die reeds hun medewerking hieraan verleenden en verzoekt verdere medewerking van de leden voor toekomstige waarnemingen.

Reeds op 23 nov. j.l. waren door verschillende leden waarnemingen verricht, in samenwerking met enkele waarnemers in Herstal (bij Luik). Enkele waarnemingen waren:

Bij Herstal trokken 629 meeuwen boven de Maas naar het Noorden.

Tegenover Pt. Lanaye trokken ca. 750 meeuwen boven de Maas naar het Noorden.

Bij Borgharen trokken ca 1000 meeuwen boven de Maas naar het Noorden

en ca 160 meeuwen boven het Juliana-Kanaal naar het Noorden.

Tegenover Itteren trokken ca 1400 ex. boven de Maas naar het Noorden.

Op de slaapplaats te Born werden tot 17.35 h ca 1000 meeuwen drijvend op het water van de berghaven geteld.

Op bijna 2 km ten N. van de haven van Born trokken 27 meeuwen boven het Juliana-Kanaal verder naar het N. Deze gingen dus niet in Born slapen.

Op ca 2½ km ten N. van de haven van Born langs de Maas waren tot 17.20 h geen meeuwen gepasseerd.

Het verschil in aantal tussen de 1400 meeuwen, die tegenover Itteren waren waargenomen en de 1000 ex., die op de slaapplaats in Born waren gezien, moet waarschijnlijk verklaard worden uit het feit, dat te Born niet laat genoeg waargenomen werd.

De heer **Van Nieuwenhoven** onderstreept het verzoek tot medewerking van de heer Kemp, niet alleen omdat het werk belangrijk is, maar ook omdat dit onderzoek echt een werk is van het Genootschap, dat toch van af den beginne is een genootschap van onderzoekers. Bovendien wordt door dit onderzoek, waaraan iedereen kan deelnemen, de band tussen de leden verstevigd.

Br. Agatho zegt dat hij in de buurt van Helmond in 1956 voor het eerst de bosrietzanger in korenvelden zag, terwijl in Limburg het voorkomen en broeden van deze vogel in korenvelden reeds langer bekend is. Hij vraagt, wanneer is dat in Limburg begonnen. De heer **Mommers** antwoordt hierop dat hij dit verschijnsel nooit anders gekend heeft en dat het zelfs zo is, dat in zijn jeugd de mensen nooit spraken van een bosrietzanger, maar van een „Korentaatsch".

DISTRIBUTION AND DECLINE OF BAT POPULATIONS IN S. LIMBURG FROM 1942 TILL 1957,

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Zoological Laboratory, University of Utrecht.

CONTENTS

INTRODUCTION

In 1937 B e l s (1952) started bat-banding in the artificial limestone caves in S. Limburg, and from 1952 on the authors have continued his work, with the result that in the period 1937—1957 more than 15000 bats belonging to 12 species have been banded in this area. The small species have been collected from 1942 onwards, and from then until 1957 individuals of all species occurring in the area have been counted each year, except in the winter of 1948/49.

The results of the banding are or will be published elsewhere.

In the present paper some conclusions are recorded concerning the distribution, the relative abundance, and the size of the populations of 7 bat species hibernating in the caves of S. Limburg during the winters of the last 15 years. These conclusions are mainly derived from data collected by B e l s from 1942 till 1952. In order to obtain a correct base for comparison of the number of bats counted in different winters and different caves, we selected the data of one visit per year, only to those caves which have been visited regularly during the period of investigation.

The bats which are sufficiently abundant in

the area to be investigated belong to the species: *Rhinolophus hipposideros, Myotis myotis, M. dasycneme, M. emarginatus, M. mystacinus, M. daubentonii* and *M. nattereri.*

