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Insect Pollinators of the Mer Bleue Peat Bog of Ottawa*

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Abstract. Insect visitors to flowers of the major insect-pollinated plants of the Mer Bleue peat bog of Ottawa were studied. Ten hours of collecting on each of 13 plant species produced 1362 insects belonging to 184 species, mostly of Hymenoptera and Diptera. All major entomophilous species of the bog flowered in May and June; this suggests a possibility of competition for pollinators. The plant species generally attracted a diverse but somewhat numerically small assemblage of insect species. There was a notable segregation of insect species to certain of the plant species considered. There were differences in the abilities of the abundant plant species to draw pollinators. *Vaccinium myrtilloides* proved to be the most successful in attracting pollinators, and *Kalmia angustifolia* the least successful.

The Mer Bleue peat bog of Ottawa is an important scientific and cultural resource. The usefulness of this outstanding wilderness area has been enhanced by the publication of descriptions of various facets of the natural history of the area which have appeared in *The Canadian Field-Naturalist* in the series introduced by Baldwin and Mosquin (1969). The present study attempts to add to this knowledge by providing a preliminary evaluation of the pollination relationships of the major entomophilous plant species of the Mer Bleue.

The reproductive success of many outcrossing plant species is partly dependent on their ability to attract suitable pollinators. Competition for pollinators between cultivated and wild plants has been extensively studies (e.g., Free 1970), and it is clear that in both domesticated and natural habitats there is frequently a dearth of pollinators in relation to the needs of the plants (Hocking 1968; Mosquin 1971; Kevan 1972). Natural communities of plants and animals are the results of millenia of selection, and study of such communities may be expected to reveal pollination relationships which represent the outcome of co-evolution.

Many areas are populated by highly diverse communities of pollinator-requiring plants. The complex interactions of numerous plant species are difficult to interpret, and it is desirable to examine competition in habitats that are populated by few pollinator-requiring plants, and that are sufficiently extensive to monopolize the interests of a pool of pollinating agents. In north temperate areas, perhaps no other habitat better satisfies these criteria than peat bogs, as these are depauperate in plant species diversity (Small 1972), and often occupy very extensive tracts of land. The Mer Bleue peat bog of the Ottawa area is large (6300 acres), well-described (Joyal 1970; Small 1974), and has existed for several thousand years (Camfield 1969). It therefore provides an ideal area for the study of how a natural plant community shares the available pollinator resources.

It is well known that pollinators are attracted to specific plant species in order to obtain nectar and pollen; this attraction is effected by a variety of olfactory and visual stimuli. Some bog plant species, including many orchids, require particular pollinators (Thien and Marcks 1972). An additional determinant of a plant species' ability to attract pollinators is the density of that species in the area. As embodied in "Arnell's dominating flower phenomenon" (Faegri and van der Pijl 1971, p. 60) many Lepidoptera and bees tend to ignore rare plant species. Time of flowering is another aspect that is important to a plant species' success in attracting pollinating agents (Robertson 1924). By spreading flowering time throughout the season, the members of a plant community reduce the demand for pollinators at a given time (Levin and Anderson 1970; Mosquin 1971). Previous phenological studies (Judd 1958; Pojar 1974; Heinrich 1975), have indicated that flowering of species in bogs is staggered.

In a study of the major bee (Apoidea) pollinators of five Ericaceous plant species (four of which

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were also examined in the present study), Reader (1975) calculated coefficients expressing possible competitive relationships for pollinators by the plant species. Evidence for interspecific competition for pollinators in bog species has not yet been obtained, however, and is not available from the present study.

Materials and Methods

During the 1973 season, collections of flower-visiting insects were made on 13 plant species of the Mer Bleue. The plants included all except the infrequent entomophilous plants of the bog proper, and two species from the margin of the bog, *Salix fragilis* and *Spiraea alba.* The latter two species flowered before and after, respectively, the major entomophilous species of the bog proper, and provided a means of evaluating the availability of pollinators outside the competitive season of the major bog plant species.

The site studied was near the end of the Dolman Ridge Road. This road is built on a large sand ridge, that narrows to a width of 500 m near the study area, and extends well into the bog. The location was chosen because it appeared representative of much of the bog which is in a late successional stage; it is dominated by ericaceous shrubs with pockets of larch (*Larix laricina*) and black spruce (*Picea mariana*). Most collections were made at least 100 m into the bog proper, and all collections were made within 500 m of each other. Most soil-dwelling bees avoid residing in much of the bog because of the moistness of the substrate (Osgood 1972), but do inhabit its margins. As the study area was not distant from the sand ridge, the available pollinator pool was larger than in more remote sites within the bog.

