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Feasibility of monitoring bats on transects with ultrasound detectors

by

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Abstract

In 1990 an experimental study was started to test if point and line counts along transects could be used for monitoring bats. Later, this was incorporated into the Dutch Mammal Monitoring Programme. In 1995 counts on 10 transects resulted in 1682 recorded presences of 9 species. Each transect of 13-17 km consists of 20 points and 20 lines in between, on which bats are recorded. Counts are performed monthly from April-September. Transport is usually by bicycle. Ultrasound detectors are tuned to approx. 40 kHz. Variables noted are presence, maximum number heard at one time and total number of registrations, for each point or line. Results from 6 transects have shown that all three variables are strongly correlated, but that presence showed the least variation. It is therefore preferred for monitoring purposes, but has the disadvantage of possible saturation (maximum is 100%). Results from points and lines were also strongly correlated, but variation at points was smaller.

Some species showed some seasonality in presence, resulting in variation being smaller in some months than in others. This differed between species, so counts in different months seem necessary. The maximum presence per season showed similar variation as the mean presence per season.

Results indicate that by using approx. 100 transects, differences between years of 20-40% (depending on species) or more can be detected. Monitoring bats this way, however, requires well-trained observers.

Résumé

En 1990, une étude expérimentale a été mise en place pour tester l'utilisation des dénombrements par points ou en ligne le long de transectes pour la surveillance des chauves-souris. Plus tard ceci a été incorporé dans le Projet Néerlandais de Surveillance des Mammifères. En 1995 des dénombrements de 10 transectes donnaient 1.682 présences constatées pour 9 espèces. Chaque transecte de 13-17 km comprenait 20 points et 20 lignes intercalées, où des chauves-souris ont été recensées. Les dénombrements s'opéraient mensuellement d'avril à septembre. Les déplacements se sont faits généralement en vélo. Les détecteurs d'ultrason étaient réglés à 40 kHz. Les paramètres notés étaient: la présence, le nombre maximal entendu au même moment et le nombre total des enregistrements pour chaque point ou ligne. Les résultats de 6 transectes ont montré que les trois paramètres sont étroitement correlés, mais que le paramètre 'présence' montre la moindre variation. Celle-ci est donc préférée pour les besoins de surveillances, bienqu'elle ait le désavantage d'une saturation possible (le maximum étant 100%). Les résultats des points et des lignes sont également étroitement correlés, mais la variation aux points est plus faible.

La présence de quelques espèces montre un certain effet de saison ce qui implique une variation plus faible dans certains mois que dans d'autres. Ceci différait selon les espèces, c'est pourquoi des dénombrements dans des mois différents semblent nécesaires. La présence maximale par saison montrait une variation similaire à la présence moyenne par saison.

Les résultats indiquent qu'en effectuant approximativement 100 transectes, des différences annuelles de 20-40% (dépendant des espèces) ou plus peuvent être trouvées. Cependant, la surveillance des chauves-souris par cette méthode nécessite des obervateurs compétents.

Zusammenfassung

Im Jahr 1990 wurde eine experimentelle Studie durchgeführt, um zu testen, ob Punkt- und Linienzählungen entlang Transekten zur Erfassung von Fledermäusen benutzt werden können. Diese Studie wurde später in das holländische Säugetier-Erfassungsprojekt aufgenommen. Im Jahre 1995 ergaben Zählungen auf 10 Transekten 1.682 Nachweise von 9 Arten. Jedes Transekt von 13-17 km Länge bestand aus 20 Punkten und 20 Linien dazwischen, auf denen Fledermäuse gezählt wurden. Die Zählungen wurden monatlich von April bis September durchgeführt. Als Transportmittel diente gewöhnlich ein Fahrrad. Die Ultraschall-Detektoren wurden auf ca. 40 kHz ausgerichtet. Als Variablen wurden für jeden Punkt oder jede Linie die Anwesenheit, maximale Anzahl der zur gleichen Zeit gehörten Tiere und die Gesamtzahl der Nachweise notiert. Die Ergebnisse von 6 Transekten haben gezeigt, dass alle drei Variablen streng korreliert sind, dass aber die Anwesenheit die geringste

Variation zeigte. Sie wird deshalb für Erfassungszwecke bevorzugt, hat aber den Nachteil einer möglichen Sättigung (maximal sind 100%). Die Ergebnisse von Punkten und Linien waren ebenfalls streng korreliert, aber die Variation bei Punkten war geringer.