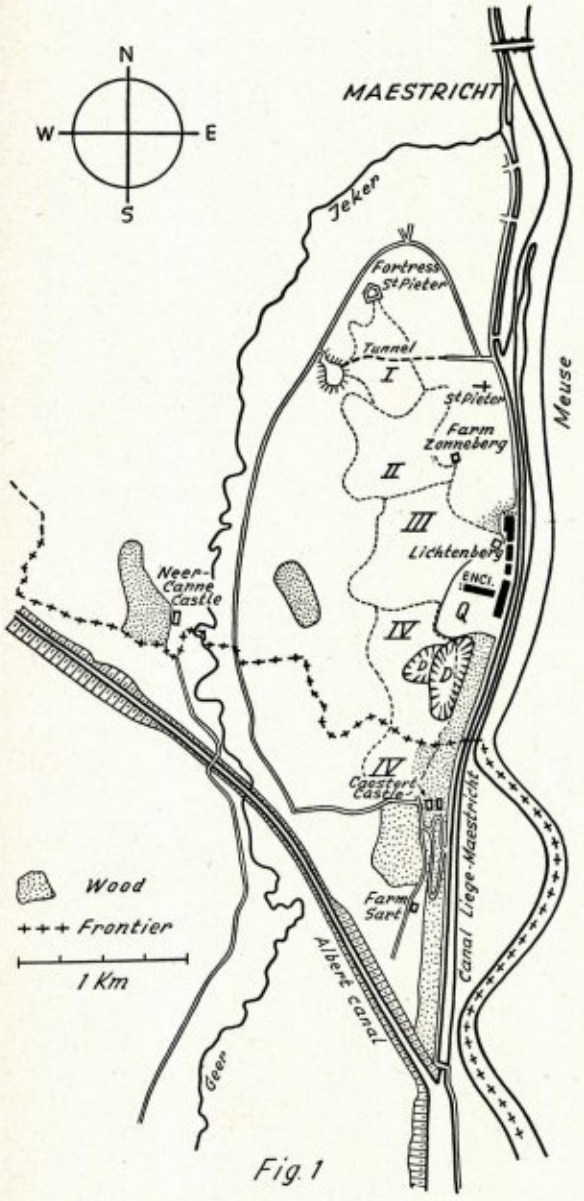

Fig. 1. Map of the St. Pietersberg, showing the topography of the labyrinths of subterranian corridors in this hill. I: Northern Labyrinth; II: Zonnoberg Labyrinth; III: Slavante Labyrinth (nr 13-18); IV: Southern Labyrinth (nrs 19 and 22); D: ENCI dump; ENCI: cement industry; Q: quarry.

I. THE CAVES CONSIDERED

The geographical, historical, geological and speleological particulars of the caves of S. Limburg are reviewed in the papers of Bels (1952) and van Nieuwenhoven (1956). Bels registered more than 150 cave entrances in the area. We will restrict our description to the following ones which we will divide into two categories:

1. The Southern labyrinth of the St. Pietersberg, occupying a considerable part of the hill and being identical with Bels's cave nr 19 and nr 22. The labyrinth has been very large and extends into Belgian territory (fig. 1). It has been visited regularly until the winter 1946/47. Afterwards numbers of hibernating bats have decreased seriously by quarrying in the Dutch and culture of mushrooms in the Belgian part. Moreover, the main part of the corridors of the Dutch S. labyrinth has recently collapsed, as a consequence of the activity of the local cement industry. Therefore, the Southern labyrinth has since 1947 been considered lost as a hibernation quarter for bats.

2. The sampling caves. These are 18 caves which have been visited regularly during the period 1942—1957. Their entrances are recorded on the map of fig. 2 and, according to their geographical position, they may be grouped within the following sections:

Sect. St. Pietersb.: Slavante nrs 13—18
Section Geulvalley: Kloostergroeve nr 82
Leraarsgrot nr 91
Ravengrot nr 92
Schenkgroeve nr 163
Sect. Valkenburg: Fluwelengrot nrs 63—67
Gemeentegrot nrs 68—72
Plenkert 1 nr 76
Plenkert 2 nr 77
Section Heer : Nieuwe grot nr 44
Heerderberg 1 nr 45
Keerderb. 1, 2, 3 nrs 46—48
Scharnderberg nr 105
Heerderberg 2 nr 106
Heerderberg 3 nr 107
Sect. Riessenberg : de Hel nr 112
Section Sibbe : Vallenberg nr 57
Sect. Jeker-valley : Cannerberg nr 30

The numbers of the caves are given according to Bels (1952).

