Hydrology LIFE (LIFE16/NAT/FI/000583)

Action D4: Monitoring protected bats

Action synthesis report

10.2.2023

Ville Vasko , Anna Blomberg, Simon Gaultier & Jon E. Brommer

University of Turku

The project has received funding from the LIFE Programme of the European Union. The material reflects the views by the authors, and the European Commission or the CINEA is not responsible for any use that may be made of the information it contains

Table of Contents

Summary

As part of the Hydrology LIFE project action D4, the activity of bats were surveyed. Surveys were carried out May to September in 21 sites (located in 11 areas). At 14 sites, a wetland was restored as part of this LIFE project. Bat activity was recorded both prior to the restoration (in years 2018, 2019) as well as after their restoration (2021,2022). At the same times, bats were recorded at 7 sites that were not included in wetlands restoration efforts. We here present details on the sites where recordings were made, methodology of making the recordings and the analysis and broad overview of the data. In total, 10 423 recording nights were collected. The dominant bat group was *Myotis spp*. and Northern bat (*Eptesicus nilssonii*). Nathusius' pipistrelle (*Pipistrellus nathusii*) was reasonably abundant at one site. Overall, bat activity increased after restoration, although also an increase in activity was found in several control sites. Although formal analysis of the data is not part of this report, it is clear that restoration had no negative effects on bats but likely improved the site for feeding for bats.

Bats and wetlands

Bats were chosen as a group to be monitored in hydrological restoration, because they are strictly protected and the information on how they respond to restoration in boreal environments was scarce. It was assumed, that bats could benefit from restoration in several ways. All boreal bat species are insectivores, and increasing water level could positively affect insects. Bats also roost in trees, for example under loose bark, and trees dying because of rising water level could create new roosting sites.

Figures 1-2. Ultrasonic microphone (left) and SongMeter 4 unit (right) were used during this action to record the ultrasound of bat calls at wetlands

Methods

The monitoring was conducted as Before After Control Impact (BACI) design. There were 21 monitoring sites, of which 14 were restoration sites and seven control sites. Originally, only four sites were planned to be controls, but three sites were re-classified as additional controls, because restoration was not done at those sites.

We used ultrasonic passive recorders (SongMeter SM4) to record bat echolocating calls at monitoring sites. The device was programmed to record every night, from dusk until dawn, between May 1st and September 30th. Batteries and memory cards of the detectors were changed once per month.

The original plan was to carry out most of the restoration work in 2020. Therefore, the monitoring was designed to cover years 2018–2019 (”Before” years) and 2021–2022 (”After” years), while 2020 was left without monitoring. However, because of practical and logistical reasons, on different sites the restoration

was done in different years. This resulted some sites having more ”Before” years than ”After” years and vice versa.

In one detector/microphone pair there were more severe problems causing noise files to dominate the recordings and the data of the whole season being useless. This happened twice and was not noticed before analysing the data after the season (Maisaarensuo 2019 and Vajosuo2 2022).

The 21 sites were spatially grouped in 11 areas (Figure 3). However, not each area had a control site due to limited number of detectors available. Control sites were mainly in large national parks, where they were chosen among similar habitats as the restoration sites. There are 3 of the 7 controls in the Pinkjärvi area due to the postponing of restoration.

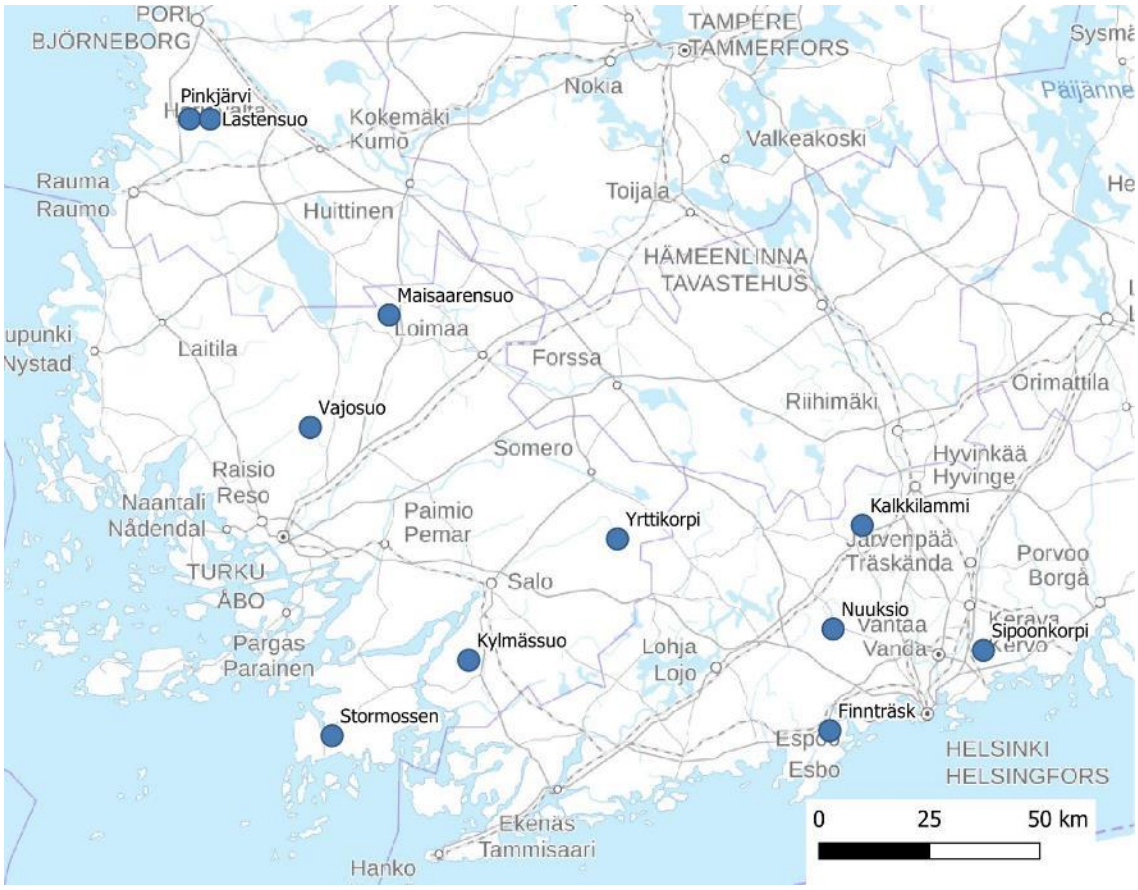


Figure 3. Bat monitoring sites in SW Finland.

The sites were chosen to represent different types of restored peatlands. Only one detectors was installed in each restoration site to better cover the diversity of different sites. In the big national parks Nuuksio and Sipoonkorpi, there were 2–4 sites within each park, otherwise there was one monitoring site per protected area.

Most of the sites were forest, because some bat species are known to avoid open areas in summer. However, some open and semi-open areas were chosen as well. Soil productivity also varied across the sites. Furthermore, distance to closest open water area was measured, because most bat species are known to prefer water as part of their home range.

Detectors were placed 5-15 metres from ditches to avoid machines breaking them when blocking the ditches. The microphone was placed 1,5–2 metres from the ground level.

Table 1. Monitoring sites. For each site, the table lists the name of the location with a detector (some sites had multiple detectors distinguished with numbers), impact (R – restored; C – Control), its coordinate (Lon – Longitude; Lat – Latitude), year in which the restoration took place and comment on restoration based on observations during field work conducted during the project.

Site name	Impact	Lon	Lat	Restoration time	Comment
Finnträsk	**R**	24,54483	60,12729	2020	
Kalkkilammi	**R**	24,64814	60,54630	2021	Trees removed 2019, ditches closed during 2021 field season
Kylmässuo	**R**	23,06114	60,23778	2018	Ditches closed in September 2018
Kylmässuo K	**C**	23,05664	60,23099		
Lastensuo	**R**	21,83138	61,29437	2021	Trees removed 2020, ditches closed during 2021 field season
Maisaarensuo	**R**	22,64102	60,92401	2021	Water level did not rise noticeably
Nuuksio 1	**R**	24,52484	60,33454	2020	
Nuuksio 2	**R**	24,54146	60,33965	2020	
Nuuksio 3	**R**	24,55401	60,32679	2021	Ditches closed in spring 2022
Nuuksio 4	**R**	24,47350	60,27474	2021	Water level did not rise noticeably
Nuuksio K	**C**	24,55378	60,33854		
Pinkjärvi 1	**C**	21,73246	61,28630		Was not restored; used as extra control
Pinkjärvi 2	**C**	21,75923	61,29404		Was not restored; used as extra control
Pinkjärvi K	**C**	21,74898	61,29503		
Sipoonkorpi 1	**R**	25,17037	60,29246	2020	
Sipoonkorpi 2	**R**	25,14851	60,30869	2020	
Sipoonkorpi K	**C**	25,16112	60,30907		
Stormossen	**R**	22,52247	60,06386	2018	Ditches closed in September 2018
Vajosuo 1	**R**	22,33699	60,69211	2021	Trees removed 2020, ditches closed during 2021 field season
Vajosuo 2	**C**	22,35670	60,67816	2021	Restoration was very far from the detector; used as extra control
Yrttikorpi	**R**	23,64101	60,49717	2021	Trees removed 2020, ditches closed during 2021 field season

Maps of the sites and location of detectors

In the following maps (Figures 4-15), locations of the monitoring sites are shown. The areas with blue shading are the peatlands that were planned to be restored. The acronym of the detector is provided in yellow.

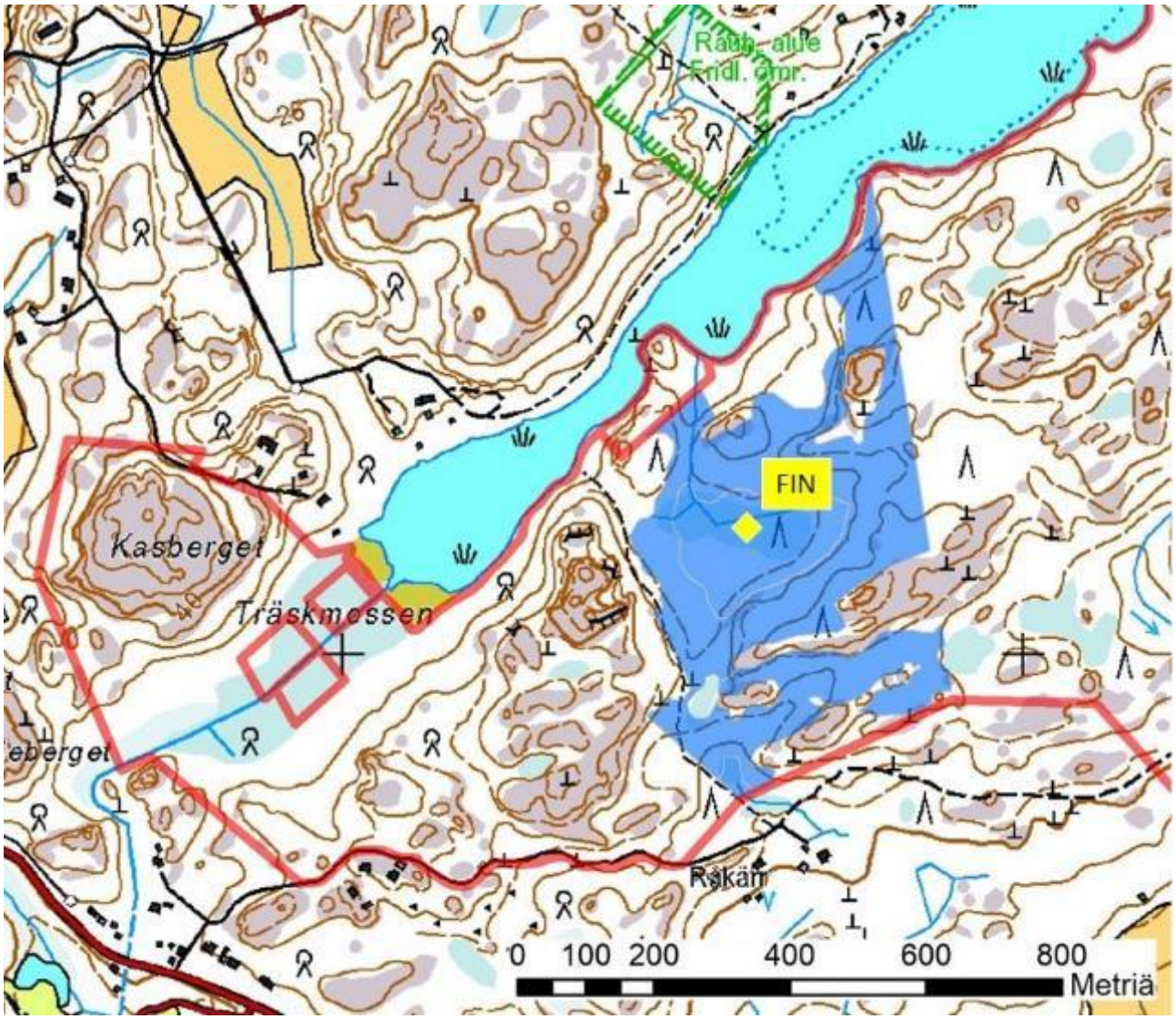


Figure 4. Location of the bat monitoring site in Finnträsk.

