1950

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George E. Bohart

Utah State University

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THE ALKALI BEE, *Nomia melanderi* Chil.

A NATIVE POLLINATOR OF ALFALFA

George E. Bohart
U.S. Legume Seed Research Laboratory, Logan, Utah

The alkali bee belongs to the subgenus *Acunemia* whose members are the only North American bees with apical transverse bands of iridescent pale green to greenish-bronze on the abdominal segments. *N. (A.) melanderi*, which is about two-thirds as large as a honey bee, is much the largest of the three species of this group inhabiting the territory from the Rocky Mountains westward. It is also the only one in which the female has a green band, or at least its remnants, on the first segment. The male is readily distinguished by the long, sharp, terminal antennal segment, and by the greatly dilated hind tibia which is much broader than long. Several subspecies of the alkali bee have been described, but it is probable that this discussion, which is based on intermountain forms, would apply generally throughout the range of the species.

*N. melanderi* occurs in scattered localities from the eastern slopes of the Rocky Mountains westward, and from near the Canadian border southward into northwestern Mexico and Baja, California. These bees are most often encountered in the larger valleys near poorly drained areas where moist alkaline soil is available for their nesting sites. Their abundance in the fields naturally bears a general relationship to the proximity and population of the nesting sites. Fields within two miles of good nesting sites generally have effective populations. Since the nesting sites often become victims of ploughing, flooding, or other agricultural practices, it is common experience for an alfalfa field to have a good population one year and none the next. Conversely, because of their habit of expanding into new sites en masse, an effective population may suddenly appear in a seed-growing area which has not been so blessed in the memory of the resident farmers.

A number of factors make alkali bees within their range the most important of the wild pollinators of alfalfa. In the first place, they are individually efficient pollinators when they visit alfalfa. Various counts in the West have placed the flower-visiting rate of the females at about 12 per minute, and the tripping rate at over 90 percent. Secondly, because of their rather restricted host range, it is not difficult in most cases to ensure that a high percentage of the population in an area will gather largely alfalfa pollen. Thirdly, their gregarious habits make it possible for large populations to nest in a small land area. A quarter of an acre of poor alkaline ground may house as many foraging bees as a 20-colony apiary of honey bees. Consequently, farmers can provide plenty of actual or potential nesting sites for alkali bees without sacrificing significant amounts of crop land.
On the debit side of the ledger, there are several reasons why alkali bees are not going to become the answer to every seed grower's dream of a big seed crop. In the first place, their distribution is limited to within a few miles of suitable nesting soil. Secondly, their period of activity is too late for first-crop bloom in most areas and sometimes even for maximum benefit to second-crop. Thirdly, parasites may take a heavy toll. In Cache Valley, Utah, a large nesting site was nearly annihilated in 1946 by the bombyliid fly, _Heterostylum robusta_ O.S., and has since been kept to a low level by this parasite.

Nesting nearly always takes place in fine-textured, somewhat cohesive, sandy or clayey soils. These soils must be damp the year around, but not flooded for extensive periods. Nesting may take place on bare ground, but is more commonly associated with a sparse growth of salt grass or other short vegetation that allows the sun's rays to strike the ground.

Although alkali bees concentrate their nests into a small area of soil, they are solitary in that each female functions as both queen and worker and constructs and provisions an individual nest burrow in the soil. Each nest consists of a vertical underground burrow branching into one or two groups of brood cells. The first group is from four to five inches deep. The second, if constructed, is from three to four inches deeper. Each group or story is composed of from five to ten separate milk-bottle-shaped cells placed side by side from a few millimeters to a centimeter or two apart. After constructing a story of roughly-made cells, the bee polishes up and then provides each cell in turn with a ball of nectar-moistened pollen on which she places an egg. After laying the egg, she seals the cell and polishes and provisions the next one. The young larva, after hatching from the egg, must complete its development without further assistance.

Adult activity begins in the summer with the appearance of males. This may precede the main emergence of females by a week or two. In Utah, males generally appear in the first half of July, and the females don't usually show up in abundance until the middle or sometimes even the end of July. In central Washington, the main emergence of females apparently takes place around the end of June, and in the Southwest it may begin in May. The males tend to be "flighty" in alfalfa fields and don't settle down and trip many flowers until after the first few weeks. Consequently, the grower, in order to take full advantage of alkali bees, must time his bloom for the main emergence of females.