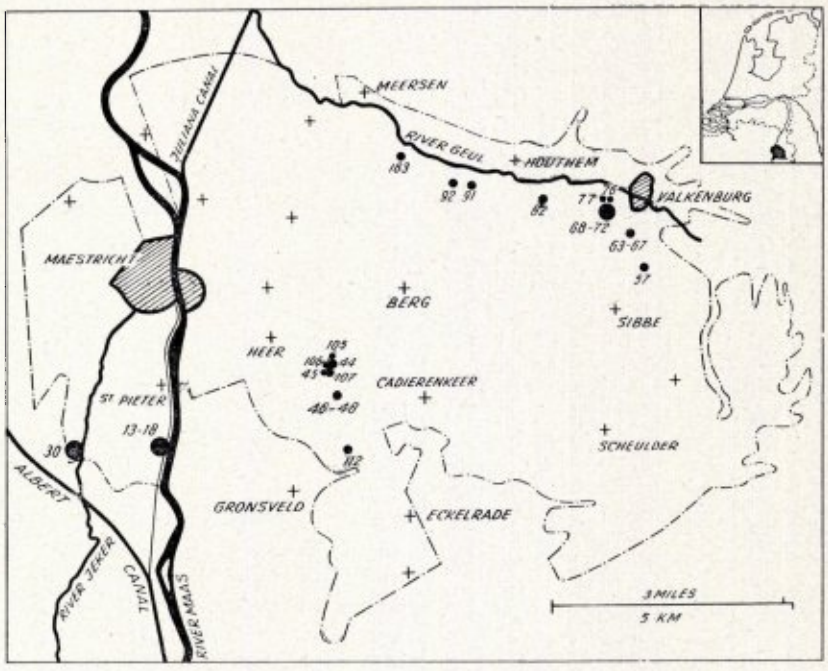

Fig. 2. The cave area of S. Limburg. The entrances of the sampling caves (cf. page 135) are indicated by black dots. The size of a dot is roughly proportionate to the size of the cave involved. According to Sluiter, van Heerdt & Bezem, 1956. (Cliché Archives Néerlandaises).

II. SAMPLING TECHNIQUE

During 5 days in December or January a team of 10—20 collectors goes out to inspect the sampling caves, and to collect the bats visible at first sight. These bats are registered, ringed and set free immediately afterwards in the cave where they are found. The bats are dispersed over a passage length of many miles. They hang on the walls and ceilings of the corridors (mostly separately, sometimes in small clusters of 2—5 individuals) or hide in crevices, where they can only be found by close examination. During these routine visits many individuals are overlooked (cf Sluiter, van Heerdt & Bezem, 1956), but it may be said that the catching effort at each visit has remained constant, as about the same number of collectors spend about the same length of time on the inspection of the cave involved. Therefore the size of the samples found each year may be used as a measure for the abundance of the species in each cave, and may be compared in different years, although probably not more than about 1/5 of the population of the caves is actually found in this way of sampling. In *M. mystacinus* a capture rate (q) of 0.14 was found for the sampling caves combined (Sluiter, van Heerdt & Bezem, 1956); in the other species this rate may vary between 0.10 and 0.25 (data not yet published). Population sizes can be estimated by multiplying the number of bats in the sample with 1/q of the species. The low values of the capture rate may be explained by habits of the bats, like hiding in crevices or changing hibernation-quarters and by the vast dimensions which the labyrinths generally have.

III. DISTRIBUTION AND RELATIVE ABUNDANCE OF 7 BAT SPECIES.

1. **In S. labyrinth of the St. Pietersberg and in all caves combined.**

TABLE 1. *Numbers of bats captured during the periode 1942—1946.*

species / cave	M. emarg.	Rhin. hipp.	M. myotis	M. das.	M. natt.	M. myst.	M. daub.	species combined
in all caves combined	1454	1405	1393	816	787	676	511	7042
in St. Pietersberg S. labyrinth nrs 19 and 22	390 (27%)	215 (15%)	983 (71%)	226 (28%)	200 (25%)	72 (11%)	171 (33%)	2257 (32%)

The recorded numbers of bats captured during the period 1942—1946 (table 1) are obtained by addition of the annual samples of these 5 years in all caves combined and in the S. labyrinth separately. Thus, a quantitative impression is given of the relative abundance of 7 bat species hibernating in the caves during this period, and of the share which the S. labyrinth supplied in the total population of each species.

2. **In the sampling caves.**

TABLE 2. *Numbers of bats captured in the sampling caves 1942—1956.*

species / cave	Rhin. hipp.	M. emarg	M. myst.	M. natt.	M. das.	M. daub.	M. myotis	species combined
St. Pietersberg Slavante nrs 13—18	59	510	796	801	300	492	193	3151
Geul-valley nrs 82, 91, 92, 163	459	643	279	404	409	204	253	2651
Valkenburg nrs 63—67, 68—72, 76, 77	755	658	398	131	310	100	158	2511
Heer nrs 44—48, 105—107	299	205	356	168	200	193	138	1559
Riessenberg nr 112	218	138	97	33	74	46	88	694
Sibbe nr 57	443	74	45	25	36	11	28	662
Jeker-valley nr 30	141	17	161	36	27	25	17	424
sampling caves combined	2374 (21%)	2245 (19%)	2132 (18%)	1598 14%)	1356 11%)	1071 (9%)	876 (8%)	11652 (100%)

