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Original article

Time of drone flight of *Apis laboriosa* Smith in Nepal

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Summary — Drones of *Apis laboriosa* were found to fly in the early afternoon between 12.20 h and 14.20 h in Nepal. These flights were not associated with either cleansing flights or orientation flights. Weather conditions during the observation period did not permit flight in the late afternoon or evening. It is suggested that the time of drone flight may serve as an isolating mechanism between the closely related *A laboriosa* and *A dorsata;* however, additional data are required.

***Apis laboriosa* / *Apis dorsata* / drone flight / Nepal**

INTRODUCTION

The taxonomic status of *Apis laboriosa* Smith 1871 has been the subject of some discussion in recent years. After examining workers of *A dorsata* and *A laboriosa,* Sakagami *et al* (1980) concluded on the basis of morphological characters that they should be considered as separate species. Ruttner (1988) has stated that the differences noted by Sakagami *et al,* are of a quantitative rather than qualitative nature and do not in themselves justify assigning a specific status to *A laboriosa.* All the commonly recognized species of *Apis* (*cerana, dorsata, florea, mellifera,* and the recently "rediscovered" *koschevnikovi*) exhibit striking differences in drone genitalia.

Although no such differences have been noted in the genitalia of males of *A laboriosa* and *A dorsata,* McEvoy and Underwood (1988) argued for recognition of *A laboriosa* and suggested that a possible isolating mechanism (given the apparent sympatric distribution of the 2 in Assam) could be the time of drone flight. A recent study of *A laboriosa* in Nepal provided an opportunity for some preliminary observations to be made of the flight activity of *Apis laboriosa* drones.

MATERIALS AND METHODS

Studies were carried out at a cliff site at an altitude of 2 680 m in the valley of the Modi Khola river in Kaski District, West–Central Nepal. A viewing platform suspended from bolts anchored to the cliff face made it possible to observe an *A laboriosa* colony at a distance of less than 1 m. The entire surface of the colony was visible and drones were easily distinguishable from workers. Flight activity of the colony was monitored from 09.30 to 18.30 h on 4 days during the period 2–10 September 1988. Drone flight was assessed by counting the number of drones arriving on the surface of the colony during 10-min intervals. These counts were begun within about 1 min after the first drone was seen leaving the colony and ended after drone flight was suspended *(ie,* no exits or arrivals for a full

10-min period). On the 14th September, the colony comb was cut and the bees were killed and counted to determine the number of workers and drones in the colony.

RESULTS

At most times, only worker bees could be seen on the surface of the protective curtain of the *A laboriosa* colony. On all 4 observation days, drones began to appear on the surface of the curtain between 12.15 and 13.00 h. Flight activity was seen on only 2 days; inclement weather curtailed drone flight at about 13.30 h on 1 day and entirely prevented it on the other 2 days. In addition, and also apparently because of the weather conditions, no worker flight was observed later than 15.30 h.

Flight by drones was not associated with either cleansing flights (no such flights took place within the observation period) or orientation flights (Lindauer, 1956). Altogether, 357 arrivals of drones were observed, all between 12.20 and 14.20 h. Of 287 arrivals observed on the 10th September, the only day when full flight occurred, 211 (74%) took place between 13.20 and 14.20 h (fig 1; for convenience, observation periods have been combined into 20-min intervals.

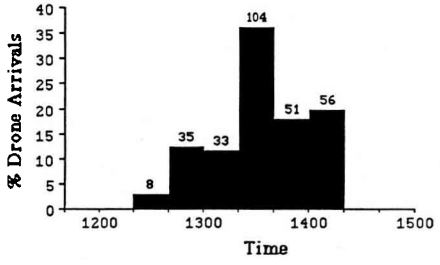

Fig 1. Time of drone flight (arrivals) of *Apis laboriosa* on the 10th September. Data are broken into 20-min intervals; numbers of drones as indicated.

An orientation flight was observed at 10.30 h on the 10th September, but no drones were seen taking part in it. From 12.00 to 12.10 h on that day, 609 workers were observed returning to the nest. Worker flight activity continued unabated at the time the first drone was seen departing at 12.27 h. The activity level was so high that it proved impossible to monitor both worker and drone flight simultaneously. Thus, at the time of initiation of drone flight, there was no diminution in foraging activity, such as might occur prior to an orientation flight (Lindauer, 1956); the flights observed were probably mating flights.

Inspection of the colony on the 14th September revealed that although there were several thousand cells of capped worker brood, there were no eggs or drone brood and only 2 unsealed larvae. Of a total colony population of 21 312 only 230 insects were drones.

DISCUSSION

The absence of eggs and unsealed brood is probably an indication that the colony was making preparations for a migratory move, normal behavior for *A laboriosa* colonies at this altitude in September (Underwood, 1990). While the migratory status of a colony may influence the timing of orientation flights (Lindauer, 1956), there are no data to suggest that impending migration would affect the time of day at which drones take mating flights.

