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CONTENTS

SUMMARY

Insect visitation is necessary for the pollination of blossoms of the low-bush blueberry. Native bees are of particular importance in this respect and individuals of several species are numerous enough to constitute an appreciable pollinating force.

Changes in certain cultural practices, in effect since the thirties, have caused substantial reductions in the native bee populations. Recent observations, however, have shown that adjustments in these practices can have a beneficial effect on native bees with accompanying increases in their numbers.

Collections of native Apoidea were made in various areas of Maine and eastern Canada from 1961 through 1965 in order to determine the species present and their relative abundance in blueberry fields. Of the 89 species collected, 59 were taken on low-bush blueberry blossoms, and 10 in close association with low-bush blueberry. Twenty species of parasites and inquilines were collected; 18 of these are in the order Hymenoptera and 2 species are in the order Diptera.

Species in the families Halictidae and Andrenidae were by far the most numerous (32 and 23 species), followed in decreasing occurrence by species in the families Bombidae, Anthophoridae, Colletidae, and Xylocopidae.

Eight new records for Maine and 34 new host records for *Vaccinium* have been compiled from the material collected to date.

Strong variations occur in terms of distributions of species, numbers of individuals within species, seasonal occurrence, preference of nesting sites, and several other biological aspects.

Flower constancy appears to be oligolectic; indications are that the species involved are limited to the number and kinds of pollen source by physiological adaptations. Other expressions of adaptations are lacking.

NATIVE BEES ASSOCIATED WITH THE LOW-BUSH BLUEBERRY IN MAINE AND EASTERN CANADA

L. W. BOULANGER[1], G. W. WOOD[2], E. A. OSGOOD[1], AND C. O. DIRKS[3]

INTRODUCTION

The low-bush blueberry complex (predominantly the species *Vaccinium angustifolium* Ait. and *V. myrtilloides* Michx., and their close relatives) is an important economic entity in many areas of Maine and eastern Canada.

Blossoms of the species in question are dependent on insects for pollination and fruit set because of structure as well as the relatively small amount of heavy, rather large pollen they bear. Both factors virtually negate the possibility of sufficient pollen transfer by means other than insect activity. Numerous workers in the past have clearly demonstrated the necessity of insect visitation for fruit set; mechanical agitation of the blossoms and the use of growth hormones were unsuccessful and the exclusion of pollinators completely prevented fruit set in areas so treated.

Prior to the work of Phipps (1930) nothing is available in the literature on the need for and activity of pollinators; it can be assumed that fruit set, good or bad, was taken for granted. While native pollinators were undoubtedly observed working bloom, there is no list of species involved or attention to the problem of pollination until the work by Phipps. In studying insects associated with blueberries and huckleberries, he collected 18 species of Diptera and 20 of Hymenoptera visiting blueberry blossoms during a 5-year period prior to 1930. This list was to receive modest additions in ensuing years but up to the study described in this paper no comprehensive coverage has been reported.

Decreases in the numbers of native bees pollinating blueberries became apparent in the early thirties. This was especially true in Washington County where the so-called "blueberry-barrens," some 250,000 acres of unforested land, were in production. Growers found it more practical to burn these large tracts *in toto* rather than alternating smaller areas from year to year. While such a procedure was an economic gain there is good evidence to support the assumption that it unfortunately caused serious reductions in the resident populations of native bees. It is believed that there are limits beyond which the female bees will not

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go to collect the pollen and nectar needed for provisioning the cells in which the bee larvae will develop; in such instances, females will move to a more suitable location. This may well be the primary factor involved in the reduction of populations on large burns. This argument is reinforced by the information obtained from recent studies in which it is obvious that burning long narrow strips of land in alternate years results in strong increases in numbers of native bees. Many aspects of this problem present intriguing ecological counterpoints and investigations on several are under way.

Studies were initiated in 1961 on the native Apoidea associated with the low-bush blueberry to determine the species present and to assess their relative abundance in the areas surveyed.

PROCEDURE

Location and Description of Collecting Areas

Collections in Maine were made in York, Waldo and Washington counties; those in Canada were made in Charlotte County in New Brunswick, Cumberland County in Nova Scotia, the Lac St. Jean area of Quebec, and the Avalon Peninsula of Newfoundland. The latter two areas were sampled in only one season, Waldo County in two seasons, and the remainder were sampled for five seasons.

Typically the low-bush blueberry thrives best on well-drained, sandy soils but it is also found on a wide range of soil types. Short descriptions follow on those collection areas of interest or with different general conditions.

