

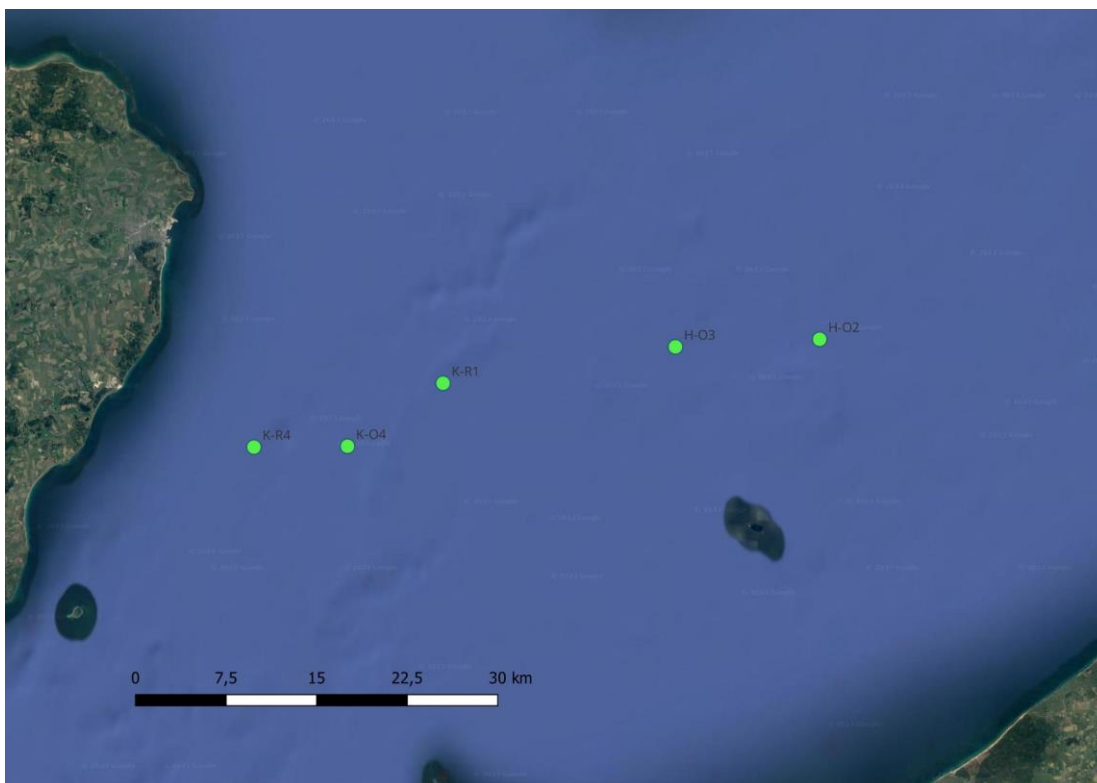
## BAT MONITORING IN RELATION TO THE OFFSHORE WIND FARM DEVELOPMENT AREAS NEAR HESSELØ AND IN SOUTHERN KATTEGAT – PRELIMINARY ASSESSMENT BASED ON SURVEYS IN 2023

Bat migration across the offshore area in Denmark is poorly known and information from the southern part of Kattegat is not available. Due to the planning of several new offshore wind farms in this area, there is a need for information on bat migration and behaviour in the area as baseline for the environmental assessment and risk assessment.

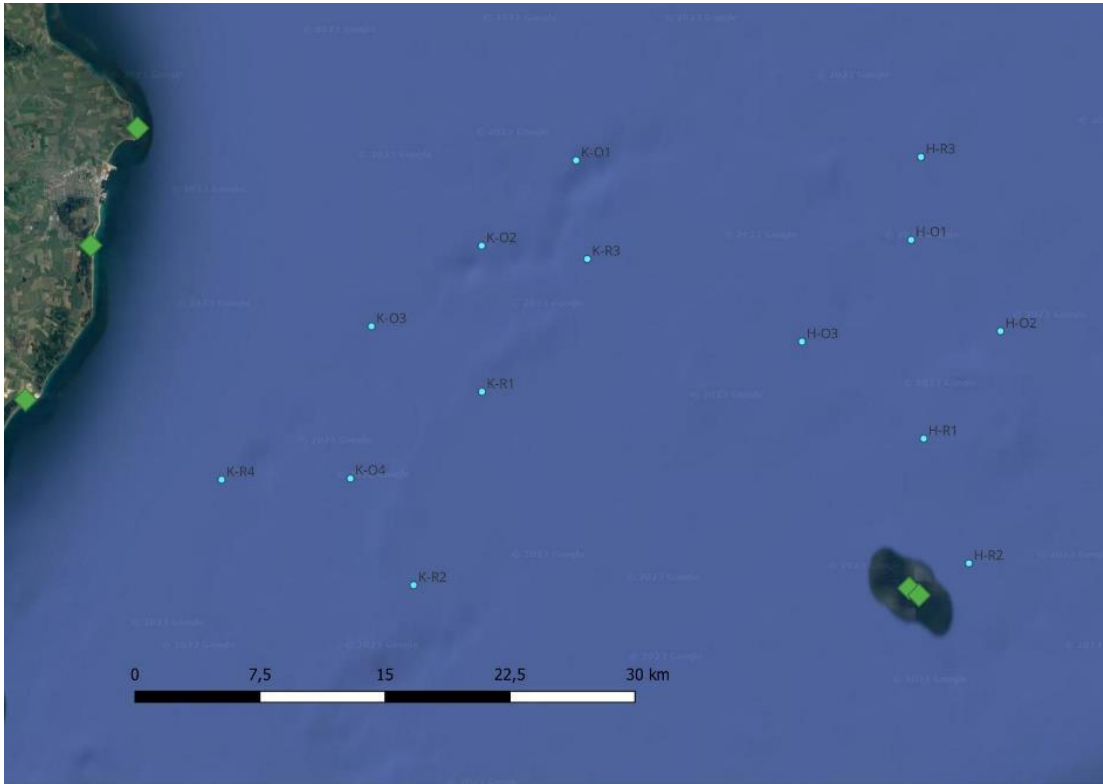
To support the decisions and environmental assessment a bat monitoring program was initiated by Energinet in spring 2023. The program will run for two years in total. This preliminary note is based only on the very first data collected in 2023.

