Daytime Activities of Birdlike Noctule in Saitama

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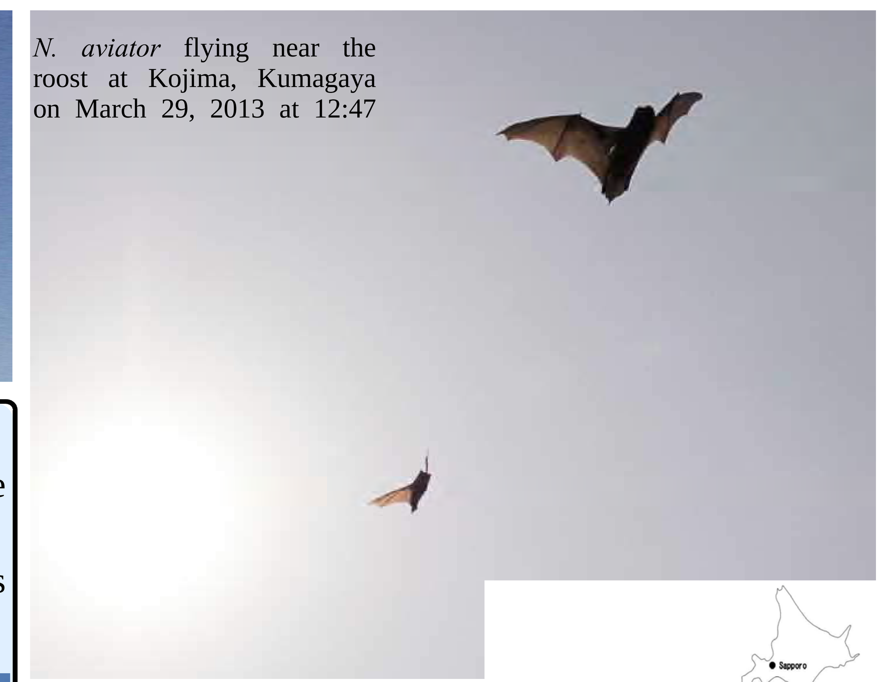
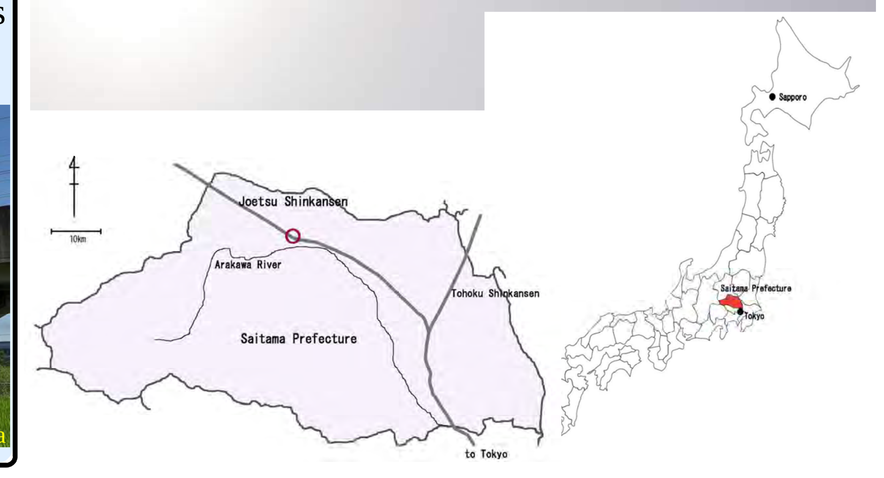
November 16, 2013 at 14:39



N. aviator flying near the roost at Kojima, Kumagaya on March 29, 2013 at 12:47



Introduction

Insectivorous bats are normally nocturnal and feed on nocturnal insects, but are occasionally seen flying during the day. We have already reported in the 2013 Annual Meeting of the Mammal Society of Japan（6） the following:

・Most daytime flight observations in Saitama were presumed to be *Nyctalus aviator*. Daytime flights are seen throughout February, March, April, August, and November and most flights were recorded in November.

・Daytime flight reports outside of Saitama were recorded in April, May, October, and November from Hokkaido, Iwate, and Kanagawa Prefectures.

・We observed *N. aviator*'s daytime flights near an autumn-to-spring roost in Kojima（Kumagaya City, Saitama Prefecture, Japan） and at a riverside about 1.5km away from the roost. We confirmed the bats emit echolocation calls through a bat detector. In addition, we observed the bats chasing insects many times.