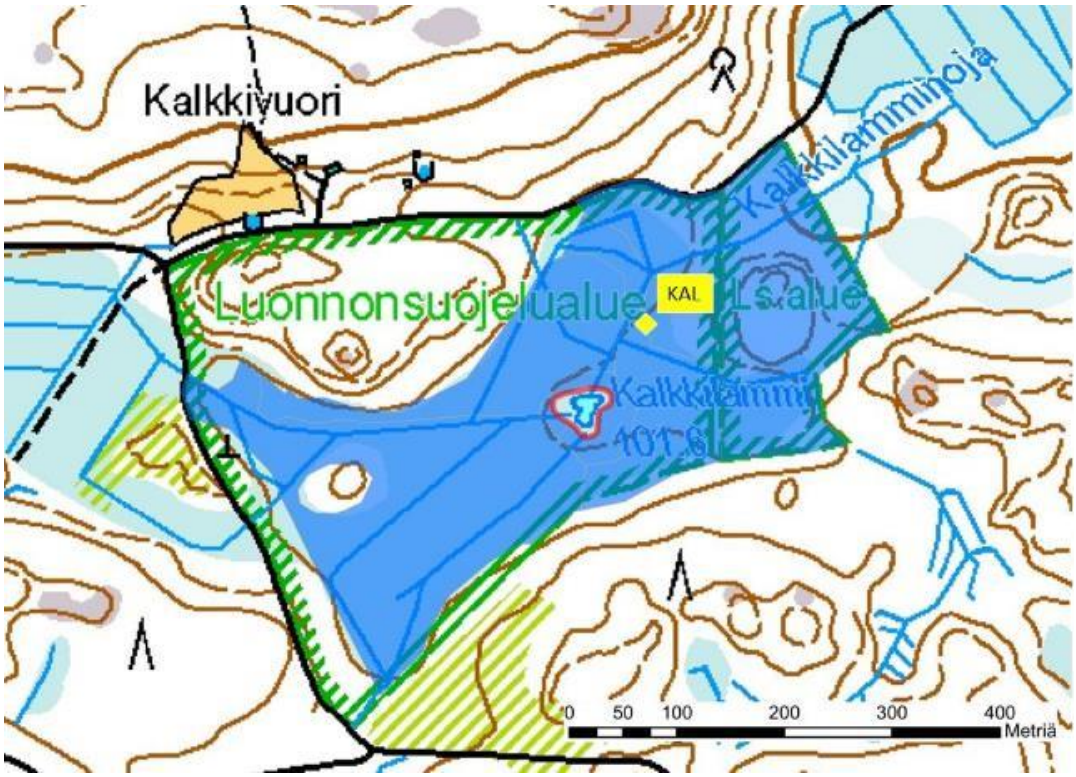


Figure 5. Location of the bat monitoring site in Kalkkilammi.

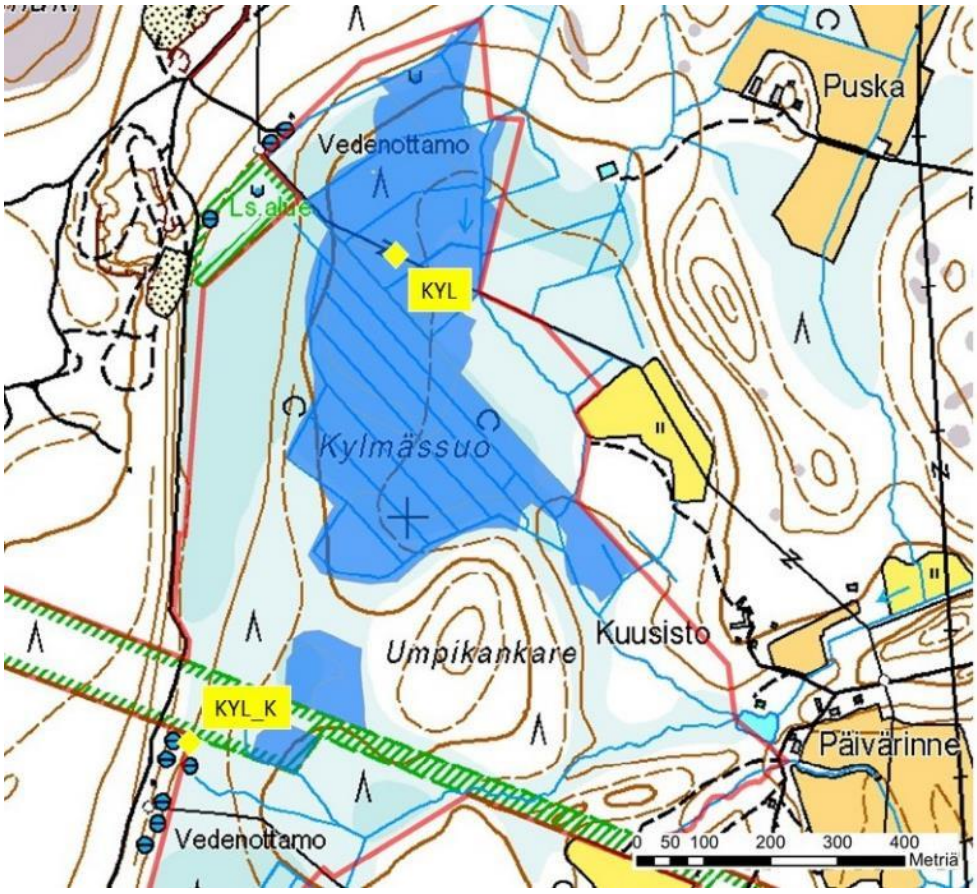


Figure 6. Location of the bat monitoring sites in Kylmässuo.

Figure 7. Location of the bat monitoring site in Lastensuo.

Figure 8. Location of the bat monitoring site in Maisaarensuo.

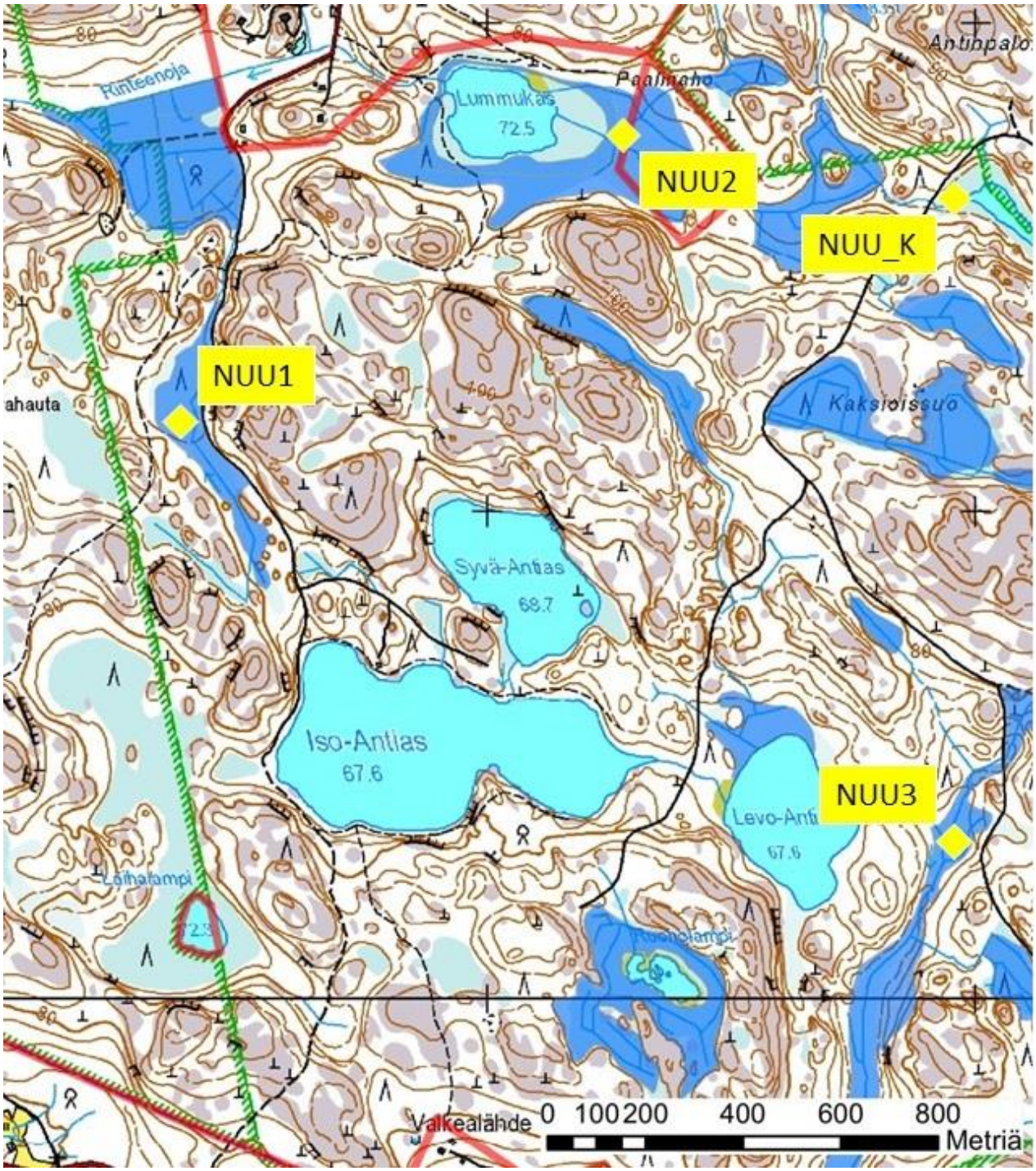


Figure 9. Locations of the bat monitoring sites in Nuuksio (northern part).

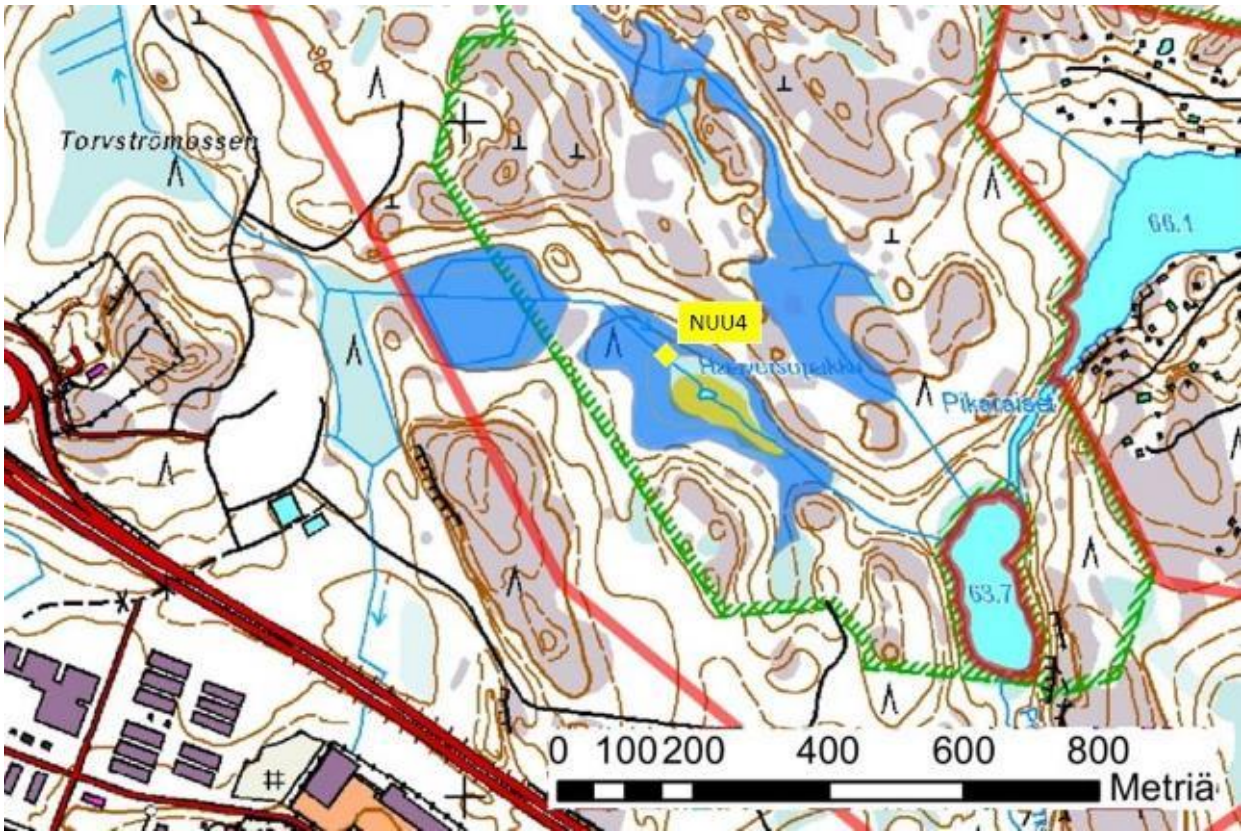


Figure 10. Location of the southernmost bat monitoring site in Nuuksio.

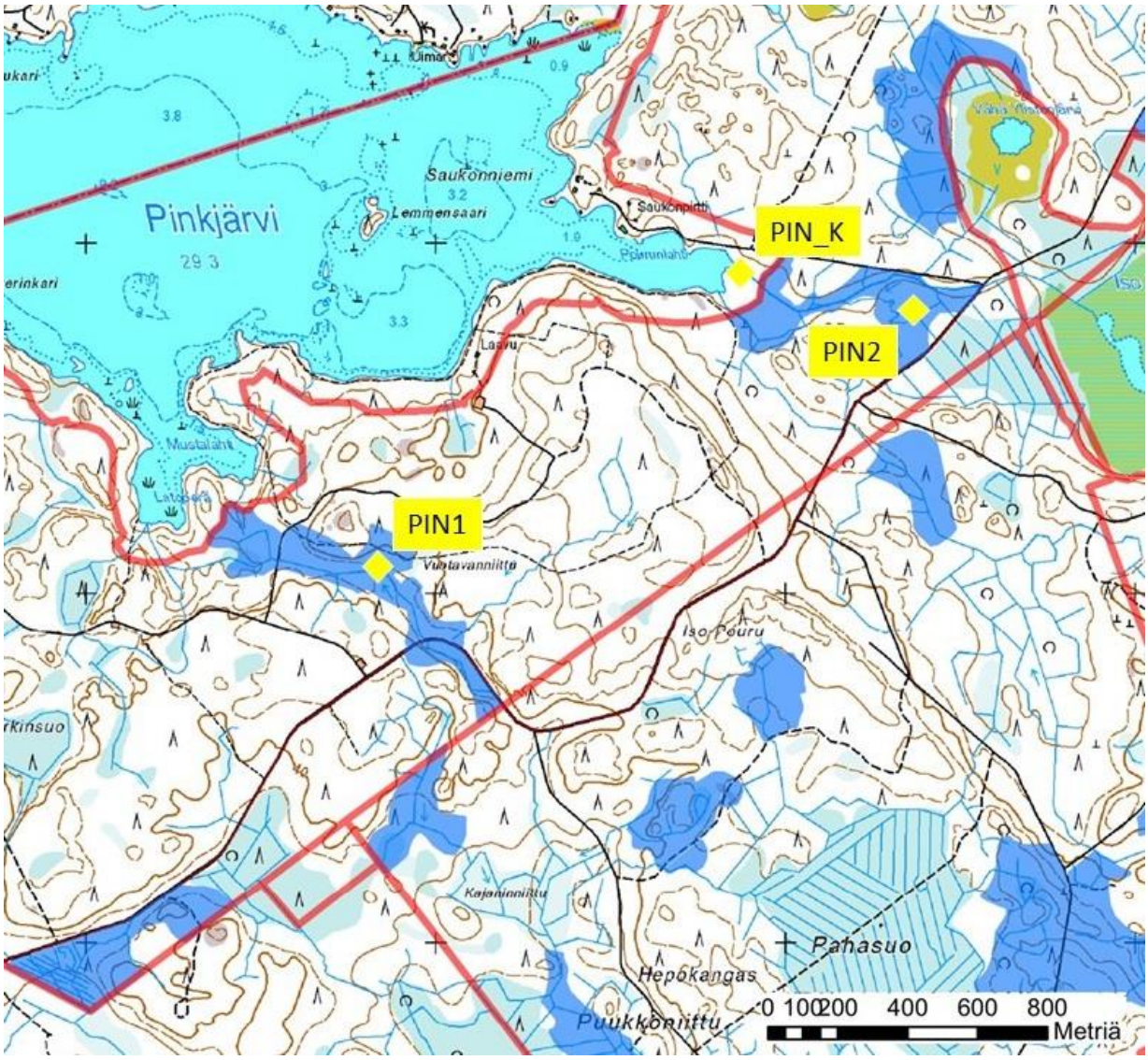


Figure 11. Locations of the bat monitoring sites in Pinkjärvi.

