

Bats in the Voorberg and the Jezuïetenberg

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Abstract: The numbers of hibernating bats in the Voorberg-Jezuïetenberg marl quarry complex, southwest of Maastricht, were monitored between 1987 and 2020 by means of annual counts at the turn of the year. The numbers counted in that period grew from 30 to 99, mainly as the result of an increase in the number of Geoffroy's bats. In the 2008-2009 season, it was investigated whether bats are home-steady during the hibernation season. It turns out that all species regularly woke up and moved around. The three-weekly counts in 2008-2009 also showed that most species gradually move towards the exit during the hibernation period, with only the Geoffroy's bats remaining in the rear part of the complex. Most species leave the quarry around the end of March, with the exception of Geoffroy's bats, which stay until mid-May.

Keywords: Voorberg, Jezuïetenberg, Boschberg, Geoffroy's bat, greater mouse-eared bat, Bechstein's bat.

Introduction

The marl quarries in southern Limburg form a special category among the Dutch winter roosts for bats. There are large differences between them, which are related to, among other things, the period of exploitation / mining, the extent of the quarry, the stability of the system (whether there are any cracks or have been collapses), the number of floors, differences in height and the quarry's climate. Together with fellow observers, the author of this paper has systematically surveyed the hibernating bats in the Jezuïetenberg and the Voorberg quarries, southwest of Maastricht, every winter period since 1987. In 2005 he first became a volunteer guide in the Jezuïetenberg. After his appointment as a guide, during his tours through the tunnel system throughout the year, his interest was aroused by the bats present in the entrance areas outside the winter period, which were present in places not visited by them during the winter period. This prompted him to look more closely at changes

in the seasonal distribution of hibernating bats with the objective of determining whether the hibernation of bats in these two quarries is a dynamic event or a static, uninterrupted activity. The climate in the Jezuïetenberg is much more constant than in the Voorberg, because this quarry does not have its own direct connection, via an entrance, with the outside air. One has to go through a more than 100 m long corridor from the entrance of the Voorberg to get to the Jezuïetenberg. The difference in climate between these two systems, with the Jezuïetenberg as the 'warm' part of the quarry and the Voorberg as the 'cold' part, offers the possibility of characterizing the hibernating bats here as heat-loving or cold-loving.

Location of the Voorberg and the Jezuïetenberg

South of Maastricht, on the west bank of the river Maas, there are two parallel ridges, separated by the valley of the river Jeker: Sint Pietersberg to the east the Louwberg to the west. In both ridges underground marl has been extracted for building and arable farming,

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which has created several corridor systems.

There are four medium-sized quarries in the Louwberg. From north to south, these are the Apostelgroeve, the Fallenberg, the Boschberg and the Kasteelgroeve. The second and third of these lie almost next to each other, undergoing changes in the twentieth century (natural and man-made) that made their structures more complex.

The collapse of the middle part of the Fallenberg quarry in 1920 led to the rear part becoming isolated in 1920 and it is now known as the Jezuïetenberg. This collapse only prevents humans from entering it. Bats can still fly through.

In 1944 the northern part of the Boschberg was separated from the rest of the quarry as a result of the construction of thick walls around the then underground war industry. The isolated northern part is now called the Voorberg. In 1954 a connection was made from the back part of the Voorberg to the isolated rear part of the Fallenberg in order to make the artistic expressions of the Jesuits that exist in that part accessible (figure 1; see also www.jezuïetenberg.eu). There is a passage that joins the Voorberg and the Jezuïetenberg but this is sealed off by a door, which has small openings to allow bats to pass through. Various works have been carried out in the Voorberg - Jezuïetenberg complex to stabilize it since then. The Jezuïetenberg is slightly higher than the Voorberg, so the climate in the Jezuïetenberg is relatively warm compared to the Voorberg, where colder air flows in through the entrance. These two quarries were visited during the bat counts and the migration research described below.

On 14 October 1996, the Jezuïetenberg was awarded the status of a protected national monument. Management is in the hands of the Jezuïetenberg Foundation, which organizes guided tours of the quarry. The quarry is open for visitors almost all year round. Previously, kerosene gasifiers, which gave off heat and combustion smoke, were initially used as lighting during the tours. Since 2018, only LED lighting has been used by the guides; which



Figure 1. The Voorberg and the Jezuïetenberg.