York County low-bush blueberry areas are found on immense, rolling to flat, sandy deltas and outwash plains formed by the deposition of glacial till by large glacial streams. Colton loamy sand, a Podzol soil, is the predominant type. White pine (*Pinus strobus*), was the principal growth on the outwash plains but removal of the original forest, burning, and natural growth have resulted in a scrubby growth of pitch pine (*Pinus rigida*), and some white pines, black oak (*Quercus velutina*), and other oaks (*Quercus* spp.), and an undergrowth of bracken and sweet fern (*Pteridium aquilinium* and *Comptonia peregrina*), blueberry (*Vaccinium* spp.). birch (*Betula* spp.) and tall grasses. Removal of competing plants results in a dense cover of low-bush blueberry.

Waldo County lies in the region of the central coastal-escarpment and is typified by hilly, extremely rocky areas separated by relatively smooth, rolling terrain. Low-bush blueberries are found in most areas of the county and many producing fields are located on hillsides, hilltops, and abandoned pastures. These reclaimed areas are generally smaller than those found in York and Washington Counties.

Washington County blueberry areas are immense in size, exceeding those of York County; vast tracts, devoid of all but scrub vegetation, are known as "blueberry-barrens." These support such plants as sweet fern, lamb-kill (*Kalmia angustifolia*), gray birch (*Betula populifolia*), wild cherry (*Prunus* spp.), red pine (*Pinus resinosa*), and low-bush blueberry. Large, rolling, outwash plains are deeply gullied and are predominantly of Colton gravelly sandy loam. Colton sandy loam and Duane and Walpole sandy loams in the depressed areas all are resultant from glacio-fluvial deposits. Scantic silt loam, derived from marine and lacustrine sediments is found in the lowest areas. The presence of huge stones in the Colton soils areas gives evidence of the proximity of these areas to the glaciers during the outwash period.

The Charlotte County soils of New Brunswick have developed on glacial till and typically contain Carleton shaly loam or Gagetown gravelly sandy loam. The parent material of Carleton soils is either a gravelly loam or clay. The land is stony and large boulders and outcrops are common. Gagetown soils have developed on coarse gravel deposits that occur in the form of outwashes, kames, or eskers. Topography varies with land form and may be a level plain or in the form of hills and ridges. Drainage is excessive. The surface layer of black organic material is seldom over one inch in thickness, and blueberry yields are not as high as on Carleton soils.

Cumberland County soils in Nova Scotia are also developed on glacial till with the parent material being gravelly loam or gravelly sandy loam. The soil is included in the Wyvern Association. Surface relief ranges from undulating to hilly, drainage is good, and the land is often stony.

Lac St. Jean soils consist of fluviomarine, fluviolacustrine, and deltoid deposits laid down during submergence of the area by the Champlain Sea during the Pleistocene era. Deposits range from coarse sand to very fine wind-blown sand to sandy loam, and in some locations these have a depth exceeding 100 feet. Vegetation consists of blueberry, sweetfern, lambkill, and sparse stands of white spruce, (*Picea glauca*) balsam fir, (*Abies balsamea*), and jack pine, (*Pinus banksiana*).

The Newfoundland blueberry soils on the Avalon Peninsula are a well-drained podzol developed on glacial till derived from precambrian slates and shales. It is locally known as the Cochran Series and because of its origin and the leaching effects of a relatively high precipitation (approximately 63 inches annually) is inherently low in major plant nutrients.

Collection Methods

Techniques were essentially the same in all cases; sweeping nets with 6-foot handles were used. A sweep was made only every third or fourth step when walking across the blueberry field during bloom in order that the insects not be disturbed ahead of the collector. After a suitable number of strokes, the entire bag was enclosed in a large cyanide killing jar until the insects were immobilized. The contents were then transferred to smaller containers, in which were placed wads of cotton wetted with ethyl acetate, which were then brought to the laboratory where insects were separated from plant debris and later mounted. Condition of the insect specimens was very good in all but a few isolated cases.

A few of the Canadian specimens were taken directly from blueberry blossoms in individual vials but this method was abandoned when it proved to be too tedious and slow for the intended survey.

While it may be suggested that several other plants are found in proximity to blueberries, care was taken to restrict sweeping to blueberry blossoms thereby limiting collections to those species working on *Vaccinium angustifolium* and *V. myrtiloides*.