In table 2 distribution and relative abundance of the same species are shown in the sampling caves only. They are divided into the geographical sections mentioned on pag. ... The S. labyrinth of the St. Pietersberg being omitted here, the period of investigation may be extended until 1957 for a comparison of the sections and the species. The differences in the total numbers (species combined) captured in the sections must be partly ascribed to differences in size and number of the caves belonging to a section. Regarding the species in table 2 separately it becomes evident that also other factors must be influencing the distribution pattern found.

3. **Conclusions.**

From the data in table 1 it may be concluded that the share of the S. labyrinth of the St. Pietersberg in the combined populations of all caves and of all species has been more than 30 %. Much higher still has been this percentage for *M. myotis* (71 %), but relatively low for *Rhinolophus hipposideros* (15 %) and *M. mystacinus* (11 %). As a consequence of the loss of this labyrinth as a hibernation quarter (cf page ...) the population of *M. myotis* in S. Limburg suffered the most serious decline of all species after 1947.

Table 2 shows that another part of the corridors in the St. Pietersberg (Slavante) has the greatest share (30 %) in the total population of the sampling caves combined. Regarding the species separately we can, however, observe specific preferences in habitat selection. For instance, *Rh. hipposideros* evidently prefers a relatively small cave like the Vallenberg (nr 57, section Sibbe) to the vast labyrinth of Slavante (nrs 13—18); *M. emarginatus* and *M. dasycneme* are found in greater numbers in other sections (Geul-Valley, Valkenburg) than in Slavante.

During the period 1942—1957 considered as a whole *Rh. hipposideros* and *M. emarginatus* have been relatively the most abundant species in the sampling caves combined, closely followed by *M. mystacinus* (Table 2). Recently *M. mystacinus* has taken the leading position in the sampling caves, as the populations of the two other species mentioned have decreased most seriously during the last 12 years. This will be shown in the next chapter.

IV. ANNUAL SAMPLE SIZES 1945—1956.

In fig. 3—6 sample sizes of the combined sampling caves can be followed from year to year during the last 12 years, except in the winter 1948/49 when no caves were visited.

As mentioned before (page ...) the sample size may be taken as roughly proportional to the population size. The graphs show considerable fluctuations of sample sizes, which, however, in our opinion, are not correlated with similar fluctuations of the populations. The fluctuations recorded may be ascribed to "sampling-effects" and to incidental disturbances of the bats. In order to obtain a rough estimate of the fate of the population between 1945 and 1956 we have fitted straight lines to the points, and from these lines we calculated the initial and the terminal values of the sample sizes. Results are recorded in Table 3.

TABLE 3. *In this table sample sizes are calculated from the adjusted numbers according to the assumption that the regression is linear (cf. fig. 3—6). Decline is given in percents of the initial sample size.*

species	adjusted samp. size in 1945	adjusted samp. size in 1956	decline 1945-'56
M. daub.	76	90	—18%*)
M. myst.	171	163	5%
M. das.	119	72	39%
M. natt.	151	91	40%
M. myotis	96	31	68%
Rh. hipp.	262	57	78%
M. emarg.	271	51	81%
7 spec. comb.	1146	555	52%

*) accress.

From this table it may be concluded that the populations of *M. daubentonii* and *M. mystacinus* in the sampling caves have been constant in size during the last 12 years. In *M. dasycneme* and *M. nattereri* a population decline is most probable, but is much less serious than it

