.	<i>Compositae.</i>
<i>Andrena parnassiae</i> , Ckll.	<i>Parnassia Caroliniana.</i>

According to this list 24 of the 47 species of *Andreninae* considered in this paper, or fully one-half are oligotropic. The *Compositae* supply 10 of these with pollen, and the willows come next with 5 oligotropic bees. The importance of the *Umbelliferae* in this respect is also evident, 4 such visitors being adapted to them. As regards *Andrena geranii* this bee figures in Robertson's list as an oligotropic species of *Hydrophyllum appendiculatum*, but in our surroundings it collects pollen from *Hydrophyllum Virginicum*, the only representative of that genus in our flora, and it therefore has to be considered an oligotropic bee of the genus *Hydrophyllum*.

Seasonal forms. There are numerous instances recorded of an insect-species appearing at one period of the season in a form differing more or less from the form assumed at another period. These are called seasonal forms. A few cases are mentioned in the literature, all of them from the Eastern states, in which a species of *Andrena* taken later in the season has been regarded as identical with some species flying in the spring. Observations carried on throughout a number of years warrant the statement, that in our region no seasonal forms of *Andrena* occur. Species after species makes its appearance in the order indicated in the list at the beginning of this paper. As regards their time of flight there is a great diversity among the different species, some of them flying over 2 months, while others are

present during a few weeks only. In each species one generation is produced annually, and the bee appears the following season at the time of flight of the respective species.

It has been pointed out that all of our species of the summer-group are oligotropic, and all but one adapted to the *Compositae*, and in this respect they differ essentially from the species of the spring-group. In connection herewith it may be emphasized that while the early *Umbelliferae*, represented especially by the genera *Thaspium*, *Taenidia*, *Heracleum*, *Angelica* and *Sanicula* are very attractive to members of the spring-group of *Andreninae*, the late *Umbelliferae* with the genera *Cicuta*, *Sium*, *Oxypolis* and *Conioselinum* have no relations whatever to the *Andreninae* of the summer-group. *Cornus stolonifera* has its flowering season in the spring, but some specimens produce flowers throughout the summer and as late as the middle of September. It is significant that the flowers of this species are visited very abundantly by many *Andreninae* of the spring-group, but that after the middle of July a single species has been noticed on the flowers, and this is *A. multiplicata*, the latest species of the spring-group, which holds out until the end of July. All of these considerations point to the fact that our *Andreninae* of the summer-group, so far as their relations to flowers are concerned have nothing in common with those of the spring-group, and they furthermore support the statement, that in our region at least, no seasonal forms of *Andreninae* are produced.

January 12, 1905.

References.

1. *E. Loew.* Blumenbesuch von Insekten an Freilandpflanzen, Jahrbuch des botanischen Gartens zu Berlin, III, 1884.
2. *Chas. Robertson.* Flowers and insects, XIX, Botanical Gazette, XXVIII, p. 27.