### Methods

In spring 2023 (4<sup>th</sup> April) bat detectors were installed on the Island Hesselø and on several buoys in the southern part of Kattegat (figure 1 & 2). Five detectors on buoys were active in spring and summer (figure 1), whereas twelve out of fourteen detectors on buoys were active in autumn (figure 2).



*Figure 1 – Bat detectors on five buoys in southern part of Kattegat active from 4<sup>th</sup> April to 7<sup>th</sup> September.*



*Figure 2 – Bat detectors on Hesselø (green squares) and on fourteen buoys in southern part of Kattegat active from 7<sup>th</sup> September to 7<sup>th</sup> November. Bat detectors on Djursland are not included in this report.*

The land-based detector on the island were mounted on trees in the central part of the island. The specific positions was selected on spot with a high probability of feeding bat activity if any bats were present on the island (figure 3).



*Figure 3 – Bat detector mounted on an ash tree on Hesselø island.*

The detectors mounted on buoys were the SeaBat model used for other projects offshore in Denmark. Both detectors are based on the AudioMoth technology and were setup to record all bat activity from half hour before sunset to half hour after sunrise. The recordings were divided into 5 seconds recordings separated by 10 seconds' pause. The sorting of the recording was made by the software Kaleidoscope.

The range of the recording depends on the species of bats. Loud speaking bat like common noctule may be recorded up to 100 meters from the detector, whereas small and more silent bats may be recorded up to less than 25 meters from the recorder. Due to these differences, the amount of recording of different species cannot be compared directly.

The basic measure is recordings per night. The number of recordings cannot be translated into number of individuals. However, large activity and a high number of recordings per night may indicate more individuals.

## Results

### *Hesselø*

Five species of bats are recorded on the island of Hesselø. All occurrences are connected to migrating and roaming bats. Most numerous migrating species are Nathusius pipistrel (trodflagermus) (figure 3), Common noctule (brunflagermus) (figure 4) and Particolored bat (skimmelflagermus) (figure 5). Daubentons bat (vandflagermus) (figure 6) and Soprano pipistrel (dværgflagermus) (figure 7) are less frequent and the occurrences may be accidental.

There are no indications of breeding bat on the island Hesselø. Breeding season for bat are mid-June to mid-August. In the period there are only one record of a bat (soprano pipistrel) most likely a roaming individual from Zealand, Jutland or Sweden.

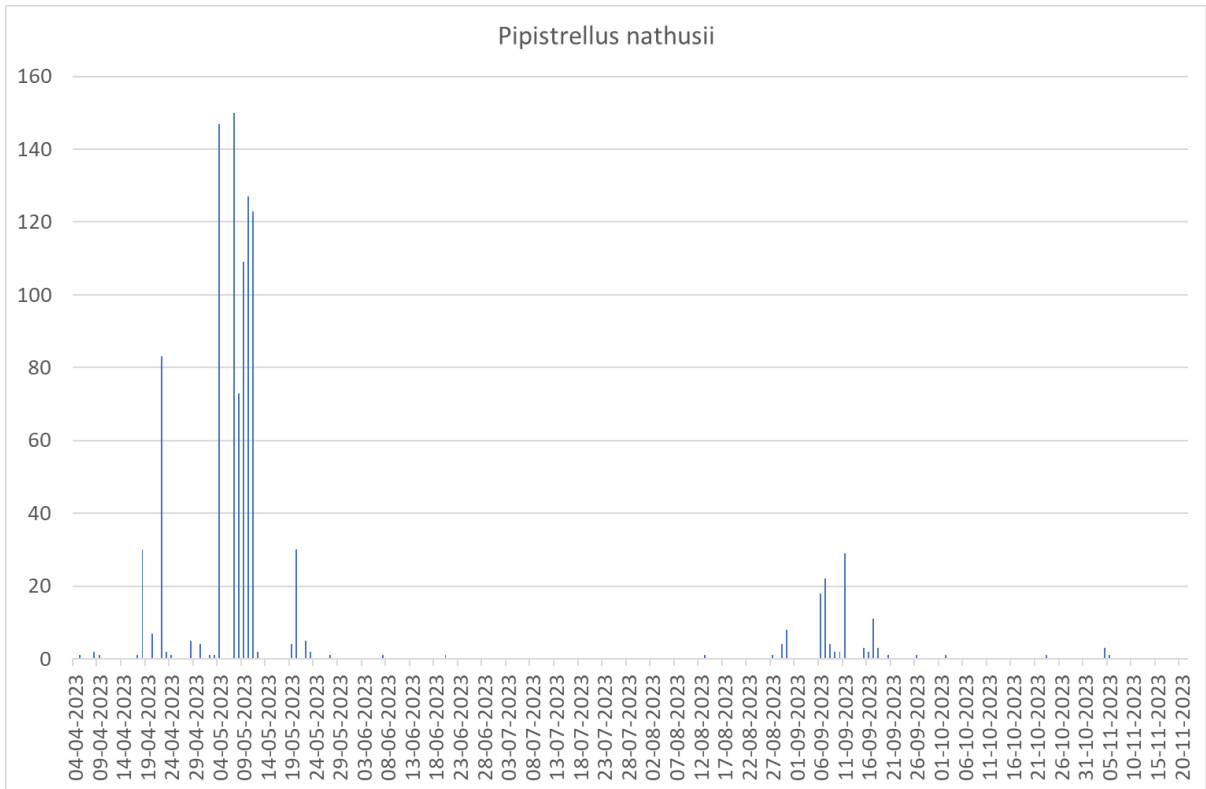


Figure 4 – Number of recordings of nathusius pipistrel - Troidflagermus (*Pipistrellus nathusii*) per night per detector on Hesselø 2023.