Ten man-hours were spent netting or aspirating insects on each of the 13 plant species examined. The 10 hours spent on a given plant species were devoted entirely to that species, while ignoring pollinators on other plants. Collections were made between 1000 and 1500h, during the peak flowering period of the species. Collecting was curtailed on windy, rainy, overcast, or cold days, because any one of these conditions markedly reduced insect-visiting activity. In an attempt to acquire only insects whose activities might effect pollination, insects stopping casually at flowers were not collected. Collectors were free to wander in the study area, and the attempt was made to collect as many insects as possible within the allotted time. Insects previously not collected or rarely collected from the Mer Bleue are deposited in the Canadian National Collection of Insects (CNC).

In an attempt to evaluate the necessity for insects for seed set, inflorescences of 10 plants of each species were bagged with insect-excluding bags, and subsequently examined for seed set.

Observations

The progression of flowering of the major entomophilous species in the Mer Bleue is shown in Figure 1. Flowering of these species was more or less confined to May and June. A number of relatively infrequent species flowered somewhat later: *Vaccinium oxycoccus* L. and *Sarracenia purpurea* L. in late June, and *Drosera rotundifolia* L. and *Cypripedium acaule* Ait. in middle to late July.

The insect species of which at least 10 individuals were collected, and the plant species on which they were obtained, are listed in Table 1. A table giving this information for all insects collected is available from the Depository of Unpublished Data, National Science Library, National Research Council of Canada, Ottawa, Canada K1A 0S2. Table 2 presents a statistical summary of the numbers of insect species and of individuals taken on each of the 13 plant species studied. Altogether 184 insect species of six orders were collected; 71 of these were represented by only one individual, and 32 by only two individuals. During the 130 hours of collecting 1362 insects were captured—approximately one insect every 6 minutes.

Kalmia polifolia, Smilacina trifolia, Andromeda galucophylla, and *Calopogon pulchellus* were sparsely present in the study area (Figure 1) and attracted relatively few insects. *Vaccinium myrtilloides* was visited almost exclusively by bees (Apoidea) and clearly was the most attractive plant to bees. In relation to its abundance, *Kalmia angustifolia* received notably few insect visitors.

Two insect orders, Diptera and Hymenoptera, accounted for 91.4% of the individuals collected. The Diptera were especially diverse, and of the 107 species collected, few were represented by large numbers of individuals. On the other hand, a number of bee species were represented by many

TABLE 1. Species of insects collected on plant species. Only insect species for which at least ten individuals were collected are shown.
♀ = worker caste (for Apidae only).

Insect species	Number of individuals	Plant species: 1. *Salix fragilis*	2. *Chamaedaphne calyculata*	3. *Nemopanthus mucronata*	4. *Andromeda glaucophylla*	5. *Kalmia polifolia*	6. *Smilacina trifolia*	7. *Vaccinium myrtilloides*	8. *Aronia melanocarpa*	9. *Ledum groenlandicum*	10. *Gaylussacia baccata*	11. *Kalmia angustifolia*	12. *Calopogon pulchellus*	13. *Spiraea alba*
LEPIDOPTERA														
Adela purpurea Wlk.	20	20												
Thymelicus lineola Ochs.	10												7	3
COLEOPTERA														
Macrodactlyus subspinosus F.	15													15
Cyphon prob. *variabilis* (Thunb.)	37	37												
DIPTERA														
Hybomitra minuscula (Hine)	12													12
Hybomitra typhus (Whit.)	14											1	13	
Dilophus caurinus McAtee	87			87										
Spilogona fatima (Huckett)	13	1	7	4		1								
Sphaerophoria sp. (spp?)	15		1			2		8	4					
Pyrophaena rosarum (Fab.)	11			2		6			1			1		1
Melanostoma sp.	26		1	15		9		1						
Sericomyia transversa (Osb.)	32				4		1		2		23	2		
Eristalis dimidiata Wied.	18							2	5		7			4
Helophilus latifrons Lw.	19							1	14		4			
Helophilus fasciatus Walk.	11		1					2	4		3	1		
Helophilus laetus Lw.	10							3	4					3
Syritta pipiens (L.)	19					1		14				3		1
Toxomerus marginatus (Say)	14												14	
Syrphus torvus O.S.	14			1				13						