Einige Arten zeigen jahreszeitliche Unterschiede in der Anwesenheit, daraus resultiert, dass die Variation in machen Monaten geringer als in anderen. Dies unterschied sich zwischen den Arten, so dass Zählungen in verschiedenen Monaten notwendig erscheinen. Die maximale Anwesenheit pro Jahreszeit zeigt eine ähnliche Variation wie die mittlere Anwesenheit pro Jahreszeit.

Die Ergebnisse zeigen, dass bei Anwendung von ca. 100 Transekten zwischen den Jahren Unterschiede von 20-40 % (abhängig von der Art) oder mehr gefunden werden können. Die Erfassung von Fledermäusen mit dieser Methode erfordert jedoch gut geschulte Beobachter.

1 Introduction

For monitoring bats different methods can be used. Counting hibernating bats can produce data for those species which can be observed and counted in accessable caves, military forts, ice-houses, cellars, etc. Species which during winter inhabit trees or houses are only rarely found there. These species, as well as some other species, can be monitored by using counts of bats leaving roosts. Such counts show the least variation if they concern maternity roosts before the juveniles are flying. They give only information on a limited part of the population, i.e. reproducing females. The rest of the population is thus not monitored. Also a species as the Nathusius Pipistrelle, which is only rarely reproducing in the Netherlands, can not be traced this way. To be able to trace developments in all species and all populations in the field, we decided to test the method of counting bats on points and lines using ultra-sound detectors.

2 Methods

The first two transects were started in 1990, some more were started from 1992 onwards. Each transect has 20 points and 20 lines in between. We start counting on line 1 and finish with point 20. The total length of the transects is 13-17 km, transport is usually by bike. Counts were performed each month from April - September, i.e. 6 counts each year.

Points are chosen at places where we can expect bats of several species to occur. Points are usually chosen close to canals, ponds and lakes for species as Daubentons Bat and Pond Bat, or at edges in woodland. At each point bats are counted during 3 minutes. Up till 1997 bats were also counted on the lines in between the points.

Bats are counted as the number of bat-passes for each species, but more important also as the maximum number heard or observed at one time on each point or line. The ultrasound detector was tuned to approximately 40 khz. Thus most of the smaller species could be heard well, the larger species could be heard too, especially at close range. When such a larger species was heard, the detector was tuned to its maximum frequency to check its identity.

Counts were only performed when weather conditions were at least fair, thus windspeed less than 3 Beaufort, temperature at least 8°C and virtually no rain.

Counts were started approximately 1 hour after sunset.

The results for points and lines were treated separately. Three variables were used. The presence is the percentage of points or lines on which a species has been observed. The sum of maximums is the total of all maximum-estimates at each point or line and the sum of passes is the total of passes on all points or lines.

3 Results

3.1 Variables

It appeared that all three variables were strongly correlated, within all transects and within all species. This implies that their indication-value may be very similar. Even when tested against some other variables they appeared to be very similar in indication-value. Only the sum of all passes differed slightly, possibly due to the fact that a stationary bat when flying to and fro will produce more passes. In fact, the sum of passes is considered to tell more about differences between suitability of habitats, then about differences in population-level. Thus it seems rather inapropriate for monitoring purposes.

For monitoring purposes variables are particularly interesting if they show a low variation, because low variation means high reliability. It appeared that the presence, the percentage of points or lines on which a species occurred, showed the least variation, followed by the sum of maximums. This was valid for all species, both on points and lines, in all seasons. An example is shown in table 1 for the pipistrelle. The sum of passes showed by far the highest variation. As mentioned before, this implies that the sum of passes is the least appropriate for monitoring purposes.