Migrating nathusius pipistrel seem to be most significant in spring migration from Mid-April to Mid-May, whereas the autumn migration, at least in 2023 are less prominent from late August to Mid-September (figure 4).

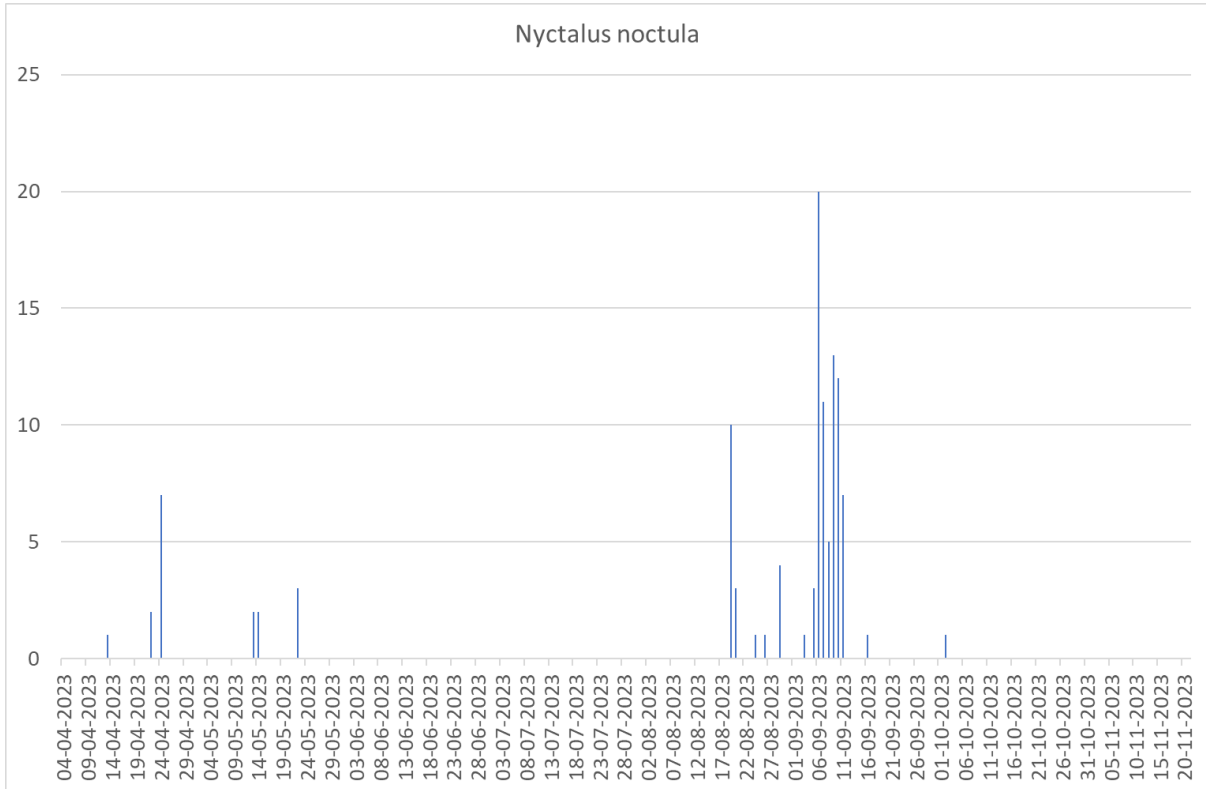


Figure 5 – Number of recordings of common noctule - brunflagermus (*Nyctalus noctule*) per night per detector on Hesselø 2023.

Migrating of common noctule are less prominent on Hesselø both in spring and autumn (figure 5). The peaks in August and September are probably connected to feeding more than migration.

