Bat migration at Måkläppen (Falsterbo) 2010 - 2014

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Introduction

Bat migration in Europe is known since Eisentraut (1934) started his bat banding project in 1934, but many facts are still unknown. Generally, bats migrate and/or hibernate to avoid unfavourable climatic conditions (low winter temperatures) and to avoid low resource levels (Fleming & Eby 2003). In other words, migration enables some bat species to populate higher latitudes with increasing seasonality and decreasing insect production. In contrast to birds, bats can combine migration with hibernation, which results in lower migration distances for bats (Fleming & Eby 2003, Hutterer et al. 2005). Although noctules (*Nyctalus noctula*) are considered to be partly sedentary in Sweden (Ahlén 2011, Ryberg 1947), Gerell (1987) showed from ringing recoveries that noctules mostly hibernate on the European continent (see also Hutterer et al. 2005).

All around the Baltic Sea several departure points are known (Ahlén 1997, Ahlén et al. 2009, Baagøe 2001, Baagøe & Jensen 2007, Meyer 2011, Rydell et al. 2014, Seebens et al. 2013). Ahlén (1997) surveyed bat migration at some well-known bird migration localities and documented at least three bat species (*Nyctalus noctula, Vespertilio murinus, Pipistrellus nathusii*) which left the Swedish coast in direction towards the sea at different places along the Swedish coastline of the Baltic Sea. Ahlén et al. (2009) described several departure points of bats from Gotland, Öland, the Swedish mainland coasts and Denmark (Falster, Bornholm). Ahlén et al. (2007) reported Parti-coloured bats, northern bats, noctules and Nathusius´ bats from a near shore wind farm in Öresund. Klöcker (2002) reported the occurrence of migrating noctules and Nathusius´ bats (*Pipistrellus nathusii*) in autumn on the island of Fehmarn, Germany. Meyer (2011) confirmed these results and could show during a two-year study, that both species and Pipistrellus pygmaeus regularly passed the island Fehmarn during spring and autumn migration periods.

After all it seemed that bats use the same departure points as passerines do in the Baltic Region (Bairlein et al. 2014, Karlsson 2004).

Since 2007 an automated detector systems is running to study bat migration along the German East Frisian Islands (Bach et al. 2005, Bach et al. 2009, Frey et al. 2012). Out of that experience and the idea that bats often use the same migration routes as passerines in the Baltic Region (s.o.) we tested whether it was possible to survey bat migration at Måkläppen, since Falsterbo is known as a bird and bat migration point in southern Sweden (Ahlén 1997, Karlsson 2004).

Methods

Måkläppen is a small island near the Falsterbo peninsula at the south-westernmost tip of Sweden. The island is a bird- and seal sanctuary and access is prohibited from 1st of February to 31st of October. The bat detector system was situated at the seamark on the outer part of Måkläppen (see fig. 1).

A test of the study design was carried out mainly during spring migration in 2010, but also in a small period during autumn migration. After that we tried to survey bat activity at Måkläppen between April and October during in 2012-2014 (tab. 1).

Tab. 1: study periods

	study period
2010	22.4.-25.6. + 22.9.-16.10.
2012	6.6.-28.10.
2013	22.4. – 20.9.
2014	17.4.-31.10.

To monitor the bat activity we used the automated bat detector system AnaBat^{TM} SD1 (Titley Electronics, Australia). The AnaBat system is a so called dividing system and we used the dividing factor 8. The monitoring time was determined between sunset and sunrise. We reloaded the battery with a solar panel and used a modem which allowed us to download the data instantly. Because the system worked well over the whole study period we only had to enter the island for installing and reinstalling the equipment and sometimes to check the system and refine the time for monitoring.

Fig. 1: position of the AnaBat detector at the seamark (left), microphone with reflection mirror (middle) and the solar panel (right).