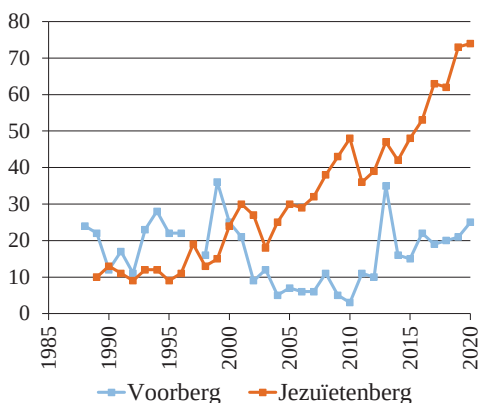


Figure 2. Changes in the total number of bats in the Voorberg-Jezuïetenberg complex from 1987-2020.

releases less heat.

Method

The annual counts of hibernating bats in the Jezuïetenberg and the Voorberg are tradition-

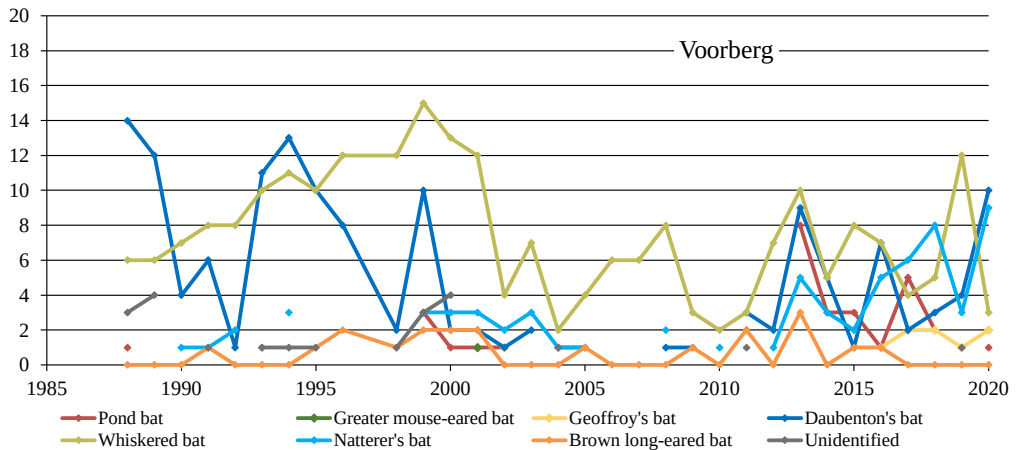


Figure 3. Changes in the numbers of bat species in the Voorberg 1987-2020.

ally carried out on 29 December each year. All the bats found in the area are noted, although not every bat present can be traced. Some bats are not visible because they have crawled away deep into crevices or cracks and, above all, because in both quarries, especially the Jezuïetenberg, certain corridors cannot be entered for safety reasons.

In order to gain insights into seasonal changes in the distribution of bats, a standard count was conducted every three weeks in the winter of 2008-09. The first took place on 8 October 2008 and the last on 20 May 2009. On these days, one bat counting group each time visited the Voorberg and the adjacent Jezuïetenberg in rotation with another counting group. Each time the bats found were located on a map of the two corridor systems.

Results

Winter censuses 1987-2020

The numbers of bats counted in the Voorberg - Jezuïetenberg quarry complex have increased over the years, as in many other quarries. Figure 2 shows the results of the annual counts. Between 1987 and 2020 the overall numbers more than tripled: initially 30 bats were

counted and by 2020 this had increased to 99.

A closer look (figures 2, 3, 4 and 5) shows that the increase in numbers in the complex has mainly occurred in the Jezuïetenberg and that the increase there is due to an increase in Geoffroy's bat (*Myotis emarginatus*); this species now makes up half of the total numbers there. The other species have remained more or less constant in numbers. In the Voorberg, the numbers of all species of bats have remained roughly the same over the whole period. Over the years, eight species of bats have been found hibernating. Whiskered bat (*Myotis mystacinus*) and Brandt's bat (*M. brandtii*) are taken together here because these species cannot readily be distinguished without handling them. It is worth noting that:

- the number of Natterer's bats (*M. nattereri*) is slowly increasing;
- the number of whiskered bats (*M. mystacinus/brandtii*) is slowly decreasing;
- the number of Daubenton's bat (*M. daubentonii*) in the complex follows the trend of the Daubenton's bats in other quarries in South Limburg: slowly descending;
- the pond bat (*M. dasycneme*) and the greater mouse-eared bat (*M. myotis*) both occur in low numbers fluctuating from 1-5 specimens;
- Bechstein's bat (*M. bechsteinii*) is occasion-