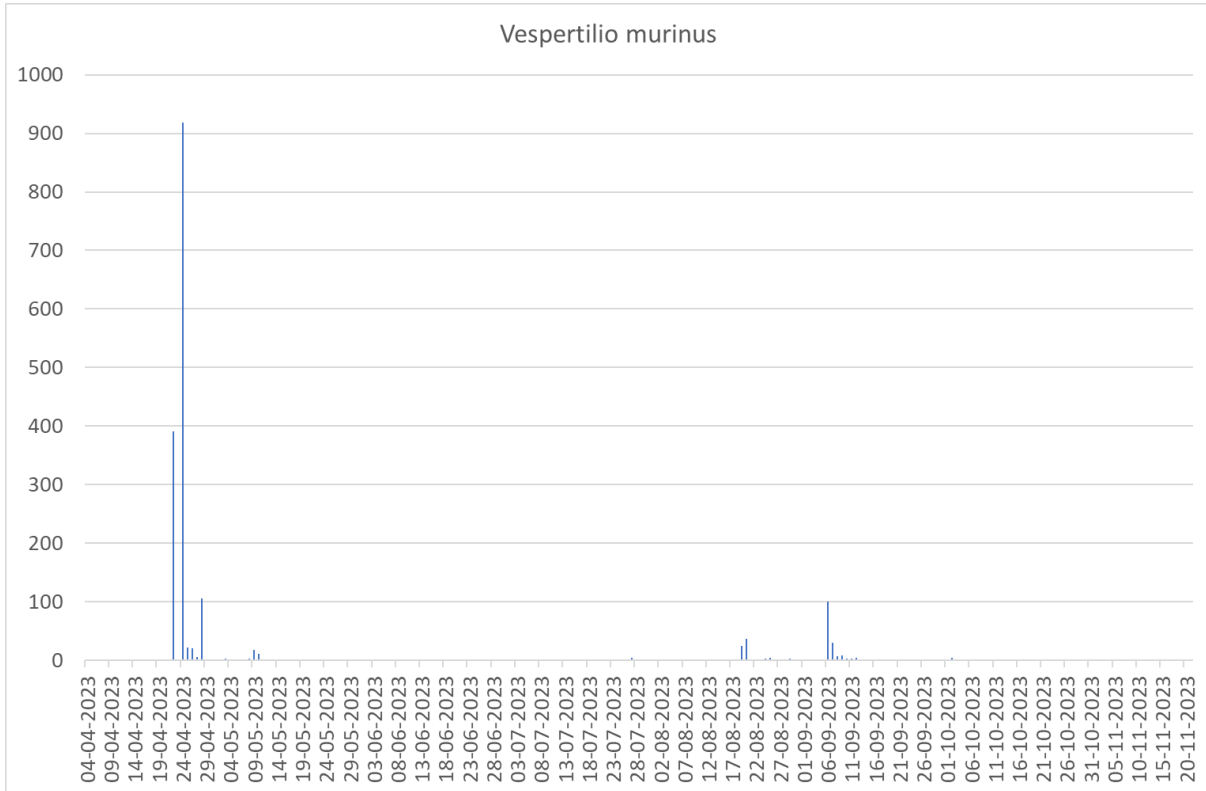


Figure 6 – Number of recordings of parti-colored bat- skimmelflagermus (*Vespertilio murinus*) per night per detector on Hesselø 2023.

The patterns of parti-colored bat on Hesselø are quite difficult to interpret. The species only occurs on few nights in spring and autumn (figure 6). The peaks in August and September are probably connected to feeding more than migration.

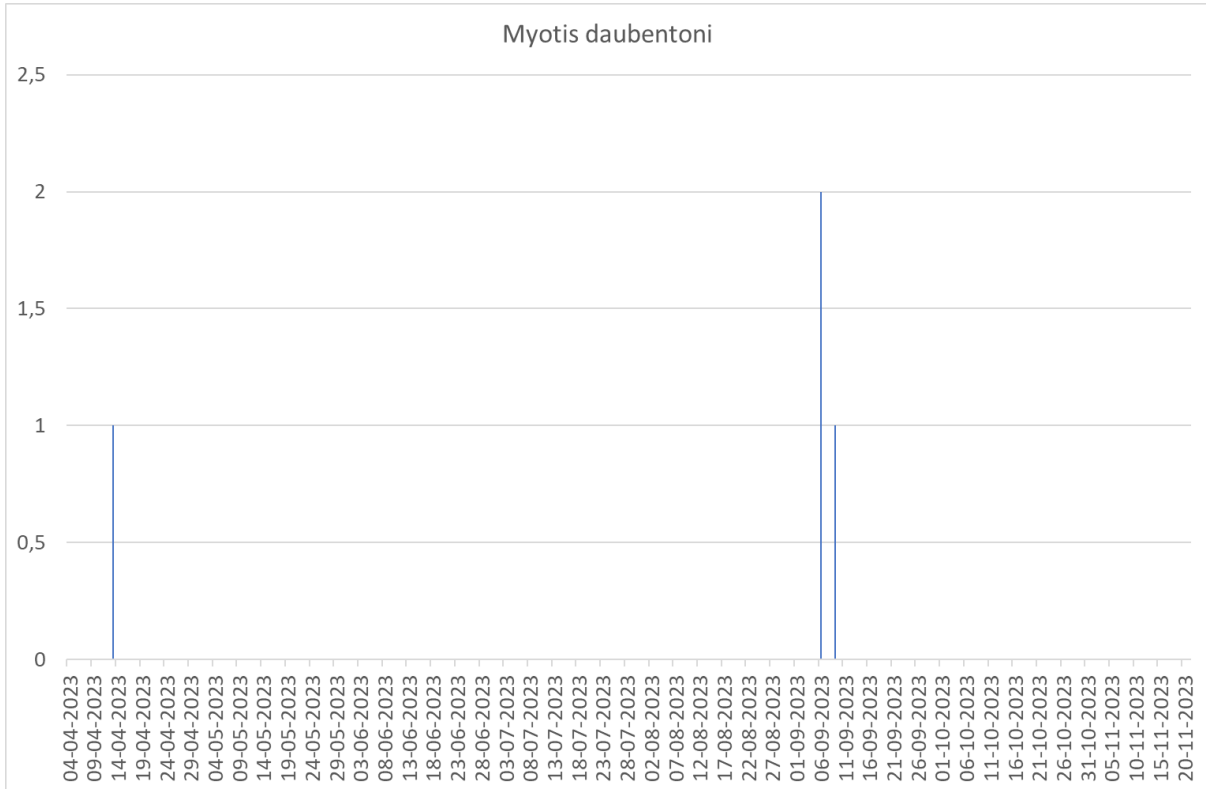


Figure 7 – Number of recordings daubentons bat - vandflagermus (*Myotis daubentoni*) per night per detector on Hesselø 2023.

