EUROBATS

2nd Session of the Meeting of Parties

Bonn, Germany, 1-3 July 1998

Resolution No. 2

Consistent Monitoring Methodologies

The Meeting of the Parties

Recalling the Resolution agreed at its first session (18-20 July 1995) on *the Implementation of the Conservation and Management Plan* (Annex K page 45 of the report of the meeting);

Recalling also, under Priority 2 of that Resolution, that the Advisory Committee was charged with the development of monitoring methodologies which would detect trends **of bat populations** at appropriate confidence levels over an appropriate time-scale in a cost-effective manner, and the adoption of common standards of monitoring by participating organisations;

Recognising that no single methodology would be appropriate within these terms of reference for all European bat species, but that each species, or group of species, may require individual monitoring-methodologies;

Acknowledging the decision of the Advisory Committee initially to address only a limited number of species, owing to the need to take account of the expense of addressing all species at once;

Recommends that the attached guidelines for monitoring be employed by all Parties and their governmental institutions, to ensure consistency in the acquisition of results;

Encourages Non-Governmental Organisations involved in the monitoring of bat species in Europe adopt as general practice the attached guidelines in pursuing their monitoring objectives;

Further encourages both Parties and Non-Governmental-Organisations to continue to exchange information on results of monitoring and survey work, and to provide the Secretariat of the Agreement with results of monitoring work;

Instructs the Secretariat, in consultation with the Advisory Committee, to establish a database of monitoring activities and results throughout the Agreement area, and to report back to the next Meeting of Parties on progress and results;

And further instructs the Advisory Committee to review the intersessional progress of the Secretariat's and the Parties' monitoring work, advise the Secretariat in further development of the database, and finally refine the guidelines as necessary and according to experience gained during the intersessional period, and report back to the next Meeting of Parties.

EUROBATS

Guidelines on the recommended methodologies
to be employed for the monitoring of bat species
in Europe

Introduction

1 Recommended methods

Bat populations can generally be monitored in three ways:

- counts at maternity roosts or other summer roosts
- counts in hibernation sites
- counts away from roosts using bat detectors

Disturbance should be minimised as much as possible and roost counts should be undertaken quickly.

2 Counts at maternity roosts

Counts of bats in, or emerging from, maternity roosts have often been used as a way of monitoring the status of species. The most suitable species for monitoring in this way are the species where:

- the bats appear to be relatively faithful to their sites, and return predictably to the same site each year
- the establishment of a new colony is a rare event
- the species tends to form large colonies, and
- the bats can easily be distinguished from other species which may be present.

For woodland species, counts in bat-boxes may be suitable.

2.1 Sampling

In countries or regions where the species is widespread, a sample of sites should be counted on a regular basis, with roosts selected to give a range of roost sizes (number of bats), geographic locations and land-use types. Stratified random sampling of roosts, with strata selected for roost size and/or land-use type probably provides the most statistically robust methodology.

Where the species is rare, it may be possible to count all known sites.

2.2 Timing

Counts need to be timed to take account of the breeding season, which will vary with climate. Local research may be required to determine this before setting up a monitoring project. Counts should generally be timed to occur between the time when bats arrive in the maternity roost and the time that the earliest births occur. This will give an indication of the number of adult females in the population associated with the maternity site.

2.3 Number of counts

Because of the logistics and cost of organising counts it is recommended that the number of counts at each site is limited to two (or perhaps three) within a fifteen-day period, covering the period between the arrival of the bats and the first possible date for parturition. Statistical advice is that it is better to organise counts at more roosts than to increase the number of counts at each roost. However, it is also important that the

agreed number of counts is carried out at each roost and that the same time period is used each year.

2.4 Count methodology

An agreed national methodology for the collection of data should be established before a national monitoring project is established. Suggested elements to include are:

bats should be counted as they emerge from the maternity roost. Observers should be stationed outside each entrance to the roost, but not so close as to disturb the bats or obstruct their flight lines.

the number of bats emerging in each ten-minute period should be recorded. Recording should begin when the first bat emerges and end when it is too dark to continue counting or no bat has emerged for ten minutes.

the roost entrances should not be illuminated with white light. It is recommended that no torch is used, though one fitted with a dark-red filter may be acceptable.

ultrasonic detectors can be used to give warning of the approach of a bat. They should be tuned to an appropriate frequency.

counts should not be made in bad weather-conditions, as this is known to inhibit bats from emerging. Bad weather-conditions include low temperature, rain or strong winds.