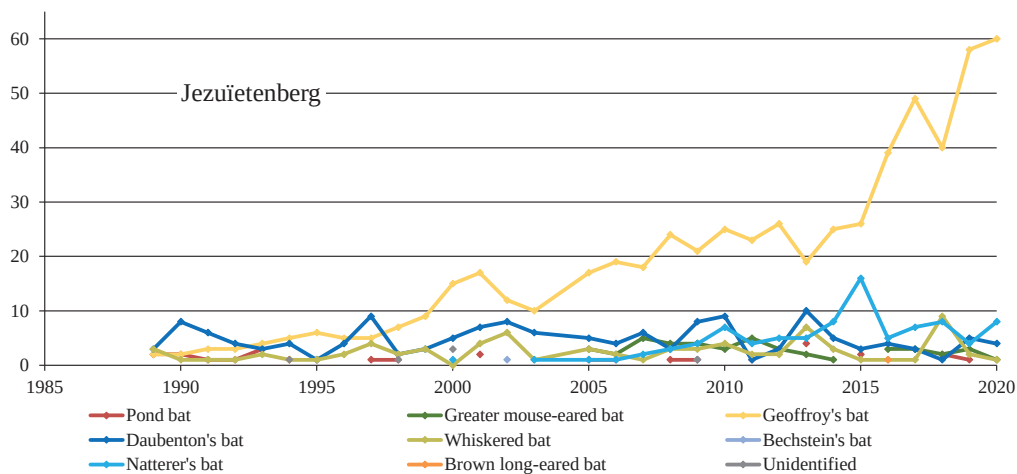


Figure 4. Changes in the numbers of bat species in the Jezuïetenberg 1987-2020.

Table 1. Distribution of the number of observed / expected bats in the Voorberg and in the Jezuïetenberg during the period 1989-2020, with significance levels; n.s.=not significant, n.a.= not applicable.

	Voorberg		Jezuïetenberg		P
	observed	expected	observed	expected	
<i>M. emarginatus</i>	9	56.5	612	564.5	<0.001
<i>M. daubentonii</i>	148	27.4	153	273.6	<0.001
<i>M. nattereri</i>	65	14.2	91	141.8	<0.001
<i>M. mystacinus</i>	246	29.5	78	294.5	<0.001
<i>M. myotis</i>	1	4.1	44	40.9	n.s.
<i>M. dasycneme</i>	38	6.0	28	60.0	<0.001
<i>P. auritus</i>	21	2.1	2	20.9	<0.001
<i>M. bechsteinii</i>	0	0.2	2	1.8	n.s.
unidentified	22	2.5	6	25.5	n.a.

ally observed;

- brown long-eared bats (*Plecotus auritus*) are rarely seen.

The bats' preference for hibernating in the Jezuïetenberg or the Voorberg is shown in table 1. By means of a chi-squared test, the observed number in the Voorberg or Jezuïetenberg is compared with the expected number, derived from the corridor length in both systems (ratio: 11:1). It appears that Geoffroy's bat has a significant preference for the more climatically stable and warmer Jezuïetenberg, while Daubenton's bat, the whiskered bat, Natterer's bat, the pond bat and the brown long-eared bat show a sig-

nificant preference for the colder Voorberg, where the climatic conditions are more variable. No preference could be determined for the greater mouse-eared bat and Bechstein's bat due to their low numbers.

These observations confirm those in other marl quarries that hibernating Geoffroy's bats move further into the quarries to hibernate and that they rarely stay in the relatively colder entrance areas. Bechstein's bats and greater mouse-eared bats exhibit similar behaviour. When they are (rarely) found in the vicinity of a quarry entrance, the animal is not hanging freely on a marl wall, but has crawled into an uneven spot (crevice, niche)

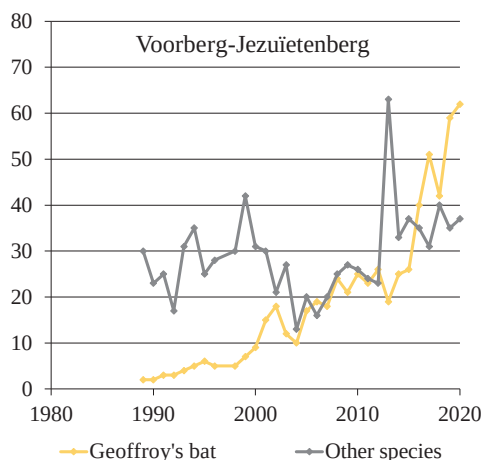


Figure 5. Trends in the number of Geoffroy's bat and other species in the Voorberg-Jezuïetenberg complex 1987-2020.

where it would be less exposed to air currents; thus seeking their own local microclimate.