DISCUSSION

Distribution of Species

It is apparent from table 1 that strong differences occur in distribution of the various species taken in the sample areas. However, several qualifying statements are in order to equate the collections. For example, York and Washington counties in Maine, and New Brunswick and Nova Scotia in Canada were the most extensively sampled areas; as such, the species recovered or lacking in these locations can bear some degree of comparison. Waldo County in Maine was sampled in only two seasons and not as diligently as the above areas; Quebec and Newfoundland collections were made in only one season. The latter areas in Maine and Canada obviously cannot receive the same degree of comparison applied to the former areas.

It is therefore entirely possible that species taken in other locations but not reported for Waldo County, Quebec and Newfoundland do occur in these areas but have not yet been taken. Future efforts will be made to clear up these points.

Variations in the number of species occurring in the different areas may also be due to differences in composition of the flora or existence of suitable soil types for nesting. Such variations are exhibited at considerable distance as in the case of *Andrena forbesii* which was collected

in York County and New Brunswick but has yet to be taken in Washington County which is centrally located, geographically, between the two. *Colletes validus* also shows wide separation in sites of occurrence and has been taken in only two locations, Lac St. Jean, Quebec and York County, Maine. The difference in climate between the two areas indicates a broad tolerance of extremes by this species. Variations are also evident where lesser distances are involved. In Washington County, for example, it is not unusual to find either *Andrena regularis* or *A. vicina* as the predominant species in certain areas. In other areas, both species are found in what appear to be relatively equal numbers. Some species are, on the other hand, found in only one sampling area. A case in point is *A. rugosa* which has been taken in only Washington County.

A few species exhibit a wide range of distribution; *Bombus ternarius* and *B. terricola,* for example, were found in the seven locations sampled. *Andrena carlini, A. vicina,* and *Dialictus pilosus pilosus* were taken in all areas except Newfoundland, and *Evylaeus quebecencis* from all but Waldo County, Maine.

Preference for certain soil types for nesting is readily evident. Over relatively small areas of the Washington County barrens, for example, discrete groups of tumuli can be found. They are separated from other groups by intervening soil areas in which the general external appearance is not too different. This type of behavior has been found to be particularly true for *A. regularis, A. vicina, A. crataegi,* and *Halictus confusus.* Studies are under way to assess the physical and chemical characteristics of such preferred areas as compared to those remaining uninhabited.

Table 1 is concerned with the geographical distribution of species taken on *Vaccinium*; table 2 lists location captures of species suspected of association with *Vaccinium* in Maine.

Abundance of Individuals within Species

Several species are found in much greater abundance than are others. For the years 1961, 1962, and 1963, the following were taken in Maine in decreasing numbers of individuals: *Andrena regularis* (258); *Evylaeus quebecensis* (225); *Andrena crataegi* (118); *A. vicina* (91); and *Dialictus pilosus pilosus* (82). In contrast, many of the other species reported in this paper have been taken in relatively low numbers and in some cases, as few as two or three individuals were collected.

The scarcity of species of Megachilidae is not unusual in view of the scarcity of nesting sites. Wood and soda straw nests were distributed throughout several areas of Washington County in 1962 and 1963; these artificial devices have failed to attract any above-ground mega-

chiles. Those megachile species reported herein are ground nesters as shown by recent recoveries.

Biological Considerations

Seasonal Appearance. With the exception of those occurring late or possibly being bivoltine, species generally make their appearance shortly before *Vaccinium* blossoms. Adults of the larger andrenids are on the wing and quite evident a few days before flowering takes place; the smaller species are also present but in apparently lower numbers. Tumuli are numerous and easily seen on the blackened soil surface of the new burn areas; considerable activity is apparent but the mating and early foraging patterns have not been observed for most species. Some mating flights have been noted in the lee of solitary pines and spruces; such trees probably serve as focal points for congregating as well as offering protection from wind during pairing. The species involved have still escaped determination.

Indications are that mating of *Andrena regularis* and *A. vicina* takes place among the blueberry stems in bearing fields; further confirmation is necessary, however.

Some information was recovered on early appearance in 1966. *Halictus confusus* females were taken on April 30 well in advance of blueberry bloom which began in late May. Other species, however, appeared somewhat closer to bloom. *A. vicina* was recovered on willow on May 12; of this group, about 80% were males, indicating strong proterandry. *A. regularis* peak emergence dates as determined by caged tumuli, were May 12 for males and May 18 for females.