Table 1: Relative standard deviation (rsd or CV) of variables used on point counts in the pipistrelle

presence	67
sum of max's	97
sum of passes	128

The presence appears to be the best variable to use, but has one disadvantage: it has the possibility of saturation. When a species has a very high density, there is the risk that they are encountered on all points or transects. From then on a further increase cannot be recorded anymore. Even though such a high level of occurrence has not yet been recorded in the Netherlands, we have decided to use presence and sum of maximums both in the future.

3.2 Points and lines

It appeared that the results from counts on points and lines were strongly correlated. It also appeared that variation was usually lower at points. This was especially so for species such as Daubentons bat and Pond bat, since points were on average closer to the water than lines. But it was true for other species as well.

So if one has to choose between counts on points or lines, points are slightly more suitable for monitoring purposes. In the Netherlands we initially preferred to do both, but since 1997 have skipped the counts on lines.

3.3 Seasonal variation

It appeared that some species showed slight differences in occurrence between months. This is shown in figure 1a and 1b for Noctule and Pipistrelle.

The Noctule bat shows a rather strong peak in occurrence (shown as bars) in summer, with low variation (shown as line) in July. This suggests that July is the better month to count this species, because of this lower variation. On the other hand the Pipistrelle was common in all months, but showed the least variation in June.

So it appears that different species show differences in optimal periods for counting, although June and July seem to have low variation in most species. Nonetheless it seems necessary to have counts in different months.

Figure 1 also shows that high occurrence does not necessarily mean low variation, and it is the low variation which is important for monitoring.

3.4 Maximum and mean

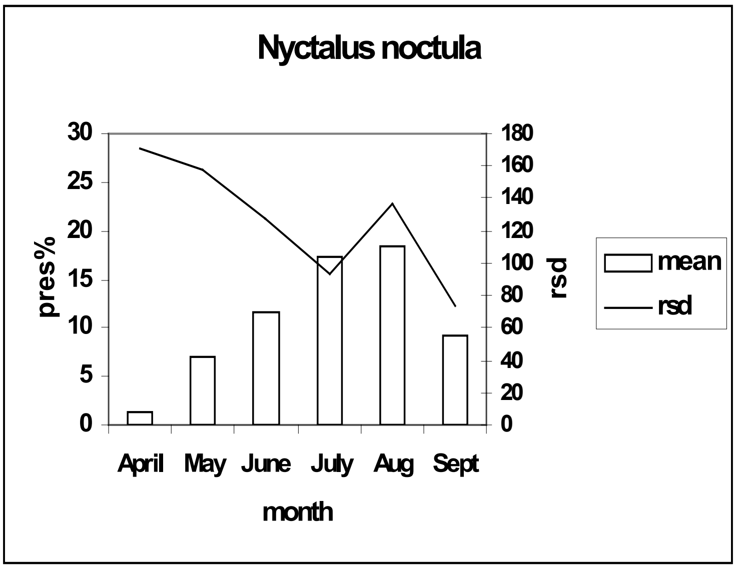
To determine an annual index in order to compare different years, it is common practice to use the mean of all counts in that year as the key-variable. It has been suggested that it might be better to use the maximum of occurrence in every year.

This could be tested on data gathered by Kees Mostert near Delft in the Netherlands. In 1993 he counted bats on a transect almost weekly. By so doing he produced a few counts each month. I took 5 random samples from those to have different monthly counts in one season. From each I determined both the mean and the maximum.

It appeared that the variation in mean and maximum showed very similar results (table 2). This implies that using the maximum does not produce a better annual index.

