The Great Lakes Entomologist

Volume 11
Number 2 - Summer 1978 *Number 2 - Summer 1978*

Article 5

June 1978

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A LOCAL REPLACEMENT OF *BOMBUS TERNARIUS* BY *BOMBUS TERRICOLA* IN NORTHERN WISCONSIN (HYMENOPTERA: APIDAE)

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ABSTRACT

During the last few years, the bumblebee *Bombus ternarius* Say has markedly decreased in numbers in Vilas County in northern Wisconsin while *Bombus terricola* Kirby has increased. The great ecological similarity of these species suggests that interspecific competition may cause or facilitate this replacement.

Bombus ternarius Say has apparently been moving north for many years. Say's description stated that it "inhabits Indiana." In the early 1900's it was collected from southern Wisconsin, but only one individual has been collected in the southern part of the state since 1927 (Medler and Carney, 1963). The distribution given by Medler and Carney as current in 1963 shows the southern boundary of the range coinciding with the vegetational "tension zone" described by Curtis (1959). Medler and Carney further state that *ternarius* is "the most abundant (bumblebee) species" in this area of the state, "along with *B. terricola* (Kirby)." In Vilas County, which is well north of the tension zone, this assessment of abundance would have been correct in 1973 but has become incorrect since then.

I have been studying pollination in Vilas County, not bumblebee population dynamics, and I only have quantitative population data for one type of habitat, the roadside stands of hawkweeds (*Hieracium aurantiacum* L. and *H. florentinum* All.) which bloom in late June and July. However, it is my strong subjective opinion that the clear reduction of *ternarius* which has occurred in this habitat has also occurred in the other habitats frequented by the species, which include bogs, woodlands, and blueberry openings (Thomson, 1975).

My data for each year come from sampling in a number of different hawkweed stands along highways US 51 and County M. The area of collection spans about 20 km of road; different year's data include some stands in common. In 1973 and 1976 I collected the bees by sweeping, while in 1974 and 1975 I observed individuals foraging. The bees were almost all workers, but a few queens were caught or seen as well (Table 1).

In all years there were smaller numbers of other *Bombus* and *Psithyrus,* but the data are insufficient to show any trends. I did not have the impression that any of these species changed in abundance.

Table 1. Numbers of bees caught in successive years.

	B. ternarius	*B. terricola*
1973	29 (32.2%)	61 (67.8%)
1974	22 (34.4%)	42 (65.6%)
1975	16 (16.7%)	80 (83.3%)
1976	1 (1.4%)	70 (98.6%)

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In 1974 and 1976 I estimated the combined density of *ternarius* and *terricola* while they foraged on hawkweeds. Although there were variations depending on the floral composition of a stand (Thomson, in press), the values for similar stands are relatively constant from year to year. Two sites were sampled in both years; in both of these, bee densities increased slightly. Thus the decline in *ternarius* must have been accompanied to some extent by an increase in *terricola.*

With respect to feeding, these two are the most ecologically similar species of *Bombus* in the area. Although Hobbs (1967, 1968) has pointed out some ecological differences between *ternarius* and *terricola* in southern Alberta, these relate to gross habitat preferences and not to feeding when the bees do occur together as in the present case. Body sizes of all castes are similar, and tongue lengths, which largely determine feeding overlap (Heinrich, 1976), are even more similar (Medler, 1962a; Medler and Carney, 1963; Heinrich, 1976). Lists of plants visited by the two species are virtually identical in Vilas County (Thomson, 1975), in Wisconsin in general (Medler and Carney, 1963) and in bog habitats in Maine (Heinrich, 1976).

In Maine, Heinrich showed that food is often in short supply; these species would be expected to compete strongly for it. Inouye (1976) has shown that tongue lengths, through their influence on food competition, are very important determinants of bumblebee community structure. His concluding generalization, in which Pyke (Unpubl.) concurs, is that most bumblebee communities only comprise one common species of a particular tongue length. Thus one usually finds one common short-tongued bee, one medium, one long, and possibly a nectar-robbing species. This certainly suggests instability in the present case, where the two commonest species are both short-tongued. Morse (1977) has documented behavioral avoidance (within an inflorescence) of large foraging individuals of *terricola* by small individuals of *ternarius;* but it is uncertain whether this facultative reduction of interference competition has more than a small influence on community structure, which Heinrich (1976), Inouye (1976), Pyke (Unpubl.) and I feel is more affected by exploitation competition. Since Fye and Medler (1954; also see Medler, 1962b) were able to increase some *Bombus* spp. populations by providing artificial domiciles, nest sites might also be objects of competition. Both species are subterranean nesters, but details of their preferences in Vilas County are not known.

Substantial fluctuations in bumblebee populations have been reported commonly, especially in the European literature (Inouye, 1976) The changes are often "erratic and unpredictable" (Holm, 1966), and often related to weather or weather-caused food shortage (Bohart and Knowlton, 1952). However, three features of the *ternarius/terricola* case combine to suggest a more direct species interaction: the ecological similarity of the species; the continued directionality of the changes; and the opposite, apparently compensatory, nature of the changes.

Although the two bumblebees do coexist in native habitats, their large ecological overlap would tend to increase any deleterious effects of interspecific competition. While Gausian exclusion certainly does not fully explain the shrinking range of *ternarius,* the high potential for food and nest competition might make the balance between these species particularly susceptible to destabilization by external factors such as habitat deterioration. The role of competition in the local destabilization described here would be worth investigating, as would the relationship between local and regional abundance shifts in these species.

ACKNOWLEDGMENT

The Department of Zoology, University of Wisconsin, provided lodging at their Trout Lake research station as well as travel support during this research.

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