Malays. Appl. Biol. (2017) 46(2): 59–66

RANGING BEHAVIOUR OF EDIBLE NEST SWIFTLET (*Aerodramus* sp.) IN KUALA LANGAT DISTRICT, SELANGOR, MALAYSIA

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Accepted 20 May 2017, Published online 27 June 2017

ABSTRACT

The edible bird's nest has been consumed by humans for centuries for its medicinal properties and health benefits. Traditionally, the dried gelatinous coating of the edible-nest swiftlet is boiled together with rock sugar and eaten as a delicacy. However, today, the edible bird's nest has also been commercialised into health and cosmetic products. Despite the importance of the product, many questions remain within the nest builder, the edible-nest swiftlet (*Aerodramus fuciphagus*) specifically regarding their ecology and behaviour in nature. The ranging behaviour of the *Aerodramus* sp., and its foraging areas were studied in the Kuala Langat district. The swiftlets were successfully tagged and tracked using vehicles. The research was conducted from March 2013 to July 2013. It was found that swiftlets had an average core area of 1687.06 ha (16.87 km²), a home range size of 6437.47 ha (64.37 km²) and an average flying distance from their birdhouses which ranged from 2 to 6 km. They were mostly found roaming in open fields, young oil palm plantations and nearby forested areas. Pearson correlation analysis showed that 50% of core feeding range areas and 95% of feeding range areas of the swiftlets correlated negatively with wind velocity (mph) at $r = 0.8057$, $P = 0.0287$ and $r = 0.820$, $P = 0.024$, respectively. The average flying speed of the swiftlets correlated positively with wind velocity and the correlation was significant ($r = 0.8423$, $P < 0.05$).

Key words: Component, radiotracking, ranging behaviour, swiftlet

INTRODUCTION

A few swiftlets are so similar that they are imperfectly known and require other peculiarities to fit them into today's taxa. For years, they have been classified under a single genus of *Collocalia* sp. (Jean, 1947). Then, Madoc (1956) enhanced the records when he discovered 15 species of swiftlets, which were categorised as winter visitors from the north and the other three as typical residential species of the Malayan region during the time. These three were *Apus* sp., *Hemiprocne* sp. and *Collocalia* sp. A few anatomical characteristics and behaviour have been studied to help in classifying swiftlets. However, other preliminaries such as echoing ability (Henri, 2005) and nest characteristics were not reliable as a guide to the phylogeny (apodidae: swiftlet). Echolocation was previously used to distinguish the genus, *Collocalia,* and *Aerodramus*. However, in 2004, Price *et al* (2005) discovered the pygmy swiftlet, *Collocalia troglodytes* with echolocation ability. The trait can no longer be used to distinguish the species. In 2013, studies were conducted on the taxa by using a genetic approach. Cranbrook *et al.* (2013) discovered that the Peninsular Malaysian swiftlet combined genetic components from the north (*A. inexpectatus, A. germani*) and south (*A. fuciphagus*). The swiftlets that were captured as samples showed more brownish plumage similar to Thunberg's brown rumped swiftlet (*Aerodramus fuciphagus*). However, since there is a possibility that it is a hybrid species, the species in this paper is referred to as *Aerodramus* sp.

Most studies about this species enhanced on breeding biology and behaviour (Langham, 1980; Tarbuton, 1990; Phach & Voisin,1993; Mardiastuti *et al.*, 1997; Quang & Voisin, 2007; Tarbuton, 2011) taxon studies (Lee *et al.*, 1996; Steadman, 2002; Thomassen *et al.*, 2003; 2005), echolocation

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(Price *et al.*, 2005; Thomassesn *et al.*, 2006; Brinklov *et al*., 2013; Rheidt *et al.*, 2014) bird's nest industry, growth and development (Reichel *et al.*, 2007), diet (Lourie & Thompkin, 2000; Valdez & O'Shea, 2011), anatomy and morphology (Zuki *et al.*, 2012; Shah & Aziz, 2014), and species conservation (Shirish & Sankaran, 2011). However, there is still lack of information on this species such as their movements, habitat preferences, and feeding and ranging behaviour.