Preferably, a comparison of the time of drone flight of *A laboriosa* and *A dorsata* should be made using data from the 2 species where they occur sympatrically, or at least in relatively close proximity. Unfortunately, data for the time of *A dorsata* drone flight in Nepal are unavailable (have in fact not been collected). It has been reported that *Apis dorsata* drones take mating

flights between 18.15 h and 19.00 h in Sabah on the island of Borneo (Koeniger *et al*, 1988), between 18.00 and 18.45 h in Sri Lanka (Koeniger and Wijayagunasekera, 1976), and in a 15–20-min period just before dark in Mysore State, India (FC Dyer, personal communication).

Indirect evidence that *A dorsata* drones in Nepal may follow this pattern of flying at dusk was suggested by observations of worker flight in Rampur, Chitwan District. In March 1984, a time when drones were known to be present (from samples of the populations of the colonies under observation), 2 *A dorsata* colonies were observed at close range (< 2 m) on successive days between 08.30 and 16.30 h. Although workers were foraging actively, no drone flights occurred; indeed, no drones appeared on the curtain surfaces of these colonies (personal observations).

If drones of *A dorsata* colonies nesting in the Himalayan foothills also fly at dusk, the data for *A laboriosa* suggest that the time of drone flight may serve as a reproductive isolating mechanism between the two species. Evidence presented here must be regarded as preliminary, however; there is an evident need for additional data. In particular, it must be established that *A laboriosa* drones do not fly at dusk, even under favorable weather conditions.

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Résumé — Période de vol des mâles d'*Apis laboriosa* Smith au Népal. Une colonie d'*Apis laboriosa* qui nichait dans une falaise à 2 680 m d'altitude dans le Centre-Ouest du Népal a été observée à une distance < 1 m. L'activité de vol de la colonie a été suivie pendant 4 j en septembre 1988. Les couches externes du rideau protecteur de la colonie étaient habituellement uniquement constituées d'ouvrières mais, lors de chacun des jours d'observation, les mâles ont commencé à faire leur apparition à la surface entre 12 h 15 et 13 h 00. Le vol des mâles, observé sur 2 j seulement, se limitait à la période 12 h 20–14 h 20. Les conditions météorologiques n'ont pas permis le vol des mâles en fin d'après-midi ni dans la soirée. Les vols des mâles n'étaient associés ni à des vols de propreté, ni à des vols d'orientation. Sur les 287 arrivées observées le 10 septembre, seul jour où les vols se sont pleinement déroulés, 211 (74%) ont eu lieu entre 13 h 20 et 14 h 20 (fig 1). Les mâles d'*Apis dorsata* volent le soir (juste avant le coucher du soleil) à Bornéo (Koeniger *et al*, 1988), au Sri Lanka (Koeniger et Wijayagunasekera, 1976) et dans l'Etat de Mysore en Inde (FC Dyer, communication personnelle). Si c'est aussi le cas pour le Népal, les observations présentées ici suggèrent que la période de vol des mâles peut servir de mécanisme d'isolement entre les espèces *A dorsata* et *A laboriosa* étroitement apparentées. Mais il est nécessaire de rassembler des données complémentaires.

***Apis cerana* / *Apis laboriosa* / vol des mâles / Nepal**

Zusammenfassung — Drohnenflugzeiten von *Apis laboriosa* Smith in Nepal. Ein Volk von *Apis laboriosa,* das an einer Felswand im westlichen Zentral-Nepal in einer Seehöhe von 2680 m nistete, wurde aus einer Entfernung von weniger als 1 m beobachtet. Die Flugtätigkeit

des Volkes wurde vier Tagelang im September 1988 beobachtet. Die äußere Schichte des Schutzvorhanges des Volkes bestand gewöhnlich aus Arbeitsbienen, aber an jedem der vier Tage begannen zwischen 12.15 und 13.00 Drohnen zu erscheinen. Drohnenflug wurde nur zwei Tagelang beobachtet; er war auf die Zeitspanne zwischen 12.20 und 14.20 beschränkt. Die Wetterbedingungen erlaubten keinen Drohnenflug am späten Nachmittag oder Abend. Die Drohnenflüge hatten nichts mit Orientierungs- oder Reinigungsflügen zu tun. Von 287 beobachteten Ankünften am 10. September, dem einzigen Tag mit vollem Flug, erfolgten 211 (74%) zwischen 13.20 und 14.20 (Abb 1). Die Drohnen von *Apis dorsata* fliegen am Abend, unmittelbar vor der Dunkelheit; dies wurde sowohl in Borneo beobachtet (Koeniger *et al,* 1988), als auch in Sri Lanka (Koeniger und Wijayagunasekera, 1976) und im Staat Mysore, Indien (FC Dyer, persönliche Mitteilung). Wenn diese Flugzeiten auch für Nepal zutreffen, so legen die Beobachtungen der gegenwärtigen Untersuchung nahe, die Drohnenflugzeiten als einen Isolierungsmechanismus zwischen den nahe verwandten Arten *A dorsata* und *A laboriosa* zu betrachten. Es müssen aber noch weitere Daten gesammelt werden.

***Apis cerana* / *Apis laboriosa* / Drohnenflug / Nepal**

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