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THE SEASONAL CYCLE AND HABITAT OF A TROPICAL BUMBLE BEE

By Charles D. Michener[1] and Moh. Amir[2]

Abstract: In the mountains of Java, in areas of rather uniform temperature and high rainfall, *Bombus rufipes* is active throughout the year. Fresh reproductives have been taken in all seasons. New colonies are evidently established by lone queens as in other *Bombus* species but 3 worn queens were seen leaving a single nest, suggesting that some queens of this species may remain together, leading to permanent colonies like those of *Bombus atratus*.

Bumble bees (genus *Bombus*) are found primarily in the cool north temperate parts of the world. A few species do occur in the equatorial and austral regions, particularly in the Western Hemisphere where 2 species are found in the lowland forests of the Amazon Valley (Moure & Sakagami 1962) and several are found in the mountains and in southern South America. There is only a single record, quite possibly based on a mislabeled specimen, for subsaharan Africa (Tkalců 1966). In the Indian area bumble bees are not known south of the Himalayan region. In Southeast Asia *Bombus* occurs in the mountains as far south as the island of Java, about 7° S latitude.

In the many species of strongly seasonal temperate and subarctic regions, the overwintered queens establish nests in the spring, colonies of workers develop in summer, males and new queens are produced in late summer, and all except the fertilized young queens die by autumn. Even *Bombus transversalis* in the Amazon Valley has a seasonal life cycle, colonies being active for only a few months, mostly during the dry season (Dias 1958). Colonies of *Bombus atratus* in southern Brazil survive for years even in the somewhat seasonal climate of that area (21°–22° S) (Zucchi 1973, Michener 1974). Collection data from Brazil (Moure & Sakagami 1962) show that workers of *B. transversalis* from the equatorial region can be taken in nearly every month although reproductives have not been taken during the wetter months. *B. morio* in the northern part of its range (10°–20° S) and *B. atratus* over a wider area (10°–30° S) have been collected as workers in nearly all months. The same is true of reproductives, especially of *B. atratus*, in the more northern area (10° – 20° S). Other *Bombus* whose life histories or phenologies have been studied are highly seasonal. For this reason we believe it worthwhile to present our fragmentary data on the activity of *Bombus rufipes* in Java, where there is relatively little seasonal variation in the weather.

Distribution and Habitat. In Java, *Bombus* is restricted to the mountains. All our data concern West and Central Java. One male has been taken at 700 m altitude but all other records are between 1000 and 3000 m. The following list indicates the localities from which we examined specimens:

WEST JAVA: Mt Salak, 1200 m; Mt Pangrango-Gede complex: Puncak Pass, Telagawarna, 1450–1500 m; Cibodas, 1400–2900 m; Lebak Saät (slope of Mt Gede), 2400 m; Mt

[1] Departments of Entomology and of Systematics and Ecology, University of Kansas, Lawrence, Kansas 66045, U.S.A.

[2] Museum Zoologicum Bogoriense, Bogor, Java, Indonesia.

Pangrango, 2800–3000 m, Cibeureum (above Cibodas), 1700 m; Cisarua (north slope of Mt Gede). 1000 m; Mt Tangkuban Prahu, 1200–1300 m. Mt Papandayan, 2200 m. Sukanegara, Jampang District, 700 m, Mt Malang. Mt Patuha, 2450 m. Mt Pangalengan, 1250 m. CENTRAL JAVA: Mt Slamet, 1500 m. Mt Telomoyo, 1900 m. Diëng Plateau: Kawah Sibanteng, 2400 m; Lake Wemo, 2090 m. Mt Merapi.

The following notes on the habitats where *Bombus rufipes* exists are based on observations by one of us (C.D.M.) made in May 1973. In the reserve at Cibodas the bees were seen in the forest. Several queens were flying over the ground surface in the undisturbed forest and also along forest paths, exactly as temperate species do when searching for nesting sites. Both castes as well as males were seen on the rather scarce flowers in the forest. Presumably mountain forest, together with the heath areas above the forests on the high mountains, are the original habitat of this bee.

The species was also taken near the guest house at Cibodas, on flowers outside the forest in the botanical garden. It was especially common on a species of *Dahlia.* On the Dieng Plateau *Bombus rufipes* was extraordinarily abundant on flowers of labiates and introduced *Fuchsia* in the vicinity of Lake Werno. The original forest is gone in this area but there is a little secondary growth in some places as well as considerable areas of introduced *Acacia* and other vegetation. On Mount Merapi the *Bombus* was taken in an area from which the forest is completely gone; although there are large areas planted with *Acacia, Bombus* were a little higher, in an area of dense bushes.

Climate. Unlike typical *Bombus* habitats, there is little seasonal fluctuation in weather on the Javan mountains. In general, West Java is rather uniformly wet while Central Java has a more pronounced dry season. This distinction, however, is not very apparent from the data presented in TABLE 1. At each locality there was a dryer season from June

TABLE 1. Monthly mean rainfall (mm) and temperature data for mountain localities in Java.