Daubentons bat only occurs accidentally on Hesselø. Only four records in 2023. The patterns may be related to migration (figure 7).

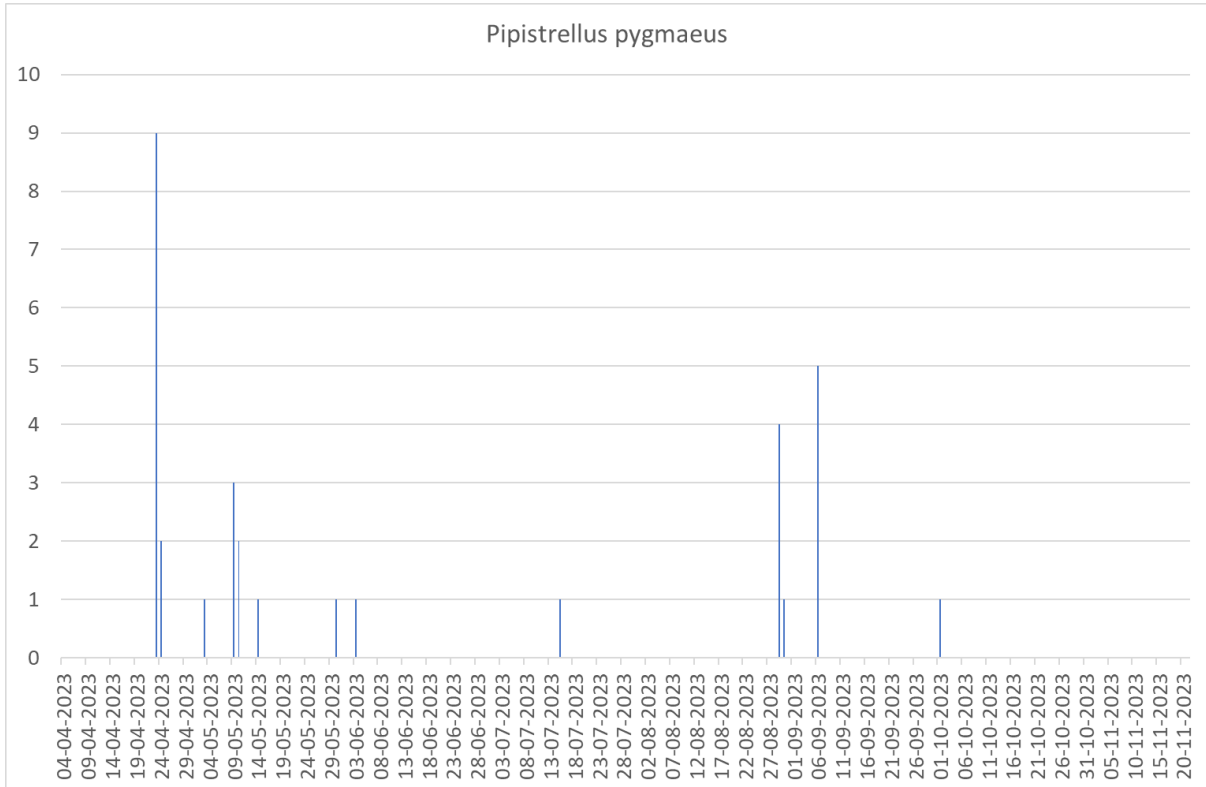


Figure 8 – Number of recordings of soprano pipistrel - dværgflagermus (*Pipistrellus pygmaeus*) per night per detector on Hesselø 2023.

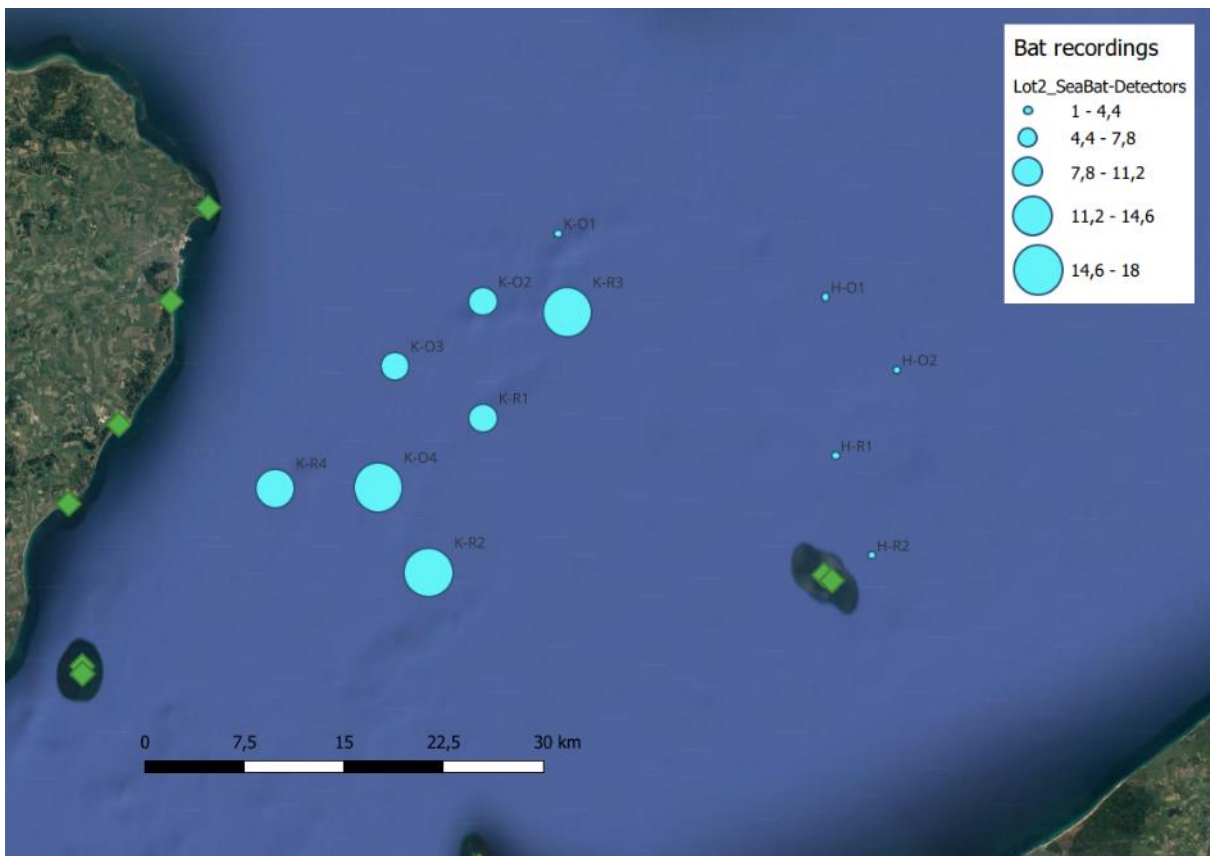
Soprano pipistrels are recorded few times from April to October (figure 8). The patterns did not indicate any major migration routes and are probably roaming individuals from Zealand or Sweden.