・We analyzed the bats' feces during the survey period. In total, we confirmed the fragments of insects in 9 orders. *Patanga japonica*（order Orthoptera, family Catantopidae） and family Syrphidae of order Diptera are predominantly diurnal.

・We also photographed a bat holding what we believe to be a dragonfly in its mouth at Kitamoto Natural Observation Park on November 8, 2012.

The Joetsu Shinkansen Railway at Kojima

N. aviator flying out of the roost on October 30, 2014 at 12:36

Aim

We will discuss the daytime emergence and return surveys of the *N. aviator*'s roost in five consecutive seasons from autumn 2012 with the climate data and why *N. aviator* sometimes fly during the day.

Because it is not uncommon for *N. aviator* to emerge before sunset（1）, we defined daytime as more than one hour after sunrise or before sunset along the lines of Speakman（8）.

Study Area and Methods

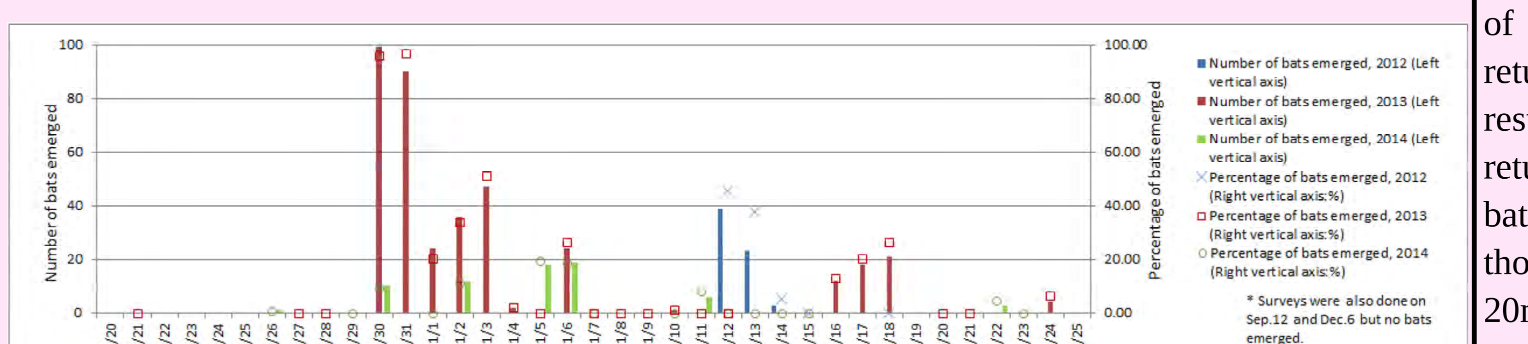
Daytime emergence and return surveys were conducted at a roost in a narrow space of the high-raised Joetsu Shinkansen Railway in Kojima. （36.1526N, 139.3416E, alt 45 m） This roost is used by *N. aviator* mainly from September to May and the peak number of bats in the roost was 177（unpublished）. The survey was conducted by visual surveillance and/or by video surveillance over 62 days in total. The starting time of the surveys was different day by day. The surveys always started after counting and identifying bats in the roost by photographing.

Weather data was collected from the website of the Kumagaya Meteological Office which is located 3.51km east of the roost. We utilized seven types of data as seen in Table 2-1. We compared the average of these data from days that daytime flight occurred and when it didn't. The data of September 21, 2013 was excluded as it is more than one month before the first daytime flight was observed. Rainfall data of the previous night is also used for days that daytime flight was seen and was not seen.

Results:

Figure 1. Number of bats emerged during the daytime and percentage of the bats emerged from the total number of bats in the roost.

Emergence and return during the daytime was observed for 27 out of 62 surveyed days. November 12, 2014 was excluded as no bat emergence was seen and only one returning bat was observed on that day. 99 individuals, which was about 96% of the bats in the roost, emerged between 13:29 and 15:24 on October 30, 2013. 90 individuals, which was about 97% of the bats in the roost, emerged between 15:21 and 15:47 on October 31, 2013.