Thus, this study was conducted to develop a more rigorous understanding of the behaviour of these swiftlets by studying their individual movements. Direct observation on animal continuous trajectory or path through space and time resulted in information such as population distribution, identification of important resources, dispersal strategies, social interactions, and their general patterns of spatial use. The contribution of such a study is obvious as the outcome can be capitalised as guidelines for better swiftlet species management in the future whether in their natural habitat (caves) or artificial habitat (birdhouses).

MATERIALS AND METHODS

Study site

The study was conducted in the Kuala Langat district, Selangor. The birds were trapped in Kampung Sungai Lang oil palm plantation, Banting, Selangor, Malaysia. The number of birdhouses identified within the district was 15, where 10 birdhouses were built in oil palm areas, and the remaining five birdhouses in residential areas. The study was conducted during the dry season from February 2013 to July 2013.

Radiotracking

Bird samples were usually captured directly from their nests using traps (Hunter & Baldwin, 1962; Phach & Voicin, 1998). In this study, mist nets and bird calls were used by setting them up in the oil palm plantations during dusk, from 05:00 to 08:00, and dawn, from 18:00 to 20:00. The chosen trapping areas should have good airways for swiftlets to fly down and good oil palm coverage to provide camouflage to mist nets. The mist nets were raised 15 m in the air before bird sounds were played.

Only swiftlets that weighed over 7 gm were tagged with glue-on transmitter (Advanced Telemetry System, Isanti, MN). Radio transmitters were attached to each bird dorsally across the rump with the aerial lying along the tail feathers (Hafidzi & Hamzah, 2003). Signals were detected with an ATS portable receiver and three-element yagi antenna attached on top of the vehicle (Figure 1) trials have been conducted in open fields and residential areas to measure the efficiency of the receivers on a moving vehicle. The locations of the swiftlets were hardly detected using triangulation as

Fig. 1. yagi antenna was attached on top of the vehicle during vehicle tracking and group of ebn swiftlets flying nearby.

they tended to move. Therefore, exact locations were used as fixed points with the assumption that the swiftlets may roam within a 500 m radius from the points.

Home range size was calculated using the Kernel method with Ranges IV software (Kenward, 1988). Based on the Kernel method, it was calculated that 95% and 50% of utilised areas were considered as home ranges and core areas, respectively.

RESULTS AND DISCUSSION

Assumptions on determination of frequency range

An independent-samples t-test was conducted to compare the distance between transmitter and receiver before signal loss in open fields and oil palm plantations. There was a significant difference in the scores for open fields (M = 682.7, SD = 61.31) and oil palm ridges (M = 454.9, SD = 64.08) conditions; t (29) = 1.96, p = 0.05. Another test was endorsed with condition; p (29) = 2.33, p = 0.01.

These results suggest that open fields do affect the ability of a receiver(s) to receive signals. Specifically, in open fields, where there are less obstacles and ridges, signals from a transmitter can be better detected by the receiver for nearly 1500 m. In oil palm plantations, the receiving distance is only around 700 m. Therefore, it is safe to assume that during vehicle tracking, transmitter receiving range may be around 500 m from a moving receiver whether in open fields or oil palm plantations.

Feeding range size

In radio telemetry, home range is determined by plotting progressive range size against cumulative radio fixes. When additional radio fixes reach an asymptote, the number of locations is assumed to be sufficient to estimate home range. This study showed that an asymptote was reached at around 40 fixes (Figure 2). Kenward (2001) noted that the home range of most animals can be determined from 25 to 50 radio locations.

Only BB2 was identified as male through DNA identification. This is because during feather plucking for DNA samples, a primer feather accidentally fell off, which provided a large source of feather tip. Others remained undetermined because there were insufficient DNA samples for analysis. However, plucking more feathers was not possible because swiftlets are very small birds. Plucking more feathers especially the primer feathers could affect flight and result in displays of unnatural behaviour.

A single male swiftlet has a home range size of 14,547.2 ha and a core area of 2559.48 ha. Swiftlets in the Kuala Langat district had an average core area of 6437.47 ha and an average home range size of 6437.47 ha (Table 1). Overlapping in the 50% core analysis (Figure 3) is a proof that swiftlets are like other species that live in colonies; such as the tree swallow (*Tachycineta bicolor*) and the barn swallow (*Hirundi rustica*). They are colonial nesters and not aggressively territorial (Hebblethwaite & Shields, 1990).