HYMENOPTERA												
Apis mellifera L.	24	1♀		1♀		1♀	20♀			1♀		
Bombus terricola terricola Kby.	82	3♀					2♀-12♀		3♀,19♀	1♀,6♀		36♀
Pyrobombus impatiens (Cress.)	30		1♀		2♀	1♀	17♀		5♀	3♀		1♀
Pyrobombus perplexus (Cress.)	21	2♀				1♀	3♀,11♀	2♀				2♀
Pyrobombus sandersoni (Flkn.)	34	2♀	1♀			1♀	7♀	2♀	3♀	5♂,9♀	2♀	2♀
Pyrobombus ternarius (Say)	50	2♀	1♀	1♀	1♀	1♀,2♀	5♀,11♀	1♀	3♀,6♀	2♀,4♀	1♀,2♀	7♀
Andrena alleghaniensis Vier.	11			6♀				3♀	2♀			
Andrena bradleyi Vier.	48	5♂	8♀,17♂			2♀	12♀			4♀		
Andrena carlini Ckll.	11	1♀	6♂	1♀,1♂			1♀		1♀			
Andrena carolina Vier.	16	1♂					6♀		4♀	5♀		
Andrena mandibularis Robt.	34		1♀	6♀,1♂		9♀,4♂	1♀		9♀		2♀,1♂	
Andrena regularis Mall.	66		4♂	1♂		6♀	10♀	7♀	31♀	7♀		
Andrena vicina Sm.	83	2♀,9♂	2♀,17♂	1♀,3♂		1♀	7♀	1♀	11♀	29♀		
Colletes inaequalis Say	73	4♀,47♂	3♀,3♂				11♀	2♀	3♀			
Dialictus pilosus (Sm.)	12			1♀		4♀		7♀				

