Micro-projet | Microproject
Chiro'Act

# Monitoring of Parti coloured Bat (*Vespertilio murinus murinus*) and other bat species along the North Sea coast: methods and manual.

***Parti coloured bat (Bram Conings ©)***

## 1.0. Introduction

This manual is written as part of an action in the transboundary micro-Interreg-project 'Chiro'Act'. Its main objective is to provide an overview of all feasable methods to detect the presence of the Parti coloured bat in a certain region and to monitor it over a long period, in particular along the North Sea coast, during migration and during the mating period. Nursery colonies and hibernacula are not considered in this manual. The different methods can be applied in single surveys, as well as in long time monitoring. In the latter case it is advised to maintain -as far as achievable- a standardised protocol, applying the same methods uniformely year after year, during the same period of the year, for the same lenght of time, using the same or similar equipment, during similar weather conditions, etc. This will result in more reliable data that can be used to determine or at least to help estimate population trends. It is usefull in any case to take as many notes as possible, describing the methods, equipment and conditions during the inventory, and also to collect images.

### 1.1. Verspreidingsgebied van de Tweekleurige vleermuis

In the Benelux and eastern France this species reaches the western border of its distribution area. Individual animals have been observed as far as Bretagne, the north-western tip of France. A probably relatively small part of the population from the northwestern part of the European summer distribution area is known to migrate south and south-west in the autumn, including along the North Sea coast, sometimes over long distances, up to more than 1500 kilometres. The distinction between dispersion and migration is not always clear, but the spikes in the number of observations in Belgium in the spring (April/May) and especially in the autumn (mid-August to mid-October) and a very calm period from late May to mid-August, seem to be a strong indication for a migration pattern.

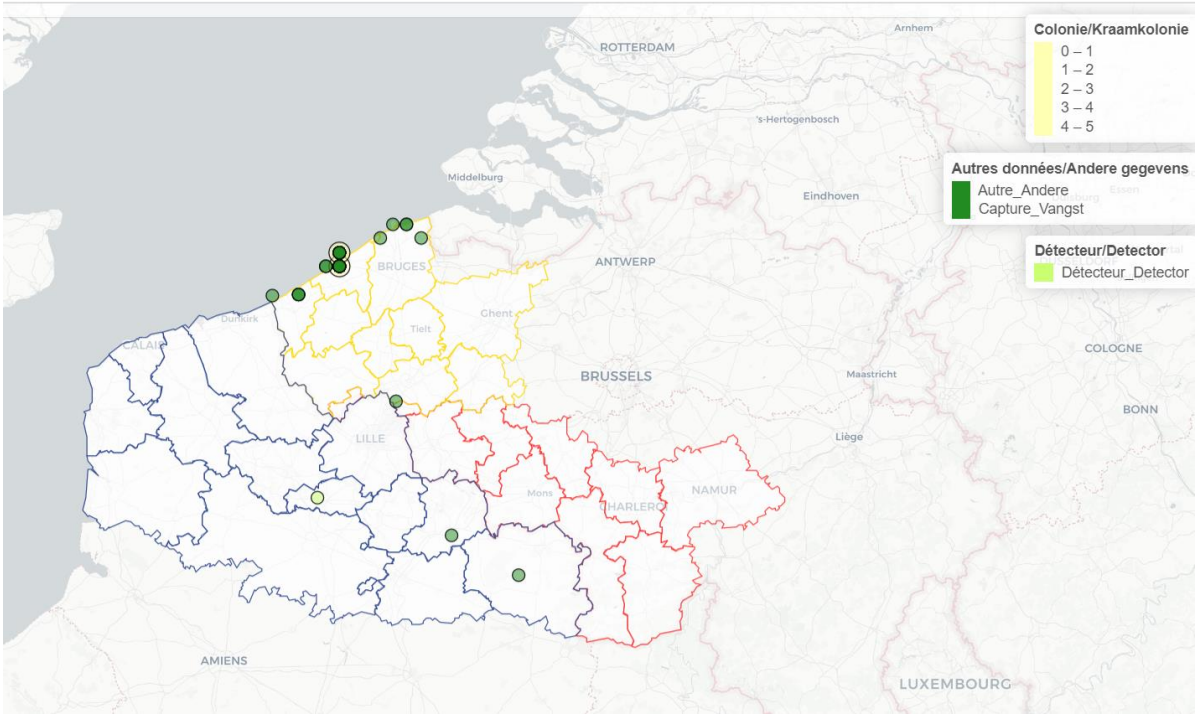
***Map 1: Global distribution of Vespertilio murinus murinus/ussuriensis. Source: Udo Schröter, 2020, Wikipedia.***


***Map 2: Known distribution of Vespertilio murinus murinus in Europe. Source: Dietz en Kiefer, Die Fledermäuse Europas, 2014.***

A distribution map (regularly updated) for the Netherlands can be found here:
https://www.verspreidingsatlas.nl/8496250

### 1.2. The Low Countries: endpoint of a south-west-ward migratory route along the North Sea coast for the Parti coloured bat?