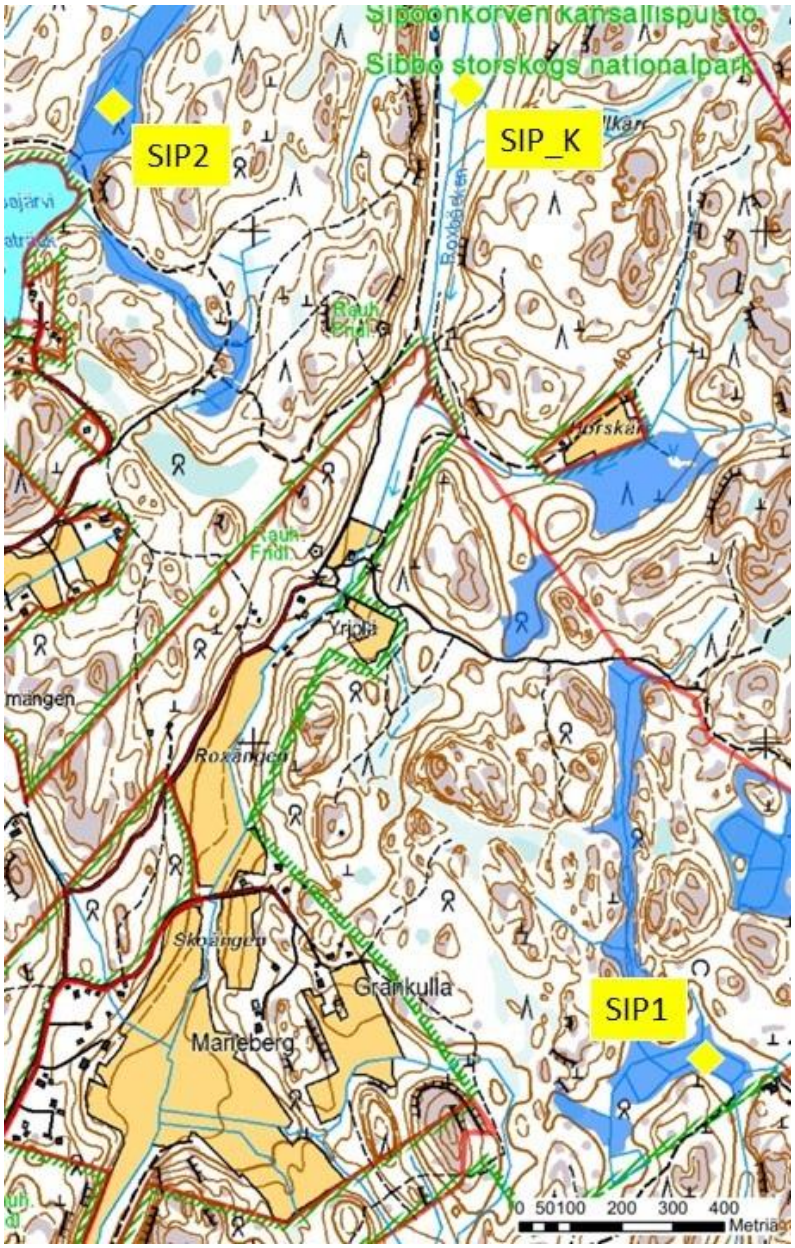


Figure 12. Locations of the bat monitoring sites in Sipoonkorpi.

Figure 13. Location of the bat monitoring site in Stormossen.

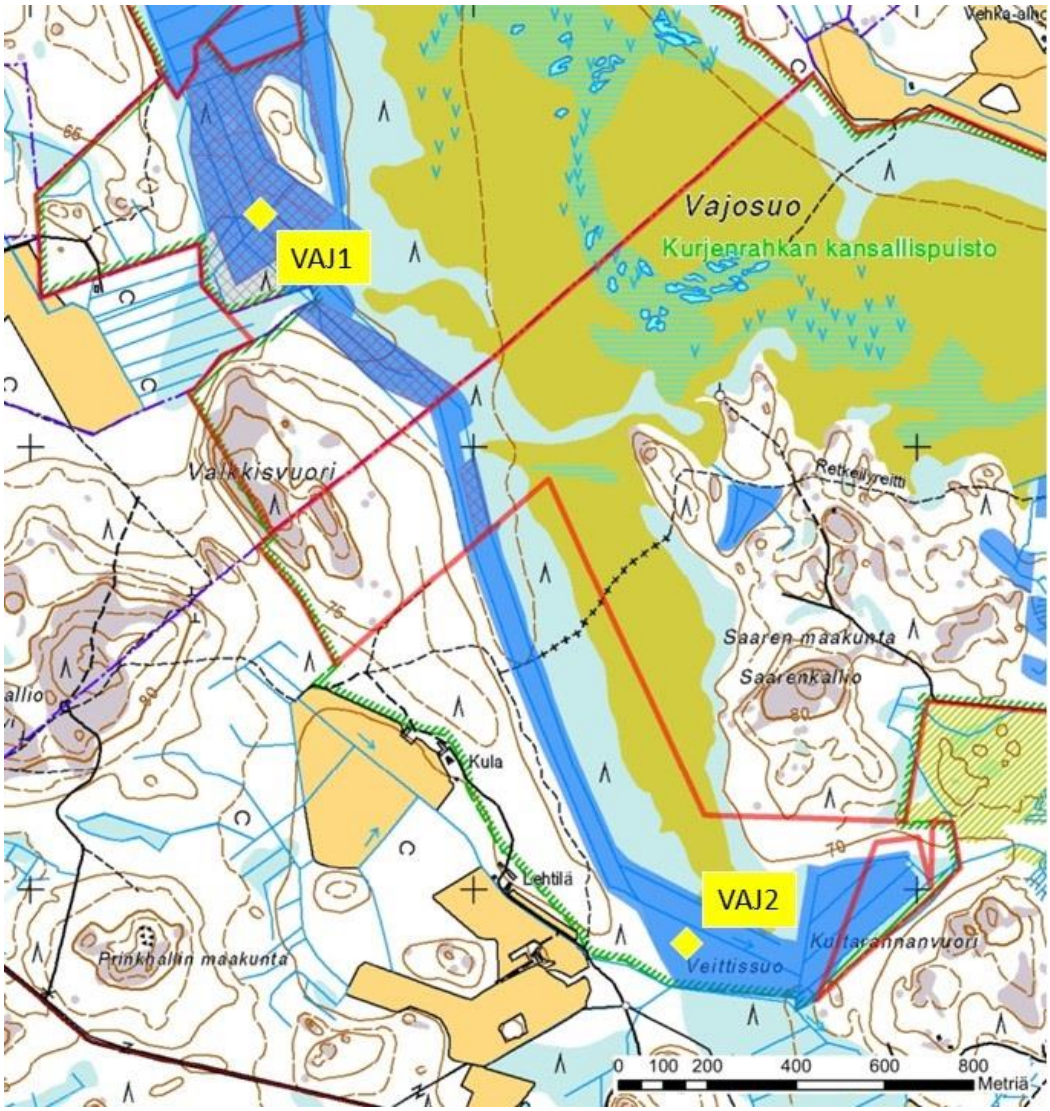


Figure 14. Location of the bat monitoring sites in Vajosuo.

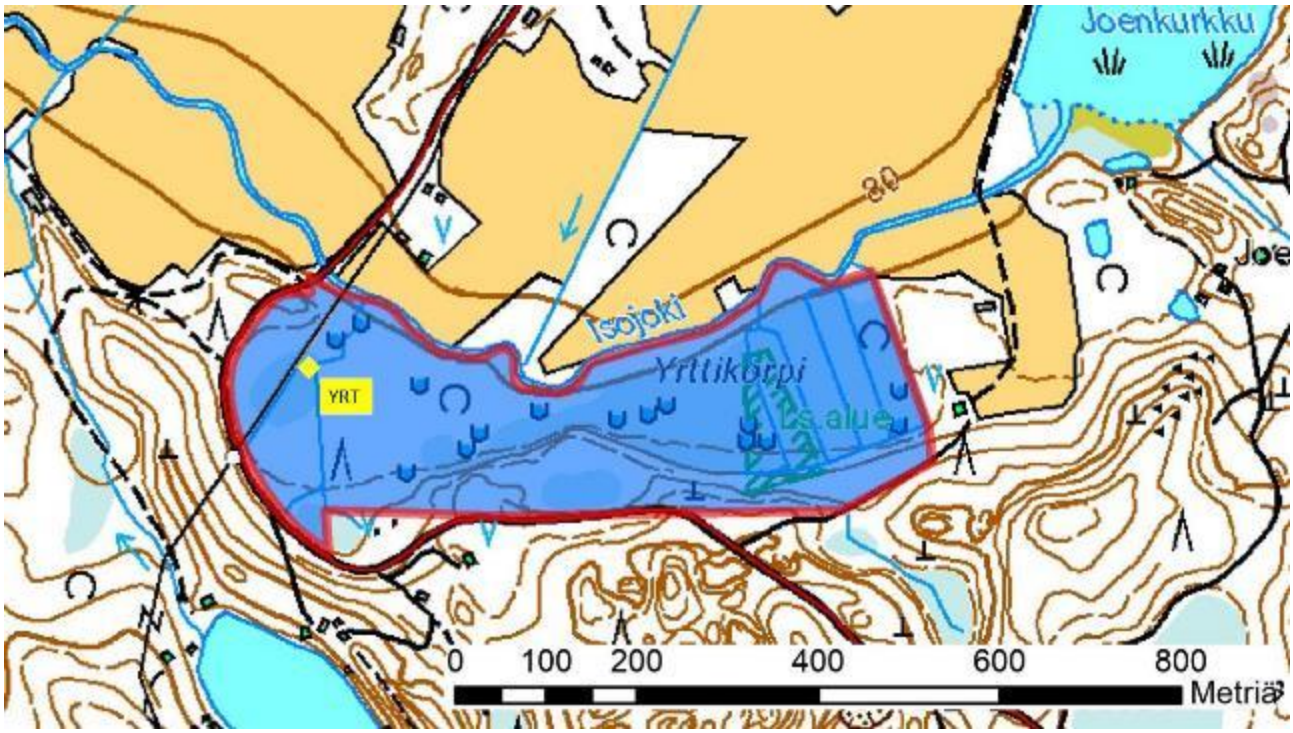


Figure 15. Location of the bat monitoring site in Yrttikorpi.

Data

The data consisted of 10 423 recording nights in total. The dominant bat group was *Myotis spp*. with 480 000 recordings. Northern bat (*Eptesicus nilssonii*) was recorded 275 000 times and Nathusius' pipistrelle (*Pipistrellus nathusii*) 23 000 times, mostly on one site. In addition, there were a few hundred recordings of Long-eared bat (*Plecotus auritus*) and individual recordings of Noctule bat (*Nyctalus noctula*).

The data was analyzed with the program SonoChiro, which automatically classifies the recordings into species classes and gives an index of reliability for the classification. Because *E.nilssonii* and *Myotis spp*. are very common in SW Finland, the observations of those groups were not manually verified. Four Myotis species (*M.brandtii, M.daubentonii, M.mystacinus, M.nattererii*) occurring in the data were grouped into Myotis spp. because distinguishing between the species by the program is not reliable.

There were some technical problems causing some of the detectors not to record full time between visits (e.g microphone breaking, running out of space on memory cards). Therefore, monthly numbers of recording nights were calculated before analysing bat activity.

The number of minutes (defined by the time stamp) with >0 detection of a species per night was computed (active minutes). Activity is expressed as the average number of active minutes per number of nights the detector was operational for each month.