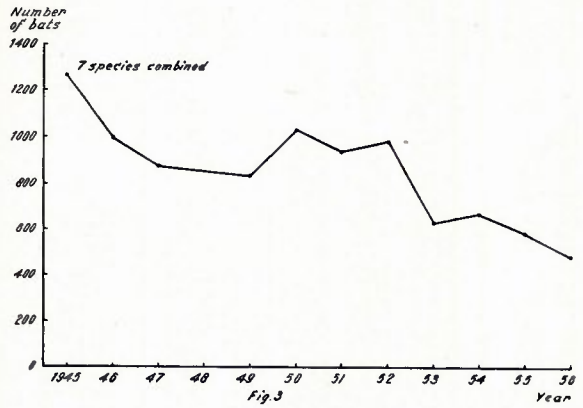

Fig. 3

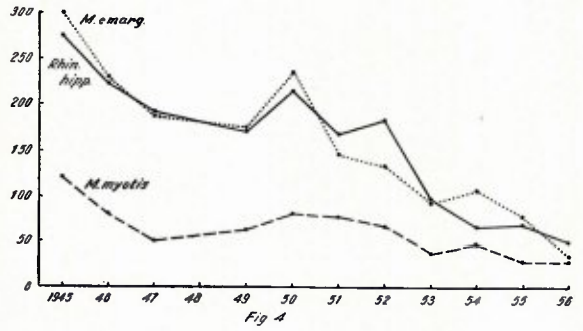

Fig. 4

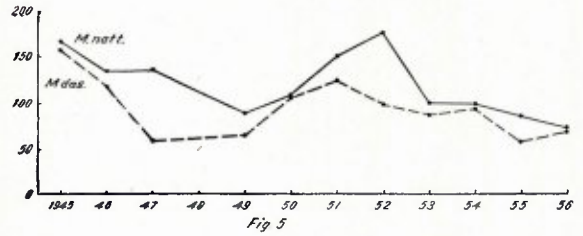

Fig. 5

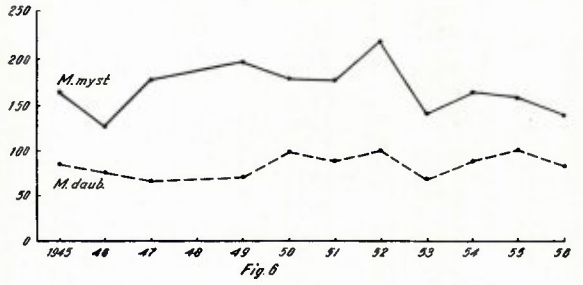

Fig. 6

Figs. 3—6. Annual sample sizes 1945—1956 (sampling caves combined) of 7 bat species plotted against time. Fig. 3: 7 species combined; fig. 4: *Rhinolophus hipposideros, Myotis emarginatus* and *M. myotis;* fig. 5: *M. nattereri* and *M. dasycneme:* fig. 6: *M. mystacinus* and *M. daubentonii.*

is in the three remaining species. The decline of 52 % found for the 7 species combined is due for the greater part to considerable losses of individuals of *M. emarginatus* and *Rh. hipposideros.*

V. CAUSES OF DECREASE.

Decrease in population size may be due to mortality or (and) to emigration; the factors causing it may act in winter or (and) in summer. Very little is known about the summer haunts of these bats and nothing can be said about the food situation, predation, diseases, etc.

Much more is known about their winter haunts (the caves) and about the factors that might disturb them during hibernation. No predators of bats are living in the caves of S. Limburg as far as we know. The individuals found hibernating were always in good condition, and dead specimens are very rarely seen in the caves. The only dangers imminent here originate from activities of man by whom the hibernating quarters are disturbed or even ruined. We will now consider two types of disturbing activities: economical exploitation and our own banding activity.

1. Economical exploitation of the caves.

In Chapter I the total loss of the vast S. labyrinth in the St. Pietersberg as a consequence of the quarrying of limestone for the cement industry has already been mentioned (page ...).

As far as the sampling caves (page ...) are concerned: from 1945 until now an increasing disturbance by quarrying, mushroom-culture and sight-seeing may be observed in many of them. The Leraarsgrot (nr 91) has been reduced to about one half of its original size by a large limestone quarry. Explosions in this quarry may have disturbed the bats sleeping in the nearby Ravengrot (nr 92). During many years the main part of the corridors of the Schenkgroeve (nr 63) has been taken up by muhsroom beds. This has recently also become the case in the Cannerberg (nr 30). It is generally accepted that muhsroom culture drives away the local bat population. Whether this is due to the smell of the horse dung or to the presence of workmen in the cave, is not known.

A third type of disturbance is caused by

sight-seeing trips of tourists which are especially held in the large Gemeente-grot (nr 68—72) at Valkenburg during the summer season. Preparations for these visits, such as smoothing paths, installing coloured electric lights and drawing and sculpturing on the walls, are made during the winter and these activities may drive the bats away.

2. **Banding activity.**

In his recent publication on the ecology of bats hibernating in the caves of S. Limburg van Nieuwenhoven (1956) points to the loss of body weight as a consequence of handling bats during hibernation and argues that repeated disturbance of their sleep may cause entire populations to emigrate or even to die out. As a matter of fact, many bats are woken up in the sampling caves once a year when they are banded or recaptured. Moreover, the ring is sometimes bitten tight which may cause serious injuries, but this happens mainly in the stronger species.