Striking is the relatively high number of sightings in recent decades in the Dutch coastal region and western Netherlands (several dozen animals) and along the Belgian coast (some dozen animals) compared to the coast in the north of France and along the Channel, where over a much larger distance of coast hardly any sightings or findings have been reported. Statistics on the situation in Belgium can be found here: https://waarnemingen.be/species/424/statistics/. (Note: on date of this publication, the historic data -prior to 2010 - in waarnemingen.be are still incomplete). It is not currently clear whether this contrast also reflects reality, and whether the west of the Low Countries is therefore a kind of endpoint for this migratory route along the North Sea coast, or if there is a lower detection rate along the northern French coast. The purpose of this manual is to fill this possible gap in knowledge about this species. However, the observations in the interior prove that this species is also being addressed in northern France. Both these observations and the observations of Parti coloured bats in the Belgian interior are situated almost exclusively along large watercourses such as the large rivers and canals. A possible attempt at detection and further monitoring of Parti coloured bats inland seems to be the most likely to be succesfull along the large watercourses, in particular during the autumn migration, between mid-August and mid-October.




***Map 3: Recent observations of Parti coloured bat (Vespertilio murinus) in the project area (Source: Micro-Interreg-project Chiro'Act). Please note: any observations outside the project area -circumscribed in yellow, red and blue- are not indicated on this map! (updated maps: www.waarnemingen.be en www.waarneming.nl).***

### 1.3. Evolution in detection and observation methods in the past decades.

Dutch and Belgian observations show a clear trend in the type of observations of Parti coloured bats collected in recent decades. For example, in the early years - with a first case described in 1989 in Blankenberge - mainly finds of weakened animals were reported, for a large part through Wildlife Rescue Centres (WRC's) in Belgium - including the WRC in Ostend. In the course of the 2000s, verifiable (i.e. full spectrum recordings) detector observations were also included. In Belgium, automatic detectors have also been used along the coast since 2012. The first years were in interrupted periods, but for several years now, a number of permanent detectors have been installed by the Flemish Institute for the Sea (VLIZ) and the RBINS along the Belgian coast and in the North Sea (www.lifewatch.be/en/sensors), although these institutions -as do of course most volunteers- still experience at least some difficulties in processing the large amount of collected data. Remarkable was the detection -by means of an automatic detector- of a Parti coloured bat over the North Sea during an expedition with the then research ship the Belgica.

## 2. Methods for monitoring Parti coloured bats and other species of bats along the North Sea coast.

### 2.1.1. Façade scouting: a new method for monitoring bat migrations along the North Sea coast.

One type of sightings, the number of which has been increasing significantly in Belgium for a number of years, are the sight observations of bats resting during the day on the outside of buildings in the built-up zone along the North Sea coast, in particular on the seawall and the surrounding zone. This form of monitoring can easily be carried out by anyone using binoculars or a telescope, and is most likely to be succesfull in the period from mid-August to the end of October. Photographs form reliable evidence for this fairly well-recognizable species. For lay people, confusion is possible with other species, such as the Serotine or Nathusius pipistrelle, but qualitative photographs can usually be conclusive. One method that gives many bird watchers the chance to collect useful photos -in the absence of a camera with a telephoto lens- is to photograph using a smartphone through the lens of binoculars or a telescope. To learn to recognize this species, it is enough to view a series of photos via Internet sources or in field guides. Currently, there is no standard protocol to apply façade scouting as a method for long term monitoring. The annual periodic visual screening of a fixed number of streets in the built-up zone of the seawall during the peak migration period seems to be a good standard. It is to be expected that the prior weather conditions that affect the migratory behaviour of the bats, will strongly determine the result of a method such as façade scouting. The further follow-up of the scientific knowledge on this will certainly prove useful in order to make this method more successful.

