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Short note

Piping by queens of *Apis cerana* Fabricius 1793 and *Apis koschevnikovi* v Buttel-Reepen 1906

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Summary — Piping queens of *Apis cerana* and *A koschevnikovi* were recorded in Sabah, Malaysia. The tooting calls of the 2 species were similar and consisted of a single continuous call lasting 2–5 s. In contrast, *A mellifera* queens give a 1–2 s tone followed by several shorter tones. Quacking by an *A koschevnikovi* queen in a queen cell was very similar to the quacking reported for *A mellifera* except the tempo was more rapid (4.39 quacks/s *vs* 3.0 quacks/s).

queen piping / *Apis cerana* / *Apis koschevnikovi*

INTRODUCTION

Queen piping behaviour has been reported and studied for only 1 species of honey bee, *Apis mellifera* L. When piping, the queen of *A mellifera* crouches on the comb and vibrates her wing muscles, thereby producing vibrations that travel through the comb and are detected by other bees with their legs (Simpson, 1964; Michelsen *et al*, 1986). The piping is also heard as a clearly audible signal, which consists of a long tone followed by a series of short tones of less than 0.5 s (Wenner, 1962). This type of signal is often referred to as 'tooting'. Queens confined by workers in their cells often respond with a rapid series of short chirps referred to as 'quacking' (Wenner, 1962). These two types of piping signals are important in regulating the emergence of virgin queens and the departure of afterswarms in *A mellifera* (Butler, 1609; Huber, 1814; Simpson and Cherry, 1969; Grooters, 1987).

During a bee collecting trip to Sabah, colonies of *A koschevnikovi* and *A cerana* were observed. We were fortunate to have the opportunity to record tooting and quacking signals of piping queens, which we describe here for the first time.

MATERIALS AND METHODS

We inspected managed colonies of *A cerana* and *A koschevnikovi* at the Tenom Agricultural Research Station in Tenom, Sabah, East

Malaysia (5°10'N, 115°57'E). When we encountered colonies in which the queen was piping, we recorded the audible sound with a Sony Professional Walkman tape recorder equipped with a Sony F99LT microphone and Sony UX-Pro90 Type II (CrO_2) high bias tape. Recordings were made from opened hives to place the microphone near the piping bees. We recorded tooting sequences from 2 colonies of *A koschevnikovi* on May 4, and from 1 colony of *A cerana* on May 5, 1988. In addition, the quacking pattern of a queen confined in a queen cell was recorded from one of the *A koschevnikovi* colonies.

The duration of each piping call and the time intervals between calls were timed twice from the recordings using a hand-operated stop watch. If there was any discrepancy between the 2 measurements, the measurement in question was taken again to resolve the discrepancy. The tape was slowed down slightly to count the number of abdominal thumps.

Sonographs were obtained by digitizing the audible taped signal with a Macintosh IIx conputer equipped with GW Instruments Speech Lab hardware and software. We recognize that this method has several limitations (Michelsen *et al*, 1986), but it is adequate to study the general pattern of the piping rather than details of sound frequencies and intensities.

RESULTS

The tooting calls of 2 *A koschevnikovi* queens differed somewhat (table I) but always consisted of a single tone 1.1–5.6 s long. The frequency of the tooting signal usually rose rapidly at the start of the signal, after which it remained fairly constant at a fundamental frequency of about 2 700 Hz before decreasing slightly at the end of the call (fig 1a and b). However, some calls began at the main frequency (fig 1c) while others failed to decrease in frequency at the end (fig 1d). Some calls exhibited considerable frequency modulation either at the beginning (fig 1d) or the end (fig 1c) of the call. The frequency range of the fundamental signal varied from 2 290 to 2 890 Hz. In our recordings there were 7 harmonics with maximum frequency of about 9 000 Hz. The intensity of audible sound was generally strongest in the middle of the toot.

Figure 1e depicts a typical *A cerana* toot. The *A cerana* queen tooted in a manner very similar to that of *A koschevnikovi* queen 1 (table I), except the interval between toots was longer for unknown reasons.

One queen of each species beat its abdomen on the comb at the end of its tooting signal. This behaviour has not been reported previously and needs to be documented more fully.

Quacking was heard only in one *A koschevnikovi* colony. Long series of quacks from a queen confined in a queen cell alternated with toots from a virgin queen moving freely in the colony. The frequency of the calls was very broad, 330–3 100 Hz, and the tones, which lasted an average of 0.06 s, were regularly spaced every 0.228 s (n = 31; fig 1f).

