

RESEARCH ARTICLE

A COMPREHENSIVE STUDY ON THE BITING ACTIVITIES OF *Leptoconops spinosifrons*: COMPARING HUMAN LANDING CATCH AND MODIFIED TRAP METHOD FOR COLLECTING BITING MIDGE POPULATIONS AT BAGAN LALANG BEACH, SELANGOR

Nur Amalina Kamarudin*, Mohd Khadri Shahar, Azahari Abd Hadi, Hillarian Mojiun, Hasirah Japarudin, Johnnetha John Gindabal, Salvie Dekau

Medical Entomology Unit and WHO Collaborating Center, Institute for Medical Research, National Institute of Health, Ministry of Health Malaysia, Setia Alam, 40170, Selangor, Malaysia.

*Corresponding Author email: amalina.kamarudin@moh.gov.my

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ABSTRACT

Leptoconops, a nuisance insect belonging to family Ceratopogonidae, mostly found near the beaches in the tropical and sub-tropical regions. In Malaysia, *Leptoconops* is often found in sandy beaches and its bites can cause irritation, affecting tourism activities. This study aimed to determine the biting cycle of *Leptoconops* inhabiting Bagan Lalang beach in Selangor. The sampling involved four visits from June to August 2022, during which emerging adults were collected via human landing catches (HLC) and trapped with modified emergence traps for a 24-hour collection period. Temperature and relative humidity were also recorded. The samples were identified following taxonomy key, the results indicated the presence of *Leptoconops spinosifrons* at the beach. The biting activities of *L. spinosifrons* occurred from dawn to dusk with peak biting of recorded from 0800 h to 0900 h and at 1700 h to 1800 h. Additionally, a total of 20 *L. spinosifrons* were trapped on the sticky tape in the emergence traps. This study represents the first report on the identification of *L. spinosifrons* from Bagan Lalang Beach, providing crucial surveillance data represents for this medically important neglected insect associated with outdoor and tourism activities.

KEYWORDS

Leptoconops spinosifrons, human landing catch, emergence trap

1. INTRODUCTION

Leptoconops is common biting nuisance and known in various part of the world, particularly in Europe, where extensive data have been published about its ecology, population and biting habits. A group researcher reported a substantial population of *Leptoconops* can cause severe injuries, impacting to tourism activities especially in coastal areas (Carrieri et al., 2007). *Leptoconops bequaerti* (Kieffer) was found close to the sea in unshaded white sand at Caribbean and Florida (Linley and Davies, 1971). A group researchers reported that first centimeter of the shallow moist sandy shore in the coastal areas of Grosseto (Italy) was the breeding site for *Leptoconops kerteszi* (Raspi et al., 2007). Besides that, *Leptoconops noei* was first report found in near riverside composed of sandy matter in Northern Spain (González et al., 2013). In Chaco province, Argentina, new species of female *Leptoconops chacoensis* was found in a forest area (Spinelli et al., 2022). Other country such as in Japan has been reported regarding biting infestation of *Leptoconops nimponensis oshimaensis* affected the activities of residents of Katoku and Isu village (Takaoka and Hayashi, 1977).

Leptoconops biting midge bites can cause painful lesions that degenerate into infected wound due to scratching. Sometimes the lesions remain intensely itching for months (Aussel, 1993; Rohani et al., 2006). Scratching may lead to secondary infection and permanent scarring. Infection caused their bite to become infected, resulting in general edema and lymphadenopathy (Aussel, 1993). However, there are no official documented complaints have been reported from the beach resort

industry regarding the attack or nuisance of biting midge in Malaysia. This is probably due to a lack- of knowledge about biting midges in human populations, as their bites often normally unnoticed.