Fig. 2. Home range of seven *Aerodramus* sp. in Kuala Langat district, Selangor.

Table 1. Home range, core area and average distance (km) of *Aerodramus* sp. in different birdhouse

Bird Sample	Sex	Tracked	*Home range (Ha)	*Core Area (Ha)	Average distance (km)
BB1	N/A*	March ’13	2161.89	602.144	2.048
BB2	Male	March ’13	14,547.20	2559.48	6.130
BB3	N/A*	April ’13	9079.24	3259.82	6.158
BB4	N/A*	June ’13	7761.84	1926.04	3.110
BB5	N/A*	July ’13	2213.53	693.20	2.017
BB6	N/A*	July ’13	5861.38	1463.60	4.848
BB7	N/A*	July ’13	3461.67	1161.19	2.871
		Mean	6437.47	1687.06	

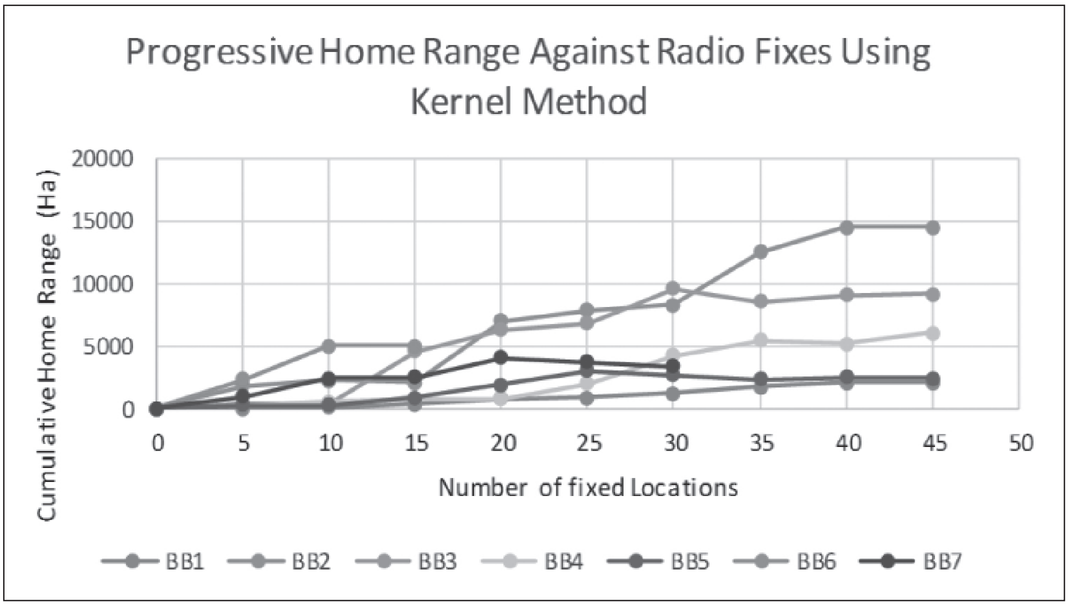

Fig. 3. Progressive home range against radio fixes using Kernel method.

Other swallow species such as barn swallows were found to forage within 1.2 km from their nests in West Virginia and 500 m in Europe. Meanwhile, fully migratory birds such as tree swallows may travel up to 60 km foraging for food (Stapleton & Robertson, 1992). Swiftlets on the other hand have an average flying distance from a birdhouse range of between 2 km to 8 km. With this ability of flying, there is a possibility that swiftlets immigrated from the west coast of Malaysia to the east coast, as Sarawak house-farm swiftlets were found to be similar to the east coast of Peninsular Malaysia’s populations in terms of plumage. character and genes (Cranbrook *et al.,* 2013).