### 2.1.2. Façade scouting: a unique opportunity to collect droppings of Parti coloured bats

In theory, the collection of droppings (for DNA analysis) under the hangout, even when a spotted animal has since disappeared, can offer the chance to identify the species, and even to carry out a dietary study. For the collection and preservation of droppings for this purpose, the Institute for Nature and Forest Research has developed a protocol (see lit.).

### 2.1.3. Façade scouting: an opportunity to observe ringed bats.

'Façade scouting' should in theory also be one of the best methods for observing ringed animals. Since 2019, the Latvian 'Pape Bird Ringing Station' is focussing more specifically on ringing Parti coloured bats, whereas before the focus was for the largest part aimed at ringing Nathusius pipistrelles. In the coming years there is therefore a chance of sightings of ringed Parti coloured bats, also along the North Sea coast. It is therefore appropriate to be attentive to any ringed bats in all sight observations of these and other migratory species. In the case of a sighting of a ringed animal, it is absolutely worthwhile to attempt to take a closer look at the animal in question in order to read the number on the ring, possibly in the hand. Contacting a local fire service (see below) can be a safe option. However, control of a bat in the hand can only be done by persons who have the necessary exemptions from the legislation in force. Ring numbers -incl. photo of the ring and the animal are best passed on to the contacts of the Bat Working Group in the region concerned. (F.: www.cmnf.fr, B.: www.natuurpunt.be/vleermuizen, NL: www.zoogdiervereniging.nl). When checking a bat in the hand, it is also always valuable to collect samples of haircoat and feces for any subsequent analysis.


***Oktober 8th 2006: a Parti coloured bat on the façade at the 7th floor of an appartment building in Ostend is being brought down by the fire service for further research (Yves Adams ©, Vildaphoto).***

***Oktober 4th 2019: Photographing a Nathusius pipistrelle (Pipistrellus Nathusius) in Bray- Dunes (Fr.) during an excursion in the frame of the micro-Interreg-project Chiro'Act. (Claire Brabant, Plecotus/Natagora ©).***

## 2.2. Monitoring Parti coloured bats using bat boxes

As far as is known, checking bat boxes is not an effective method of monitoring the presence of Parti coloured bats. As a resident of rocks and cliffs, it is obvious that this species, when passing along the North Sea coast, opts for all kinds of narrow crevices in large stone buildings, rather than in small wooden bat boxes. In the east of the range, the use of bat boxes by Parti coloured bats has been established, so it is not excluded. This method is also useful for monitoring of Nathusius bats, also for reading the numbers in any ringed animals.

***In the 'Zwinbosjes' in Knokke-Heist (B.) there have been put up several dozen bat boxes since 2005. Parti coloured bats have never been found in them (photo: Bob Vandendriessche).***

## 2.3. Acousitic monitoring of Parti coloured bats

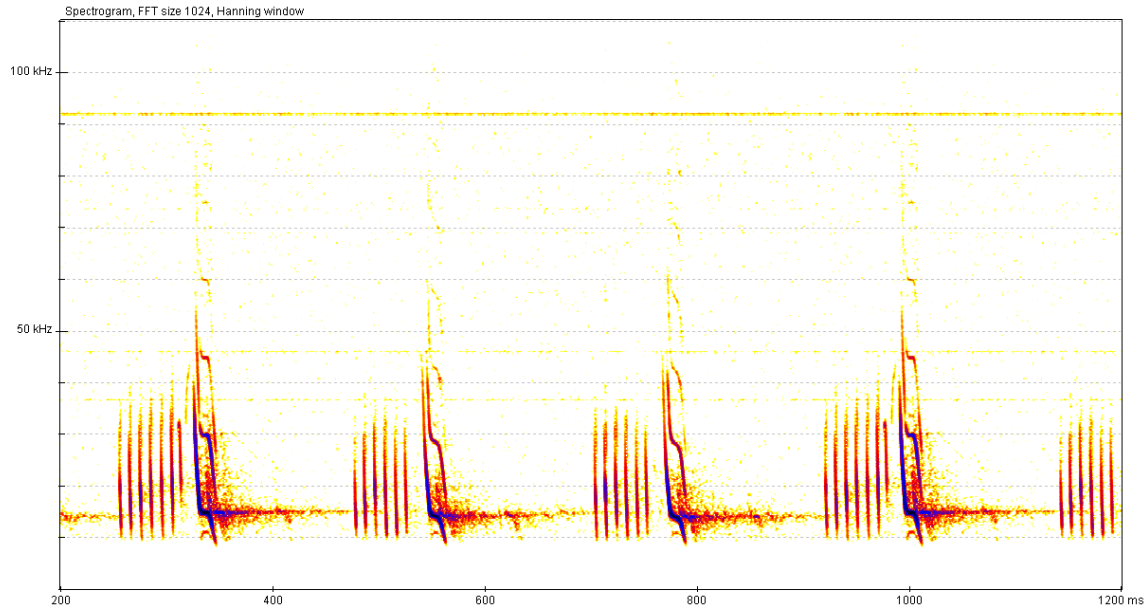
### 2.3.1. Auditory monitoring of mating songs.