In regions where mixed species groups occur in caves, a photographic method of counting bats inside the roost may be more appropriate.

when colonies are very large, it may be better to estimate the area which they cover. In some cases, for instance when the ceiling is too high or when it is not possible to see the colonies, filming of bats emerging from the roosts using infrared videos connected to bat detectors is desirable.

2.5 Data management and analysis

The value of data from roost counts increases with the length of time over which they have been collected, so monitoring projects should be considered to be long-term projects, which will require long-term commitment.

It is recommended that roost-count data are collected centrally by an appropriate organisation, which can also take responsibility for coordinating the collection of data each year.
Data can be analysed for a variety of statistical methods, such as multi-variate analysis, or presented graphically.

2.6 Counts in bat boxes

For species particularly associated with tree-roosts, counts in bat boxes may be appropriate. In this case the sampling unit is the piece of woodland rather than the individual bat-box.

3 Counts in hibernation sites

Counts of bats in hibernation sites are most suitable for species where:

- the species are faithful to their sites;
- the species can be identified accurately without disturbing them;
- the species hibernate in large numbers at one site; and
- a high proportion of the population regularly hibernates underground.

3.1 Sampling

In countries or regions where the species is widespread, a sample of underground sites should be counted on a regular basis, with sites selected to give a range of sizes (number of bats), geographic conditions and land-use types. Stratified-random sampling, with strata selected for roost size and/or land-use type probably provides the most statistically-robust methodology, though the accessibility of sites is likely to influence the sampling methodology.

Where the species is rare, it may be possible to count all known sites. Areas where only small numbers of individuals are found, spread across many sites, present great difficulties for hibernation-site monitoring and it is probably better to attempt to find maternity sites.

3.2 Timing

The extent to which bats occupy hibernation sites depends on the local climate and in some parts of Europe bats may be active almost throughout the year. This makes the method more reliable in the northern part of species' ranges, where the bats will remain in hibernation sites for longer periods. Counts are probably best done in January or February, but local research may be required to check this before setting up a monitoring project.

3.3 Number of counts

Because of the logistics and cost of organising counts and the danger of disturbance to the bats it is recommended that the number of counts at each site is limited to two per winter, at least two weeks apart from one another. Because of statistical advice and to ensure avoidance of disturbance, it is better to organise counts at more sites than to increase the number of counts at each site. However, it is also important that the agreed number of counts is carried out at each roost and that the same time-period is used each year.

3.4 Count methodology

When large colonies are present, it may be better to estimate their area of cover through the use of photography. Notes should be kept for each site indicating which areas were searched and the main areas in which bats were found. This need not be done each year, unless the site or the count methodology has changed, but it provides useful information for future researchers. It is preferable to adopt the same counting method each year, so that valid comparisons can be drawn. If the count methodology is changed, any differences should be recorded. Ideally, the extension of counting to new parts of a site should be recorded separately.

3.5 Data management and analysis

Data should be recorded separately for each site, or perhaps each sub-site, and entered into a card-index system or computer database. As with summer site-monitoring, the value of the data increases with the length of time for which recording has been established. As the method is most suited to detecting long-term changes in numbers, the omission of one year's counts may not seriously affect the dataset.

Data analysis may be through simple year-on-year comparisons or through more complex methods, such as multi-variate analysis or time-series analysis.

11. Counts away from roosts using bat detectors

Counts away from roosts using bat detectors are most suitable for any species which has a loud and distinctive echo-location call.

4.1 Line-transect or point-count surveys

Ultrasonic-detector surveys using pre-defined sampling methods provide the most statistically-robust and repeatable monitoring methodology, though they provide an index of abundance rather than absolute density. Line-transect surveys require the

observer to follow a pre-determined path of known length; point-counts require the observer to listen at a fixed point for a known time.

4.2 Sampling

Sampling areas may be chosen in a variety of ways, provided these do not violate the need for a repeatable sampling method and a random, or stratified-random, selection of areas. Sampling should cover a wide range of habitat types (these may be the strata) rather than just selecting the habitats most likely to contain bats.