Relationship between environmental variables and swiftlet movements

Pearson correlation analysis showed that the average flying speed of swiftlets correlated positively with wind velocity and the correlation was significant ($r = 0.8423$, $P<0.05$), [Figure 4(a)], while 50% core feeding range area and 95% feeding range area correlated negatively with wind velocity (mph) at $r = 0.8057$, $P = 0.0287$ and $r = 0.820$, $P = 0.024$, respectively [Figure 4(b) and 4(c)]. This could provide a theory that swiftlets use the wind as a travelling agent similar to many migrating birds to travel distances as they are able to conserve energy during the journey (Bäckman & Alerstam, 2001) or as a medium in search for food.

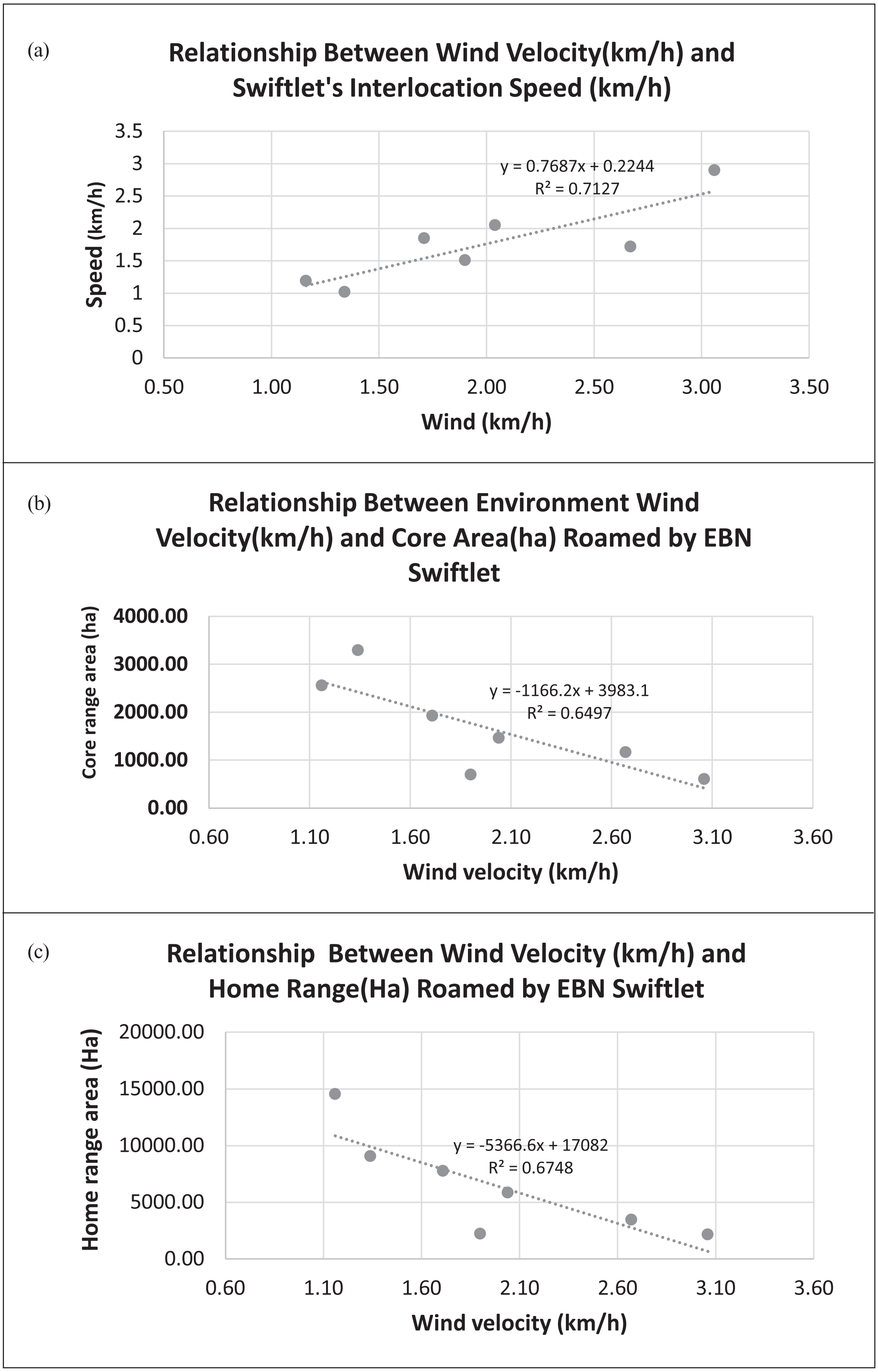

Fig. 4. Pearson Correlation Analysis Between Swiftlet Flight Behaviour and Wind Velocity.
4(a) the relationship between wind velocity (mph) and swiftlet' interlocation speed. 4(b) relationship between wind velocity(mph) and core feeding area(ha) roamed by EN swiftlet and 4(c) relationship between wind velocity (mph) and 95% feeding range.

