

PHENOLOGY OF OLIGOLECTIC BEES AND FAVORITE FLOWERS

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Authors who have discussed this subject have made no systematic phenological observations on bees or on flowers.

Referring to the supposed short flight of oligoleges, one says: "Some claim this is so because they are small. Robertson explains it by saying that the short flight is the result of the visiting of the few closely allied genera of plants." "Both opinions are probably right." Oligolectic bees are not small and their flight averages only 11.8 days shorter than their related polyleges (4, 422). In 2, 71, it is stated that these bees are no smaller than their relatives and the percentage of small bees is no greater than among the polytropes (polyleges). Of local oligoleges, 38 per cent, while of the polyleges 37 per cent, are large. There is no need to explain something which is not a fact.

Bees with short flight.—Since the female bees do the pollen-collecting, the statements here relate to them. In 1, 30, it is shown that the females of 33 *Andrenidæ*, both polylectic and oligolectic, average 48 days and complete their flight in 120 days, March 17-July 14. It was argued that it was advantageous for some of these short-flying bees to fall into 11 sets with non-competitive pollen-collecting habits. Polylectic *Andrenidæ* average only 7.7 days longer than the oligoleges (4, 427). Oligolectic bees resemble their relatives in time even more than they resemble the plants on which they depend (3, 108). The percentages of bees flying simultaneously, May-September, are from 45.9 to 47.2 (5, 522). Short flights make it possible for the bees to be distributed so that not more than 47.2 per cent are flying at the same time (3, 107). This, I think, shows the principal advantages of a short flight.

CORRELATION OF OLIGOLEGES AND FLOWERS

Of 84 oligolectic bees listed in 4, 426-7, fourteen are omitted here because their females have not been observed enough to establish their time of flight, or visits.

In the case of the other 70, the flowers which they visit for pollen average 102 days. The bees average 60 days, 20 days after the flowers begin and 22 days before the flowers end. This is not a close correlation, but the time of the bee should be well within that of the flowers. Three show the average of 42 days, 34 show less and 34 show more. The bee can hardly be expected to collect pollen until several days after it begins to fly, but it is fairly necessary that it should find the flowers in bloom. It is even more necessary that the flowers should bloom later, so that the bee can work up to its last day.

DETAILS

Colletes oligoleges. *Colletes æstivalis*, 55 days, begins 4 days after and ends 3 days before *Heuchera hispida*, 62 days, May 4-July 4. *C. brevicornis*, 32 days, begins 9 days after and ends on the same day as *Specularia perfoliata*, 41 days, April 20- June 29. *C. willistonii*, 101 days, begins 17 days after and ends 29 days before *Physalis*, 147 days, May 11-October 4. *C. latitarsis*, 108 days, begins 36 days after and ends 3 days before *Physalis*. *C. armatus*, 46 days, begins 25 days after and ends 24 days before the *Asterææ* which it visits, 95 days, July 29-Oct. 31. *C. americanus*, 73 days, begins 27 days after its *Asterææ* and *Heliantheæ*, 100 days, July 24-Oct. 31, and ends on the same day. *C. compactus*, 48 days, begins 47 days after and ends 10 days before its *Compositæ*, 105 days, July 19-Oct. 31. These *Colletes* range from 32 to 108 days, and are short or long to agree with their flowers. Only two, *C. latitarsis* and *willistonii*, get pollen from the same plants.

ANDRENID OLIGOLEGES

Salix oligoleges. The willows bloom from March 17 to August 11, 148 days. The 6 oligoleges, whose flight-times are pretty well made out, fly from 46 to 88 days, average 86 days shorter than the season of *Salix*. They average 10 days

after *Salix* begins and 76 days before it ends. All of them complete their flight 46 days before *Salix* ends. *Andrena salicis*, 47 days, begins with *Salix* and ends 101 days sooner. *Parandrena andrenoides* begins 3 days later and ends 67 days sooner. *Trachandrena mariæ* shows 8 days later and 86 earlier. *Andrena illincensis* shows 8 and 81, *salictaria* 14 and 46, *erythrogastrea* 26 and 76. Of these equally common species, 3 average 26 days shorter than the other 3, while the Andrenid oligoleges, as stated above, in general average only 7.7 days shorter than the polyleges.

