



Flying Squirrel LIFE (LIFE17 NAT/FI/000469)

Nest boxes in Estonia (actions A9, C4 & D1)

Background and purpose of nest box installation

In Estonia, natural tree cavities in old-growth forests typically offer sufficient shelter for flying squirrels (*Pteromys volans*). However, in younger stands (less than 60 years old), pine-dominated forests, and intensively managed forests, natural cavities are often lacking. Flying squirrel habitats are also highly fragmented, meaning suitable forest patches are separated by areas with little or no cover. In such fragmented landscapes, squirrels face increased risk while moving between habitat patches or dispersing.

Installing nest boxes is currently the most effective way to quickly increase the number of safe hiding places for flying squirrels in these otherwise unsuitable areas. The boxes provide secure shelter in movement corridors and improve connectivity between habitat patches.

Nest box construction and installation

During the project, several conservation camps were organised for building and installing nest boxes. The design and construction of the boxes followed the Finnish flying squirrel nest box guidelines available at: https://julkaisutmetsta-ss4.focusflow.net/assets/pdf/lp/Esitteet/Liito_oravan_ponton_rakennusohje.pdf.

Altogether, around 60 people participated in the construction and installation activities.

Installation locations were selected using the modelled habitat network, particularly focusing on dispersal corridors to provide additional shelter and enhance movement safety for the squirrels.

Site selection criteria

Several factors were considered when selecting suitable sites for nest boxes:

- Flying squirrel habitat model (Leivits, 2020)
- Habitat network model (Kont, 2021)
- Availability of natural cavities (forest age and type)
- Nest box spacing of 50–100 metres
- Preference for placement near aspens or other deciduous trees
- Some boxes were installed in already occupied habitats to increase familiarity and likelihood of adoption
- Others were placed at habitat edges to offer safe hiding spots when crossing open areas
- Only state-owned land was used for installation

Approximately 15 of the nest boxes were fitted with trail cameras in 2022 to monitor usage.



Maintenance and monitoring guidelines

Each nest box should be inspected at least once a year. The recommended period for inspection is from late autumn to early spring — before songbirds such as tits begin nesting.

During inspections, nest boxes should be cleaned to remove old nesting material, which may harbor parasites such as fleas. Other debris, such as abandoned bird or mouse nests, food caches (e.g. dead birds or rodents stored by tawny owls), and wasp nests, should also be removed.

If a box has been damaged or has fallen from the tree, it must be repaired or replaced to ensure continued usability.

Monitoring results 2022-2024

All 250 nest boxes installed during the project for the benefit of the flying squirrel were inspected and maintained once per year during the monitoring period (Table 1). In addition to these, a smaller number of older nest boxes, installed prior to the LIFE project, were also checked annually.

During each inspection, findings were documented systematically. The species using each nest box was recorded. In the case of birds, nesting success was assessed. In nest boxes used by Eurasian pygmy owls (*Glaucidium passerinum*), the contents of food caches were identified to gather data on small mammal diversity in old-growth forests.

Year	Fieldwork period	No of LIFE nest boxes checked	No of older nest boxes checked
2022	17.08 - 29.10	250	75
2023	14.07 - 28.10	250	37
2024	4.10 - 21.10	250	37

Table 1. Number of nest boxes in the monitoring programme.



Figure 1. Estonian Environmental Board's flying squirrel expert Liisa Rennel is documenting nest box findings. Photo by Uudo Timm



Over the three-year monitoring period, the number of nest boxes occupied by flying squirrels remained low. While signs of flying squirrel use were detected in four boxes in 2022, no such findings were confirmed in 2023 or 2024. Nevertheless, the boxes proved to be valuable microhabitats for a variety of species.