Leptoconops is relatively unknown in Malaysia, only a few available data regarding its ecology and biting habits. In Malaysia, only one species, *L. spinosifrons* has been reported, found on the sandy beaches of Pulau Aur and Pulau Besar (Khadri et al., 2002; Rohani et al., 2006). Biting activities of *Leptoconops* spp. was also reported in sandy beach Tenggol A Island and Tenggol B Island in Terengganu (Rohani et al., 2006). Although little is known about transmission disease by *Leptoconops* spp. to humans or livestock, they can pose a serious public health problem. Besides creating this serious public health problem, *Leptoconops* spp. can prevent the development of tourism associated with beaches and is considered as an important detriment to economic development. These *Leptoconops* can be very abundant in certain months of the year and the outdoor activities at the beaches can be affected. Thus, this study is important to identify predominant species and to determine the biting cycle of *Leptoconops* inhabited Bagan Lalang beach in Selangor.

2. MATERIALS AND METHODS

2.1 Study Area

Bagan Lalang beach is located in Sepang District, Selangor (2°35'N, 101°41'E) (Figure 1). This beach is known as a popular among locals as an ideal spot for picnics and overnight camping especially during weekends

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and long public holidays. Four samplings were conducted between June 2022 to August 2022. Every sampling was conducted for 24 hours.

Environmental factor such as temperature and RH were recorded hourly for all samplings.



Figure 1: Map of study area at Bagan Lalang beach with red mark

2.2 Human Landing Catch (HLC)

Human landing catch (HLC) technique particularly for collecting biting activities of *Leptoconops* as reported by Khadri et al., (2002) was employed in this study (Figure 2). All collectors were trained and signed the consent form prior to the study. HLC technique involved 5 persons and the biting midges were collected while they land on human to bite. This method was

carried out for 24 hours from 0700 h. Total of biting midges landed on human were recorded hourly. The collectors exposed their body parts such as legs (from knee to toes), hand (elbow to fingers) and face observed for biting midge landed. All the biting midges landed on the body parts were collected and kept inside glass vials covered with cotton wool for identification purpose and total number of samples were recorded. Number of *Leptoconops* collected per man-hour was calculated.



Figure 2: Area of exposure using HLC with red mark

2.3 Modified Emergence Traps

A total of 54 modified emergence traps were made using 5.0 litre plastic bottle with length 35 cm. From the bottom of the bottle, 4 cm was removed. Adhesive tape was cut to a length of 25 cm and attached to the bottle cap extending downwards as shown in Figure 3. Each bottle was set 6 cm deep in the sand (Figure 4). The adhesive tape will be on the surface of the sand. The emergence traps were used to trap the biting midges emerge from the sandy beach. The emergence traps were placed at 3 difference

sites namely (Site A, Site B and Site C). The distance from each site is 6 m interval (Figure 5). The sites must be 2 m from high tide level as mentioned by as shown in Figure 6 (Aussel, 1993). Eighteen emergence traps were arranged in 18 m² for each site with 1 m interval and secured the areas with red tape band with a notice sticker on the emergence traps "Research Ongoing" (Figure 7) to avoid people cross over and disturb the emergence traps. The emergence traps were observed hourly for 24 hours. The biting midges which were trapped inside the emergence traps were kept inside the glass vial.



Figure 3: Adhesive tape was attached to emergence trap



Figure 4: The trap was set 6 cm deep in the sand



Figure 5: The emergence traps were located in three sites - A, B and C with intervals of 6 m.



Figure 6: Two meter above high tide level (blue line) with damp sand, shell and debris



Figure 7: Eighteen emerging traps were arranged in 18m² for each site with 1 m interval

2.4 Sample Processing and Morphological Identification

The sample specimens were preserved in 70% alcohol before they were pinned and mounted. The genus of the biting midges was identified based on the wing character (Carter, 1921). The biting midges in the emerging traps were separated according to sex group. The species were pinned and examined under dissecting microscope (Leica EZ4W). All the characteristics of the biting midges were examined under light microscope

(Leica ICC50 HD). For morphological identification of *Leptoconops*, species descriptions in was used (Carter, 1921).