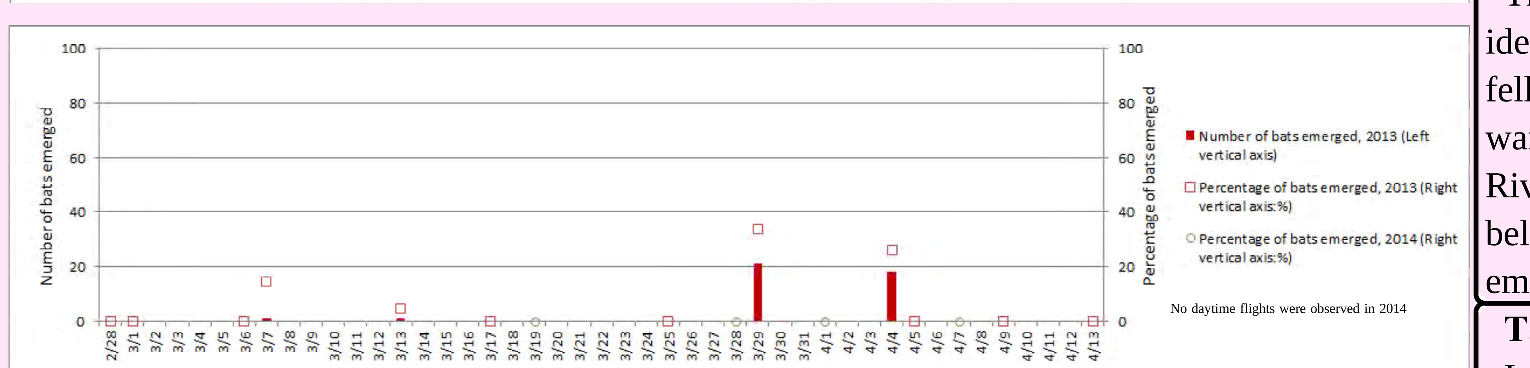
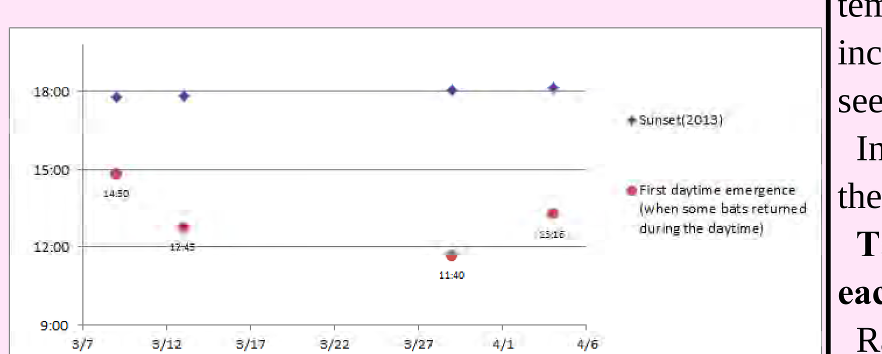


Figure 2. Starting time of daytime emergence.

The earliest emergence throughout the survey was 11:17 on November 6, 2014. Sometimes our surveys started at around 13:00 so we might have missed earlier emergences on some days, but even on the days that surveying started early in the morning there were no cases of bats emerging before 11:00. On days that only bat emergence was observed, and return was not observed during the daytime, first emergence times tend to be relatively late.