Impact sites

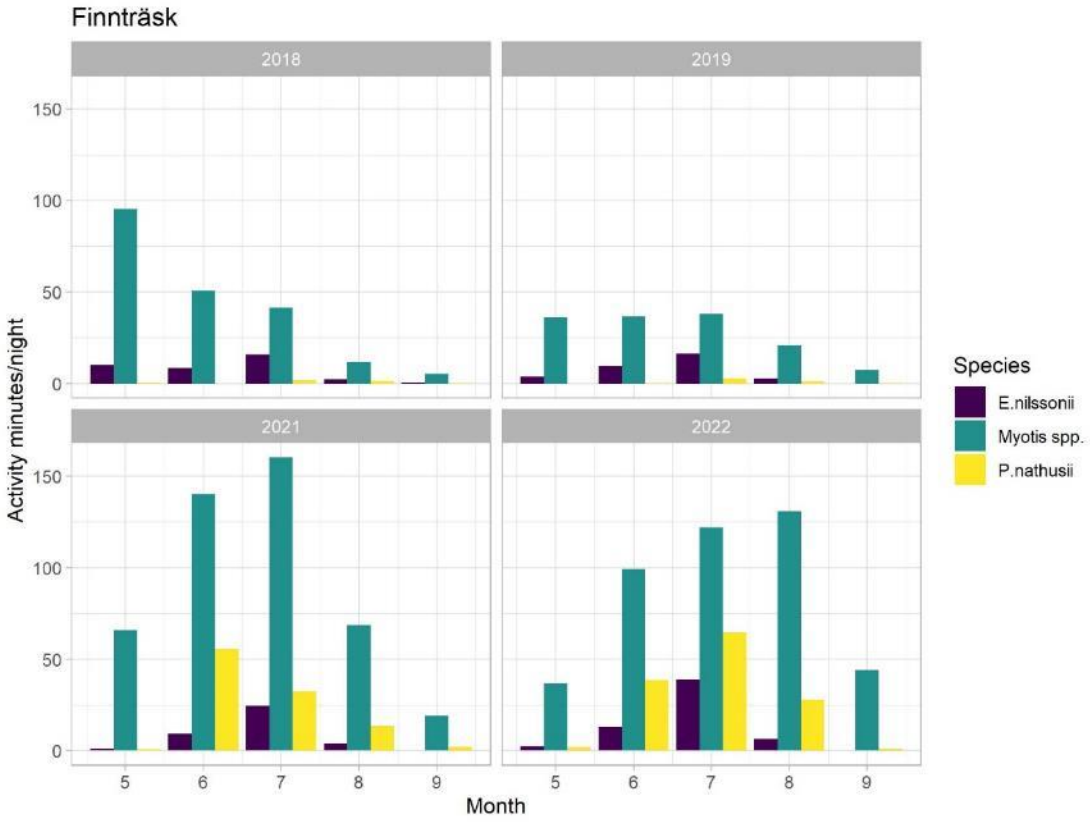
In this section, graphs on bat activity are presented site by site, along with information and photos from each site. Note different scales in activity graphs.

Finnträsk

Location: 24.54483°, 60.12728°
Restoration year: 2020
Tree cover: high
Soil productivity: high
Distance to open water: 220 m

Old spruce forest. Water level increased noticeably right after the restoration and the positive effect on bats was clear. Especially the activity of *Myotis* was higher after restoration. This site was the only one, where the vulnerable *Pipistrellus nathusii* occurred regularly. It's numbers also increased noticeably after the restoration.


Figures 16-17. Finnträsk site before (2019) and after restoration (2021).



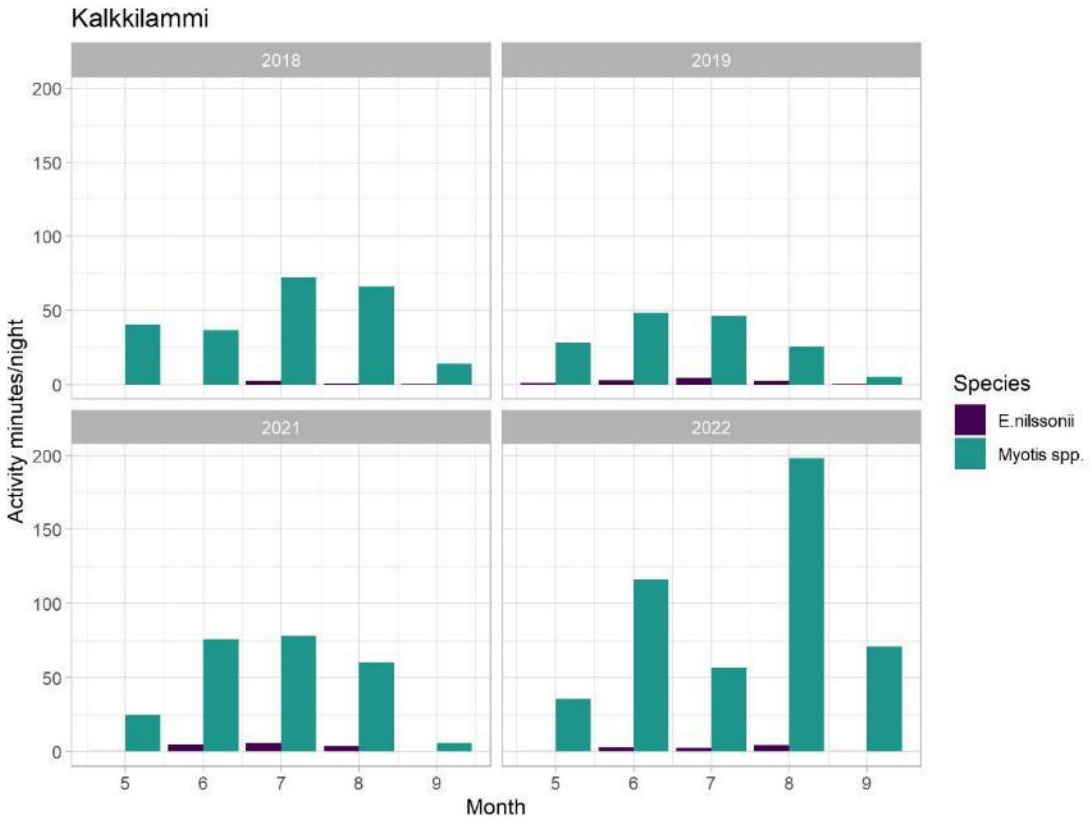
Kalkkilammi

Location: 24.64813°, 60.54630°
Restoration year: 2021*
Tree cover: moderate
Soil productivity: high
Distance to open water: 90 m (very small pond)

***trees removed 2019, ditches closed during 2021 field season**

Old spruce forest near a small pond. Detector was close to a creek coming from the pond. Water level increased moderately after the restoration. Since trees were removed already 2019, we could separate its effect from the water level effect. It seems that the partial tree removal had no effect in bats but increasing water level in 2022 had a positive effect.

Figures 18-19. Kalkkilammi site after tree removal and in the final year of monitoring.



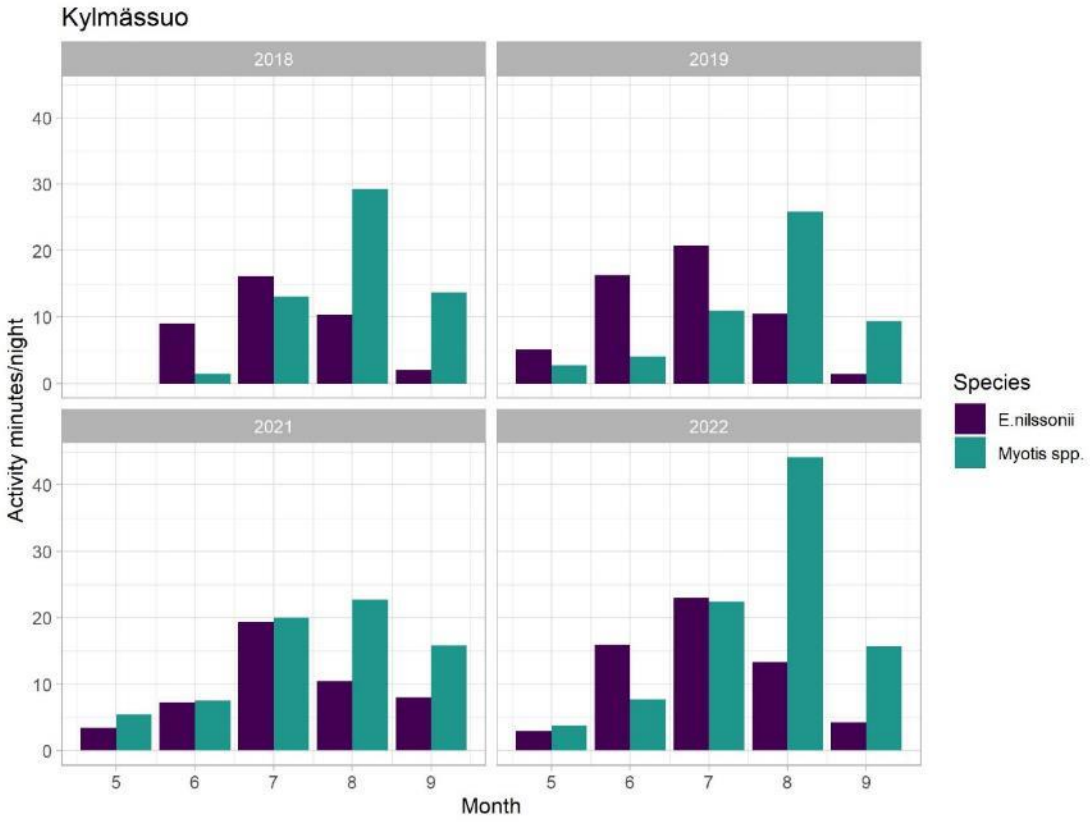
Kylmässuo

Location: 23.06113°, 60.23778°
Restoration year: 2018*
Tree cover: moderate
Soil productivity: moderate
Distance to open water: > 1 km

***ditches closed during late field season**

Mixed forest. Detector was next to a powerline opening. Water level increased moderately after the restoration, but there were no clear ponds. The restoration was done earlier than originally planned, and therefore we only had one “before” season. The effect on bats was not clear.

Figure 20. Kylmässuo monitoring site.



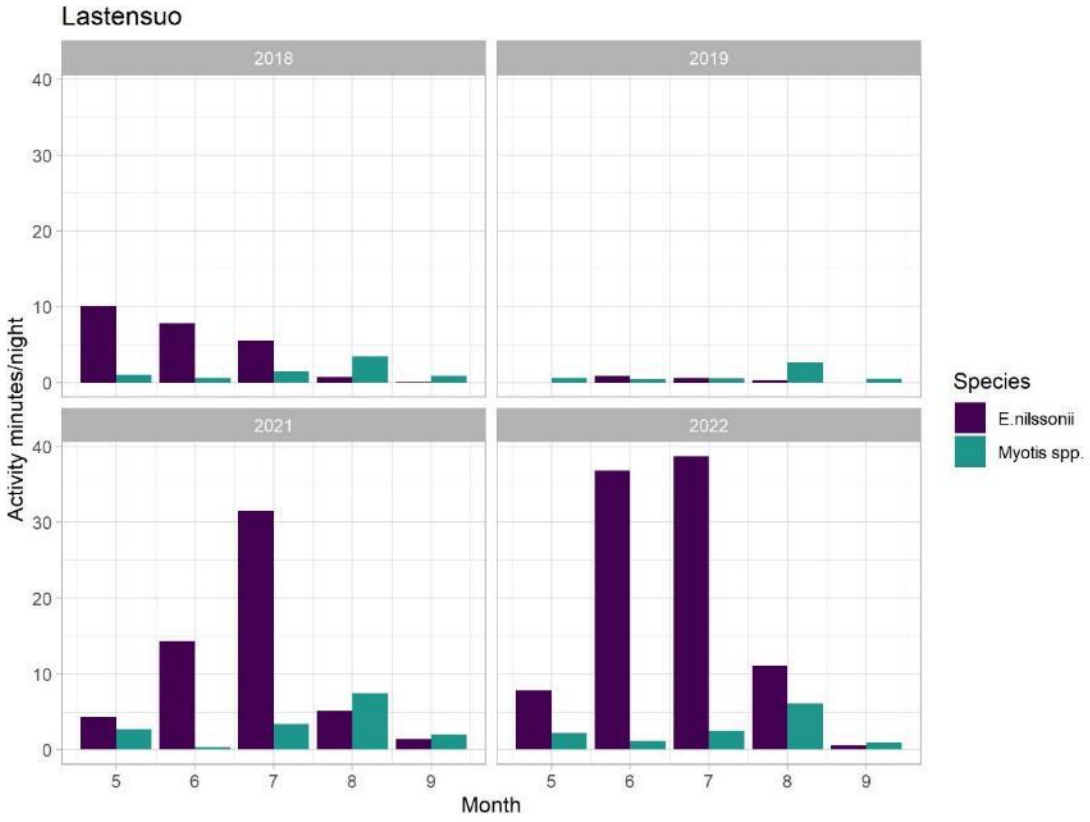
Lastensuo

Location: 21.83137°, 61.29436°
Restoration year: 2021*
Tree cover: high -> moderate
Soil productivity: moderate
Distance to open water: 120 m

***trees removed 2020, ditches closed during 2021 field season**

Edge forest of a large open peat bog. Water level increased moderately after the restoration, but a more notable change was in tree cover. Removal of trees created more open habitat suitable for *E.nilssonii*. Also, *Myotis spp.* slightly increased.

Figure 21. Location of Lastensuo monitoring site on an aerial photo, where the tree removal area is seen around the forest patch.