An interesting situation exists in the Lac St. Jean area where a brood of worker bumblebees (*Bombus ternarius* and *B. terricola*) which emerge in mid-June forms a major part of the native pollinator force. In all other areas the native pollinator force is predominantly comprised of solitary bees; overwintering queen bumblebees are present in very low numbers and no worker bumblebees are found during the blossoming period.

Nesting Habits. There exists a great deal of variation in location and construction of nests. *Colletes validus* is found predominantly in plant free areas, and in fact, seems to prefer the sloping sides of roadbeds; specimens were taken as frequently in such sites as in the fields among plants.

Andrena regularis and *A. vicina* appear to prefer the protective cover afforded by plant growth in the bearing fields and the majority of tumuli are found there. There is, however, considerable nesting in the

burned areas but we have not yet been able to determine if these represent use of the maternal nests only or if additional tunnels are dug.

Depth of the nests shows much variation influenced undoubtedly by soil type as well as habits of the particular species. *Colletes validus* tunnels, for example, have been excavated as deep as 16 inches in York County where Colton loamy sand permits easy penetration to the proper moisture stratum. *Andrena* spp. tunnels in Washington County, in contrast, are rarely more than 6 to 8 inches deep; here the gravelly nature of the soil and heavier plant root incidence undoubtedly make tunnelling much more difficult although it must still be assumed that the proper soil conditions are met at this relatively shallow depth.

We have not yet been able to locate the nesting sites of most halictid species. The abundance of *Evylaeus quebecensis,* for example, would lead one to assume that tunnels of this species would be evident. To date, however, these high numbers have not aided in detection.

As mentioned earlier, there is evidence of ground-nest construction by certain megachiles of the genus *Osmia*; confirming studies are underway on this point.

Attempts to induce migration into and utilization of prepared nesting sites have not been successful. Sand beds were constructed in 1962 in Township 19 of Washington County, an area of considerable native bee populations. These beds were excavated to a depth of 12 inches and refilled with a fine bank-run sand of light gravel content. The replaced medium was allowed to regain compaction through natural causes. The sites have been totally ignored up to 1966; the resurgence of plant growth in the past year may cause the beds to take on a more attractive aspect. Observations on these are continuing.

Flower Relationships and Foraging Habits. Floral preference is exhibited by several species such as *Hylaeus modestus modestus, Andrena bisalicis, Dialictus viridatus* and others which were collected on other hosts during the time blueberry was in bloom. Their absence from *Vaccinium* particularly in the heavily sampled locales of York and Washington counties would seem to be a good indication of preference and constancy for other plant species.

The flower constancy, among andrenids at least, is of the second type described by Linsley (1958) in that the species involved are limited to the number and kind of pollen sources by physiological adaptations. Such constancy is termed oligolectic; the synchronization of the adult andrenids to the blooming period of the major host plant is the primary adaptation of those discussed by Linsley. This makes it likely that the low-bush blueberry has become the predominant source of adult and larval food supply in the blueberry areas. Most of the other adaptations,

i.e., special periods of pollen availability and other physiological or morphological adaptations, etc., are at least not evident at this time. The solitary bee complex of the areas in question can, with some certainty, be termed oligolectic. This, in no way, disagrees with general assumptions in the literature.

Most native bees foraging on lowbush blueberry blossoms exhibit industriousness which in our observations exceeds that of domestic honeybees working the same areas. *Andrena regularis* and *A. vicina,* for example, are found visiting blossoms much earlier in the day than honeybees and continue to do so during periods of cool weather when honeybee activity is strongly curtailed. Several factors such as shaded nests, and activity during weather periods other than optimum, indicate that the species found in blueberry areas do not require the generally accepted requirements of sunlight, wind and temperature. It may be of interest that our comparisons of relative activity have all been made with honeybee colonies introduced from more southerly states solely for pollination services. We plan to investigate the activity of native colonies in this respect.

Under normal conditions, flight between flowers and foraging habits are not dissimilar from those of honeybees. Mouthparts of the larger forms of Andrenidae are long enough to reach the nectaries without difficulty. Smaller forms such as *Halictus* and *Dialictus* spp., however, must completely enter the corolla to obtain nectar; quite often only the tip of the abdomen of the bee is visible. It has been suggested that these smaller species are perhaps the more efficient pollinators since entrance into the blossom must be forced, during which maneuver, ample contact is made with the reproductive structures of the flower.

Parasites and Inquilines. In collections to date, there is evidence of substantial activity by insect enemies of the native bees inhabiting the areas discussed. Predators have not been noted to date.