If, according to Bopp (1954), we should make allowance for a percentage as high as 25 % of deaths caused by banding, we may calculate the consequences of this loss for the total population in the following way. For this calculation we will allow for a mean capture rate of 20 % in all the sampling caves for our 7 species combined, meaning that not more than 1/5 of the population is handled by us in a given year (cf. page ...). The annual ring mortality would, consequently, be $1/4 \times 1/5 = 1/20$ of the population, or 5 %. In the preceding chapter we have shown that the total population of the sampling caves combined suffered actually a decline of about 50 % in 12 years. We may conclude that ring mortality might be a considerable factor causing this decline.

In accordance with this conclusion, it is worth trying to investigate the influence of banding activity on the populations of the species separately. It is therefore convenient to divide the sampling caves into two types: A and B. In the A-caves the disturbance of bats has mainly been limited to our annual banding activity during the last 15 years (the caves nrs 13—18, 44—48, 105—107, 112, 63—67, 76—77 and 57, cf. page ...). In the B-caves (nrs 68—72, 91, 92, 163 and 30) economical exploitation may have had a decreasing effect on the population (cf. page 139). Results are recorded in Table 4.

TABLE 4. *Sample sizes and decline are calculated as in table 3.*

species	A-caves			B-caves		
	samp. size 1945	samp. size 1956	decline 1945-1956	samp. size 1945	samp. size 1956	decline 1945-1956
M. daub.	60	75	—25%*)	17	17	0%
M. myst.	122	133	— 9%*)	49	30	39%
M. das.	73	52	29%	46	21	54%
M. natt.	104	73	30%	47	18	62%
M. myotis	66	25	62%	30	6	80%
M. emarg.	148	34	77%	124	18	85%
Rh. hipp.	164	36	78%	99	19	81%

*) accress.

3. **Conclusions.**

Generally spoken the populations of the A-caves have been doing better than those of the B-caves, proving that economical exploitations of the caves as mentioned on page ... have a declining influence on the bat-populations involved.

In the A-caves, *M. daubentonii* and *M. mystacinus* show no decline, meaning that ring mortality is not likely to decrease population

size in these species. In *M. dasycneme* and *M. nattereri* the decline in the A-caves points to the possibility of a small but significant noxious effect of the banding activity. In *M. myotis, M. emarginatus* and *Rh. hipposideros* the decline in the A-caves is as serious as in the B-caves, and in these species it is impossible to exclude our banding excursions as one of the factors causing this decline.

VI. DISCUSSION.

In the foregoing pages we have shown that decrease in population size of bats may go parallel with various disturbances of the winter-haunts of S. Limburg. These disturbances would seem to hit all hibernating species equally hard, as they sleep in the same caves. If so, the consequences are, however, very different in the species separately. The populations of 4 *Myotis* species show no or small decline, whereas in 2 other *Myotis* species and in one *Rhinolophus* a considerable decline is found. It is suggested that the latter three are more sensitive to the disturbances described above than the former four species. For *Rhinolophus hipposideros* and *Myotis emarginatus* there are several reasons which could explain this phenomenon. First, these species probably do not live under optimal climatological conditions in S. Limburg, as they are very near the northern boundary of their geographical distribution area (cf Ryberg, 1947). Secondly, their hibernation periods end later than those of the other species in the same caves (cf van Nieuwenhoven, 1956) and, therefore, disturbance of their sleep which causes loss of body weight, may have more serious consequences. Thirdly, the individuals of *Rh. hipposideros* and *M. emarginatus* always hang free on walls and ceilings which makes them more vulnerable during hibernation than those of the other species which often hide in deep crevices.

These considerations are, however, not quite relevant as explanations for the serious decline we have observed in the population of *Myotis myotis* in the sampling caves during the last 12 years. In this species losses might be ascribed to ring mortality in particular. These bats, being much bigger and stronger than those of the other species investigated, are more often recaptured with seriously injured forearms as a consequence of biting on their ring.

Summarizing it cannot be denied that the banding activity in S. Limburg from 1937—1957 may be partly responsible for a considerable decline in the hibernating populations of at least three species which, taken together, supplied once about 50 % of the total number of individuals living in this area.