A suitable sampling methodology may be based on selecting squares from the national mapping system (non-stratified) or selecting areas from a national land-classification scheme (stratified). Within these areas, line-transects or point-counts can then be set up according to a standard methodology. Suitable line-transects may involve a walk across or around the square.

4.3 Timing

Sampling effort should be well-defined, either by setting the length of the transect to be followed (at a constant speed) or by pre-defining the time to be spent at each sampling point. Similarly, the time of day when the sampling is to be done should be standardised. Sampling should commence at sunset and continue for about one hour.

4.4 Number of counts

The number of counts that should be carried out during the active season will depend on the resources available. Generally, the more counts that are completed at each sampling point the lower the associated sampling variation. However, it is preferable, for statistical analysis, to sample more areas than to sample areas more intensively. Two or three counts per area is probably an optimal number.

4.5 Data management and analysis

All separate bat-passes should be recorded on a map (for transects) or associated with a sampling point (point-counts). For analysis, habitat classification along the transect or around each point should be completed during a daytime visit.

Monitoring methodologies for specific species/species groups

Myotis myotis/Myotis blythii

12. Range

M. myotis is found throughout Europe except Northern Scandinavia, the Baltic States and the United Kingdom and Ireland. *M. blythii* is a more Southern species, extending across Southern France, Switzerland, the Czech Republic and Romania down to the Mediterranean Sea. It is not present in Sardinia, Corsica and the Balearics.

13. Lifestyle

2.1 Roosts

Both species breed in caves, **often in mixed colonies**, in the southern part of their range. In the northern part of their range, they breed in roofs of large buildings. The species hibernate in underground habitats.

2.2 Foraging habitats

M. myotis prefers freshly cut meadows, cultivated orchards, wooded river banks, mixed and pine (lowland) forests without undergrowth. *M. blythii* selects steppes, dense meadows and pastures but avoids rocky areas, vineyards and all kinds of woodland.

14. Monitoring methodology

Identification of the difference between the two species is difficult with ultrasonic detectors and also in mixed colonies, but *M. blythii* has a white patch on the back of its head. As these species are faithful to their summer and winter roosts, counting inside caves in mixed colonies is recommended. For separate colonies (particularly in the north), counts at emergence are possible. For hibernation sites, counts should take place within the hibernacula.

Rhinolophus hipposideros

15. Range

R. hipposideros is widely distributed through western, central and southern Europe, but has suffered a significant decline in the north-western extent of its range. It is now extinct or very rare in the Netherlands, Poland, Germany, Belgium and northern France.

16. Lifestyle

2.1 Roosts

The species originally roosted in caves throughout the year. Now, and particularly in the northern part of its range, it tends to roost in buildings during the summer, and move to underground places for hibernation. Only in southern Europe does the species also habitually breed in underground sites.

2.2 Foraging habitats

The species is believed to forage along the edges of broadleaf deciduous woodland and riparian vegetation. Where this is fragmented, linear landscape-features (such as hedgerows) are important links between foraging areas and become themselves foraging areas.

17. Monitoring methodology

The species has a quiet and highly directional echo-location call, and the use of ultrasonic detectors is therefore inappropriate. It appears however to be faithful to its maternity roosts and depends completely on underground sites for hibernation.

Therefore the following methodologies are recommended:

- counts in maternity roosts
- counts in hibernation sites.

Myotis bechsteinii

18. Range

M. bechsteinii is distributed throughout western Europe as far as southern England, northern Germany and southern Sweden in the north. It is rare in Mediterranean countries. It is strongly associated with “old-growth” (semi-natural) forests.

19. Lifestyle

2.1 Roosts

The species dwells in forests and roosts in trees. In summer, females change roosts very frequently. In winter many use relatively warm underground sites.

2.2 Foraging habitats

The species forages by picking food from leaves (gleaner) in forests. It has very quiet echo-location calls.

20. Monitoring methodology

This species is very difficult to monitor. Currently available ultrasonic-detectors are insufficiently sensitive to detect the species away from its roost. It is therefore recommended that the species is counted during the summer in bat boxes or bird-boxes.