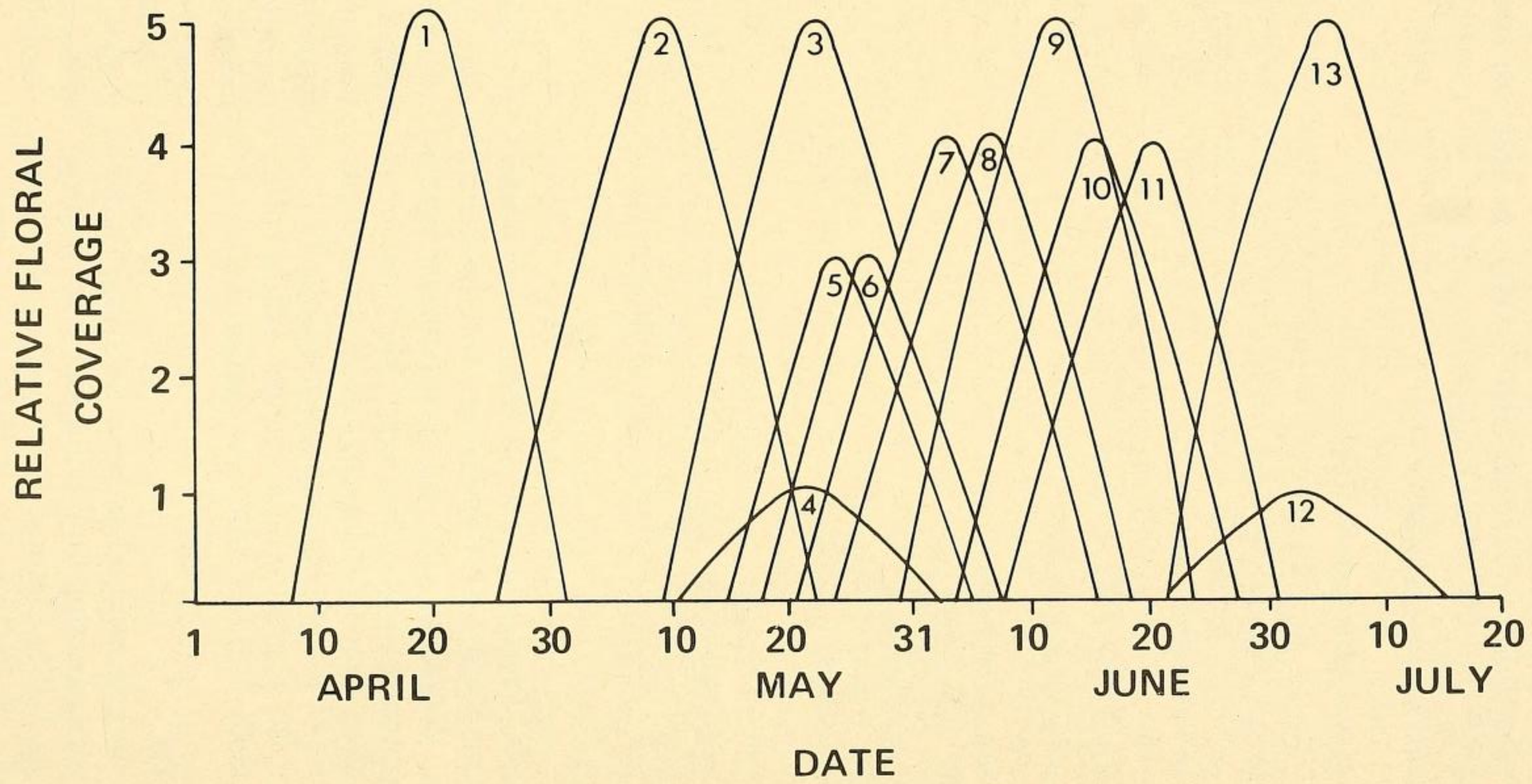

FIGURE 1. Relative floral coverage (relative percentage area covered by open flowers) and flowering periods of species examined. The numbers correspond to the plant species given in the tables.

TABLE 2–Summary of numbers of species (with numbers of insects in parentheses) collected on each species of plant

Plant species	Insect order						Sums	% of total individuals
	Homoptera	Hemiptera	Lepidoptera	Coleoptera	Diptera	Hymenoptera		
1. *Salix fragilis* L.	1(1)	1(1)	1(20)	3(45)	11(22)	17(92)	34(181)	13.3
2. *Chamaedaphne calyculata* (L.) Moench.			2(6)	1(1)	13(22)	12(68)	28(97)	7.1
3. *Nemopanthus mucronata* (L.) Trel.					31(148)	18(47)	49(195)	14.3
4. *Andromeda glaucophylla* Link.			1(1)		1(1)	2(3)	4(5)	0.4
5. *Kalmia polifolia* Wang.			1(5)		6(12)	17(40)	24(57)	4.2
6. *Smilacina trifolia* (L.) Desf.				1(1)	18(39)	3(3)	22(43)	3.2
7. *Vaccinium myrtilloides* Michx.					2(2)	21(152)	23(154)	11.3
8. *Aronia melanocarpa* (Michx.) Ell.			1(1)	1(1)	28(75)	16(36)	46(113)	8.3
9. *Ledum groenlandicum* Oeder					27(63)	16(108)	43(171)	12.6
10. *Gaylussacia baccata* (Wang.) K. Koch					9(42)	18(91)	27(133)	9.8
11. *Kalmia angustifolia* L.					10(25)	9(16)	19(41)	3.0
12. *Calopogon pulchellus* (Sw.) R. Br.			1(7)		3(17)		4(24)	1.8
13. *Spiraea alba* du Roi			6(12)	2(16)	31(64)	9(56)	48(148)	10.9
Sums	1(1)	1(1)	10[1](52)	7(64)	107(532)	58(712)	184(1362)	
% of total individuals	0.1	0.1	3.8	4.7	39.1	52.3		

[1] Columns are not additive for numbers of different insect species; a given species often was collected on different plant species.

individuals. Prominent among these were honey bees (*Apis mellifera*), bumblebees (of the genera *Bombus, Megabombus,* and *Pyrobombus*; some Hymenopterists (e.g., Mitchell 1962) refer all bumblebees except *Psithyrus* to *Bombus*), and other bees of the genera *Andrena* and *Colletes*.

All of the bagged influorescences exhibited no, or drastically reduced, fruit and seed set.

Discussion

The present study has been particularly concerned with assessing how pollinator resources are apportioned to a natural plant community composed of a limited number of plant species attracting pollinators. Given the failure of bagged flowers to set seed, it appears that pollinators were required. Whether the supply of pollinators was in fact limiting seed set cannot be deduced from the present study.