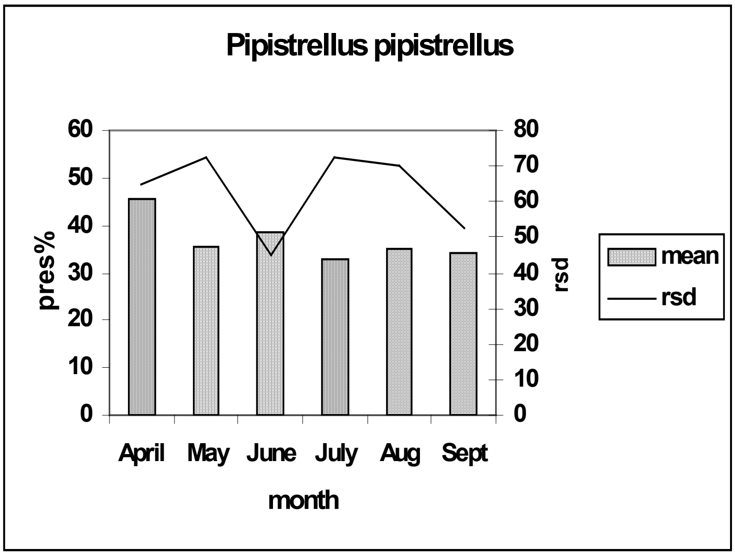
Table 2 Relative standard deviation (CV) of seasonal mean and maximum estimates for presence

	mean	maximum
M. daubentonii	31	31
M. dasycneme	224	224
P. pipistrellus	22	24
P. nathusii	8	16
N. noctula	69	71
E. serotinus	31	47



1a

Fig. 1: Seasonal variation in presence shown as mean (bars) and rsd (line) in Noctule (a) and Pipistrelle (b)



1b

3.5 Number of transects

To determine how many transects should be counted for producing valid trends, a simple model called STUD was used initially. This is based simply on the total variation found in the collected data. Our data were not sufficient for using more sophisticated models.

This model estimates the number of transects needed, based on the relative standard-deviation or RSD of the counting results, also called coëfficient of variation or CV. A chance of 5% that a result was unjustly considered a real difference was considered as acceptable. We also used a probability of 80% that a real difference is indeed found in the sample.

Figure 2 shows the relationship then between the variation in results (as rsd) and the number of transects needed to be able to find annual differences of 10%, 20% and 30%. It shows, as an example, that if the rsd in the counts is 50, we need at least 50 transects to be able to find a difference between years of 20%. It also shows that the lower the rsd (variation) is, the lower the observer effort or the higher the accuracy will be.

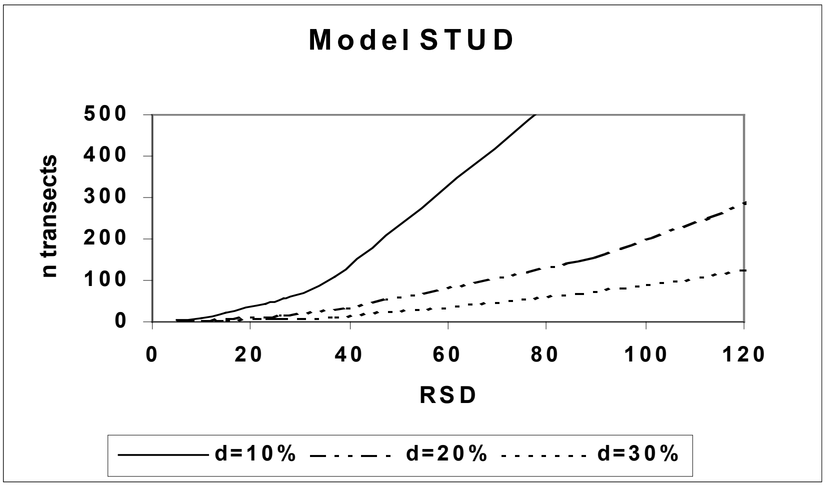


Fig. 2: Relationship between rsd, number of transects and trend detectability by using model STUD

Table 3 shows the results of using STUD for each species. It shows the species, the sample size and the number of transects needed to be able to find differences between years of 20%, 30% and 40%. For instance, if a difference of 20% between years is considered sufficient for Daubentons' bat, we can reach that goal with 93 transects.