Table I. Descriptive statistics for piping (tooting) signals of 1 *A cerana* queen and 2 *A koschevnikovi* queens.

Species	*Duration of piping (s)* x ± *SD* (n)	*Interval between piping (s)* x ± *SD* (n)
A cerana	4.3 ± 1.2 (9)	77.6 ± 77.1 (8)
A koschevnikovi (1)	4.3 ± 0.6 (45)	14.0 ± 9.1 (40)
A koschevnikovi (2)	2.4 ± 0.8 (10)	7.1 ± 8.6 (8)

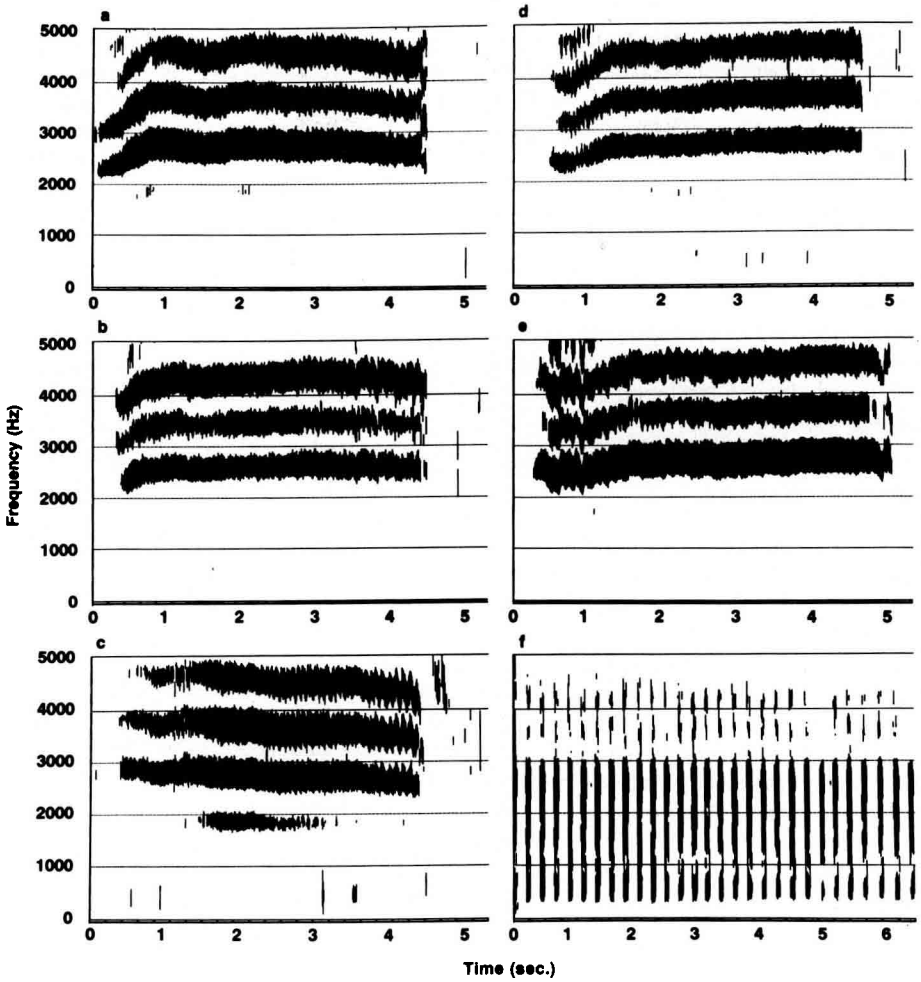

Fig 1. Sonographs of piping calls of Asian honey bees: **1a–d:** tooting calls of *A koschevnikovi*; **1e:** tooting call of *A cerana*; and **1f:** quacking call of *A koschevnikovi*. Note the time scale for **1f** is different from the other 5 figures.

DISCUSSION

The piping (tooting) signals of *A cerana* and *A koschevnikovi* are similar. From the limited data available, they have the same general pattern of a single continuous tone. In contrast, the tooting signals reported for *A mellifera* consist of 1 longer call of 1–2 s followed by several shorter calls of 0.14–1.50 s given at approximately 0.5 s intervals (Wenner, 1962; Michelsen *et al,* 1986).