The positive part of the AnaBat system is, that it creates small file sizes that makes it possible to download data via mobile phone connection. The negative part of that system is that the determination of the bat species is limited due to the dividing system. So in several cases bats can only be determinate up to a genus or group level, such as *Pipistrellus* spec. or "Nyctaloid" that contains not clearly determinable bats of the genus *Nyctalus*, *Eptesicus* and *Vespertilio.*

Results

All together we recorded 7558 bat contacts of at least nine species and the genus *Myotis* and *Plecotus* that cannot be determined further with that detector system. *Eptesicus nilsonii* (Nordisk fladdermus) was by far the most common bat recorded, followed by *Pipistrellus nathusii* (Trollfladdermus) and *Pipistrellus pygmaeu*s (Dvärgfladdermus). Most astonishing is the low numbers of *Nyctalus noctula* (Stor fladdermus), a typical migrating bat species (tab. 1). In several cases *Vespertilio murinus* (Gråskimlig fladdermus), *Nyctalus leisleri* (Leislers fladdermus) and *Pipistrellus pipistrellus* (Pipistrell fladdermus) were recorded. In many cases bat contacts could only determined as "Nyctaloid", a species group that contains the species of the genus *Nyctalus*, *Eptesicus* and *Vespertilio* (see tab. 1). In every year we recorded bats of the genus *Myotis* (e.g. *Myotis dasycneme* – Dammfladdermus) and in 2013 bats of the genus *Plecotus* (Långörad fladdermus) were recorded.

Table 1 shows that most bat species passed Måkläppen every year, while others were recorded only in one (*Myotis dasycneme, Plecotus* spec.) or few years (*Nyctalus leisleri, Vespertilio murinus*). However, the last two species might have been overlooked and included in the Group "Nyctaloid" in other years.

Tab. 1: recorded species at Måkläppen 2010 - 2014

Scientific name	English name	Swedish name	2010	2012	2013	2014
Nyctalus noctula	Noctule	Stor fladdermus	26	16	94	11
Nyctalus leisleri	Leiser´s bat	Leislers fladdermus	6	1		
Vespertilio murinus	Parti-coloured bat	Gråskimlig fladdermus		7	18	3
Eptesicus nilssonii	Northern bat	Nordisk fladdermus	287	1058	1154	837
Eptesicus serotinus	Serotine	Sydfladdermus	2	39	22	9
Pipistrellus pygmaeus	Soprano Pipstrelle	Dvärgfladdermus	53	348	474	260
Pipistrellus nathusii	Nathusius´ bats	Trollfladdermus	248	523	995	465
Pipistrellus pipistrellus	Pipistrelle bat	Pipistrelle fladdermus	1	9	82	14
Myotis dasycneme	Pond bat	Dammfladdermus	1			
*Nyctaloid**			63	28	111	220
Pipistrellus spec.			4	5	1	4
Myotis spec.			7	7	13	17
Plecotus spec.	Long-eared bat	Långörad fladdermus			4	

* = Group Nyctaloid: *Nyctalus, Eptesicus, Vespertilio*

Since this investigation was carried out to study bat migration we merely want to focus on the migrating species.
The seasonal distribution of *Pipistrellus nathusii* shows a clear pattern of a migrating species (fig. 2). It appears in early spring with a peak activity around the end of May. After mid-June (as latest) its activity drops and usually does not rise again before mid-August (2012 + 2013). That is when autumn migration starts for this species (see Rydell et al. 2014). Although there are annual differences autumn migration may last until late October (2014).