On the other hand, it may be stated that the marking-recapture method yields valuable results for the study of problems connected with hibernation and migration of bats in S. Limburg and that it adds to our knowledge of their longevity (Bels, 1952, van Heerdt & Sluiter 1953, 1954, 1955, 1956, 1957).

In addition a study of the population statistics in *Myotis mystacinus* has been based on recapture data from the sampling caves in S. Limburg recently (Sluiter, van Heerdt & Besem, 1956), and papers on the same subject in other species are in preparation. The numbers of recapture data which have been collected in S. Limburg until 1957 allow for similar statistical treatment in the species *Rh. hipposideros, M. emarginatus, M. daubentonii, M. dasycneme* and *M. nattereri* as has been done in *M. mystacinus*.

Taking into account the consequences of disturbing hibernating bats and the circumstance that the numbers of recapture data of five species of *Myotis* and one of *Rhinolophus* have grown sufficiently for statistical treatment, the authors have decided to stop bat banding in the caves of S. Limburg for all species, just as they have already stopped it for a number of species since 1955. They hope to continue the annual census in these hibernation quarters, and they will try to identify the sleeping bats in situ, handling only individuals which have been banded previously. In this way the disturbance will be limited considerably, and it will still be possible to study the bats from the ecological point of view by extending the observations on their habitat selection and on their behaviour during the hibernation period.

SUMMARY.

Distribution and population size during the years 1942—1956 are investigated in 7 bat species during hibernation in the caves of S. Limburg.

The S. labyrinth in the St. Pietersberg near Maestricht contained about 30 % of the total number of bats captured in the area, before this labyrinth was destroyed in the years after 1947. This percentage is 70 % for *M. myotis* separately.

A remaining part of the corridors in the St. Pietersberg (Slavante) is at the moment still giving shelter to about 1/3 of the total population of the main winterhaunts (called "sampling caves").

Data are recorded on the distribution of the species in the caves during hibernation which may serve as a contribution to an ecological study on habitat selection in these bats. They suggest that specific preferences exist in selecting caves for hibernation.

During the period 1942—1956, considered as a whole, the species *Rhinolophus hipposideros* and *Myotis emarginatus* have been the most abundant ones in the area. If combined with *Myotis myotis* they provided about 50 % of the individuals of the total winterpopulation. These three species show, however, a decrease in population size of 60—80 % in 12 years; in *Myotis nattereri* and *Myotis dasycneme* decline is less serious (40 %). In *Myotis mystacinus* and *Myotis daubentonii* no significant decrease of population size has been observed during the period of investigation.

Disturbance as a consequence of economical exploitation (quarrying, mushroom culture and tourism) is the main cause which drives bats away from the caves of S. Limburg. In the cases of *Rh. hipposideros, M. emarginatus* and *M. myotis* the existence of an important additional noxious influence of banding activity cannot be denied. Banding of these species was stopped in 1955.

SAMENVATTING.

Sinds B e l s in 1937 begon met het ringen van vleermuizen in de grotten van Z. Limburg zijn thans meer dan 15000 individuen behorende tot 12 soorten in dit gebied geringd. Aanvankelijk werden de kleine soorten met rust gelaten, maar vanaf 1942 zijn alle aanwezige soorten geregeld geteld. Dit heeft o.a. tengevolge, dat het thans mogelijk is een kwantitatief betrouwbare indruk te krijgen van de verspreiding over de grotten en van het verloop van de aantallen in de laatste 15 jaar voor de 7 soorten, die het talrijkst voorkomen: Kleine Hoefijzerneus (*Rhinolophus hipposideros*), Vale Vleermuis (*Myotis myotis*), Meervleermuis (*Myotis dasycneme*), Ingekorven Vleermuis (*Myotis emarginatus*), Baardvleermuis (*Myotis mystacinus*), Watervleermuis (*Myotis daubentonii*) en Franjestaart (*Myotis nattereri*).

Speciale aandacht wordt hierbij gewijd aan het z.g. zuidelijke gangenstelsel (nrs 19 en 22) in de St. Pietersberg (zie fig. 1), dat sinds 1947 voor de vleermuizen als verloren beschouwd moet worden en aan een 18-tal grotten (zie fig. 2), die in de periode 1942—1956 geregeld bezocht zijn (de z.g. monster-grotten).