3. RESULTS

3.1 Biting Activities of *L. spinosifrons* at Bagan Lalang Beach

This study was first report on the identification of *L. spinosifrons* (Figure

8) from Bagan Lalang beach. A total of 1085 *L. spinosifrons* were collected at Bagan Lalang sandy beach using HLC from four samplings for 24 h. All samples collected using HLC were female. Figure 9 shows graph of average man-hour density of *L. spinosifrons* collected at the beach. Based on the graph, the biting activities of *L. spinosifrons* were from dawn to dusk. However, *L. spinosifrons* were not appeared after 2000 h for all the samplings.

The biting peak of *L. spinosifrons* was at 0800 h to 0900 h with 32

bites/man/hour while at 1700 h to 1800 h with 36 bites/man/hour. Biting activities of *L. spinosifrons* at Bagan Lalang beach in this study was observed for four samplings with maximum biting in the morning at 0800 h to 0900 h with temperature in range 25°C to 30°C and RH in range 76% to 89%. However, temperature and RH when biting peak in the evening at 1700 h to 1800 were between 29°C to 35°C and RH with range 50% to 79%. For emergence trap, Figure 10 shows a total number of 20 *L. spinosifrons* were trapped on the adhesive tape in the emergence traps from four samplings. Four out of 20 *L. spinosifrons* were identified as male.

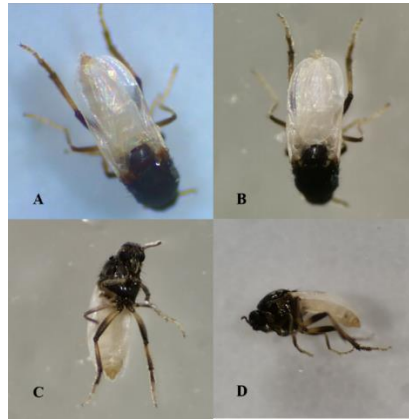


Figure 8: *L. spinosifrons*

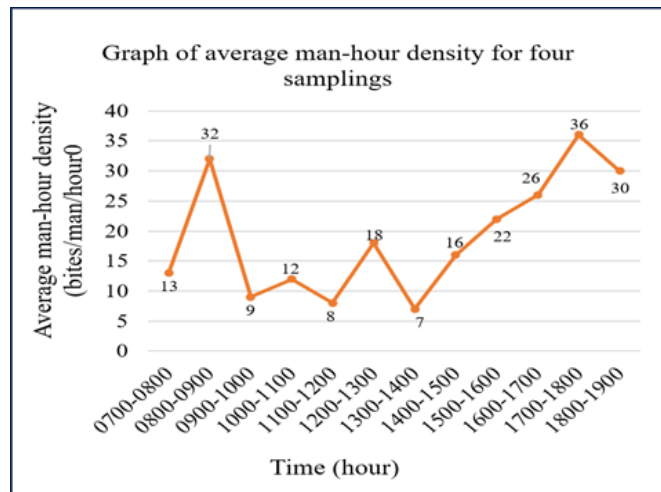


Figure 9: Graph of average man-hour density for four samplings

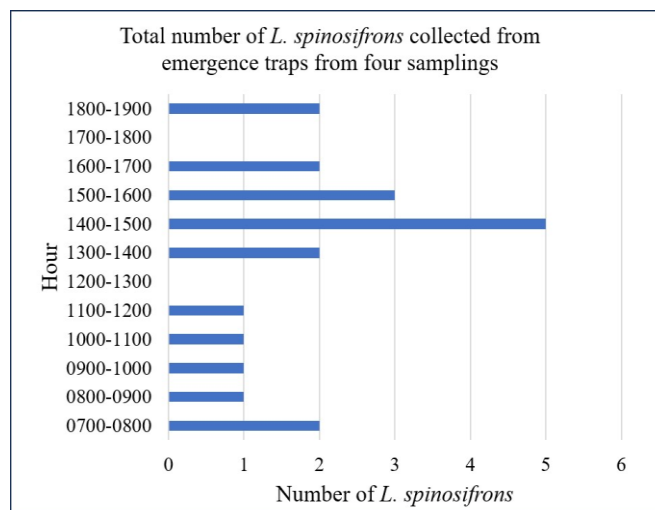


Figure 10: Graph of total number of *L. spinosifrons* collected from emergence traps from four samplings

According to statistical analysis, significant differences ($p = 0.015$) were observed among two methods used to catch the *L. spinosifrons* (Table 1). The results showed that number of *L. spinosifrons* were significantly different between HLC (Mean= 54.3, SD= 19.97) and emergence traps (Mean= 5.0, SD=2.94), $t(3) = 4.88$, $p = 0.015$. There was a significant difference in the number of collected *L. spinosifrons* between HLC and emergence traps, with mean difference of 49.