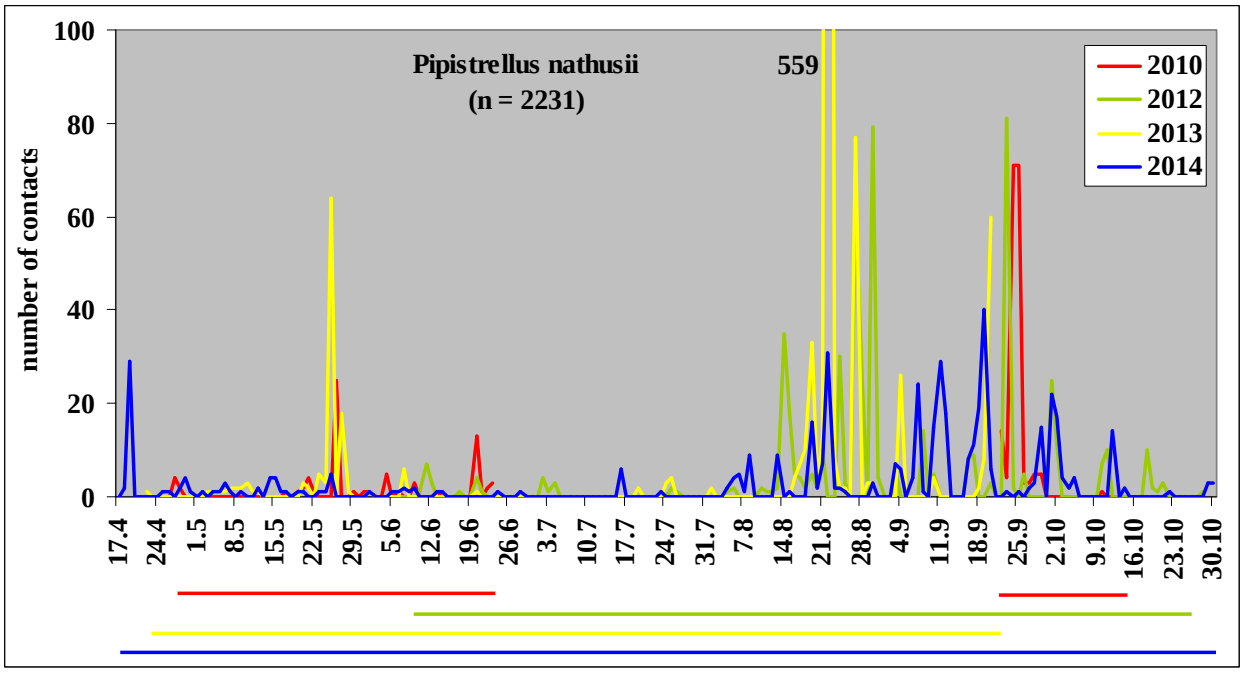

Figure 2: seasonal activity of *Pipistrellus nathusii* 2010-2014

The pattern of activities in *Pipstrellus pygmaeus* is less clear. Soprano Pipistrelles show only few activities during spring migration. It is as well almost absent during June but occurred regularly during July. In two years (2012 + 2013) it shows a typical pattern of a migrating species with raising activity after mid-August, but in 2014 no peak of activity was found during that time.