The predominant species are in the genera *Sphecodes* and *Nomada* (Hymenoptera: Halictidae; Anthophoridae) and in the families Bombyliidae and Conopidae of the Diptera. Relationship and host preferences have not yet been fully established but it appears that *Andrena* spp. are probably more strongly involved in the complex than are other genera of native bees.

Several andrenid specimens have been observed to be stylopized, but the morphological changes in sex characteristics have not been studied. The extent of Strepsiptera involvement is not yet clearly defined but it appears to be of low incidence.

Geographical distribution of the species involved is given in table 3.

Systematics

Taxonomic designations are in accordance with Mitchell (1960, 1962). Subgenera are not given but the species are listed in the order in which they occur within the subgenera in Mitchell.

Records for host plants and occurrence in Maine are also from Mitchell.

A total of 89 species were taken of which 59 were recovered directly from *Vaccinium spp.*, 10 in close proximity to *Vaccinium* spp., and 20 species which, while parasitic, were nevertheless swept from *Vaccinium* bloom.

Of this number, 8 new state records for Maine and 34 new host records for *Vaccinium* spp. have been compiled from the material collected to date. It is expected that several additions will be made from the material presently categorized under "possible associations."

The lack of a check list for host plants and species occurrence by locale in Canada prevented determination of these aspects for the provinces concerned. There may be several new locations and host plant records so hidden; however, validation is not possible at present.

Species of Bees Collected on Vaccinium spp.

Family COLLETIDAE

Colletes validus Cresson
Location: York County, Maine; Quebec
Although occurring in these locations only, the species is relatively numerous in both. Of interest is the strong similarity of surface soil types in both areas.

Family ANDRENIDAE

Andrena mandibularis Robertson
Location: Washington County, Maine
New Maine record New record on *Vaccinium*
This species was found in no other location and was relatively abundant in Township 19 where it was taken.

Andrena thaspii Graenicher
Locations: York and Washington Counties, Maine; Quebec
New Maine record
It is interesting that this species was not taken on blueberry in New Brunswick but was however, collected on *Spiraea* in August.

Andrena carlini Cockerell
Locations: York, Waldo and Washington Counties, Maine; New Brunswick, Nova Scotia, and Quebec

Andrena regularis Malloch
Locations: York, Waldo and Washington Counties, Maine; New Brunswick
This is the most abundant species collected in Maine and is also found in high numbers in New Brunswick. A strong flier and industrious worker, it appears to be one of the most important native pollinators where it occurs.

Andrena nivalis Smith
Locations: York and Washington Counties, Maine; New Brunswick
New record on *Vaccinium*
Found in low numbers; appears to be of limited importance.

Andrena vicina Smith
Locations: York, Waldo and Washington Counties, Maine; New Brunswick, Nova Scotia, Quebec
Third most abundant andrenid; its habits are much like those of *A. regularis* and it is probably similar in importance.

Andrena alleghaniensis Viereck
Locations: Washington and York Counties, Maine
New Maine record New record on *Vaccinium*

Andrena forbesii Robertson
Locations: York County, Maine; New Brunswick
An example of widely separated distribution, occurring in southern Maine and New Brunswick but not taken in Washington County.

Andrena rugosa Robertson
Location: Washington County, Maine
New record on *Vaccinium*
Occurring in very low numbers.

Andrena sigmundi Cockerell
Locations: York, Waldo and Washington Counties, Maine; New Brunswick
New record on *Vaccinium*

Andrena lata Viereck
Locations: Washington County, Maine; New Brunswick, Nova Scotia
New record on *Vaccinium*

Andrena crataegi Robertson
Locations: York, Waldo and Washington Counties, Maine; New Brunswick
New record on *Vaccinium*
This species ranks second in abundance in Maine; it is minimal in New Brunswick, however.

Andrena bradleyi Viereck
Locations: York and Washington Counties, Maine; New Brunswick, Quebec

Andrena carolina Viereck
Locations: York, Waldo and Washington Counties, Maine; New Brunswick and Nova Scotia
Relatively numerous in Maine, New Brunswick and Nova Scotia.

Andrena durangoensis Viereck and Cockerell
Locations: York and Washington Counties, Maine; New Brunswick
New Maine record New record on *Vaccinium*

Andrena rufosignata Cockerell
Locations: Washington County, Maine; New Brunswick
New record on *Vaccinium*
Relatively numerous in Maine.

Andrena wheeleri Graenicher
Locations: York, Waldo and Washington Counties, Maine; New Brunswick
New record on *Vaccinium*
An example of a wide range but rather low numbers.