Generally two or three insect species accounted for half of the individuals collected on a given plant species, and not infrequently all, or almost all, individuals of a particular insect species were collected on a given plant species. At the same time most insect species did not exhibit marked restriction to certain plant species, and indeed the majority of insect species collected occurred very infrequently in the bog, suggesting lack of dependence on the bog plant species. It should be kept in mind that the host specificity shown by insects in this particular study does not necessarily reflect either general fidelity or independence; for example, most of the individuals of *Colletes inaequalis* were collected from *Salix* and *Vaccinium*, but it is known that this bee visits a wide range of flowering plants (Mitchell 1960, p. 41). On the whole there was a pronounced segregation of insect species visiting the species of plants considered.

The insects collected likely vary considerably in

pollinating ability. (See Faegri and van der Pijl (1971) for discussions of pollinating abilities of various insect groups.) No attempt was made to assess foraging behavior, stomach contents, or pollen load, and consequently short-term fidelity which characterizes good pollinators. It would seem reasonable to postulate, however, that the bees, as in other studies, by virtue of a variety of behavioral and structural features, are the most important pollinating agents. The "bees" (including species of the Apidae, Andrenidae, Colletidae, Halictidae, Megachilidae, and Anthophoridae) composed the bulk of the Hymenoptera collected. The "social-bees"–the Apidae–appear to be especially important pollinators in the bog. Twenty individuals of the Ichneumonidae (which include parasitoids of lepidopteran larvae) were collected; these probably are not significant as pollinators. The Diptera are considered less efficient pollinators than the bees, but one family, the Syrphidae, which was richly represented in the bog, is likely quite significant in effecting pollination. Lepidoptera were very inconspicuous in the present study, although it may be noted that no attempt was made to sample for possible nocturnal visits by moths. Coleoptera, which comprised 4.7% of the collected insects, also do not appear to represent important pollinating agents in the bog.

Vaccinium myrtilloides, the bog species most attractive to bees, is a frequently cultivated low-bush blueberry. A great deal of research literature is available on the pollination ecology of the cultivated blueberry (Free 1970, Chapter 27). All of the abundant bees found on *V. myrtilloides* in this study have been previously recorded on *Vaccinium* (Mitchell 1960, 1962; Boulanger et al. 1967). Bumblebees, which were very abundant on blueberry in the Mer Bleue, have long tongues capable of reaching the nectaries at the base of the flower; these can only be reached by pushing the tongue between the stamen filaments surrounding the nectaries. A large bee population appears essential for adequate seed set of most varieties of blueberries. Small bogs, where *Vaccinium* is cropped, have often been found to have a sufficient wild bee population for adequate pollination, whereas large bogs such as the Mer Bleue usually require the introduction of honeybees (Free 1970, p. 342.). To judge by the observation of Kinsman (1957), that sufficient pollination of low-bush blueberries requires one pollinating insect per square metre during favorable weather, the *Vaccinium* population of the Mer Bleue was underpollinated, but not drastically so.

In contrast to *V. myrtilloides, Kalmia angustifolia* was the least attractive major plant species of the Mer Bleue. The reasons for this are not clear, as the less abundant *Kalmia polifolia,* which has very similar flowers, appeared fairly attractive to insects in relation to its abundance.

In terms of relative flowering time, it was somewhat surprising to find that all of the major competitors within the bog flowered in early and middle summer. Early flowering provides plant species ample time to mature fruit, but one might expect some species to flower later and thereby take advantage of possible reduced competition for pollinators late in the season. The large number of insects collected on *Salix* and *Spiraea*, which flowered before and after, respectively, the major bog species, indicated a large pollinator pool was available for early and late flowering plants. As noted, a number of infrequent plants–*Sarracenia purpurea, Drosera rotundifolia, Vaccinium oxycoccus* and *Cypripedium acaule*–flowered in late summer, perhaps indicating a measure of adaptive displacement in flowering time. As well, the unusual flowers of these species may be adapted to, and especially attractive to specific pollinators.

More extensive study than that reported here, preferably over several seasons, will be required to evaluate the competitive interspecific pollination relationships of the plants of the Mer Bleue. The present finding of apparently pronounced superiority of some plant species over others in ability to attract pollinators suggests that this factor may partly determine success in the bog.

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