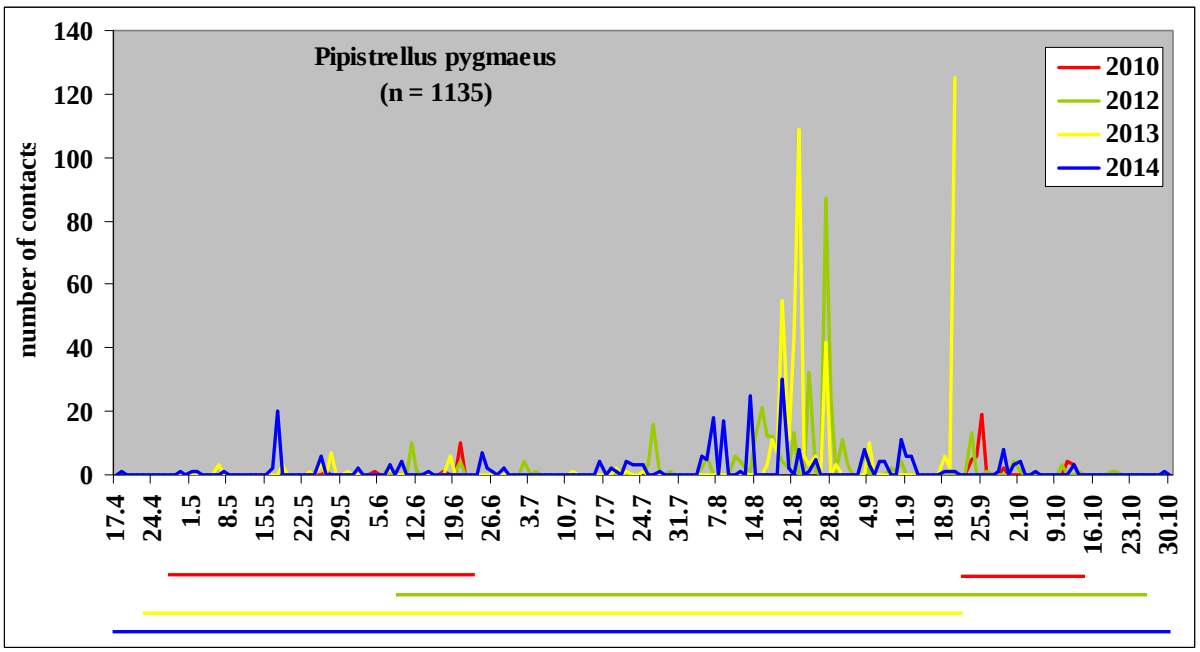

Figure 3: seasonal activity of *Pipistrellus pygmaeus* 2010-2014

Because of fewer numbers of contacts we summarized all activity data of all investigated years (fig. 4). Higher activity of noctules (*Nyctalus noctula*) occurred between mid-May and mid-June. After a lack of activity until late July the activity raised again. In contrast Leisler´s bats (*Nyctalus leisleri)* occurred mainly during the autumn migration period. Parti-coloured bats (*Vespertilio murinus*) appeared at Måkläppen both during spring and autumn migration and also in July but with few contacts.

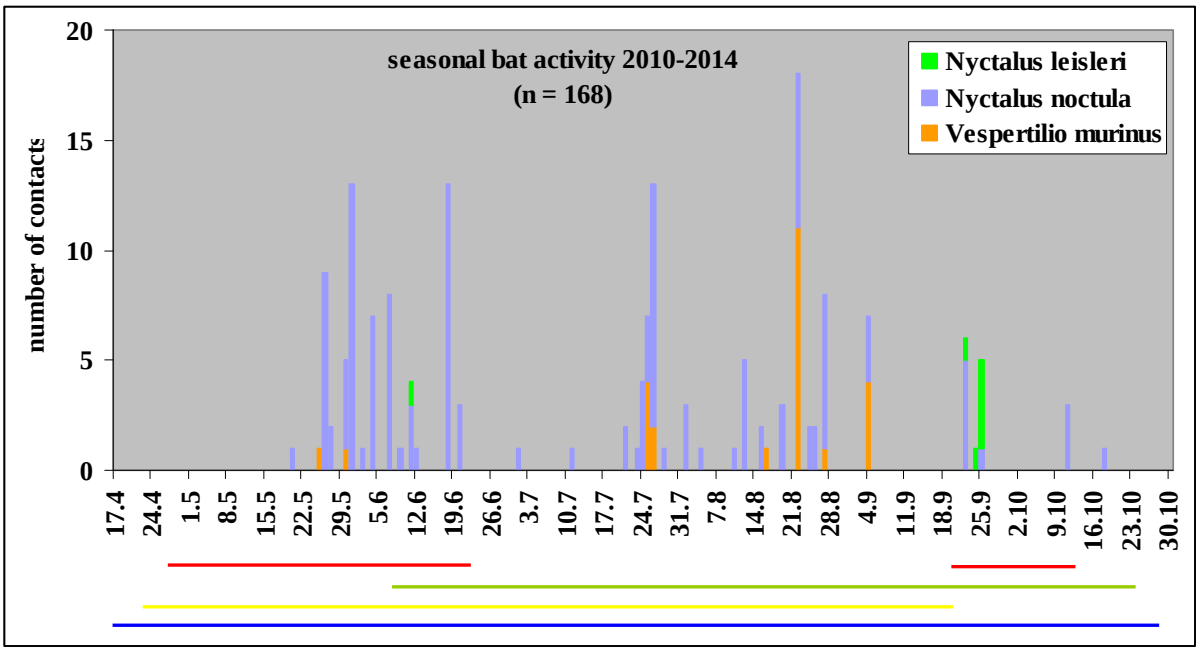

Figure 4: seasonal activity of *Nyctalus noctula, N. leisleri and Vespertilo murinus* 2010-2014

Sedentary northern bats occurred around mid-May and showed a continuous activity until late August/early September (fig. 5). That species is not known as a migrating species in southern Sweden.