Other vernal species. *Ptilandrena erigeniæ*, 50 days, begins 10 days after and ends 10 days before *Claytonia virginica*, 70 days, March 16-May 24. *P. polemonii*, 37 days, begins 2 days after and ends 4 days before *Polemonium reptans*, 43 days, April 12-May 24. *P. g. maculati*, 24 days, begins 18 days after and ends 11 days before *Geranium maculatum*, 53 days, April 13-June 4. *Pterandrena krigiana*, 35 days, begins 11 days after and ends 4 days before *Krigia amplexicaulis*, 50 days, May 1-June 19. *Trachandrena spiræana*, 13 days, begins 6 days after and ends 9 days before *Aruncus sylvester*, 28 days, May 24-June 20. *Iomelissa viola*, 51 days, begins 13 days after and ends 20 days before *Viola*, 84 days, March 17-June 8. *Andrena arabis*, 29 days, begins 34 days after and ends 9 days before its Cruciferæ, 72 days, March 20-May 30. The Cruciferæ in general bloom 226 days, March 20-October 31, far beyond the time of this bee. *Opandrena ziziæ*, 47 days, begins 15 days after and ends 30 days before the *zizioid Umbelliferæ*, 92 days, April. 18-July 18. All of these oligoleges and 26 Andrenid polyleges complete their flight in the time of *Salix*.

Late Andrenid oligoleges. *Andrena nubecula*, 79 days, begins 12 days after and ends 1 day before its Astereæ, 92 days, August 1-October 31. *Pterandrena solidaginis*, 71 days, begins 20 days after and ends 8 days before its Astereæ, 99 days, July 24-October 31. *P. asteris*, 37 days, begins 32 days after and ends 10 days before its Astereæ, 79 days, August 14-October 31. *P. alicia*, 69 days, begins 35 days after and ends 6 days before its Heliantheæ, 110 days, July 9-October 26. *P. rudbeckiæ*, 67 days begins 11 days after and

ends 70 days before its Heliantheæ, 148 days, June 1-October 26. *P. pulchella*, 48 days, begins 33 days after and ends 12 days before its Heliantheæ, 93 days, July 15-October 15. *P. helianthi*, 38 days, begins 41 days after and ends 21 days before its Astereæ and Heliantheæ, 100 days, July 24-October 31. None of the Pterandrenas get pollen from the same Compositæ.

OTHER SHORT-TONGUED OLIGOLEGES

Macropis steironematis, 33 days, begin 12 days after and ends 36 days before *Steironema*, 81 days, June 16-July 18.

Halictoides marginatus, 34 days, begins 39 days after and ends 1 day before *Helianthus*, 74 days, July 23-October 4.

Panurgidæ. *Anthemurgus passifloræ*, 51 days, begins 16 days after and ends 17 days before *Passiflora lutea*, 84 days, July 5-September 26. *Pseudopanurgus compositarum*, 54 days, begins 43 days after and ends 2 days before its Astereæ, 99 days, July 24-October 31. *P. asteris*, 62 days, begins 35 days after and ends 8 days before its Astereæ and Heliantheæ, 105 days, July 19-October 31. *P. solidaginis*, 86 days, begins 8 days before and ends 13 days before its Astereæ and Heliantheæ, 91 days, July 11-October 4. But it begins 79 days after and ends 27 days before the general Astereæ and Heliantheæ, 192 days, April 23-October 31. *P. albitarsis*, 100 days, begins 4 days after and ends 21 days before its Heliantheæ, 125 days, May 25-September 26. *P. rudbeckiæ*, 43 days, begins 61 days after and ends 44 days before its Heliantheæ, 148 days, June 1-October 26. *P. rugosus*, 61 days, begins 24 days after and ends 25 days before its Heliantheæ, 110 days, July 9-October 26. *P. labrosus*, 57 days, begins 19 days after and ends 28 days before its Heliantheæ, 104 days, July 15-October 26. *P. labrosiformis*, 42 days, begins 54 days after and ends 31 days before its Heliantheæ, 127 days, June 22-October 26. *Calliopsis coloradensis*, 31 days, begins 3 days before and ends 18 days before its Astereæ and Heliantheæ, 46 days, August 23-October 7. *Verbena verbenæ*, 75 days, begins 37 days after and ends 25 days before *Verbena*, 137 days, May 22-October 5. The flight

is 62 days shorter. *Zaperdita maura*, 59 days, begins 57 after and ends 31 days before *Physalis*, 147 days, May 11-October 4. Its flight is 88 days shorter. In time and frequency it shows little relation to *Physalis*. *Perdita octomaculata*, 65 days, begins 6 days before and ends 11 days before its *Astereæ* and *Heliantheæ*, 70 days, August 17-October 20. None of the *Compositæ oligoleges* of *Panurgidæ* get pollen from the same flowers.

LONG-TONGUED OLIGOLEGES.

Gnathosmia georgica, 49 days, begins 19 days after and ends 25 before its *Compositæ*, 93 days, Apr. 23-July 24.

Ashmeadiella bucconis, 86 days, begins 11 days after and ends 31 days before its *Astereæ* and *Heliantheæ*, 128 days, May 25-Sept. 29.

Sayapis. *S. pollicaris*, 16 days, begins 22 days after and ends 14 days before *Coreopsis palmata*, 52 days, June 3-July 24. *S. pugnata*, 58 days, begins 13 days after and ends 48 days before its *Compositæ*, 119 days, May 25-Sept. 20. *S. sayi*, 92 days, begins one day before and ends 26 days before its *Compositæ*, 117 days, July 7-Oct. 31.