### Southern Kattegat

The detector on the offshore buoys generally recorded less bat than on the Hesselø island. In spring Nathusius pipistrel were recorded four times only on the westernmost buoy (K-R4), 11<sup>th</sup> May, 14<sup>th</sup> May, 22<sup>nd</sup> May and 24<sup>th</sup> May). Parti-coloured bat was recorded during spring only on one buoy north of Hesselø (H-O2) and in late summer on three buoys (K-O4, K-R1 and H-O2). Common noctule, daubentons bat and soprano pipistrel were not recorded on the buoys in spring.

In autumn the numbers of recordings per buoy were considerable higher specially in the area between Hesselø and Djursland (figure 9). The buoys with large number of records are placed between 10 and 30 km from the coast of Djursland.



*Figure 9 - Number of bat recordings per buoy from 7<sup>th</sup> September to 9<sup>th</sup> October 2023. Green squares indicate land-based detector on Hesselø (left side) and on Hjelm and Djursland. Information from Djursland and Hjelm are not included in this report.*

Most of the recordings on the buoys were from the night after 9<sup>th</sup> and 10<sup>th</sup> September (figure 10). The weather these nights was exceptionally warm and with very low wind speed (<5 m/s) (Figure 11). The patterns of all recordings from the buoy-based detector are that most of the recording are from very low wind speed (figure 12).

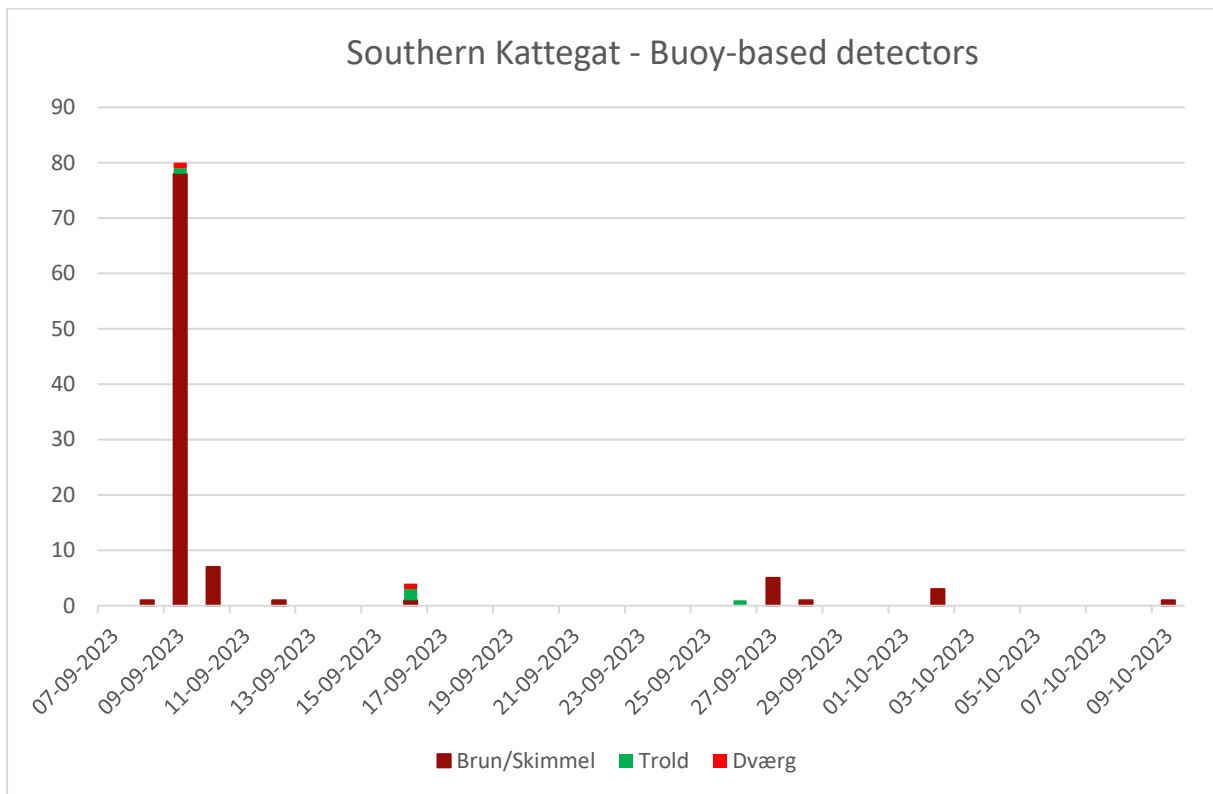


Figure 10 - Total number of bat recordings (12 buoys) per night in autumn 2023t. Common noctule/Parti-coloured Bat (Brown); *Nathusius pipistrel* (Green) and Soprano pipistrel (Red)