Acoustic monitoring of Parti coloured bats can be auditory, i.e. with the naked ear, and with the help of a detector. Auditory monitoring - possibly in combination with visual observations at dusk or in artificial light - can take place in late autumn (October-December) during the mating songs of the males, which can take place even at light freezing temperatures. According to some authors, this behaviour sometimes doesn't start until more than two hours after sunset. So males may first forage before starting the mating songs.

The peak frequency (the loudest part) of the mating song lies in the part of the sound spectrum that is audible to most people, i.e. around 13 to 14kHz. Please note that for older people or people with damaged hearing, these high sounds are sometimes undetectable. Younger people don't usually have a problem with it. The sound can be heard up to tens of meters away.

Without detector, the sound sounds like "... Zing... Zing... Zing...", in which the 'zing' is repeated up to 4 to 5 times per second. On a detector - heterodyne tuned between 13 and 14 kHz- the sound sounds like "pwooit... pwooit... pwooit", where the "pwooit" is preceded by a series of short dry pulses that sound like "trrrrrr". For those who don't know the sound, it makes sense to listen to it online before, e.g. via the BatLib app.

Since the mating song behaviour by Parti coloured bats is mainly a local event - the animals do not travel great distances during mating songs, but remain somewhere on the spot- determining it - auditory or with a manual detector- during a walking or cycling transect is effectively a better method than static use of automatic detectors in a fixed place. In theory, an automatic detector can of course also be used for a transect.




***Spectrogram of a mating song by a Parti coloured bat. Recordings: Limpens H., Agate J. en Ahlen I.***

To detect the mating songs of Parti coloured bats, choose an area with water, greenery and tall buildings, e.g. a city park with a pond along the coast. The presence of lighting makes little difference. The fact that the animals often choose the surroundings of tall buildings can have several explanations: the warmer microclimate, the function of the façades as an 'echo-wall' for amplifying the sounds in a certain direction (e.g. towards the water), and the presence of mating places, such as niches in buildings.


***The Leopold-park in Brussels: a pond in a park surrounded by tall buildings is an exemple of a suited location to look for Parti coloured bats during the mating song season. (Photo: Google Earth, 2020)***

### 2.3.2. Acoustic monitoring using detectors

Acoustic monitoring of both foraging and passing Parti coloured bats is well feasible, both on land and at sea. A conclusive or verifiable observation is only possible by collecting and analyzing so-called full spectrum sound recordings. Some experience is required to identify the sound recordings up to the species level. Specifically for recognizing the signals of Parti coloured bats, it is advisable not only to rely on so-called automatic identification software (AIS), but also to do a manual check of the recordings. For this, various software packages are available, all of which are more or less equally qualitative, but can have rather differing features with regards to design etc. When entering detector observations into databases such as waarnemingen.be or observation.org it is important to also mention the type of detector that has been used. In the annex of this manual, some types of signals from Parti coloured bats are discussed and compared with the calls of species with which confusion is often unavoidable. For the more elaborate identification of bat calls -including the Parti coloured bat- using analysis software, we are happy to refer to some specific publications (see below).

#### 2.3.2.1 Acoustic monitoring using handheld detectors.

For monitoring foraging or migrating Parti coloured bats in suitable habitats, both during the summer period and during migration, walking transects with a handheld detector can be a suitable method. However, this method is rather labour intensive. Because of the -according to estimates- (very) low numbers of Parti coloured bats in the Low Countries and northern France, this method is less efficient as a monitoring method in the strict sense. Details about setting up bicycle or car transects are described in the relevant reports of Natuurpunt Studie on this (see reference list). The sound of a Parti coloured bat as it can be heard on a heterodyne detector tuned to 25 kHz can be heard here (see below):https://www.verspreidingsatlas.nl/8496250

#### 2.3.2.2 Acoustic monitoring using automatic detectors.

When acoustic monitoring using automatic detectors with Parti coloured bat as a target species, it is important to pay attention to a number of things, such as the choice of location, the positioning of the detector, the period and the length of the period. Both the coastal strip and the wide riparian areas of all major watercourses are clearly emerging as the areas with the greatest chance of sightings of Parti coloured bats. At both locations it is worth while to try to use two detectors simultaneously, namely a detector at ground height, and a detector at a certain height, e.g. a tall tree, a building or a mast.