At least two generations of females appear during the season. However, there is no sharply defined interval between broods, and many of the overwintered generation continue to emerge until the progeny of the "early birds" are already flying. The second generation is composed principally of females. Since males develop from unfertilized eggs, it seems likely that the scarcity of males late in the season accounts for the large number of males appearing early the following season.
In Utah, the adults die off during the first part of September. The larvae, after completing their growth in about ten days, transform into naked prepupae in which condition they remain until the following summer. Warm weather brings about pupation. Within a week adults emerge and open up the old nests to take flight. Table 1 shows a typical course of events in nesting sites in Utah. In some sites, a few females emerge as late as September, but it is not known if these are stragglers of the second generation, or represent a small emergence of the next generation which normally overwinters in the prepupal stage. In the Southwest, there appears to be a full third, and perhaps a fourth, emergence of adults.

Table 1. Yearly cycle in a nesting site of alkali bees, Delta, Utah.

<table>
<thead>
<tr>
<th>Period</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-September to June</td>
<td>Prepupae in brood cells</td>
</tr>
<tr>
<td>Late June to early July</td>
<td>Pupae formed</td>
</tr>
<tr>
<td>Early to mid-July</td>
<td>Principal emergence of males</td>
</tr>
<tr>
<td>Last three weeks of July</td>
<td>Principal emergence of females</td>
</tr>
<tr>
<td>Last half of July and first half of August</td>
<td>Offspring carry through to pupation</td>
</tr>
<tr>
<td>Early to late August</td>
<td>Second generation adults (mostly females) emerge, construct and provision nests. First generation adults complete activities and perish.</td>
</tr>
<tr>
<td>Late August to early September</td>
<td>Second generation adults complete activities and perish.</td>
</tr>
<tr>
<td>Mid-September to June</td>
<td>Progeny of second generation and some of late-emerging first generation carry through as prepupae</td>
</tr>
</tbody>
</table>

In Utah, the principal host plants of alkali bees are alfalfa, white and yellow sweetclover and Russian thistle. Other less abundant flowers which they collect from readily are bind-weed (Convolvulus), salt cedar (Tamarix) and various clovers. Common competitors with alfalfa for honey bees such as grease wood, poverty weed, gumweed, and sunflower are not attractive to alkali bees in
Utah. In 1950, at Fillmore, Utah, rabbit brush (Chrysothamnus), although not touched by alkali bees for pollen during the main period of alfalfa bloom, became an important pollen source in late August and early September.

There are numerous parasites and diseases of alkali bees, but these appear to be important only in certain places and at certain times. In Washington and Idaho, a cuckoo bee, Nomada suavis Cresson, takes over a small percentage of the provisioned cells. In the same states, and in northern Utah, the larvae of the bombyliid fly, Heterostylum robusta O.S., sometimes consume up to 25 percent of the bee larvae. In Cache Valley, they have been observed to destroy 90 percent. Minor insect enemies include a conopid fly, Zodion obliquefasciatum Macq., which lays an egg in the adult bee; larvae of phorid, otitid, and sarcophagid flies which occasionally find their way into cells and consume the pollen; and a blister beetle, Nemognatha sp., whose first stage larvae are carried from flowers into the cells by the mother bees. Once in the cells the beetle larvae eat the bee egg and then the provisions.

After a rain occurs during the nesting period, many pollen balls are apt to liquify with subsequent death to the larvae. Wet weather during nesting also seems to be associated with a blackening of many prepupae.

In Utah, we are attempting to establish new nesting sites by moving brood. Methods used for obtaining brood have included cutting out soil blocks from the nesting sites, burying boxes in nesting sites, and digging them up the following season, and transferring individual prepupae from the soil into wax coated "cells" in wooden blocks.

Brood obtained by all three methods have yielded adult bees after being buried in a proposed nesting site. However, it is too early to determine whether or not any of these methods will be successful in establishing new nesting sites.