Er blijkt, dat het zuidelijk stelsel (nrs 19 en 22) in de jaren 1942—1946 ongeveer 30 % van de totale hoeveelheid gevangen vleermuizen in Z.-Limburg leverde (zie tabel 1). In het bijzonder voor de Vale Vleermuis (*M. myotis*) is het wegvallen van dit winterverblijf na 1947 catastrophaal geweest, omdat ongeveer 70 % van de vangst in Z.-Limburg van deze soort hier overwinterde. Een ander deel van de St. Pietersberg, het gangenstelsel Slavante (nrs 13—18), blijkt thans de belangrijkste van alle resterende Z. Limburgse vleermuizengrotten te zijn. In Slavante overwintert nog steeds ongeveer 30 % van het totale aantal dieren, dat is overgebleven (zie tabel 2). Dit geldt echter niet voor alle soorten gelijkelijk b.v. de Kleine Hoefijzerneus (*Rh. hipposideros*) is relatief weinig gevonden in Slavante, terwijl deze soort toch met de Ingekorven Vleermuis (*M. emarginatus*) tot de talrijkste van Z. Limburg behoord heeft in de periode 1942—1956 als geheel (tabel 2).

Beschouwen we de vangsten in deze periode jaar voor jaar en bij de soorten afzonderlijk (fig. 3—6), dan blijken *Rh. hipposideros, M. emarginatus* en *M. myotis* zeer sterk achteruitgegaan te zijn. In mindere mate is dit het geval met *M. dasycneme* en met *M. nattereri*, terwijl er bij *M. mystacinus* en *M. daubentonii* geen sprake van achteruitgang is (tabel 3). Op het ogenblik is *M. mystacinus* de talrijkste Z. Limburgse soort.

De achteruitgang van de vleermuizenstand in de grotten moet in het algemeen worden toegeschreven aan de steeds toenemende economische exploitatie, zoals mergelwinning, champignonteelt en toerisme.

Voor drie soorten (*Rh. hipposideros, M. emarginatus* en *M. myotis*) kan echter het bestaan van een schadelijke invloed door het ringen der dieren niet ontkend worden (zie tabel 4). Beide eerstgenoemde soorten zijn kennelijk meer kwetsbaar voor storing van hun winterslaap dan de overigen, hetgeen verklaard kan worden uit de volgende omstandigheden: dat ze in Z. Limburg aan de noordgrens van hun verspreidingsgebied leven, dat ze een langere winterslaap nodig hebben dan de andere soorten, en dat ze steeds open en bloot aan muren en plafonds van de grotten hangen te slapen en dus nooit wegkruipen in spleten, zoals de andere soorten vaak doen. Voor *M. myotis* geldt in het bijzonder, dat de dieren vaak hun ring dichtbijten, waardoor ernstige ontstekingen aan de onderarm kunnen ontstaan.

Tegenover de eventuele nadelige invloed van het ringen op de vleermuizenstand staan belangrijke wetenschappelijke resultaten van dit onderzoek op het gebied van winterslaap, migratie en de bepaling van de maximale leeftijd. Bovendien hebben de terugmeldingen van de geringde dieren geleid tot het opstellen van bevolkingsstatistieken. Van *M. mystacinus* is deze reeds gepubliceerd, terwijl het aantal terugmeldingen van *Rh. hipposideros* en van 4 andere *Myotis*-soorten thans groot genoeg is om op soortgelijke wijze statistisch bewerkt te kunnen worden.

Op grond van bovenstaande overwegingen hebben de auteurs reeds in 1955 het ringen gestaakt bij een aantal soorten, waarvan de jaarvangsten zo klein werden, dat hiervan geen statistisch bruikbare resultaten te wachten zijn. Daar hun tot dusverre beoogde voornaamste doel ook bij de overige soorten thans min of meer bereikt is, zullen zij ook deze soorten voortaan niet meer ringen. Zij hopen de jaarlijkse tellingen wel voort te zetten, maar zullen daarbij trachten de vleermuizen in hun slaaphouding te herkennen, dus zonder ze te storen. Slechts de dieren, die een ring dragen, behoeven dan in de hand genomen te worden voor het aflezen van het ringnummer, hetgeen een aanzienlijke beperking van de storing betekent.

Deze wijzigingen in onze tactiek behoeven geenszins de mogelijkheden voor verder onderzoek uit te sluiten, mits ook de doelstellingen ervan enigszins gewijzigd worden in dien zin, dat voortaan meer dan voorheen aandacht zal besteed worden aan vraagstukken, die betrekking hebben op het gedrag der dieren tijdens hun ongestoorde winterslaapperiode, op de keuze van hun slaapplaats in verband met de klimatologische gesteldheid in de grot en op hun bevolkingsdynamiek.

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