The use of automatic detectors to monitor the autumn migration is preferably done in as long, continuous periods as possible. Along the Belgian and French North Sea coasts this is ideally between the beginning of August (half August the latest) and the end of October or even a little longer. If a less long period is feasible, the focus is best on the month of September.

#### 2.3.2.3 Acoustic monitoring at sea

With regards to geolocating the exact position at sea, it is necessary to verify the timing of the devices used for each use, so that any recordings can be linked to the correct position of the ship afterwards (please note: some types of detectors include automatic geolocation). Of course, this also applies to manual recordings, although this method is used much less often at sea.

A method of monitoring at sea, which is not yet known, is the use of automatic detectors on a commercial voyage, e.g. as a passenger or as a crew member. In that case, the use of its own GPS tracking with the positions will be necessary, and of course also a well-set timing of the detector. In the event that different time zones are detected, a correction may be required.

When placing an automatic detector on a boat or a ship, it is particularly important to take into account any frequent interference sounds - electronic or mechanical, and not just ultrasonics!- which could result in a contiguous recording series of interference sounds, resulting in the absence of bat recordings. Any ultrasonic sources of interference can be detected with a heterodyne detector.

## 2.4 Capturing Parti coloured bats

Capturing Parti coloured bats as a method of long-term monitoring is theoretically a possibility, but in practice it will prove to be a very labour-intensive method. Due to the low numbers of passing animals, the chances of success in Belgium or northern France seem very small, but not impossible: in suitable habitats where, for example, detector observations have already been made regularly or shortly before, capture during several suitable nights and with large numbers of nets and with the help of a bat lure - which plays for example the mating songs or other social sounds of the species - may have a chance of success. In Belgium, however, Parti coloured bats have never been caught using this method. Along the Baltic coast in Latvia, small numbers of Parti coloured bats are caught every year, in addition to several thousand Nathusius pipistrelles, with the help of a very large funnel shaped trap. However, this type of installation is expensive and their drafting and construction only makes sense when the main structure can remain standing at the same place for many consecutive years.

In any case, in the event of a possible capture of a Parti coloured bat, it makes sense to collect as much detailed information as possible, and in addition to noting the usual characteristics, also to collect samples of feces (see protocol INBO) and hair samples, and possibly also to take pictures of the wing vein pattern for later individual recognition in the event of a find or recapture.

Please note: the capturing and handling of bats can only be carried out by persons who have the necessary exemptions from the national legislation in force and for purposes that are part of a scientific study.

***In this large, funnel shaped trap along the Baltic coast in Latvia (Pape Bird Ringing Station) since 2014 each autumn several thousands of bats are captured, measured and ringed for scientific research. (Photo: Bat Research Society of Latvia ©)***

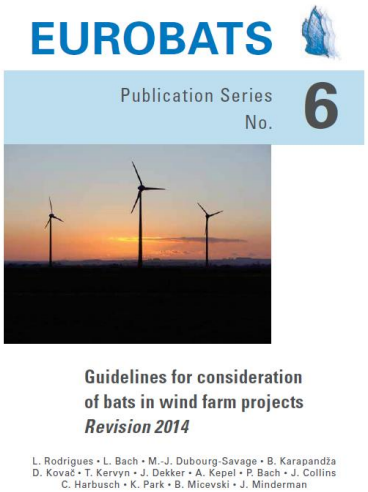
**2.5 Revalidation of weakened bats and collection of dead bats.**

In order to increase the likelihood of collection of weakened or dead bats at a WRC, it is necessary to communicate regularly through broad media about bats, so that people who find bats are more likely to report a find. It may also make sense to inform networks of veterinarians, animal shelters, zoos, environmental services and other stakeholders about the importance of the collection of weakened or dead bats. It is important to take into account and communicate the guidelines in force in relation to avoiding the possible transfer of Covid-19 from humans to bats (not the other way around). In Flanders, carcasses of bats are collected as part of a 'passive monitoring of zoonoses' (contact: Sciensano, ANB, Vleermuizenwerkgroep Natuurpunt Studie).