Swiftlets are insectivorous birds; they feed on various insect families such as *coleoptera, diptera* and *hymenoptera* (Lourie & Tompkins, 2000). These include flying insects such as flies, moths (Guichard *et al*., 2010; Tejima *et al*., 2013), beetles (Byers, 1996; Fadamiro *et al*., 1998), and parasitoids (Williams *et al.*, 2007). Sometimes they depend on the wind to move around and this movement is called anemotaxis. Studies show that sometimes flying insects depend on the wind to detect pheromones released by female insects to help locate their position. By utilising the wind flow, swiftlets do not need to roam over larger areas in search of food.

CONCLUSIONS

Vehicle tracking for wildlife studies can be conducted if a study area has good road networks. Most studies that used vehicles as tracking mode were conducted in vast and open areas such as prairies or open fields. It is relatively challenging to apply this method in tracking wildlife in Malaysia, as a tropical country is geographically at a disadvantage. Despite this, swiftlets can be tracked using radio tracking and with more advanced technology, an in depth understanding on the ecological aspects of this species can be secured. Lightweight transmitters and long-lasting batteries could contribute more effectively to the study. The usage of satellite telemetry (Meyburg & Meyburg, 2008; Barbraud & Weimerskirch, 2011) or unmanned air vehicles (UAVs) (Sarda-palomera *et al.*, 2012; Chabot & Bird, 2013) to provide more larger scale data could be areas worth reviewing.

Edible-nest swiftlets within traceable areas, were found to have an average core area of 6437.47 ha (64.37 km^2), a home range size of 6437.47 ha (64.37km^2) and an average flying distance from birdhouses ranging between 2 to 6 km. Their daily activities may be varied due to environmental factors, availability of prey, existence of predators, and sexual differentiation. Their gender can be identified using avian sexing by feathers. However, feather plucking must be done carefully to avoid missing the feather tips. Feather tips make up an important part of the feather as it stores DNA as well as gender information.

The swiftlets were found to fly around feeding spots. They displayed twist, flutter, and tail-wing-open foraging manoeuvres when scanning foraging areas, similar to glossy swiftlets (*Collocalia esculenta affinis*) observed by Shirish & Sankaran (2010). They spent substantial time in flight over foraging grounds which normally depends on the availability of insects. Swarming alate or winged termites is one of their food sources. This species of insects are found in abundance after the rain, at the beginning of the monsoon season between December and May (Lourie & Tompkins, 2000).

The ranging behaviour of the swiftlets was found to be associated with local wind velocity. As the wind velocity increased, the size of the ranging area became smaller. This suggests that swiftlets may be able to predict wind velocity during hunting. This skill is advantageous to the swiftlets as they are able to utilise their energy more efficiently while hunting as suggested by Lietchti (2006) and posits the possibility of this species migrating. They may not participate in seasonal migration, like the Artic tern (*Sterna paradisaea),* or the Manx shearwater (*Puffinus puffinus*) which travel during autumn, however, it could suggest the possibility of other types of migration such as loop migration, nomadic migration, irruptive migration, or dispersal migration.

ACKNOWLEDGEMENTS

The authors wish to thank the team leader; Assoc. Prof Dr. Hafidzi Mohd Noor and research team Asrulsani Jambari, Syukri Halim and Khadijah Md Salleh from Vertebrate Pest Laboratory, Department of Plant Protection, Faculty of Agriculture, Universiti Putra Malaysia. A special thanks to Veterinary Department, Ministry of Agriculture Malaysia for funding the research and all swiftlet ranchers for helping us out.

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