The quacking calls of *A koschevnikovi* and *A mellifera* are similar in character but possibly different in tempo. We recorded an average of 4.39 quacks/s for *A koschevnikovi* while *A mellifera* is reported to make about 3 calls/s (2.56 calls/s, calculated from Michelsen *et al,* 1986; 3.2 calls/s, calculated from Wenner, 1962).

Other than reporting them, we have not attempted to interpret the piping frequencies in this study for several reasons. First, the harmonics we recorded in our sonographs may not be meaningful (Michelsen *et al,* 1986). Secondly, we did not know the age of the queens we recorded, and the piping frequency may be affected by queen age (Michelsen *et al,* 1986). Finally, our recorded frequencies are quite different from those reported for *A mellifera* (350–480 Hz, Michelsen *et al,* 1986; 420 Hz, Wenner, 1962), even though the taped calls of all 3 species sounded similar.

In both *A cerana* and *A koschevnikovi*, piping occurred in colonies that had swarmed but did not yet have new laying queens. From the condition of the queen cells, we determined that only the first 1 or 2 queens had emerged and no afterswarms had yet departed. This agrees with the pattern of piping in *A mellifera* (Butler, 1609; Simpson and Cherry, 1969). An *A andreniformis* colony near Johor, Malaysia, also had a piping queen at a similar point in the swarming sequence (personal observation). It seems likely that piping regulates aspects of colony behaviour during the afterswarming process in all of these honey-bee species.

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Résumé — Le chant des reines d'*Apis cerana* Fabricius 1793 et d'*Apis koschevnikovi* v Buttel-Reepen 1906. Nous avons analysé le chant des reines d'*A koschevnikovi* et d'*A cerana* et les avons comparés avec ceux d'*A mellifera* L. Des colonies possédant des reines vierges qui chantaient ont été observées à la station de recherches agricoles de Tenom, Sabah, Malaisie. Le chant des reines écloses ou «tooting» (1 reine *cerana* et 2 reines *koschevnikovi*) et celui des reines enfermées dans leur cellule ou «quacking» (1 reine *koschevnikovi*) a été enregistré sur bande magnétique. Des sonogrammes ont été établis pour les enregistrements les plus représentatifs (fig 1). Le chant des reines qui viennent d'éclore est semblable chez les 2 espèces et consiste en un signal unique et continu de 1,1 à 5,6 s (tableau I). Il diffère nettement des signaux décrits pour *A mellifera* qui émet un seul son long et plusieurs sons courts. Le chant de la reine de *koschevnikovi* avant l'éclosion ressemble, en plus rapide, à celui de *mellifera* (4,39 *vs* 3,0 son/s). Nous pensons que le chant des reines contribue, dans toutes les espèces, à réguler le comportement de la colonie en période de post-essaimage.

***Apis cerana* / *Apis koschevnikovi* / reine / chant**

Zusammenfassung — Tüten und Quaken der Königinnen von *Apis cerana* Fabricius 1793 une *Apis koschevnikovi* v Buttel-Reepen, 1906. Wir berichten über die Königinnensignale Tüten und Quaken bei *A koschevnikovi* und *A cerana* und vergleichen sie mit den publizierten Werten von *Apis mellifera* L. Völker mit tütenden Königinnen wurden in der Landwirtschaftlichen Forschungsstation in Tenom, Sabah, Malaysia beobachtet. Vom Tüten wurden bei 1 *A cerana* und bei 2 *A koschevnikovi* Königinnen und vom Quaken bei 1 *A koschevnikovi* Königin Tonbandaufnahmen gemacht. Die Dauer aller Töne wurden mit einer Stopuhr bestimmt. Von den entsprechenden Auf-

nahmen wurden Sonogramme angefertigt (Abb 1). Königinnen beider Arten erzeugten ähnliche Tütsignale, die aus einem einzigen langanhaltenden Ton von 1,1–5,6 s bestand (Tabelle I). Damit unterscheiden sie sich deutlich von den beschriebenen Signalen von *A mellifera*, deren Königinnen einen langen und mehrere kurze Tütsignale erzeugen und auch nicht mit dem Abdomen auf die Wabe pochen. Die Quaksignale von *A koschevnikovi* sind ähnlich, aber schneller als für *A mellifera* beschrieben wurde (4,39 *vs* 3,0 Quaksignale/s). Wir vermuten, daß Quaken und Tüten bei den meisten Arten der Honigbiene vorkommen und in der Zeit der Nachschwärme einen regulierenden Einfluß auf das Verhalten des Volkes hat.

Königin / Tüten und Quaken / *Apis koschevnikovi* / *Apis cerana*

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