In the case of a find - both of living and dead animals - it is always important to write down the name and contact details of the finder and to collect as many details as possible about the nature of the find and the site.  It is also necessary to maintain good contacts with the staff involved in the WRC's, so that agreements can be made on the rapid exchange of information in the case of the discovery of a Parti coloured bat. This is particularly the case if, for example, a female bat were found in the maternity period. In that case, it may be worth while to try to detect the possible maternity colony.

**2.6 Monitoring bat fatalities near windturbines**

The systematic and repeated search for bat carcasses under wind turbines according to a defined protocol (see publication Eurobats) can certainly be a form of monitoring for bat species along the North Sea coast, mainly for species such as Nathusius pipistrelle and common noctule, but the numbers of Parti coloured bats are so low that the setting of trends, certainly in the short or medium term , seems very difficult. Moreover, the best way to detect bat fatalities under wind turbines is in a context of scientific research or government-led monitoring, which puts this method outside the scope of this manual. In Belgium, meanwhile, only one case has been known of a dead Parti coloured bat under a wind turbine, in the Port of Antwerp region.




***Eurobats (UNEP, Bonn) has published and revised its 'Guidelines for consideration of bats in wind farm projects', including protocols for the search of bat carcasses.***

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*https://www.verspreidingsatlas.nl/8496250*

*https://nl.wikipedia.org/wiki/Tweekleurige_vleermuis*

**Attachment**

From: *Van de Sijpe M., Lefevre A. (2010). Analyse van vleermuizengeluiden 1.0. Vleermuizenwerkgroep Natuurpunt vzw.* In the attachment below, Marc Van de Sijpe and Alex Lefevre discuss some self made recordings of Parti coloured bats in Denmark.

## ***Parti coloured bat*** ***(Vespertilio murinus)***

*First recording*

500MS SPECTROGRAM


ANALYSIS :

| Puls nummer | Start tijd (ms) | Type signaal | Pulsduur (ms) | Pulsinterval (ms) | Startfrequentie (kHz) | Hoogste frequentie (kHz) | Laagste frequentie (kHz) | Eindfrequentie (kHz) | Bandbreedte (kHz) | Frequentie QCF-einde (kHz) | Frequentie bij max amplitude (kHz) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 32716.0 | QCF | 18.3 | 470.5 | 24 | 24 | 23 | 23 | 1 | 22.8 | 23.4 |
| 2 | 33186.5 | QCF | 19.7 | 535.1 | 23 | 23 | 22 | 22 | 1 | 22.2 | 22.9 |
| 3 | 33721.6 | QCF | 19.4 | 575.2 | 23 | 23 | 22 | 22 | 1 | 22.2 | 22.9 |
| 4 | 34296.8 | QCF | 17.4 | 531.0 | 23 | 23 | 22 | 22 | 1 | 22.0 | 22.9 |

DISCUSSION ON THE RECORDED FRAGMENT :

General information:
Place and date: Denmark, Nordsjælland, June 15th 2008, 23:22
Behaviour and habitat: foraging, search phase, open habitat
Detector: Pettersson D1000x, direct ultrasound recordings, sampling rate 500 kHz
File name of the recording: Vespertilio murinus 2008-06-15-23-22.wav

Details of the visual observation:
A Parti coloured bat hunted about 20 m high above a meadow along the edge of a forest. The meadow is located in a nature reserve a few km from the coastline, with large ponds, wood sides and forests. At the time of the observation, the evening sky was still quite clear (midsummer nights at high latitude) making the bat easy to see. The Parti coloured bat was clearly smaller than a common Noctule or a Serotine and the wings were narrow. The flight was fast and linearly high above the open pasture. Regular dives with catch buzzes indicate intense hunting activities (aerial shoveling). In this region, the Parti coloured bat is quite common and several maternity colonies (Baagoe) were found. Serotines are rare or not present. Other common species in the area were the common Noctule, Nathusius pipistrelle, Soprano pipistrelle, the common pipistrelle and Daubenton's bat. Northern bat and lesser Noctule do not occur in this area as far as is known. During the moment of recording, a Soprano pipistrelle also flew nearby (FM-QCF signals with QCF end at 53 kHz). The vertical stripes in the spectrogram that occur with regular intervals are short circuits of the barbed wire around the grazing meadow.