November 6, 2014 at 13:17

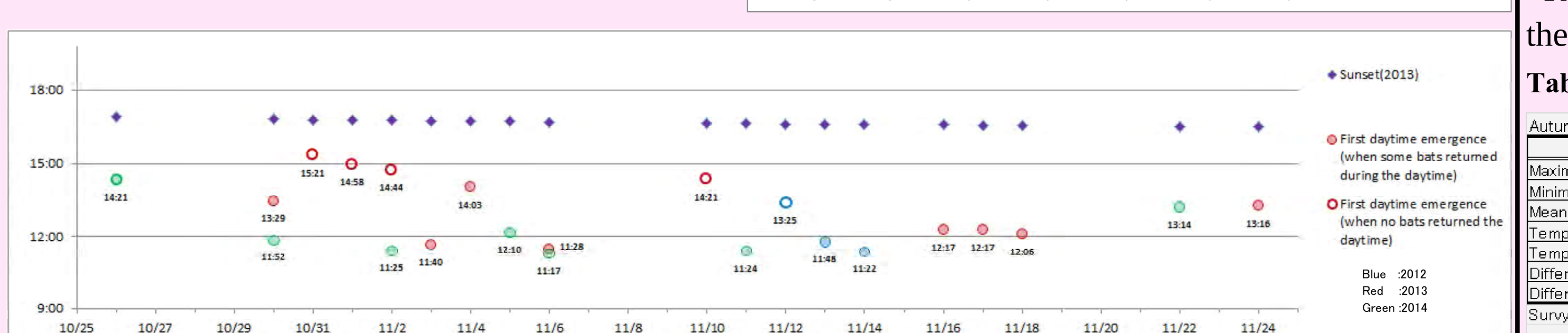


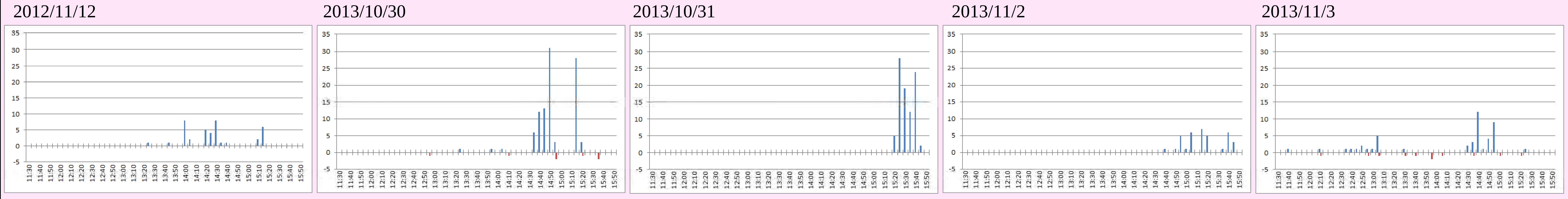
Figure 3. Number of bats emerged and returned within every five minutes during the daytime.

Figure 3 shows the number of bats emerged and returned within every five minutes on the five days when more than 30 bats emerged during the daytime. On some days, most bats emerged together at about the same time, but on other days bats emerged sporadically throughout the daytime. There is no apparent seasonal trend in bat emergence.

Each column shows the number of bats emerged and returned within each five-minute period.

Bats that emerged from the roost are shown above the x-axis and bats that returned to the roost are shown below the x-axis.

2012/11/12 2013/10/30 2013/10/31 2013/11/2 2013/11/3



March 29, 2013 at 12:41

Table 1. Amount of time bats spent outside the roost.

We calculated average emergence and return times for the roost by selecting four days when the same number of bats emerged and returned on the same day, and another six days when more than ten bats emerged and returned, for a total of ten days. When the number of emerging bats exceeds the returning bats, we consider the rest of the bats to have returned after daytime and we used the data of emerging bats up to the same number of returning bats to calculate average emergence time. When the number of returning bats exceeds the emerging bats, we used all the data recorded during the daytime. The time bats spent outside the roost was estimated from those average emergence and return times, and the average time that bats spent outside the roost was 1hour and 20minutes.

There is almost no case that emerging and returning bats are identified. However, on November 16, 2013 one torpid *N. aviator* fell from the roost, was rescued and kept until the body became warm and released at 14:49. The bat flew towards the Arakawa River. At 15:13 the same bat which was identified by its muddy belly returned to the roost. Although this case was not a natural emergence, the bat spent 24 minutes outside of the roost.

	Mean emergence time	Revised mean emergence time	n	Mean return time	n	Time bat spent outside the roost(hrs)
2012/11/13	12:44	12:08	23	14:24	15	2:16
2012/11/14	11:47		3	13:31	3	1:44
2013/3/13	12:45		1	13:41	1	0:56
2013/3/29	11:54		21	12:45	31	0:51
2013/4/4	14:13		18	14:57	18	0:44
2013/11/3	14:10	12:43	47	13:52	11	1:09
2013/11/17	13:15	12:27	18	14:32	10	2:05
2013/11/24	13:24		4	14:13	4	0:49
2014/11/2	12:16	11:58	12	13:46	11	1:48
2014/11/11	12:23		6	13:23	6	1:00
Average						1:20

Table 2-1. Daytime emergence and climate when daytime flight was and was not seen.

In autumn, the temperature at sunset on the day that daytime flight was seen is significantly higher than the temperature at sunset on the day that daytime flight was not seen.（t-test P<0.05） All other temperatures, including the temperature of the previous day's sunset, tend to be higher on the days that daytime flight was seen, although they were not significantly different.

In spring, daytime flights were seen only on 4 days and they were not t-tested but all temperatures, including the previous sunset time, also tend to be higher on the days that daytime flight was seen.

Table 2-2. Maximum rainfall per 10 minute period between sunset and midnight on the night before each surveyed day.

Rainfall does not appear to be a factor affecting daytime emergence. This is apparent as it sometimes rained on the preceding night of days that daytime flight was observed as well as days that no flight was observed.

Table 2-1.