Megachile. *M. generosa*, 87 days, begins 38 days after and ends 21 days before its *Papilionaceæ*, 148 days, May 27-Oct. 19. *M. sexdentata*, 92 days, begins 15 days after and ends 19 days before its *Astereæ* and *Heliantheæ*, 126 days, June 1-Oct. 4.

Oligotropus campanulæ, 72 days, begins 4 days after and ends 22 days before *Campanula americana*, 98 days, July 1-Oct. 6.

Euceridæ. *Melissodes cnici*, 49 days, begins 71 days after and ends 24 days before *Cirsium*, 144 days, May 25-Oct. 15. *M. coreopsis*, 25 days, begins 11 days after and ends 16 days before *Coreopsis palmata*, 52 days, June 3-July 24. *M. vernoniæ*, 38 days, begins 34 days after and ends 21 days before *Vernonia fasciculata*, 93 days, July 1-Oct. 1. *M. vernoniana*, 62 days, begins 24 days after and ends 7 days before. *M. boltoniæ*, 120 days, begins 12 days after and

ends 21 days before its Compositæ, 153 days, June 1-Oct. 31. *M. trinodis*, 91 days, begins 19 days after and ends 25 days before its Compositæ, 135 days, June 19-Oct. 31. *M. agilis*, 98 days, begins 13 days before and ends 15 days after its Compositæ, 100 days, July 24-Oct. 31. *M. coloradensis*, 62 days, begins 56 days after and ends 15 days before its Compositæ, 133 days, June 10-Oct. 30. *M. simillima*, 66 days, begins 24 days after and ends 10 days before its Compositæ, 100 days, July 24-Oct. 31. *M. autumnalis*, 58 days, begins 33 days after and ends 9 days before its Compositæ, 100 days, July 24-Oct. 31. *Epimelissodes illinoensis*, 29 days, begins 27 days after and ends 34 days before its Helianthæ, 90 days, June 19-Sept. 16. *Anthedon compta*, 76 days, begins 5 days before and ends 18 days before *Oenothera biennis*, 89 days, July 20-Oct. 16. Only two Euceridæ get pollen from the same flowers.

Cucurbita oligoleges. *Cucurbita pepo* blooms 94 days, July 4-Oct. 4. One of its oligoleges, *Peponapis pruinosa*, 77 days, begins 11 days after and ends 6 days before, while the other, *Xenoglossa strenua*, 62 days, begins 25 days after and ends 7 days before.

Ipomœa oligoleges. *Ipomœa* blooms 125 days, June 24-Oct. 26. One of its oligoleges, *Cemolobus ipomœæ*, 80 days, begins 9 days before and ends 54 days before. The other, *Melitoma taurea*, 103 days, begins 3 days after and ends 19 days before.

Cassia oligoleges. *Cassia chamæcrista* blooms 100 days, June 28-Oct. 5. One of its oligoleges, *Epimelissodes atripes*, 36 days, begins 37 days after and ends 27 days before. The other, *Amegilla walshii*, 77 days, begins 8 days after and ends 15 days before.

Emphor bombiformis, 44 days, begins 10 days after and ends 5 days before *Hibiscus lasiocarpus*, 59 days, July 20-Sept. 16.

OTHER CASES.

Physalis oligoleges. *Colletes willistonii*, and *C. latitarsis* fly 101 and 108 days, bearing some relation to *Physalis*, which blooms 147 days, but *Zaperdita maura* flies 59 days,

88 days shorter, with little relation to *Physalis*, though it resembles the other Panurgidæ.

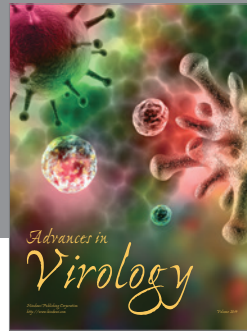
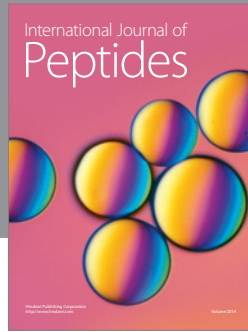
Astereæ. The Astereæ bloom 192 days, Apr. 23-Oct. 31. The oligoleges average 57 days, 135 days shorter. The short flight is not on account of the absence of the Astereæ. The flowers which these bees visit for pollen average 93 days, 36 days longer than the bees.

Heliantheæ. These bloom 154 days, May 25-Oct. 26. The 9 oligoleges average 57 days, 97 days shorter. The Heliantheæ which they visit for pollen average 117 days, 60 days longer.

Other Composite oligoleges. The Compositæ bloom 192 days, Apr. 23-Oct. 31. Eighteen oligoleges average 89 days later in beginning, and 32 days earlier in ending, or 121 days shorter. The flowers they visit average 107 days.

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