Temporal distribution in the complex during the 2008-2009 winter season

During the winter season of 2008-2009, during twelve bat countings, all bat observations were accurately mapped on counting maps. Comparison of these maps showed that bats did not stay in the same place for long periods of time. Only a few individuals were found at the same roost after three weeks. However, they sometimes stayed in the immediate vicinity, ranging from one metre to a few corridors away. Of course, it is not certain that in any particular case it was one and the same bat because the animals could not be recognized individually. Figure 6 shows the distribution of the observed bats on three different dates.

Daubenton's bats, and especially whiskered bats, appear to move frequently: these two species were almost never found at the previous roost during a subsequent count. In other words, hibernation appears to be a dynamic event for these species. By contrast, Geoffroy's bats appeared to move very little.

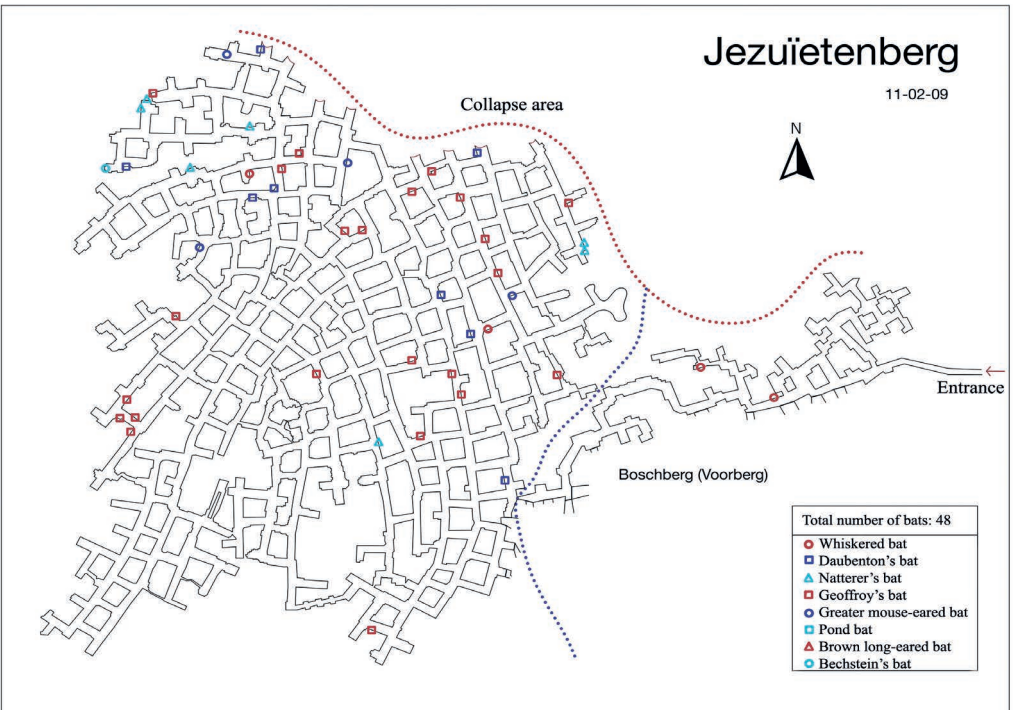
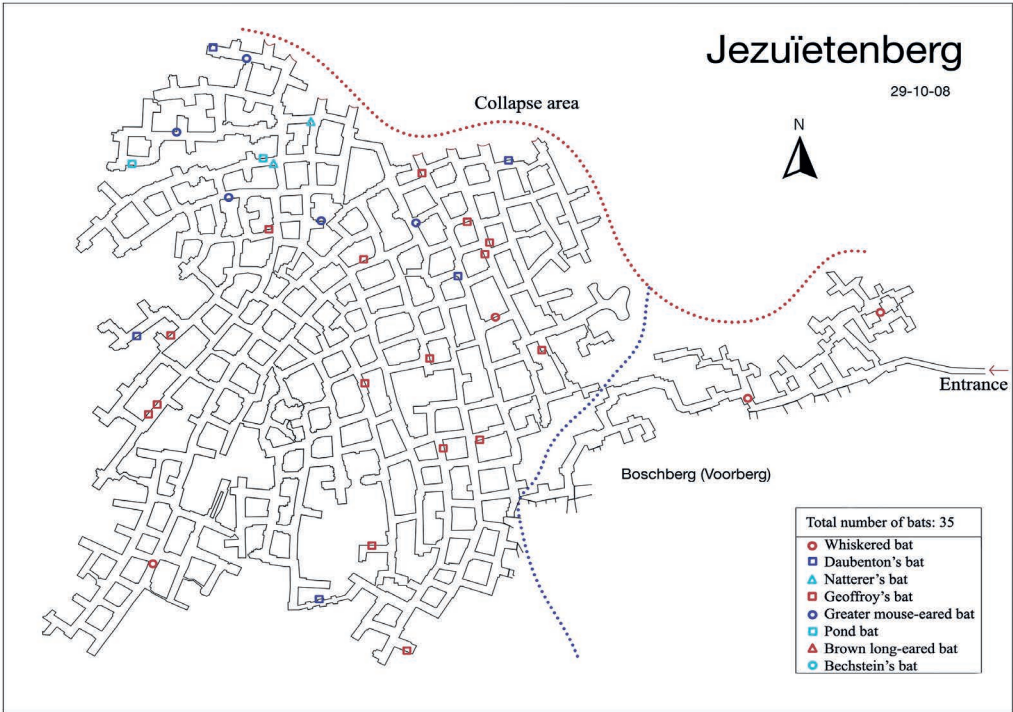
Changes in numbers during the 2008-2009 winter season