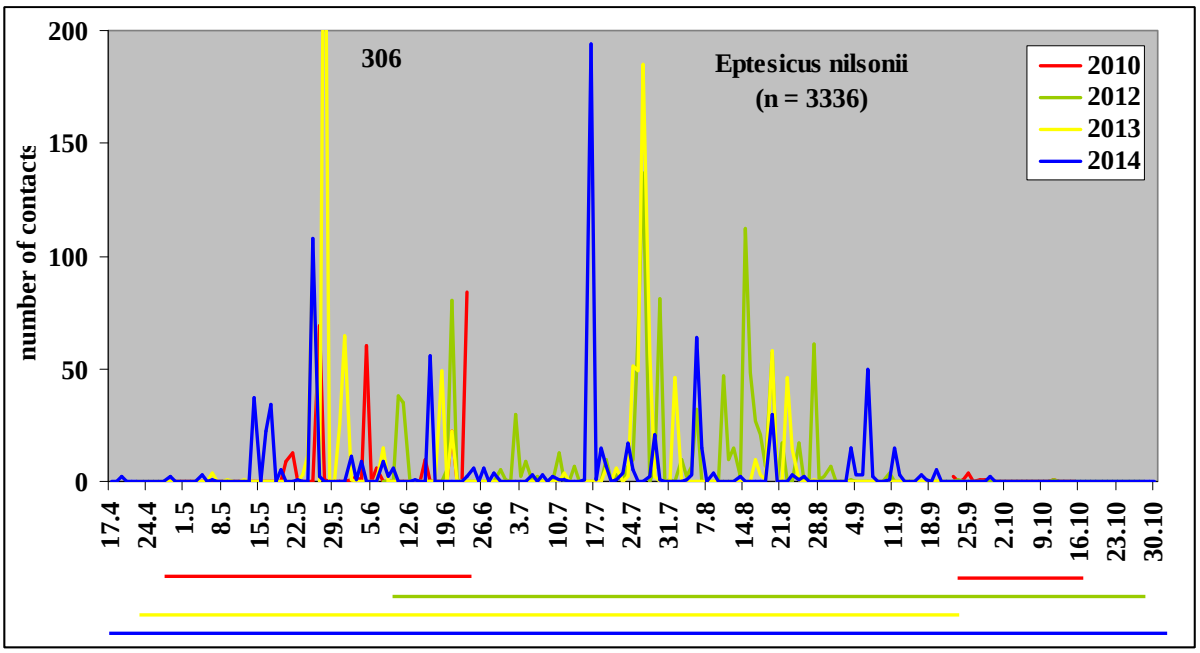

Figure 5: seasonal activity of *Eptesicus nilsonii* 2010-2014

All other bats species forage at Måkläppen without any seasonal pattern. The overall activity showed a first peak in May, then decreased and increased again in early August.

Discussion

It could be shown that Måkläppen is used intensively by foraging and/or migrating bats of at least ten species. Some species are very common (*Pipistrellus nathusii*, *Eptesicus nilsonii*) while others are rare (*Motis dasycneme*, *Plecotus spec.*, *Nyctalus leisleri*).

Although *Pipistrellus nathusii* and *P. pygmaeus* is known with nursery roosts in Falsterbo both species show a clear activity pattern corresponding with migration. These results also correspond with the findings of Ahlén (1997) and Ahlén et al (2009). For other species as *Nyctalus leisleri* and *Vespertilio murinus* the contacts are too few to show a clear migration pattern, although migration can be assumed.

In contrast northern bats, also known to be sedentary at Falsterbo, show a more or less continuous foraging activity at the outer parts of Måkläppen.

For *Nyctalus noctula* the situation is unclear. Hutterer et al. (2005) mention this species as a migrating species also in Scandinavia (see also Gerell 1987). However, this species is also known to be partly sedentary in Sweden (Ahlén 2011, Ryberg 1947). The data for noctules from Måkläppen show a similar pattern as for northern bats.

Two species, serotine and pipistrelle bat, are spreading northwards and have reached Falsterbo for several years already (Ahlén 2011). They are regularly foraging at Måkläppen.

To clarify the situation of migrating species like noctules, parti-coloured and Leisler´s bats it would be good not only to continue an acoustic monitoring at Måkläppen but also using other methods like bat boxes and mistnetting. Mistnetting would allow taking in hair samples for Stable isotope analyses [Voigt et al. 2012] and ringing would give us a better insight of the bat situation as a whole and the migration of bats at the Falsterbo peninsula in particular. Falsterbo, together with Ottenby (Öland) is predestined as one of the most important place to study bat migration in Sweden.

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