4. DISCUSSION

Leptoconops spinosifrons is reported from Bagan Lalang beach for the first time. Infestation of *L. spinosifrons* was positive at Bagan Lalang beach because this genus mostly distributed at coastal areas. Most of *Leptoconops* exploit pure sand or sandy soils in the supratidal zone and above. In this study, *L. spinosifrons* was found on the surface of sandy soil

at the beach. This observation was similar with previous studies by (Carter, 1921; Cheng, 2003). *Leptoconops* adults exhibit a distinct resting behavior as their place seems to be on or just below the surface of sand or sandy soil, either on the breeding sites or near them (Carter, 1921). *L. spinosifrons* is usually rests on the sand in their breeding area and this species emerges 10-12 days after the breeding zone in the upper part of the beach is inundated by the highest tides (Carter, 1921; Cheng, 2003).

This study showed *L. spinosifrons* were active from 0700 h to 1900 h with the maximum number of *L. spinosifrons* at 0800 h to 0900 h and 1700 h to 1800 h. The diurnal pattern of biting activity of *L. spinosifrons* in this study was similar with the previous study reported by (Khadri et al., 2002; Raspi et al., 2007; González et al., 2013; Boorman, 1993). A group researchers also reported the diurnal species of *Leptoconops* commonly show two biting peaks which are in the morning after sunrise and late afternoon close to sunset (Kasičová et al., 2021). This diurnal species is not appeared at night after sunset period. This study also showed that temperature and RH did not affect the biting activity of the *L. spinosifrons* as the variation of temperature and humidity were due to unpredictable weather during the samplings. Previous study also reported that humidity and temperature did not influence the activity in breeding place of *Leptoconops* (Aussel, 1993).

This species could not be collected using light traps because of its diurnal pattern of biting activity. Because of this reason, it is possible that *L. spinosifrons* were collected in great numbers using HLC method in this study. *Leptoconops* species is usually attracted to human smell, more specifically carbon dioxide. These smells can cause the presence of blood nearby detected by female *Leptoconops*. The previous study showed light traps and sweep net techniques were failed to trap any *Leptoconops* spp. beyond the sandy beach area (Khadri et al., 2002). Thus, light trap is an ineffective for trapping *Leptoconops* spp. There were many techniques used in previous study to collect *Leptoconops* spp. such as mechanical aspirator, chemotropic, sticky traps and HLC (Raspi et al., 2007; Carrieri et al. 2007; Khadri et al., 2002; Strickman et al., 1995).

Modified emergence traps used in this study showed very small number of *L. spinosifrons* collected compared to HLC technique. Although this method is cheap, but this method is limited to catch *L. spinosifrons* that are flying. This emergence trap can only trap the *L. spinosifrons* that were emerge under the sand. Kettle and Linley (1967) reported that sticky traps have limitation to catch those that are flying as this trap can only catch insects settling on the sticky surface. In Jamaica, the sticky traps are cheap but they were inefficient and needed to much labour to produce the traps (Kettle and Linley, 1967). Although HLC was the most effective technique to catch the *L. spinosifrons* compared to emergence trap, but emergence trap can be still used to trap male *L. spinosifrons*.

5. CONCLUSIONS

Leptoconops spinosifrons leave small red marks with itchy bites after biting and these bites remain itching for a few days. The evidence data of this study represents the main reference for the neglected medically important insect as this species affected the outdoors and tourism activities if the number of this species might be very abundant in certain months of the year.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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