Andrena cressonii Robertson
Location: Washington County, Maine
New record on *Vaccinium*
Occurs in very low numbers; 3 specimens taken in 1962 in Deblois.

Andrena illinoiensis Robertson
Location: Washington County
New Maine record New record on *Vaccinium*

Andrena melanachroa fragariana Graenicher
Locations: Washington County, Maine; New Brunswick
New Maine record New record on *Vaccinium*
A very small andrenid (♀ 6 mm.); taken for the first time in Maine in 1965.

Andrena wilkella Kirby
Location: Newfoundland

Family HALICTIDAE

Halictus rubicundis (Christ)
Locations: Washington County, Maine; New Brunswick and Quebec
This is apparently a bivoltine species; individuals were taken on buckwheat on August 8 in Twp. 19.

Halictus ligatus Say.
Location: Waldo County, Maine
New record on *Vaccinium*

Halictus confusus Smith
Locations: Washington County, Maine; New Brunswick and Nova Scotia
New record on *Vaccinium*
Taken on buckwheat on same dates and locations as *H. rubicundis;* also collected September 3 in Washington County, Maine.

Lasioglossum forbesii (Robertson)
Locations: York and Washington Counties, Maine; New Brunswick

Lasioglossum leucozonium (Schrank)
Locations: Washington County, Maine; New Brunswick

Lasioglosum zonulum (Sm)
Location: Nova Scotia

Lasioglossum athabascense (Sand)
Locations: New Brunswick and Quebec

Evylaus arcuatus (Robertson)
Locations: York County, Maine; New Brunswick
Another example of presence in widely separated areas without occurrence in the intervening regions.

Evylaeus foxii (Robertson)
Locations: York and Washington Counties, Maine; New Brunswick and Nova Scotia
Another bivoltine species; individuals taken on buckwheat on August 9 in Twp. 19.

Evylaeus quebecensis (Crawford)
Locations: York and Washington Counties, Maine; New Brunswick, Nova Scotia, Newfoundland and Quebec
One of the most widely distributed and abundant species collected.

Evylaeus truncatus (Robertson)
Location: Washington County, Maine
New record on *Vaccinium*

Dialictus admirandus (Sand)
Location: New Brunswick, Nova Scotia

Dialictus albipennis (Robertson)
Location: York County, Maine
New record on *Vaccinium*

Dialictus inconspicuous (Smith)
Location: Waldo County, Maine

Dialictus perpunctatus (Ellis)
Locations: York and Washington Counties, Maine
New record in Maine New record on *Vaccinium*

Dialictus pilosus pilosus (Smith)
Locations: York, Waldo, and Washington Counties, Maine; New Brunswick, Nova Scotia and Quebec.
New record on *Vaccinium*

Dialictus rohweri (Ellis)
Location: Waldo and Washington Counties Maine
New record on *Vaccinium*

Dialictus versans (Lovell)
Locations: York, Waldo and Washington Counties, Maine; New Brunswick
New record on *Vaccinium*

Dialictus (Chloralictus) oblongum (Lovell)
Location: New Brunswick

Dialictus (Chloralictus) vividatum (Lovell)
Location: New Brunswick

Augochlorella striata (Provancher)
Locations: York, Waldo and Washington Counties, Maine; Nova Scotia

Family MEGACHILIDAE

Osmia (Chenosmia) atriventris Cresson
Locations: Waldo and Washington Counties, Maine

Osmia (Nothosmia) distincta Cresson
Location: Quebec

Osmia (Chenosmia) inermis (Zetterstedt)
Location: Washington County; New Brunswick

Osmia (Acanthosmioides) integra Cresson
Location: Washington County, Maine
New Maine record New record on *Vaccinium*

Osmia (Nothosmia) inspergens Lovell & Cockerell
Location: Washington County, Maine

Megachile melanophoea melanophoea Smith
Location: Quebec

Family XYLOCOPIDAE

Ceratina dupla dupla Say
Location: Waldo County, Maine
New record on *Vaccinium*

Family BOMBIDAE

Bombus borealis Kirby
Location: Newfoundland

Bombus frigidus couperi Cresson
Location: Newfoundland

Bombus perplexus Cresson
Locations: Washington County, Maine; New Brunswick

Bombus ternarius Say
Locations: York, Waldo, and Washington Counties, Maine; New Brunswick, Nova Scotia, Newfoundland, and Quebec.