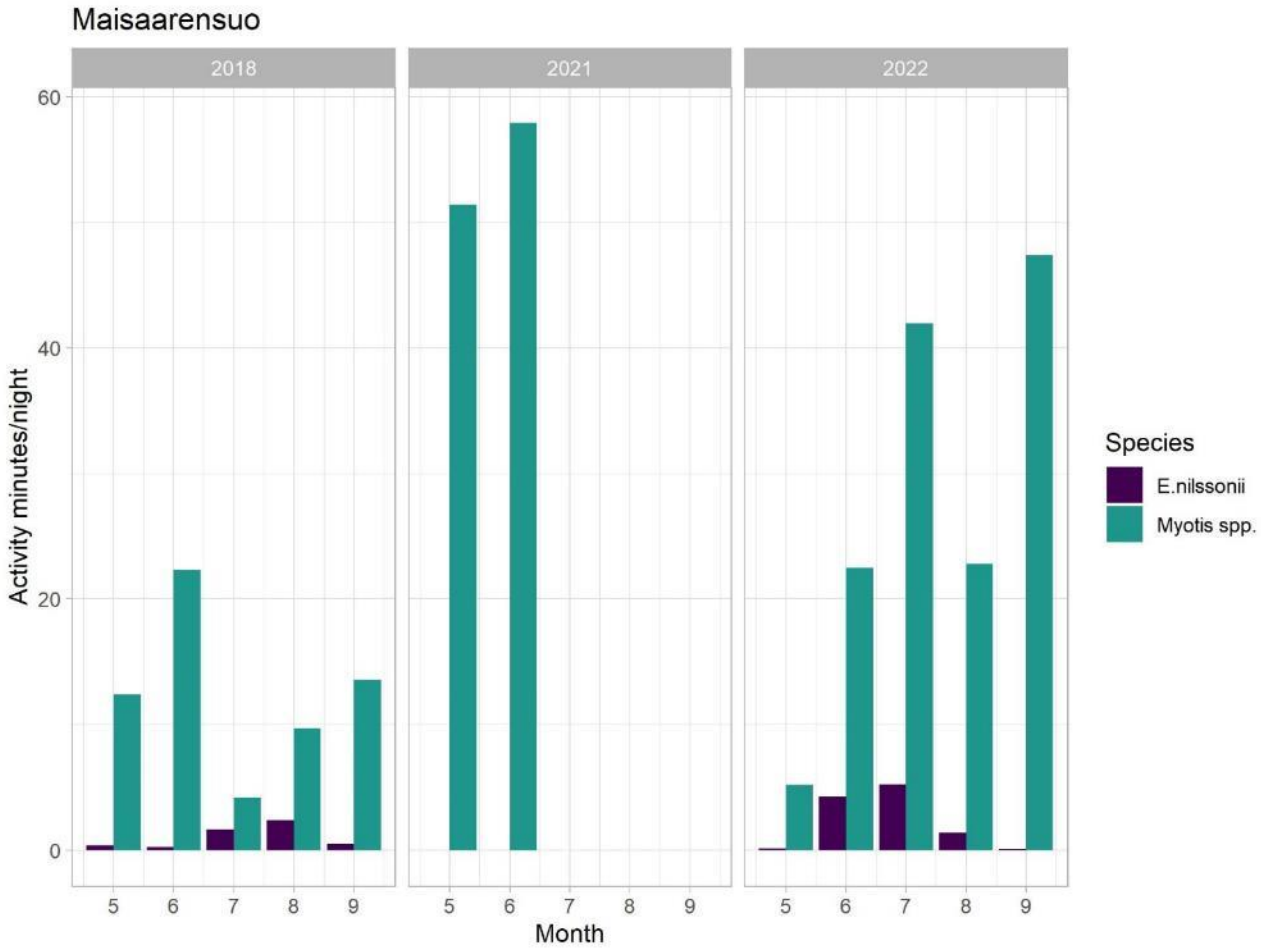


Maisaarensuo

Location: 22.64101°, 60.92400°
Restoration year: 2021 (spring)
Tree cover: high
Soil productivity: moderate
Distance to open water: > 1 km

Edge forest of a large open peat bog, next to big fields. Water level did not increase noticeably after the restoration, and tree removal was conducted far from the microphone. Nevertheless, Myotis spp. appeared to increase on the site.

There were technical problems with the device. In 2019 the detector recorded seemingly normally, but in the analysis phase the data did not contain any bats. In 2021 the microphone stopped working in the middle of the field season, which was not noticed until autumn.

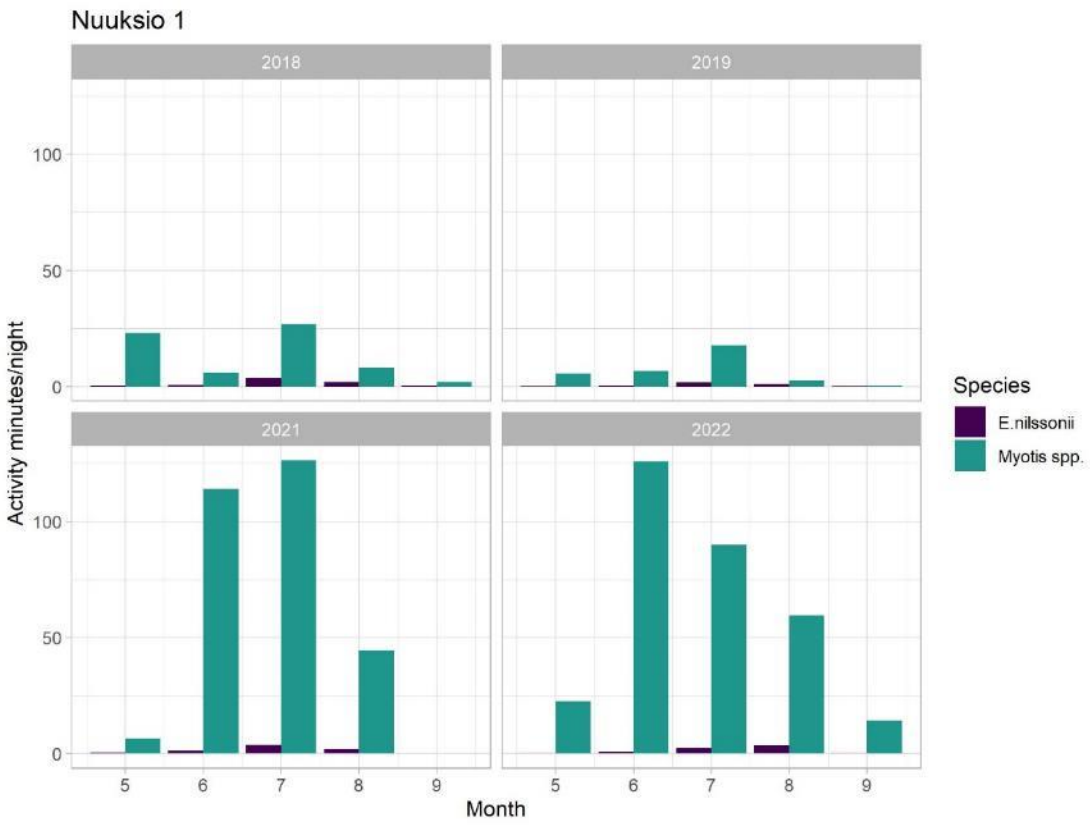


Nuuksio 1

Location: 24.52483°, 60.33453°
Restoration year: 2020
Tree cover: high
Soil productivity: high
Distance to open water: 580 m

Old spruce forest. Water level increased noticeably after the restoration. The positive effect on Myotis spp. was very clear. Tree cover probably remained too high for E.nilssonii.

Figure 22. Nuuksio 1 site before restoration.

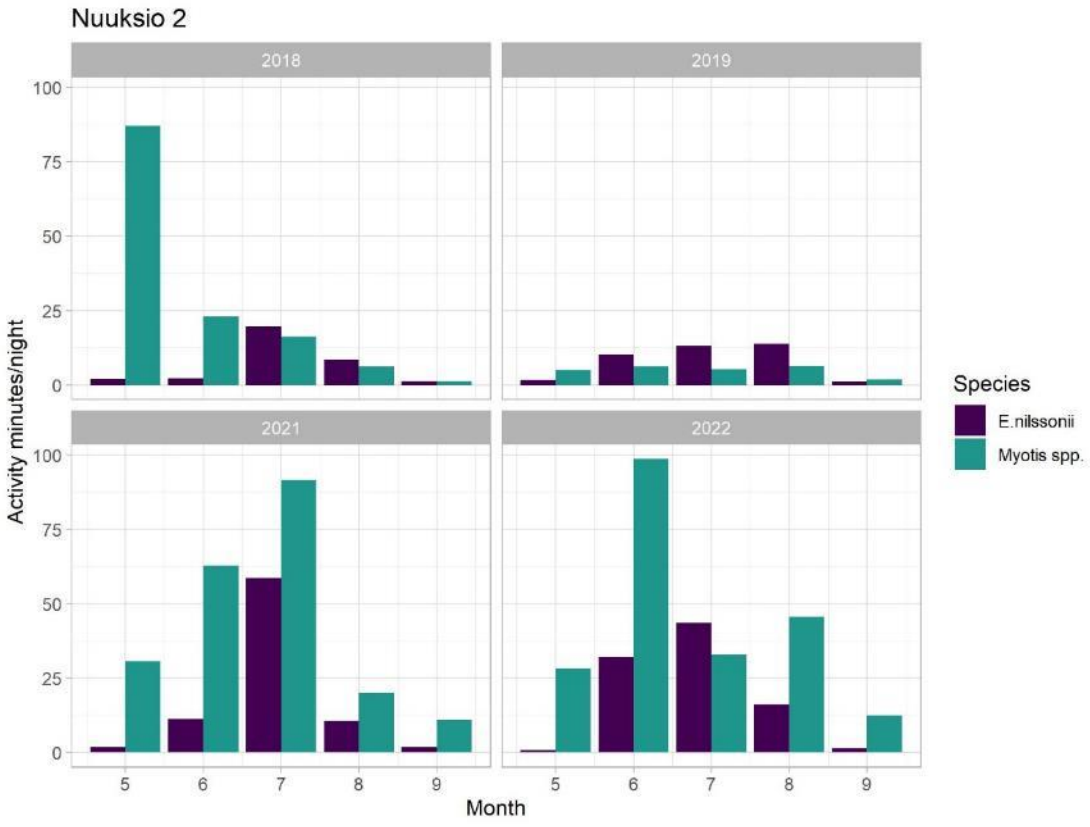


Nuuksio 2

Location: 24.54146°, 60.33964°
Restoration year: 2020
Tree cover: moderate
Soil productivity: moderate
Distance to open water: 150 m

Mixed forest close to a lake. Water level increased noticeably after the restoration and positive effects on both groups were clear. The habitat was more open compared to Nuuksio 1, which explains the increase of E.nilssonii.

Figure 23. Nuuksio 2 site in the first spring after restoration.



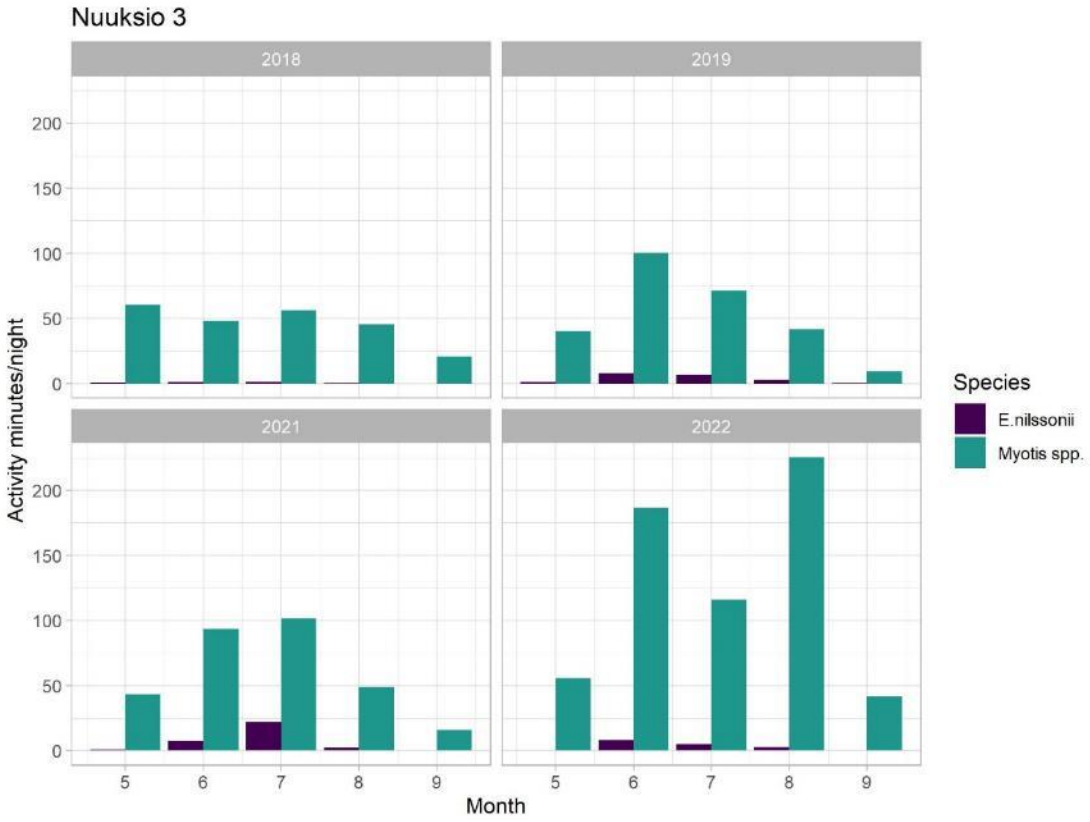
Nuuksio 3

Location: 24.55401°, 60.32678°
Restoration year: 2021*
Tree cover: high
Soil productivity: high
Distance to open water: 180 m

***ditches closed in winter 2022**

Old spruce forest with a small creek. The natural channel of the creek was mostly dry but was restored, and water level increased noticeably. The positive effect on Myotis spp. was very clear.

Figures 24. Nuuksio 3 site before and after restoration.