During the winter season of 2008-2009, a total of 378 bat sightings of eight species were recorded, spread over twelve counting events. The numbers of bats in the quarry increased over the course of the autumn (figure 7): by the end of September, half of the bats were present. The maximum number was reached in January. The bats then gradually left the quarry and by mid-May the last ones had left. However, this picture varied in the two parts of the quarry complex. The increase in numbers in the Voorberg was considerably slower and lasted longer: the maximum numbers were only reached in March and by the beginning of April the bats had all already left.

Because there has been a large increase in numbers of Geoffroy's bats in the complex over the years and because they are only found in the Jezuïetenberg, figure 8 shows the seasonal pattern of the Geoffroy's bat against that of the other species with a division between the two parts of the quarry. The other species appear to leave the Jezuïetenberg earlier than Geoffroy's bats. It is possible that the increase in the number of the other species in the Voorberg is the result of their departure from the Jezuïetenberg. Yet, it has also been observed that Geoffroy's bats remain in the Jezuïetenberg throughout the winter and then leave the quarry directly from there at the beginning of May. It was also observed that the bats move towards the entrance during the course of the winter. This process of internal migration was previously described by Daan (1973), who studied this phenomenon in the Geulhemergroef near Berg en Terblijt.

Conclusions

Between 1987 and 2020, counts of hibernating bats were carried out in the Voorberg-Jezuïetenberg complex and the total number of hibernating bats increased threefold in this