Bombus terricola Kirby
Locations: York, Waldo, and Washington Counties, Maine; New Brunswick, Nova Scotia, Newfoundland, and Quebec
With *B. ternarius*, occurring in all areas sampled.

Bombus vagans vagans Smith
Location: New Brunswick

Bombus vagans bolsteri Franklin
Location: Newfoundland

Bombus affinis Cresson
Location: New Brunswick

Bombus bimaculatus Cresson
Location: New Brunswick

Species Possibly Associated with Low-Bush Blueberry

A number of native bees have been taken in close proximity to *Vaccinium*; these were generally captured while visiting blossoms of *Prunus, Amelanchier, Pyrus, Solidago*, and buckwheat (*Fagopyrum*) growing adjacent to or within the perimeter of blueberry fields. Buckwheat was planted on blueberry land in Township 19, Washington County in 1962 to serve as a possible attractant to late occurring species or those exhibiting bivoltine habits. Several species were taken on these plantings in early August.

Family COLLETIDAE

Colletes simulans armatus Patton
Location: Washington County, Maine
Hosts: *Solidago, Fagopyrum*
Collection date: August 9.

Hylaeus cressonii cressonii (Cockerell)
Location: Washington County, Maine
Host: *Fagopyrum*
Collection date: August 9.

Hylaeus ellipticus (Kirby)
Location: Washington County, Maine
Host: *Solidago*
Collection date: August 9.

Hylaeus modestus modestus Say
Location: York County, Maine
Host: *Pyrus melanocarpa*
Collection dates: June 5-15

Family ANDRENIDAE

Andrena bisalicis Viereck
Locations: York and Washington Counties, Maine
Hosts: *Prunus, Amelanchier*
Collection date: May

Andrena miserabilis bipunctata Cresson
Location: York County, Maine
Host: *Amelanchier*
Collection date: May 16

Family HALICTIDAE

Dialictus oblongus (Lovell)
Location: Washington County, Maine
Host: *Fagopyrum*
Collection date: August 9

Dialictus viridatus (Lovell)
Location: Washington County, Maine
Host: *Pyrus melanocarpa*
Collection date: June 15

Evylaeus divergens (Lovell)
Location: Washington County, Maine
Host: *Pyrus melanocarpa*
Collection date: May

Agopostemon texanus texanus Cresson
Location: York County, Maine
Host: *Pyrus melanocarpa*
Collection date: May

Parasites and Inquilines

The species listed below are those taken from *Vaccinium* spp. and other plants. Most occur in relatively low numbers on blueberry, apparently visiting blossoms sporadically for nectar and possibly pollen, in search of host species, or perhaps merely resting.

Order Hymenoptera

Family HALICTIDAE

Sphecodes carolinus Mitchell
Location: York County, Maine
New record on *Vaccinium*

Sphecodes confertus Say
Location: York County, Maine
Host: *Pyrus melanocarpa*
Collection date: June 5

Sphecodes dichrous Smith
Location: Washington County, Maine
Hosts: *Solidago, Fagopyrum*
Collection date: August 9

Sphecodes persimilis Lovell and Cockerell
Locations: York, Waldo and Washington Counties, Maine
New record on *Vaccinium*
This species is the most numerous of the genus collected to date.

Sphecodes ranunculi Robertson
Location: York County, Maine
New record on *Vaccinium*

Sphecodes solonis Graenicher
Location: Washington County, Maine
Host: *Fagopyrum*
Collection date: August 9

Sphecodes stigius Robertson
Location: Washington County, Maine
Host: *Fagopyrum*
Collection date: August 9

Family ANTHOPHORIDAE

Nomada capitalis Mitchell
Location: Waldo County, Maine
New record on *Vaccinium*

Nomada cressonii Robertson
Locations: York and Washington Counties; New Brunswick
New record on *Vaccinium*

Nomada pygmaea Cresson
Locations: York and Washington Counties, Maine
New record on *Vaccinium*

Nomada imbricata Smith
Location: Washington County, Maine
New record on *Vaccinium*

Nomada illinoiensis Robertson
Location: New Brunswick

Nomada lepida Cresson
Locations: Washington County, Maine; New Brunswick
New record on *Vaccinium*

Nomada maculata Cresson
Location: York County, Maine
New record on *Vaccinium*

Nomada ulsterensis Mitchell
Location: Washington County, Maine
New record on *Vaccinium*

Family BOMBIDAE

Psithyrus insularis (Smith)
Location: New Brunswick

Psithyrus ashtoni (Cresson)
Location: New Brunswick
New record on *Vaccinium*

Psithyrus fernaldae Franklin
Location: New Brunswick
New record on *Vaccinium*

Order Diptera

Family BOMBYLIIDAE

Bombylius spp.
Locations: York and Washington Counties, Maine; New Brunswick

Family CONOPIDAE

Myopa spp.