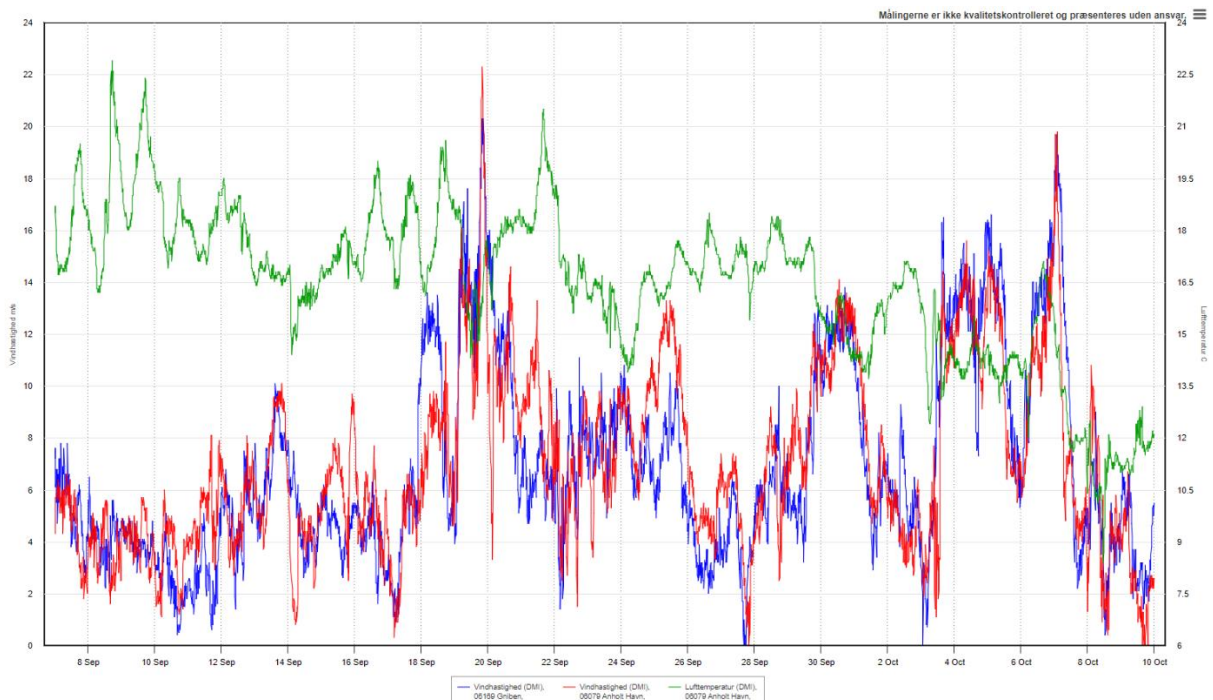


Figure 11 – Weather information from DMI station at Griben (Sjællands Odde) and Anholt. Average wind speed (Blue and red) and Temperature (Green)