Autumn

	Daytime flight	No daytime flight	t-values
Maximum temperature (℃)	19.0	18.1	>0.05
Minimum temperature (℃)	9.1	7.4	>0.05
Mean temperature (℃)	13.7	12.5	>0.05
Temperature at sunset (℃)	16.6	14.8	<0.05*
Temperature of the previous day's sunset (℃)	15.8	14.8	>0.05
Difference between temperature at sunset and average temperature over 30 years (1981-2010)(℃)	3.0	2.4	>0.05
Difference between temperature at the sunset and average temperature over 30 years on the previous day(℃)	1.0	0.2	>0.05
Survyed days (n)	23	22	

*Significant at P<0.05

Spring

	Daytime flight	No daytime flight
Maximum temperature (℃)	23.6	18.2
Minimum temperature (℃)	8.6	5.2
Mean temperature (℃)	15.3	11.4
Temperature at sunset (℃)	18.1	14.3
Temperature of the previous day's sunset (℃)	16.8	12.9
Difference between temperature at sunset and average temperature over 30 years (1981-2010) (℃)	8.1	3.6
Difference between temperature at the sunset and average temperature over 30 years on the previous day (℃)	6.4	1.9
Surveyed days (n)	4	12

Table 2-2.

Autumn

	Rainfall	n1	n2
	No rain	14	16
Rain(mm)	0.0	4	4
	0.5	4	0
	1.0	1	0
	1.5	0	1
	2.0	0	1

Spring

	Rainfall	n1	n2
	No rain	4	11
Rain(mm)	0.0	0	1
	0.5	0	0
	1.0	0	0
	1.5	0	0
	2.0	0	0

* 0.0 rainfall means less than 0.5mm precipitation per 10 minute
*n1:Number of days that daytime flight occurred
*n2:Number of days that daytime flight didn't occur

Discussion

Why is *N. aviator* seen more often than other insectivorous bat species flying during the daytime? According to Speakman （9, 10）, Speakman et al.（11）, risk of avian predation may be one of the main reasons that insectivorous bats don't feed during the daytime more often. *N. aviator* is a large bat and a swift flyer, therefore predation risk may not be as high. Once during our survey, we observed one *N. aviator*, having just flown out of the roost, being chased by two crows（*Corvus* sp.） which happened to be passing by at around 14:40 on October 30, 2013, but the bat escaped. As *N. aviator* is large and conspicuous it easily grabs the attention of people, therefore there is a possibility that its daytime flights are overestimated. Although *Vespertilio sinensis* and *Pipistrellus abramus* share the nearby roosts at the Shinkansen railway with *N. aviator*（5,7）, they never fly out during the day. These two species are smaller than *N. aviator*, consequently their predation risk might be higher than *N. aviator*.

Daytime flight was observed from late October to late November and from early March to early April. Why does *N. aviator* fly during the day in these periods? In our previous poster presentation（6）, we confirmed that *N. aviator* were feeding. Since then, we have confirmed feeding buzzes multiple times. Hirakawa（3） presumed that the low air temperature of the three consecutive nights preceding each daytime flight, and therefore the shortage of food intake, might cause the daytime flight of insectivorous bats. Our result from the previous night's temperature（Table 2-1）is inconsistent with this. Speakman（8） noted that in April, bats emerged on days which followed significantly cooler nights than the nights preceding day when no daytime flying was observed. In May, June, July, August and September no significant differences were seen. From October to March the temperatures on the days that daytime flight was seen, were significantly warmer. We did not record enough occurrences of daytime flight each month to determine whether such days were significantly warmer or cooler than days when no flight was observed. There is a tendency, however, that when daytime flights were seen, the temperature on the day and the previous night is warmer in either of autumn and spring. During the periods when daytime flights occurred, the bats often returned to the roost less than 1 hour after evening emergence. Therefore, we suspect that nighttime foraging is not enough. To verify this, the insect food supplies should be investigated. The feces of this species more often contain a lot of bird feathers in autumn and spring, and it is certain that this species preys on birds.（2, 4） Correlation between daytime flight and bird predation should be investigated, as it could supply enough energy at once to make daytime flights unnecessary.

Outlook

This roost survey is insufficient, and it provides only fragmented information as we can spend only a limited amount of time on the survey. Automatic recording of emergence and return at the roost 24hours a day, 365days a year would provide further evidence of trends about daytime activity. Furthermore, if individuals could be identified, body nutrient states and age might relate to daytime flight.

We have not discussed year variation, but considering no daytime flight was seen in spring of 2014 there may be a difference year by year in daytime flights, and it might be related to accumulated fat before hibernation or temperature during winter. Like Speakman（8） cooperation with bird watching organizations could result in more daytime flight reports.

N. aviator in the roost