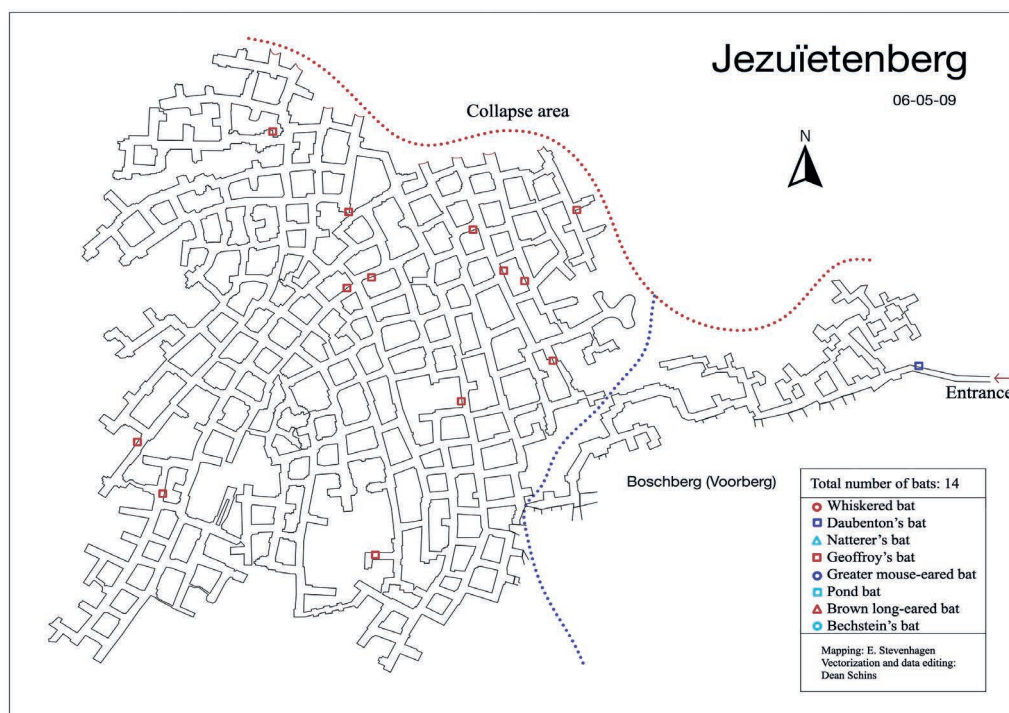


Figure 6. Locations of bat observations, by species, in the Voorberg and the Jezuietenberg on three counting dates in the winter of 2008-2009.

period, although this increase is mainly due to the Geoffroy's bat. The numbers of the other species, have remained about the same, with some fluctuations. Geoffroy's bats are known to be on the increase in several other quarries, so what is happening in the Voorberg-Jezuietenberg is consistent with this (Weinreich & Verheggen 2022, this issue). The Voorberg is closer to the entrance for bats than the Jezuietenberg. This means that the former is more exposed to external temperature fluctuations. This is reflected in the internal distribution of the species: the Geoffroy's bats mainly hibernate in the back of the quarry. Daubenton's bats, whiskered bats and Natterer's bats hibernate throughout the quarry complex, but with a preference for the Voorberg. In the 2008-2009 hibernation season, the seasonal development of bat numbers and their distribution was monitored by means of counts taken every three weeks. By following the roost positions of

species over the course of the season, it became clear that hibernating is not a process in which bats always stay in the same place, but that it is a more dynamic event. Bats move around internally on a regular basis and the extent to which this happens varies between species.

Overall Geoffroy's bats stayed in their hibernaculum for a longer time: from the end of September to the beginning of May than the other species which stayed a much shorter period from the end of September to the end of March/beginning of April.

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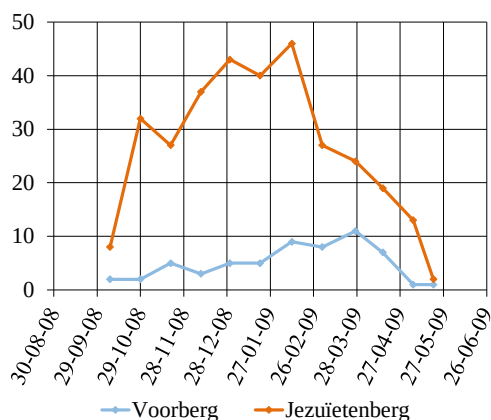


Figure 7. Changes in the number of bats in the Voorberg-Jezuïetenberg complex during the winter season 2008-2009.

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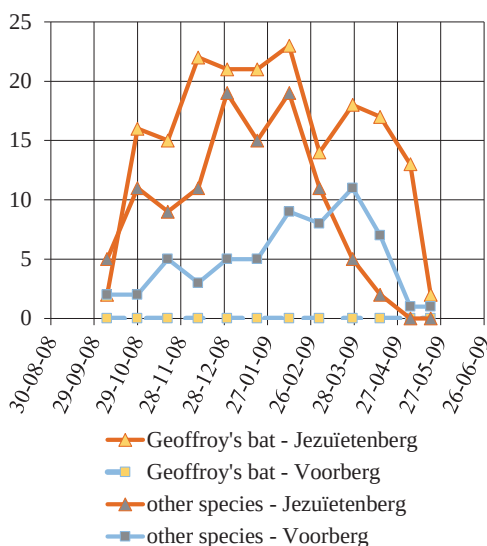


Figure 8. Changes in the number of Geoffroy's bats in the Voorberg-Jezuïetenberg complex during the winter season 2008-2009.

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