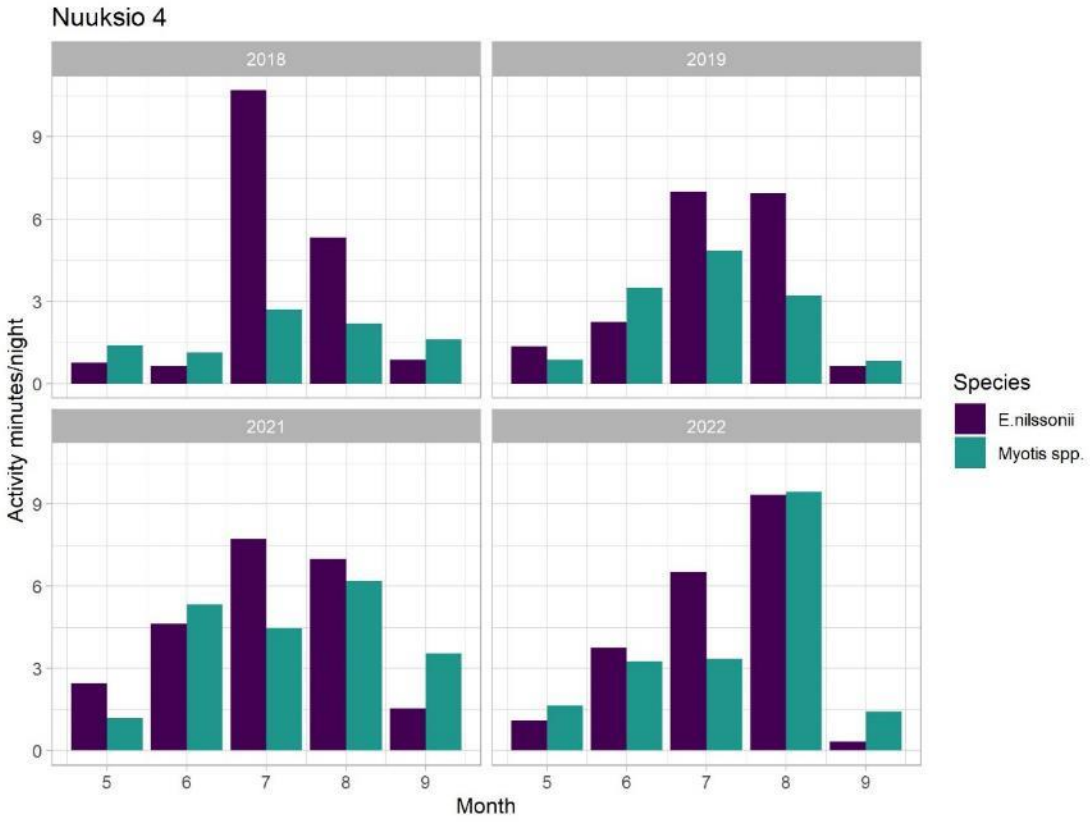
Nuuksio 4

Location: 24.47349°, 60.27474°
Restoration year: 2021*
Tree cover: high
Soil productivity: moderate
Distance to open water: 120 m (very small pond)

***after field season**

Mixed forest next to an open bog with a small pond in the middle. The only ditch was already quite closed before the restoration, and water level did not change noticeably. The bat activity on this site was the second lowest of all study sites (note the scale in graphs). There was no clear effect of restoration.

Figure 25. Nuuksio 4 monitoring site before restoration.

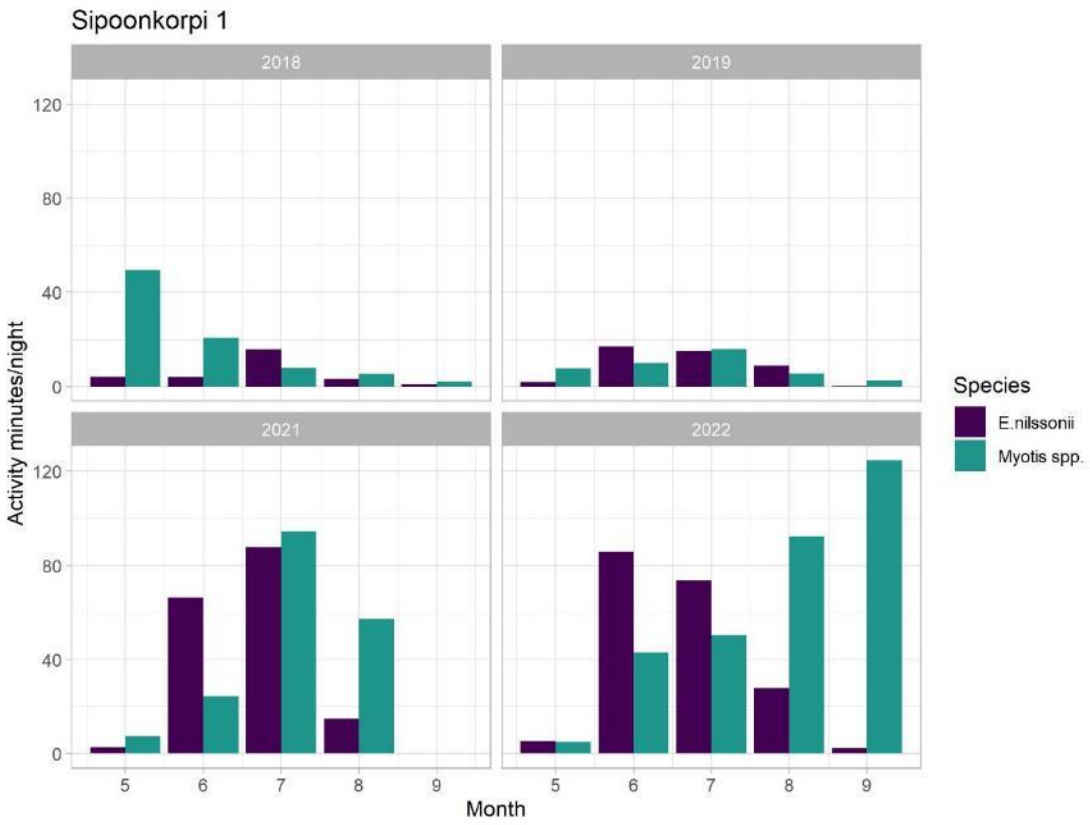


Sipoonkorpi 1

Location: 25.17036°, 60.29245°
Restoration year: 2020
Tree cover: high
Soil productivity: high
Distance to open water: >1 km

Old spruce forest. Water level increased noticeably, so much that it was difficult to reach the detector site after restoration. This was also seen in the bat activity. Both groups clearly increased.

Figure 26. Sipoonkorpi 1 site after succesful restoration.

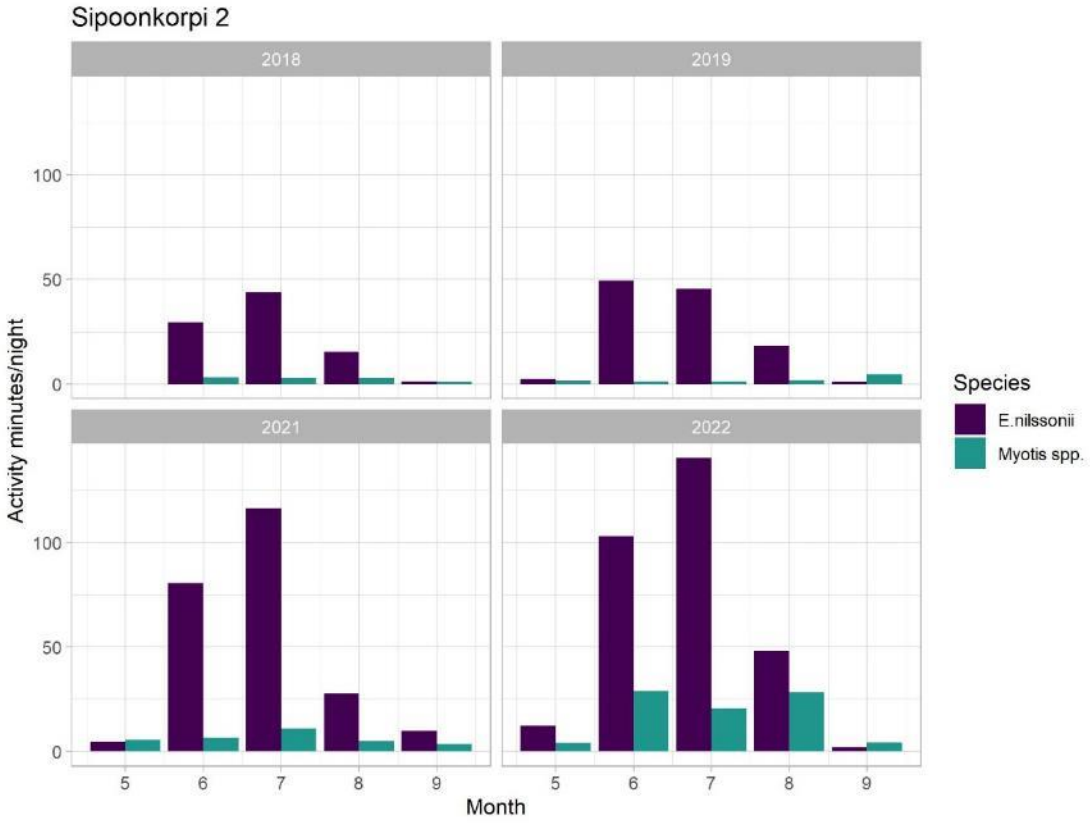


Sipoonkorpi 2

Location: 25.14851°, 60.30868°
Restoration year: 2020
Tree cover: high
Soil productivity: high
Distance to open water: 130 m

Border of old spruce forest and young deciduous forest. Water level increased moderately. The site was good for E.nilssonii, probably because there was hunting space above the younger forest. Restoration increased the activity of E.nilssonii, but relatively the activity of Myotis spp. increased even more, because it was very low before restoration.

Figure 27. Sipoonkorpi 2 site in the last autumn of monitoring.



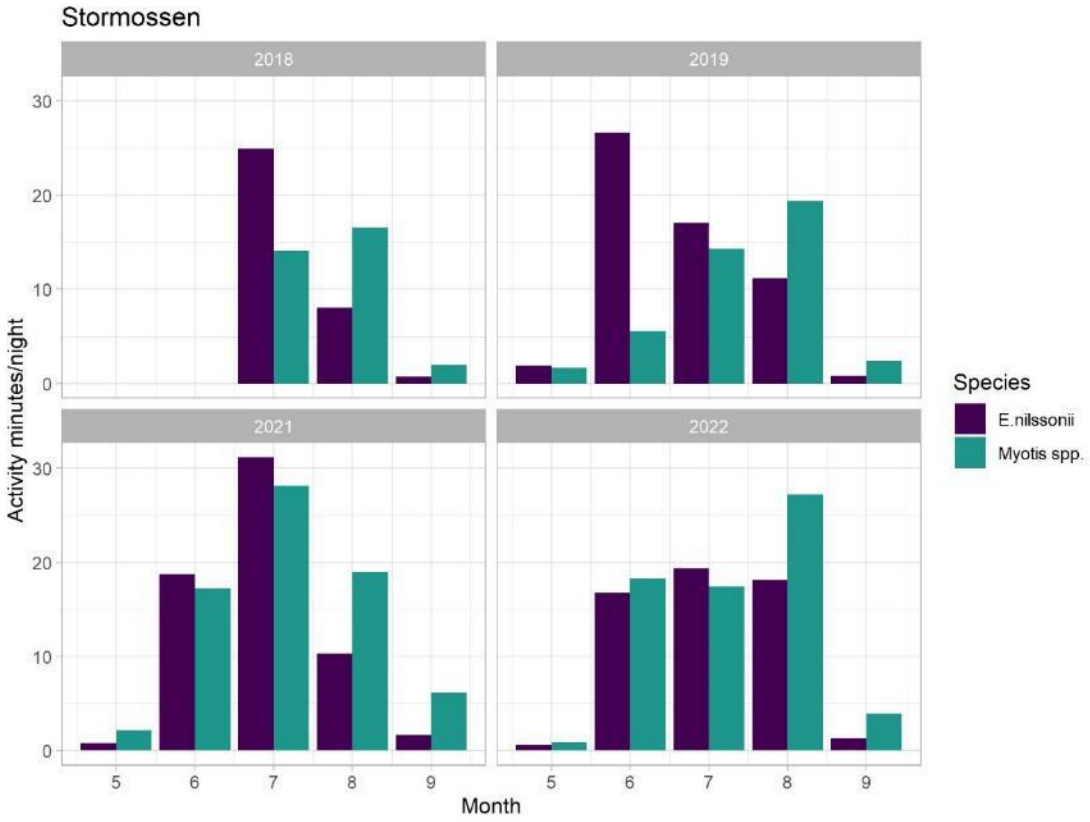
Stormossen

Location: 22.52246°, 60.06385°
Restoration year: 2018
Tree cover: low
Soil productivity: moderate
Distance to open water: >1 km

***ditches closed during late field season**

Edge of a large open bog. The detector was clearly on the open, which made it different to most other sites. Restoration was done earlier than planned, and we had only one season before restoration. The effect on bats was not clear. This was probably due to the detector being quite far away from the forest edge, where the water level rose more noticeably, and the habitat being too open for Myotis spp.

Figure 28. Stormossen was the most open bat monitoring site.



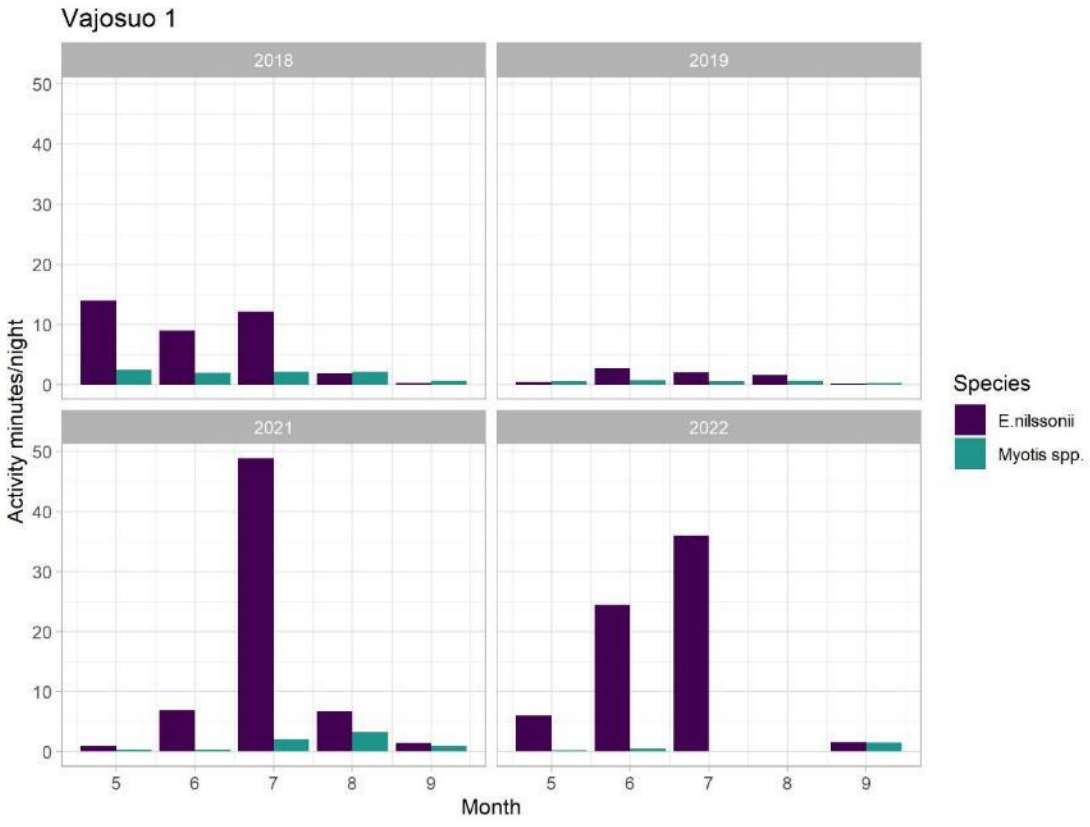
Vajosuo 1

Location: 22.33699°, 60.69210°
Restoration year: 2021
Tree cover: high -> low
Soil productivity: moderate
Distance to open water: >1 km

*** trees removed 2020, ditches closed during 2021 field season**

Pine-dominated peatland forest, where trees were totally removed. This changed the landscape completely for bats. Also the water level clearly increased. The activity of E.nilssonii increased, because the species prefers open landscape. However, the activity of Myotis spp. was low in the first place and remained low, because the landscape was too open for them.