	WEST JAVA									CENTRAL JAVA		
	MT SALAK* (1500 m)			CIBODAS** (1400 m)			LEMBANG** (1250 m)			MT SLAMET*** (1500 m)		
	Rain	Max.	Min.	Rain	Max.	Min.	Rain	Max.	Min.	Rain	Max.	Min.
Jan.	968	28	21	442	21	16	150	24	17	407	26	16
Feb.	492	26	22	368	22	16	147	24	17	491	26	15
Mar.	99	29	22	402	22	16	163	25	17	469	25	15
Apr.	642	31	22	373	22	16	187	24	17	360	25	15
May	210	32	22	333	22	16	123	24	17	177	26	15
June	53	33	22	157	21	14	74	24	16	118	26	13
July	61	33	19	78	21	14	76	24	15	102	26	11
Aug.	65	32	20	65	22	14	41	25	15	66	26	12
Sept.	34	33	21	157	22	14	86	26	15	109	26	13
Oct.	337	33	21	331	22	15	123	25	16	184	27	12
Nov.	346	28	21	380	22	15	278	24	16	259	26	14
Dec.	389	31	21	430	22	16	329	24	16	384	25	15
Totals	3696			3516			1777			3126		

* Observations at Dermaga by Bogor Agricultural Institute, 1 year (1963) only.

** Adapted from: Observations made at secondary stations in the Netherlands Indies, Meteorological and Geophysical Service, Dept. of Public Works and Communication, Batavia (Dr J. Boerema); figures for Lembang are means for 3 years for rainfall, 4 years for temperatures; for Cibodas the figures are based on 2 year's data. Cibodas is on the slopes of Mt Gede; Lembang is on a mountain north of Bandung, from which no *Bombus* have been collected.

*** Adapted from: Meteorological observations made at Baturraden Station, Central Bureau of Climatology, Jakarta; rainfall based on 1 year, temperatures on 3 years for most months.

through September, more extended (May through October) on Mt Slamet in Central Java. Rain falls each month, however, and at the altitudes where *Bombus* occurs the habitat is probably always rather wet. There are 20 to 80 rainy days during the 4 driest consecutive months of the year. Diurnal variations in temperature are marked as suggested by the differences between monthly maxima and minima but seasonal variations amount to only a very few degrees.

Seasonal activity of Bombus rufipes. Workers have been taken in every month of the year. TABLE 2 shows the months when reproductives have been taken. Queens and probably males are active outside their nests throughout the year. Worn and unworn individuals appear also to be found throughout the year.

TABLE 2. Seasonal occurrence of reproductives of *Bombus rufipes.*

	♂♂	QUEENS
Jan.	1	1
Feb.	1	2**
Mar.	3**	1*
Apr.		1
May***	10	12*
June***	16**	9**
July	3	4**
Aug.	3	4
Sept.	2**	1
Oct.	3**	
Nov.		3**
Dec.		1

* Bees with scarcely-worn wings included.
** Bees with unworn wings included.
*** The large number of captures in May and June are probably due to greater activity of collectors at that season.

The finding of unworn, presumably young, reproductives in most months indicates that this species produces reproductives at all seasons, as might be expected considering the climate. This does not necessarily mean that each colony does so, although this may be the case. The numerous captures of reproductives during the dry season suggest that many colonies produce reproductives at that time. The same or other colonies apparently do so at other seasons, and there is no evidence that the dry season is the principal reproductive period, although it may be. Dr M. A. Lieftinck, who collected much of the material, notes (in litt.) that May and June was the favored season for holidays and collecting trips, a fact which he says could easily explain the greater numbers taken during those months.

The 2 queens taken while searching for nesting sites at Cibodas in May 1973, by C.D.M. were only slightly worn, as might be expected.

Nests. That Indonesian *Bombus* nest in the ground is not a new finding. Meer Mohr & Lieftinck (1947) reported digging nests of *B. senex* in Sumatra. Queens of *B. rufipes* fly over the ground searching for nest sites, as noted above. Near Lake Werno on the Diëng Plateau, C.D.M. located 1 nest entrance. It was an irregular hole about 2 cm in diameter, in slightly sloping, weedy ground. The hole extended down for at least 25 cm. Lack of time prevented digging the nest.

Three large queens left the nest at Lake Werno during a few minutes of observation. A few workers were also coming and going. The queens had moderately to well worn wings, suggesting that queens may live and work together in the same nest, as in *Bombus atratus* (Zucchi 1973, Michener 1974).

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LITERATURE CITED

Dias, D. 1958. Contribuicão para o conhecimento da bionomia de *Bombus incarum* Franklin da Amazônia. *Rev. Brasil Ent.* 8: 1-20.

Meer Mohr, J. C. & M. A. Lieftinck. 1947. Over de biologie van *Antherophagus ludekingi* Grouv. (Col.) in hommelnesten (*Bombus* Latr.) op Sumatra. *Tijdschr. Ent.* 88(1945): 207-14.

Michener, C. D. 1974. *The social behavior of the bees.* Harvard Univ. Press. 404 p.

Moure, J. S. & S. F. Sakagami. 1962. As mamangabas sociais do Brasil (*Bombus Latreille*). *Studia Ent.* 5: 65-194.

Tkalců, B. 1966. *Megabombus (Fervidobombus) abditus* sp. n. aus Aequatorial-Afrika. *Acta Mus. Morav.* 51: 271-74.

Zurcchi, R. 1973. Aspectos bionômicos de *Exomalopsis aureopilosa* e *Bombus atratus* incluindo consideracões sobre a evolucão do comportamento social. Tese, Dept. de Biologia, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Brazil. viii + 172 p.