Summary of the sound analysis:

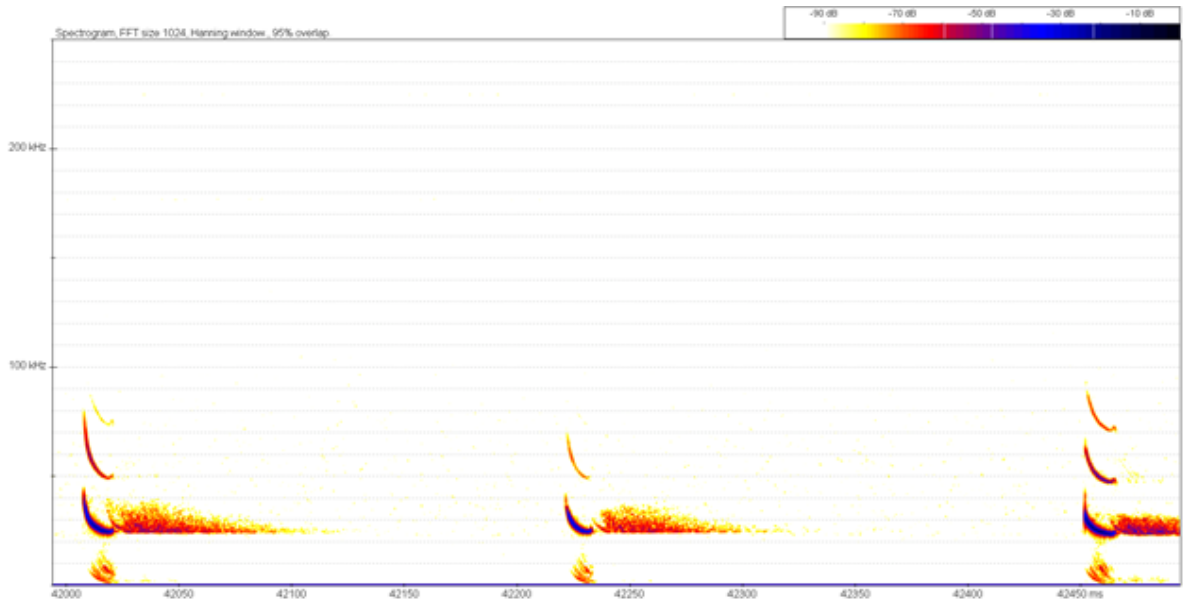
The selected pulse sequence of 4 signals consists of more or less equal QCF types, with a pulse duration of 17.4 to 19.7 ms and a bandwidth of 1 kHz. The pulse intervals are very long and remain more or less the same during the course of the sequence (variation of 470 to 575 ms). The successive pulses have the QCF end at more or less the same frequency, between 22.0 to 22.8 kHz. The start frequencies of the successive signals are also always at the same frequency (23 to 24 kHz). One upper harmonic is visible. The pulse intensity of successive signals is quite constant (all pulses about the same loud), as evidenced by the hues in the spectrograms.

Comparison with other species:

In addition to the Parti coloured bat, the lesser Noctule can also emit pulse sequences high in the open air with only QCF signals with the QCF end between 22 and 25 kHz. Lesser Noctules usually use a shorter pulse time (< 15 ms) than the Parti coloured bat (17-20 kHz). However, in some cases, lesser Noctules can also use long QCF pulses, which also have very low bandwidths (1 kHz). Parti coloured bats that hunt high in the air in this way often use very long pulse intervals (500 ms) and the pulse intervals between the successive pulses in the pulse sequence are often quite constant. In addition, the QCF end frequency also remains fairly constant between successive pulses. This reflects in heterodyne the typical sound of wet tapping of the same pitch in a very slow and very regular rhythm ('tjok-tjok-tjok'). In the lesser Notcule, the pulse duration, the QCF end frequency and the pulse intervals between successive pulses change much more frequently in a pulse series, creating a much more irregular sound ('tjok-tjok-twiet-tjok', a typical characteristic of Nyctalus species). Serotines flying high in the open air, like Parti coloured bats, can emit pulse sequences, with regular long (500 ms) pulse intervals and QCF end frequencies at 22 to 23 kHz, which remain constant at successive pulses in the pulse sequence. In almost all cases, however, Serotines use pulses with a bandwidth of still 5 to 10 kHz, so not the very flat QCF signals with bandwidths of 1 or 2 kHz that the Parti coloured bat often uses. Parti coloured bats often hunt high in the air through rapid aerial shoveling, Serotines fly only exceptionally at that altitude and prefer to hunt lower along the trees (semi-open habitat, slow aerial shoveling).