Figures 29-30. Vajosuo 1 site was the one where tree cover changed the most.



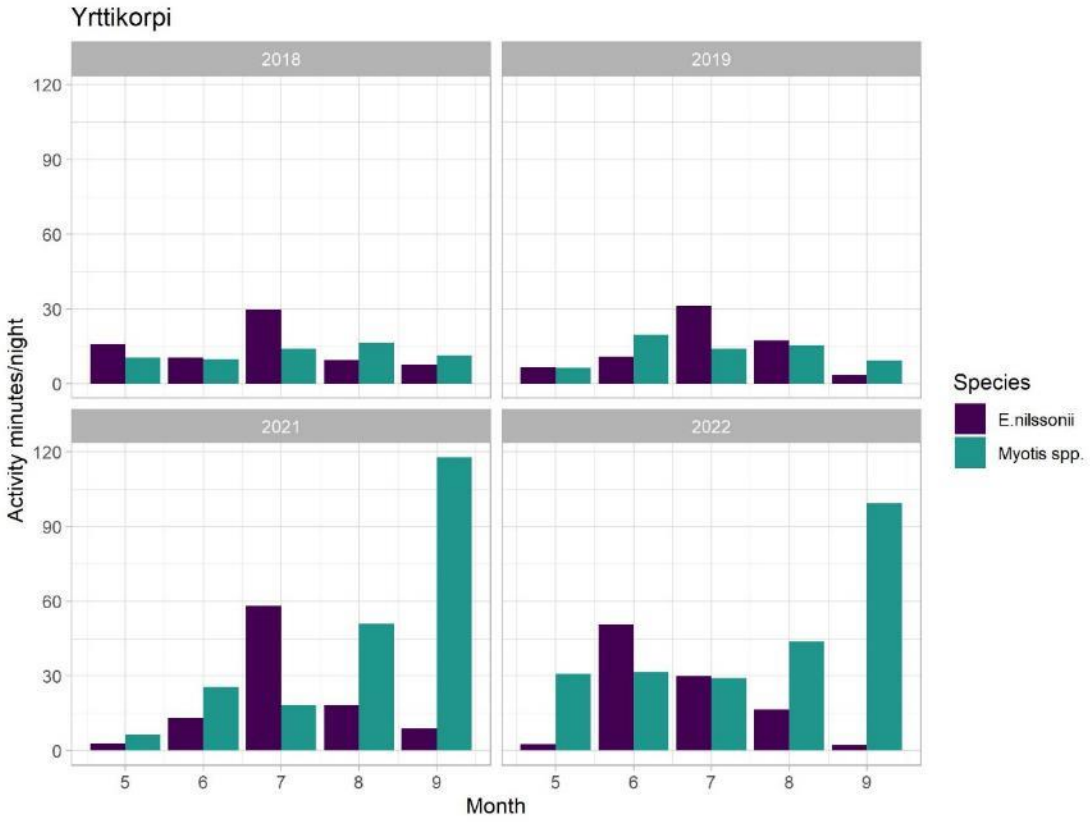
Yrttikorpi

Location: 23.64100°, 60.49717°
Restoration year: 2021
Tree cover: moderate
Soil productivity: high
Distance to open water: 280 m

***trees removed 2020, ditches closed during 2021 field season**

Spruce-dominated mixed forest. A small protected area between fields and commercial pine forests. The detector was placed next to a powerline opening. Trees were partly removed and water level increased markedly, which apparently made the site more suitable for Myotis spp.

Figure 31. Yrttikorpi site in spring 2021. Trees growing close to the ditches were cut before blocking them.


Yrttikorpi
2018
2019
2021
2022
Activity minutes/night
120
90
60
30
0
5
6
7
8
9
Month
Species
E.nilssonii
Myotis spp.

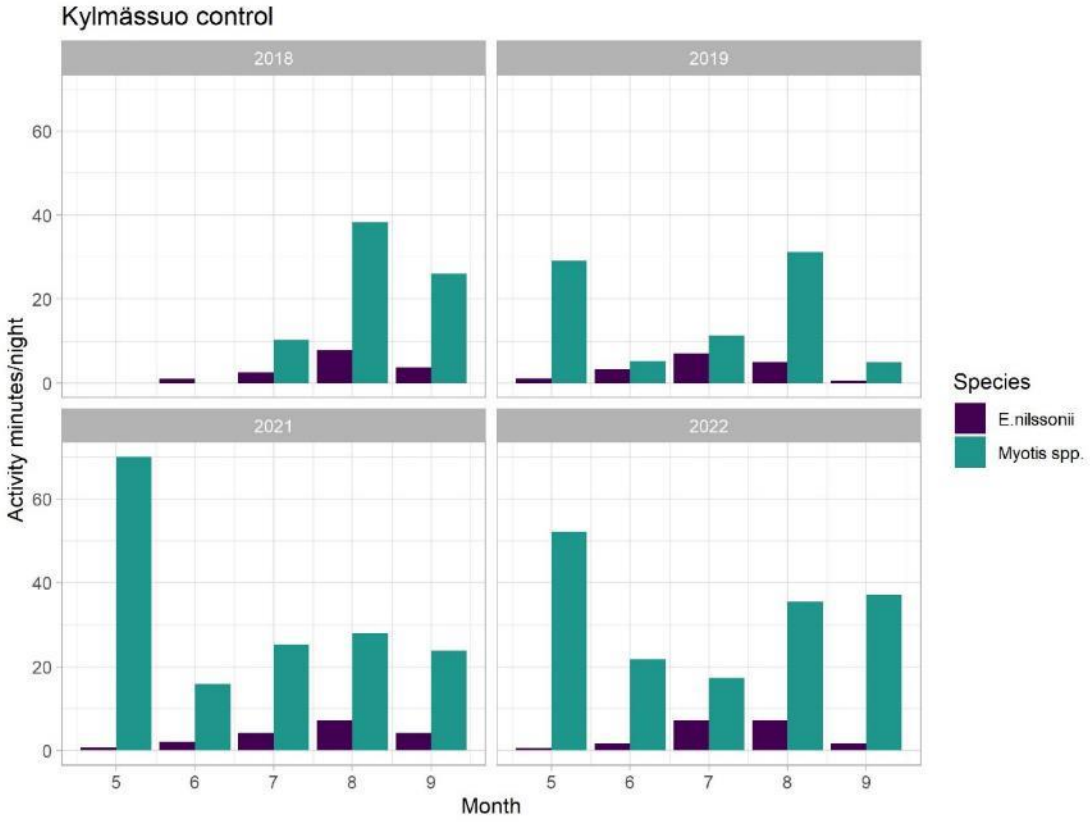
Control sites

In this section, details are provided on the sites that were not restored.

Kylmässuo control

Location: 23.05663°, 60.23099°
Tree cover: high
Soil productivity: high
Distance to open water: >1 km

Old, very moist spruce forest. *Myotis spp*. might have slightly increased on this site, although the monthly variation is great.

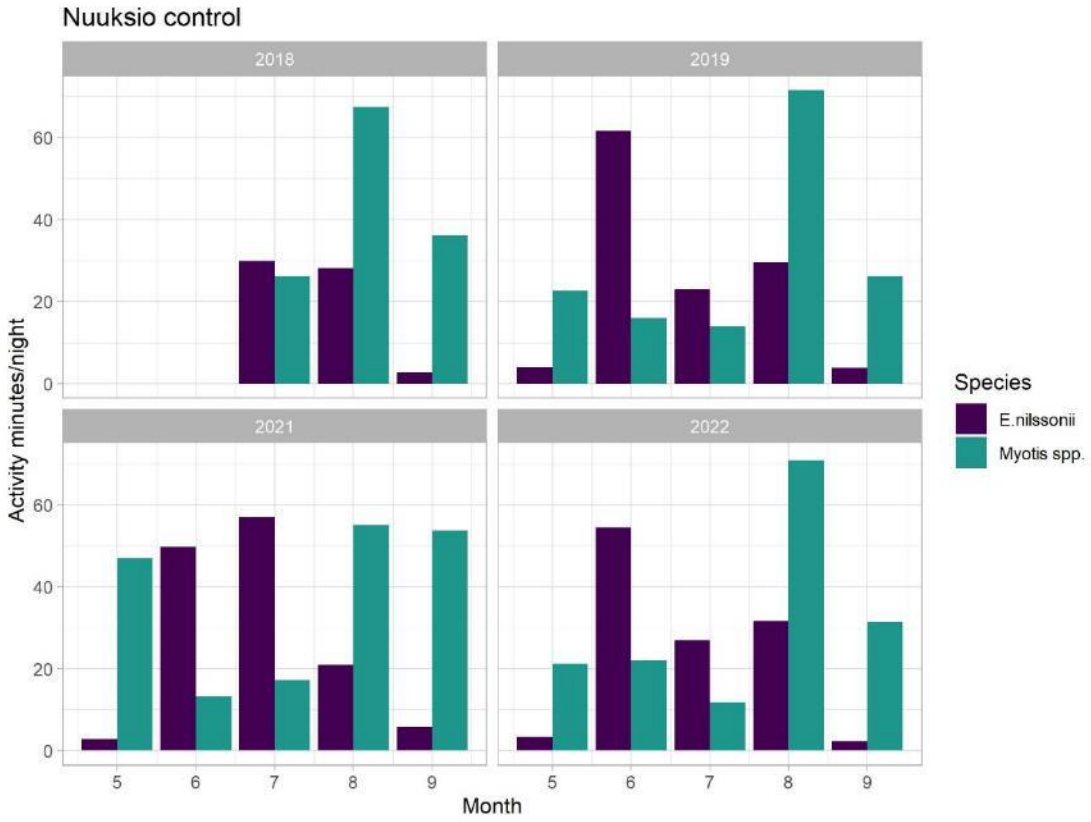


Nuuksio control

Location: 24.55378°, 60.33854°
Tree cover: low
Soil productivity: low
Distance to open water: 20 m

Pine forest and small reed area close to a lake. *E.nilssonii* and *Myotis spp.* were equally abundant and no change in bat activity was observed.

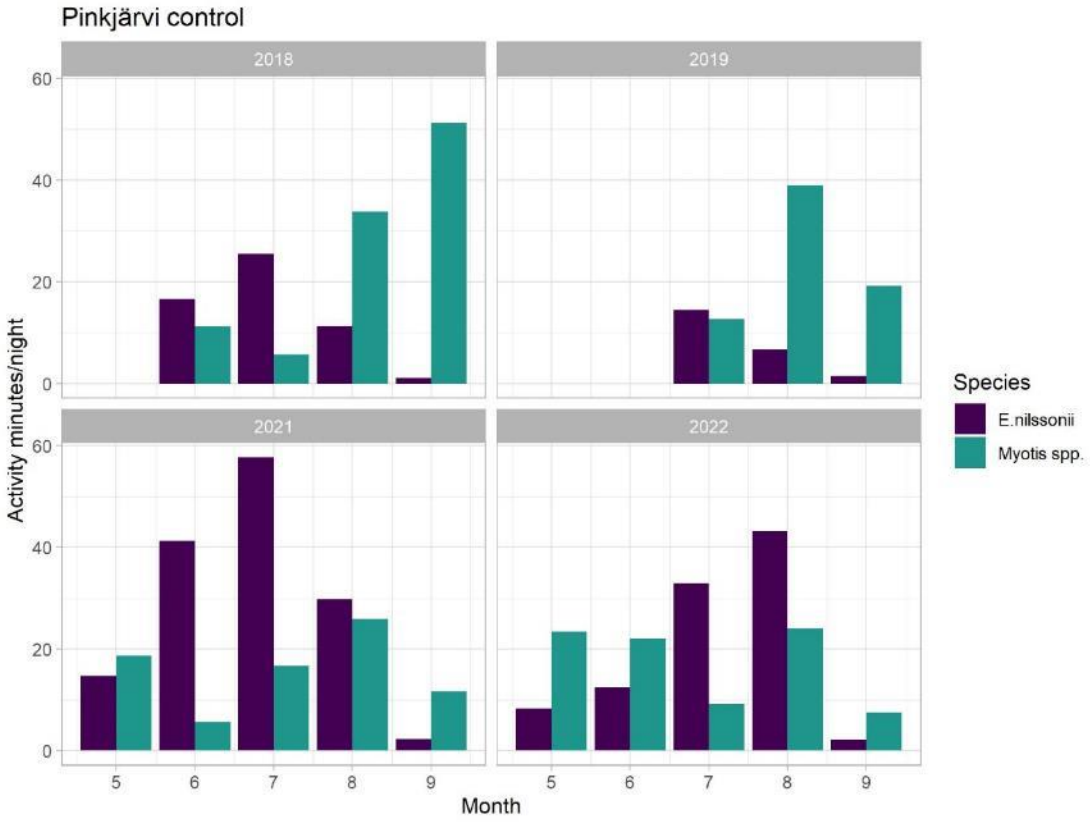
Figure 32. Nuuksio control site.