Myotis capaccinii

21. Range

M. capaccinii is mainly restricted to Mediterranean areas.

22. Lifestyle

2.1 Roosts

The species dwells in caves, sometimes of a huge size. They usually roost about three to five metres from the ground, but also crawl into crevices in the walls both inside and outside the cave. Colonies in France and Spain may be no more than ten individuals, whereas colonies in the Balkan Peninsula can reach 10,000. One of the main characteristics of *Myotis capaccinii* is its common aggregation with other species, in particular *Miniopterus schreibersii* and/or *Myotis myotis/M. blythii*. The species also winters in caves, but the sexes are segregated, and the size of colonies is generally small and sometimes quite isolated in the western pat of the range; they are gathered in huge colonies in the eastern part.

2.2 Foraging habitats

These are mainly over rivers and other water-surfaces, which it often shares with *Myotis daubentonii*.

23. Monitoring methodology

Ultrasonic detectors are ineffective with this species, because of the current impossibility of distinguishing from *Myotis daubentonii*. It is recommended that the species is counted at its hibernacula (eastern Europe) or at its breeding roosts (Western Europe). For the latter, as the species tends to leave the roost later than other species with which it shares the roost (in particular *Miniopterus schreibersii*), counting the bats emerging from the roost when other species have departed would be the most suitable.

Eptesicus nilssonii and *Eptesicus serotinus*

24. Range

Eptesicus nilssonii and *Eptesicus serotinus* are fairly common species in Europe. *Eptesicus nilssonii* is a true northern bat, and the only known species regularly to occur north of the Arctic Circle. Most abundant in Scandinavia (except Denmark), the Baltic states and parts of the Russian Federation. *Eptesicus serotinus* occurs throughout the rest of Europe, its known northern range extending to 60°N.

25. Lifestyle

2.1 Roosts

Both species are mainly building-dwelling in the summer, forming sometimes quite large colonies. *E. nilssonii* winters in caves, mines, underground store-rooms and cellars, although it has been known to hibernate in walls or rooftops of buildings and in hollow trees. *E. serotinus* probably spends the whole year in buildings.

2.2 Foraging habitats

Eptesicus nilssonii hunts insects around woods and forests, whereas *Eptesicus serotinus* is a more typical open-country species, hunting where woods, parks and gardens are found in a generally open agricultural landscape.

26. Monitoring methodology

Both species have loud calls which are distinctive from all other species, and it is recommended that they should be monitored on line-transects with ultrasonic detectors. *E. nilssonii* can also be counted in underground hibernation sites in parts of Eastern Europe and *E. serotinus* can be counted at emergence from summer roosts.

Miniopterus schreibersii

27. Range

Miniopterus schreibersii's European range encompasses southern Europe, mostly in Mediterranean regions.

28. Lifestyle

2.1 Roosts

The species is very social, frequently found in colonies of hundreds or thousands of individuals throughout the year. During the warmer months, it often forms colonies with *Myotis myotis*, *Myotis blythii*, *M. capaccinii*, *Rhinolophus euryale*, *Rhinolophus blasii* and *Rhinolophus mehelyi*. It is considered to be a typical cave-dwelling species, although it does roost in abandoned mines or large underground buildings.

2.2 Foraging habitats

The species feeds in open habitats, but can also be known to forage in scrubby woodlands.

29. Monitoring methodology

In both breeding and hibernating colonies, a visual count should be undertaken as quickly as possible inside the cave or mine, assessing the size of the colony by estimating, through photography (stereoscopic if the roof is sloping) the square metre area which it covers (1 square metre corresponding to about 2,000 specimens).

Nyctalus noctula

30. Range

Throughout Europe except Ireland, Scotland and northern Scandinavia.

31. Lifestyle

2.1 Roosts

Summer roost sites are usually in tree holes, occasionally buildings, and hibernation may be in tree holes or, particularly in central Europe, crevices in buildings, bridges or rock faces.

2.2 Foraging behaviour

Nyctalus noctula is a large, fast-flying species with loud echolocation calls. It forages high in the air above forests, wetlands or other open areas.

2.3 Migratory behaviour

The species is migratory in some parts of its range, where low winter temperatures dictate the need for southerly autumn migration.

32. Monitoring methodology

Counts at maternity and hibernation sites probably do not give a reliable index of noctula population density. However, the ease with which it can be detected and identified with a bat detector means that bat detector surveys (e.g. line-transects) are recommended for monitoring this species. A possible extension to this methodology may be the detection of calling males during the mating season.