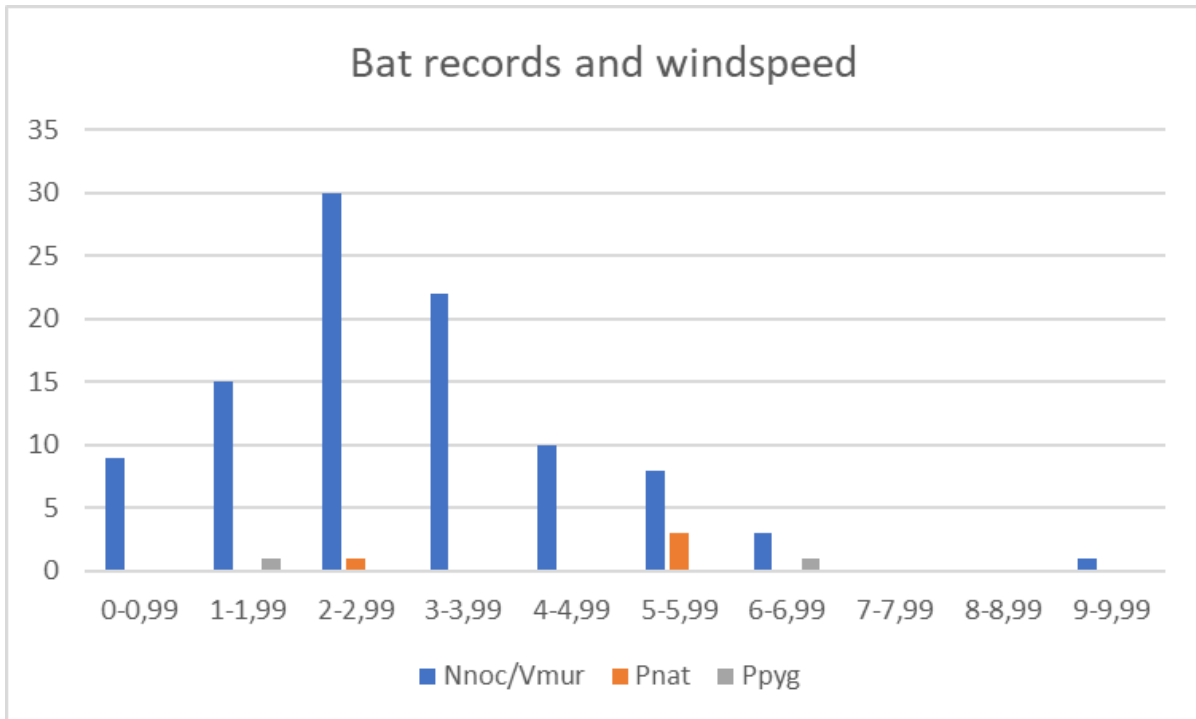
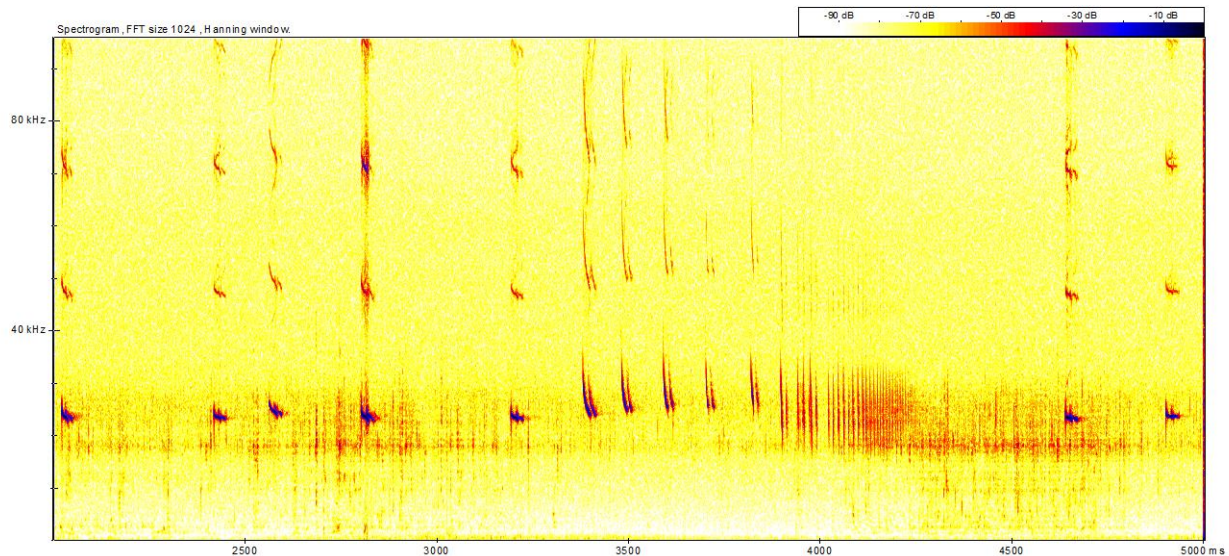


Figure 11 – Relation between number of bat recordings on the 12 buoy-based detectors and windspeed (m/s) measured at DMI station on Sjællands Odde (Gniben). Nnoc/Vmur = Common noctule and Parti-coloured bat; Pnat = Nathsius pipistrel and Ppyg = Soprano pipistrel.

All nights with bat observation had temperatures higher than 15 degrees Celsius, except one night in October with one observation of a common noctule (temperature 11.6 C at Gniben).

The reason for the large number of bat recordings in early September nights may not be related to migration. It is more likely that the occurrences are linked to feeding behaviour of the larger bat such as common noctule and particolored bat. In late summer and early autumn species of large moths are known to migrate and aggregate in large numbers and it is likely that the bats are feeding on these insects. The patterns shown on figure 9 also indicate that these bats are flying out from the east coast of Djursland. The theory of feeding behaviour as the main driver for the presence offshore is supported by many feeding buzzes (ultra-sounds with indication of feeding behaviour, see figure 12) on the recordings from the detectors on the buoys.



*Figure 12 – Recording of common noctule with feeding buzzes SeaBat08 (Buoy K-O2), 9<sup>th</sup> September 2023, 22:59. The first part of the recording shows navigation signal only. The second half of the recording shows signals 'zooming' in on prey.*

In the interpretation of the results, it is very important not to compare number of recordings of the offshore buoy-based detector with the number of the recordings from the land-based detector. The buoys are placed on the open sea and the bats are just passing by. Due to the range of the detectors and the low number of buoys in a large area the likelihood of recording a bat is very low. On the island the bats will typically feed, and rest and number of recordings will be much higher. The island will most likely also attract migrating bat from a larger sea area because of the safe resting place for a day rest.

### Conclusion

Based on the very first data from the southern part of Kattegat it can be concluded that there is no indication of breeding bats on Hesselø. During spring migration from mid-April to mid-May several bat species occur on Hesselø. This indicates some kind of migration in the area, most likely from Zealand to Sweden, but potentially also from Jutland to Sweden.

In late summer and early autumn, in nights with high temperature and low wind speed, bats from Djursland (Jutland) use the southern part of Kattegat for feeding. Most likely related to the presence of large insects over the open sea. During these nights an increase in the bat activity on Hesselø is also observed. However, the area north of Hesselø seem to be outside the range of the feeding for most bats. This feeding behaviour seems to be restricted to night with wind speed below 5 m/s and temperatures higher than 15 degrees C.

The data collection will continue in 2024 and this may add some better information on the pattern and the magnitude of the migration as well as feeding patterns of bats from the surrounding coastal areas.