Table 3 Number of transects needed for each species

Results are shown as sample size (n) and number of transects needed to detect annual differences of 20% (d=20), 30% and 40%. Only numbers of transects over 70 are shown.

	n	d=20	d=30	d=40
M. *cf*. mystacinus	8	152	69	
M. daubentonii	63	93		
M. dasycneme	55	358	160	91
P. pipistrellus	63	86		
P. nathusii	63	268	120	
N. noctula	63	333	149	85
E. serotinus	39	221	100	
P. auritus	16317	142	81	

With a smaller number of transects it will take more years to be able to discover trends.

Other studies with transect counts of bats (although a very limited number) show similar or somewhat smaller variations, so our data are best considered to be on the safe side.

3.6 Number of counts per season

Initially counts were performed monthly from April - September. Recently data of 8 transects were reanalyzed, indicating that results from counts in May, July and August produced very similar trends compared to results from all counts. We therefore decided to limit the counts to May, July and August.

3.7 Dutch Mammal Monitoring Programme

This method was adopted for one of the schemes in the Mammal Monitoring Programme in the Netherlands. Most schemes of this programme are now also incorporated in the National Network for Ecological Monitoring (NEM). For this network the Dutch National Statistical Service has issued guidelines for monitoring wildlife. For the number of transects or study plots needed it uses the rule of thumb that a number of 25-50 should be sufficient for detecting trends over a period of 5-10 years.

Unfortunately the transect counts are not incorporated in the NEM because of insufficient participants.

As a tool for analysis they provided the model TRIM, which is freely available through Internet (http://neon.vb.cbs.nl/sec_lmi_n/incpro/tri001pl.htm). We have tried to arouse the interest of other observers to cooperate with this scheme of transect counts. So far we have only managed to have counts on 14 transects with 9 species of bat. We will, however, put more effort in trying to increase this notably, by training and motivating more observers.

The first results, based on the model TRIM, seem to show that, so far, there are no sound indications of a trend in Pipistrelle and Daubenton's bat, but there seems to be a negative trend in Noctules (Figure 3). This shows the need for such a monitoring scheme.

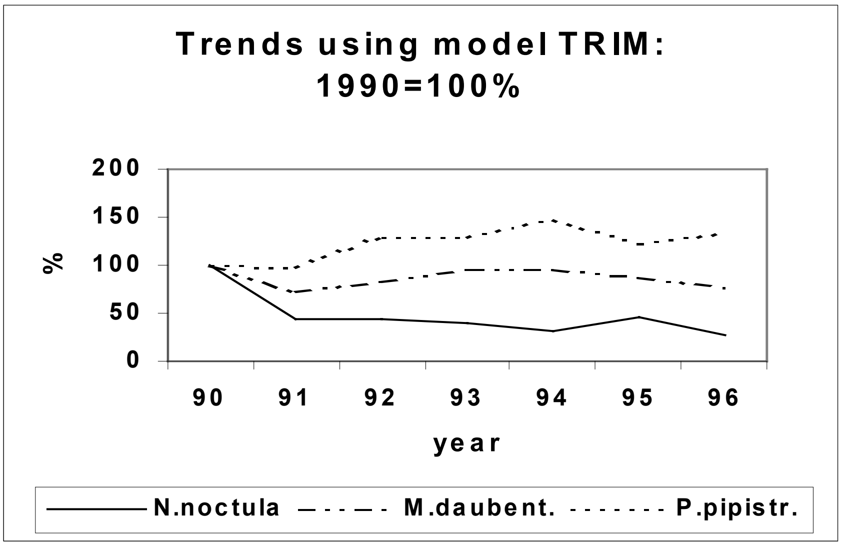


Fig. 3: Trends in three species of bat in the Netherlands calculated by model TRIM

It is only possible to have such a monitoring scheme in countries with only a limited number of species, which can reasonably be distinguished from one another by using ultrasound detectors. The Netherlands is such a country, especially the northern and western half of it. In other countries it may be more difficult, but why not give it a try?

Myotis daubentonii, dessin Philippe Pénicaud (©)