**Second recording:**

500MS SPECTROGRAM




ANALYSIS:

| Puls nummer | Start tijd (ms) | Type signaal | Pulsduur (ms) | Pulsinterval (ms) | Startfrequentie (kHz) | Hoogste frequentie (kHz) | Laagste frequentie (kHz) | Eindfrequentie (kHz) | Bandbreedte (kHz) | Frequentie QCF-einde (kHz) | Frequentie bij max amplitude (kHz) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 41568.4 | FM-QCF | 12.4 | 234.4 | 39 | 39 | 24 | 24 | 15 | 25.2 | 25.3 |
| 2 | 41802.8 | FM-QCF | 12.3 | 205.2 | 30 | 30 | 23 | 23 | 7 | 24.1 | 24.4 |
| 3 | 42008.0 | FM-QCF | 13.1 | 213.8 | 45 | 45 | 24 | 24 | 21 | 25.2 | 25.9 |
| 4 | 42221.8 | FM-QCF | 11.7 | 230.3 | 42 | 42 | 24 | 24 | 18 | 25.2 | 26.3 |
| 5 | 42452.1 | FM-QCF | 13.4 | 231.7 | 35 | 35 | 23 | 23 | 12 | 24.1 | 25.3 |
| 6 | 42683.9 | FM-QCF | 12.5 | 213.3 | 36 | 36 | 24 | 24 | 12 | 24.7 | 25.9 |
| 7 | 42897.2 | FM-QCF | 14.6 | 226.9 | 46 | 46 | 23 | 23 | 23 | 24.1 | 25.9 |
| 8 | 43124.1 | FM-QCF | 11.8 | 250.0 | 43 | 43 | 24 | 24 | 19 | 25.2 | 25.9 |

DISCUSSION OF THE RECORDING:

General information:
Place and date: Denmark, Nordsjælland, Juni 15th 2008, 23:20
Behaviour and habitat: foraging, search phase, semi-open habitat
Detector: Pettersson D1000x, direct ultrasound recordings, sampling rate 500 kHz
File name of the recording: Vespertilio murinus 2008-06-15-23-20.wav

Details of the visual observation:

A Parti coloured bat hunted above a meadow near a large lone tree at a height of about 10 m. The meadow is located in a nature reserve a few km from the coastline, with large ponds, wood sides and forests. At the time of the observation, the evening sky was still quite clear (midsummer nights at high latitude) making the bat easy to see. The Parti coloured bat was clearly smaller than a common Noctule or a Serotine and the wings were narrow. The flight was fast and linearly high above the open pasture. Regular dives with catch buzzes indicate intense hunting activities (aerial shoveling). In this region, the Parti coloured bat is quite common and several maternity colonies (Baagoe) were found. Serotines are rare or not present. Other commonly dispersed species in the area were the common Noctule, Nathusius pipistrelle, Soprano pipistrelle, the common pipistrelle and Daubenton's bat. Northern bat and lesser Noctule do not occur in this area as far as is known. The vertical stripes in the spectrogram that occur with regular intervals are short circuits of the barbed wire around the grazing meadow. No other bats were around during this recording. The Parti coloured bat will take a nosedive a little later while a catch buzz could also be heard, then fly a little lower above the meadow, and then continue the hunt flight high above the meadow.

Summary of the sound analysis:

The selected pulse sequence of 8 signals belongs to the search phase of the hunting flight, and consists of more or less equal FM-QCF signals with a pulse duration of 11.7 to 14.6 ms and a bandwidth of 7 to 23 kHz. The pulse intervals are quite long and very regular (205 to 250 ms). The QCF end frequencies of the successive pulses vary little from 24.1 to 25.2 kHz. Up to two upper harmonics are visible. The pulse intensity of successive signals is quite constant (all pulses about the same loud), as evidenced by the hues in the spectrograms.

Comparison with other species:

In semi-open terrain, for example near trees, Parti coloured bats emit pulse sequences of only FM-QCF signals. The pulse sequence is a regular follow-up of such FM-QCF signals always with almost the same QCF end frequency (here 25 kHz). The pulse intervals are more or less constant during the entire pulse sequence. This leads to a very regular pulse rhythm in heterodyne. The pulse intervals are longer in the Parti coloured bat than in Serotines flying in the same conditions (semi-open habitats). In heterodyne, the rhythm of Parti coloured bat sounds slower than that of the Serotine, moreover, the Parti coloured bat lacks the tap dance rhythm because the successive pulses in a pulse sequence have almost the same amplitude (sound strength), while the sound strength at the Serotine in a pulse series alternates between loud and less loud pulses. Lesser Noctules use rarely or never long pulse sequences of FM-QCF signals with regular intervals of which the consecutive pulses have the same QCF frequency.