Pinkjärvi control

Location: 21.74897°, 61.29503°
Tree cover: moderate
Soil productivity: moderate
Distance to open water: 10 m

Birch forest and reed very close to a lake. *E.nilssonii* might have slightly increased.

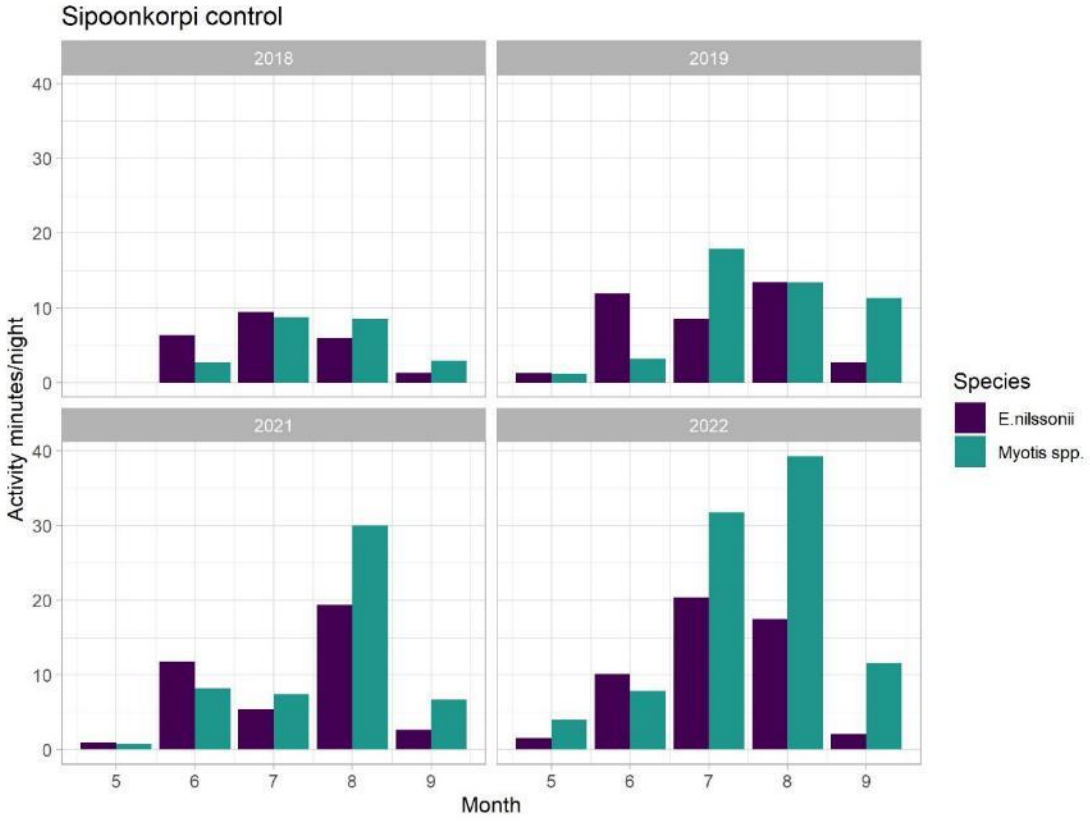


Sipoonkorpi control

Location: 25.16111°, 60.30907°
Tree cover: moderate
Soil productivity: high
Distance to open water: 780 m

Mature spruce forest on one side and young spruce/birch forest on the other. Detector was placed next to a small opening.

Figure 33. Sipoonkorpi control site.



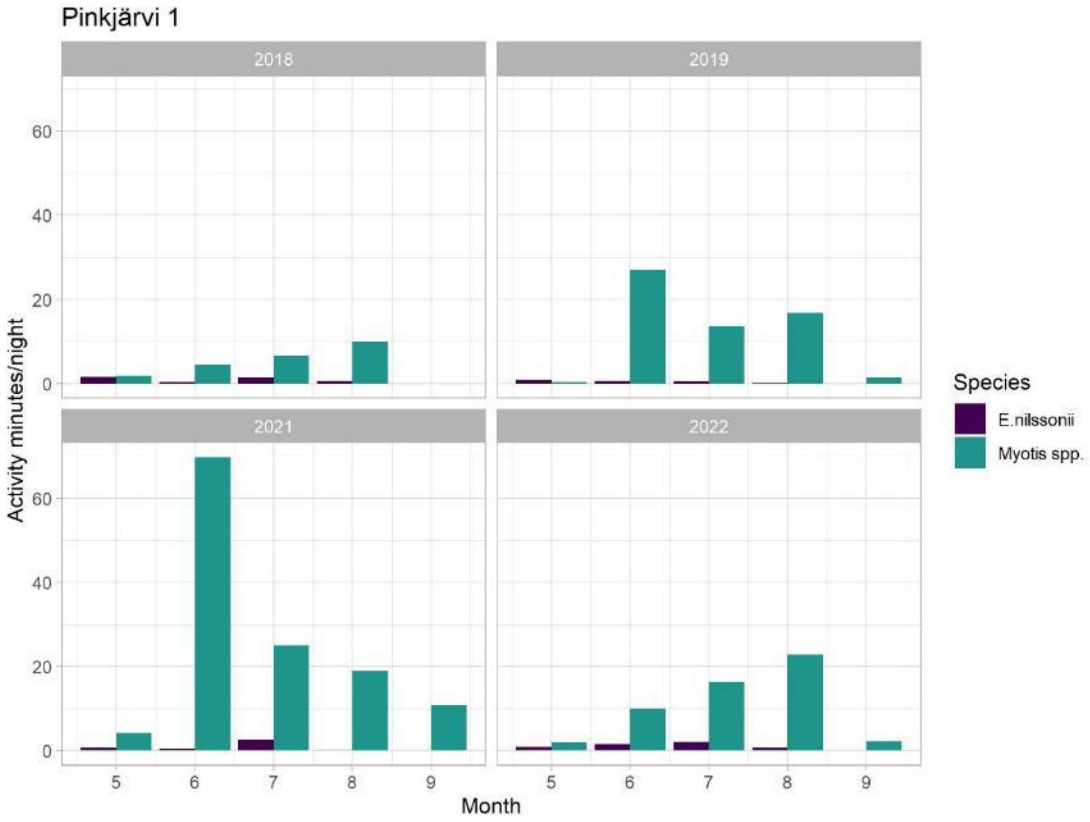
Extra controls

These sites were originally planned to be restoration sites, but were treated as controls due to failure or delay of restoration.

Pinkjärvi 1

Location: 21.73245°, 61.28629°
Tree cover: high
Soil productivity: high
Distance to open water: 450 m

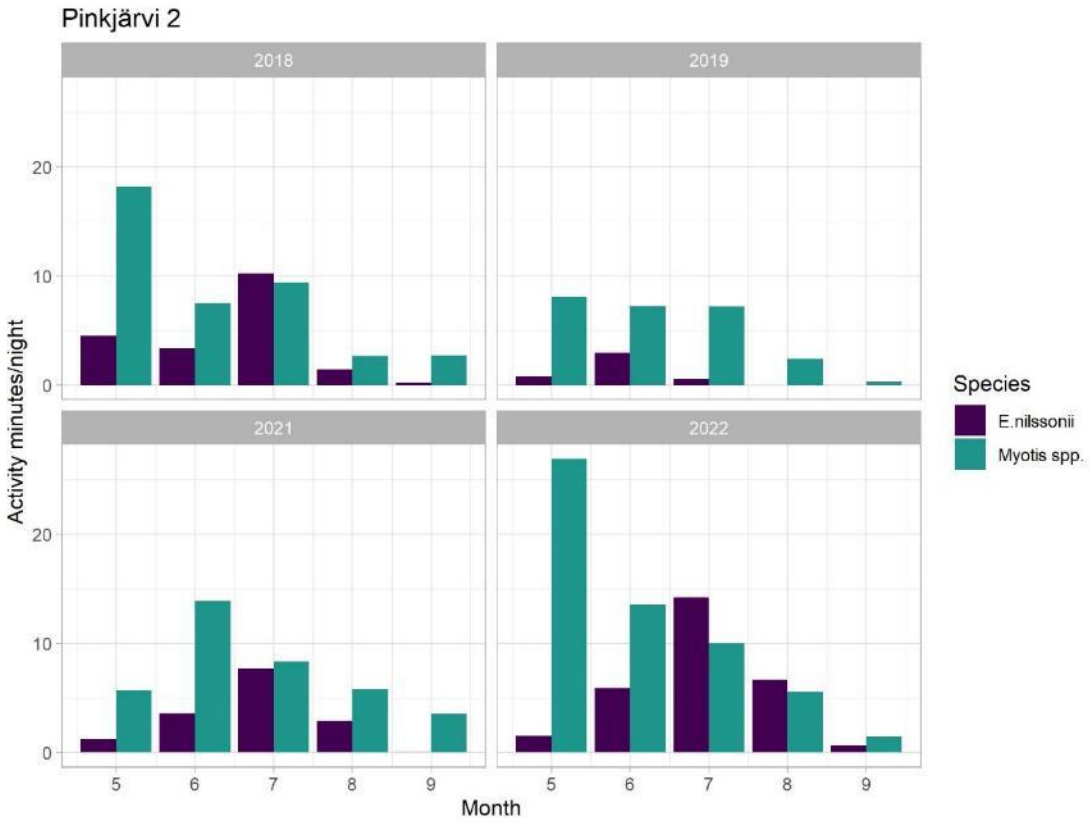
Old spruce forest. The site was not restored. *Myotis spp.* appear to have increased in 2021 but in 2022 their activity returned back to the level of 2018-2019.



Pinkjärvi 2

Location: 21.75922°, 61.29403°
Tree cover: moderate
Soil productivity: high
Distance to open water: 530 m

Old spruce forest. The site was not restored. It has been affected by beaver dams and the water level has increased already before the monitoring.



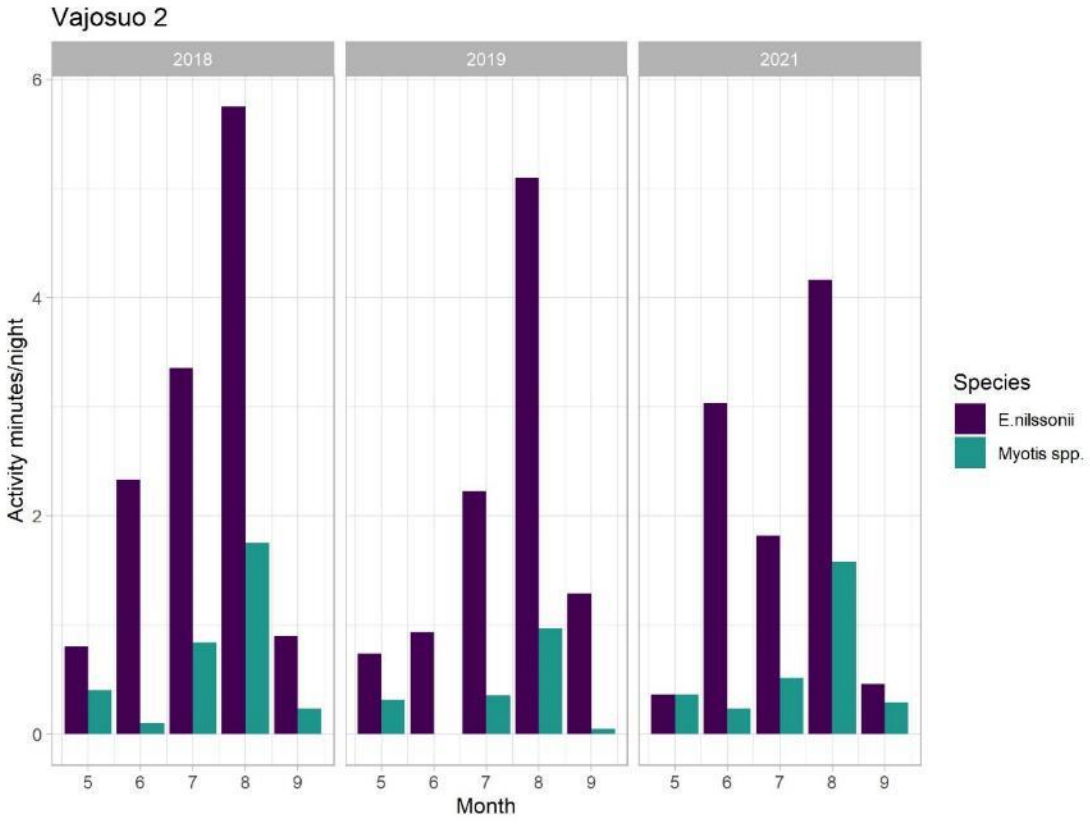
Vajosuo 2

Location: 22.35670°, 60.67815°
Tree cover: low
Soil productivity: low
Distance to open water: >1 km

The restoration was done as planned, but the detector was far away from the blocked ditches. It was placed between smaller ditches, which were not blocked, and the water level at the detector did not rise noticeably. The site was the one with least bat activity, probably because it was very open and low in productivity.

There were also technical problems with the detector in the last monitoring year. This caused the data to be useless (noise levels too high to find bats).

Figure 34. Vajosuo 2 site.



Conclusions

In most sites restoration had a clear positive effect on bats. This was not the case in all sites, however, depending on how clearly the water level increased, interactions with tree removal etc. Most importantly, restoration did not have negative effects on bats in any site. Higher numbers of Myotis compared to Eptnil in forests was expected. Many of the sites had rather closed canopy which is better for Myotis.

In some cases, the placement of the detector was not optimal, because it was difficult to estimate beforehand where exactly and how much the water level will rise. Based on our preliminary results, the positive effect on bats can occur in a very small scale (a few hundred meters). The restored sites probably cannot attract individual bats from far away, but local bats spend longer time feeding there, which causes higher activity.

Avoiding very open peatlands as monitoring sites was probably a good decision based on the low base level of bat activity at our most open sites (Stormossen, Vajosuo 2).

A more formal analysis of the data collected in this LIFE project is presented in the final report of this action.