Locations: York and Washington Counties, Maine; New Brunswick

The above species of Diptera have been observed in practically all areas visited during collections. However, the locations listed are those where the species were actually taken.

TABLE 1

Synopsis of Geographical Distribution of Native Bees Collected on Low-Bush Blueberry—1961-1965

	York	Waldo	Wash.	N.B.	N.S.	Quebec	Newf.
Family Colletidae							
Colletes validus		x				x	
Family Andrenidae							
Andrena mandibularis			x				
A. thaspii	x		x			x	
A. carlini	x	x	x	x	x	x	
A. regularis	x	x	x	x			
A. nivalis	x		x	x			
A. vicina	x	x	x	x	x	x	
A. forbesii	x			x			
A. rugosa			x				
A. sigmundi	x	x	x	x			
A. lata			x	x	x		
A. bradleyi	x		x	x		x	
A. crataegi	x	x	x	x			
A. carolina	x	x	x	x	x		
A. durangoensis	x		x	x			
A. rufosignata			x	x			
A. wheeleri	x	x	x	x			
A. cressonii			x				
A. melanachroa fragariana			x	x			
A. wilkella						x	
A. illinoiensis			x				
A. alleghaniensis	x		x				
Family Halictidae							
Halictus rubicundis			x	x		x	
H. ligatus		x					
H. confusus			x	x	x		
Lasioglossum forbesii	x		x	x			
L. leucozonium			x	x			
L. zonulum					x		
L. athabascense				x		x	
Evylaeus arcuatus	x			x			
E. foxii	x		x	x	x		
E. quebecensis	x		x	x	x	x	x
E. truncatus			x				
Dialictus admirandus				x	x		
D. albipennis	x						
D. inconspicuous		x					
D. perpunctatus	x		x				
D. pilosus pilosus	x	x	x	x	x	x	
D. rohweri		x	x				
D. versans	x	x	x	x			
Augochlorella striata	x	x	x		x		
Chloralictus oblongum				x			
C. vividatum				x			

	York	Waldo	Wash.	N.B.	N.S.	Quebec	Newf.
Family Megachilidae							
Osmia atriventris		x	x				
O. distincta						x	
O. inermis			x	x			
O. integra			x				
O. inspergens			x				
Megachile melanophaea						x	
Family Xylocopidae							
Ceratina dupla dupla		x					
Family Bombidae							
Bombus borealis							x
B. frigidus couperi							x
B. perplexus			x	x			
B. ternarius	x	x	x	x	x	x	x
B. terricola	x	x	x	x	x	x	x
B. vagans vagans				x			
B. vagans bolsteri							x
B. affinis				x			
B. bimaculatus				x			

TABLE 2

Synopsis of Geographical Distribution of Native Bees Possibly Associated with Low-Bush Blueberry in Maine—1961-1965

	York	Wash.
Family Colletidae		
Colletes simulans armatus		x
Hylaeus cressonii cressonii		x
H. ellipticus		x
H. modestus modestus	x	
Family Andrenidae		
Andrena bisalicis	x	x
A. miserabilis bipunctata	x	
Family Halictidae		
Dialictus oblongus		x
D. viridatus		x
Evylaeus divergens		x
Agopostermon texanus texanus	^	

TABLE 3

Synopsis of Geographical Distribution of Parasites and Inquilines of Native Bees Collected in Maine and New Brunswick—1961-1965

	York	Waldo	Washington	New Brunswick
Order Hymenoptera				
Family Halictidae				
Sphecodes carolinus	x			
S. confertus	x			
S. dichrous	x			
S. persimilis	x	x	x	
S. ranunculi	x			
S. solonis			x	
S. stigius			x	
Family Anthophoridae				
Nomada capitalis		x		
N. cressonii	x		x	x
N. pygmaea	x		x	
N. illinoiensis				x
N. imbricata			x	
N. lepida			x	x
N. maculata	x			
N. ulsterensis			x	
Family Bombidae				
Psithyrus insularis				x
P. ashtoni				x
P. fernaldae				x
Order Diptera				
Family Bombyliidae				
Bombylius spp.	x	x	x	x
Family Conopidae				
Myopa spp.	x		x	x

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