The following table summarizes the monitoring results from 2022 to 2024:

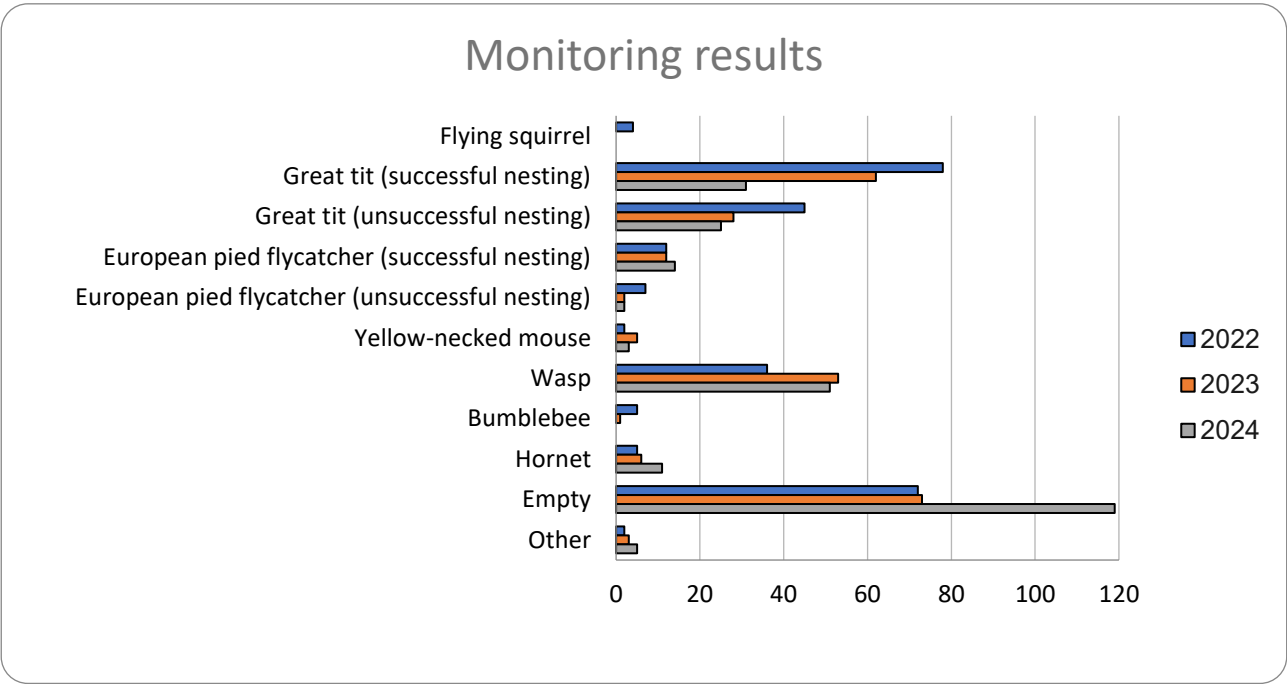


Figure 2. FS nest boxes (N=250) monitoring results 2022-2024

The boxes were most frequently used by great tits, which showed a steady but declining number of successful nesting events across the years. European pied flycatchers also utilized the boxes each year, though in smaller numbers. Other occupants included yellow-necked mice, wasps, bumblebees, and hornets. A growing number of boxes were found empty, particularly in 2024.

While flying squirrel use of nest boxes was lower than anticipated, this may reflect the species’ specific requirements for natural cavities and reluctance to adopt artificial structures in fragmented or disturbed habitats.

Continued monitoring may reveal long-term trends, especially as surrounding forests mature and habitat connectivity improves.



Figure 3. Flying squirrel inside the nest box. Photo by Uudo Timm



Figure 4. Bumblebee honeycomb was found in the bird's nest, which was in the flying squirrel nest box.
Photo by Liisa Rennel



Figure 5. Wasp's nest in the nest box. Photos by Liisa Rennel



Figure 6. If the nesting box does not fit, it can simply be used as a stable nesting platform. The song thrush's (*Turdus philomelos*) nest on the nest box. Photo by Liisa Rennel



Use of trail cameras in flying squirrel nest box monitoring

The analysis of trail camera data was carried out by Maris Mägi as part of her research. The main aim of the study was to assess the use of nest boxes installed in flying squirrel habitats and dispersal corridors using trail camera footages from 2023.

Prior to the LIFE project, trail camera monitoring in 2018 in two flying squirrel habitats confirmed that squirrels frequently used nest boxes. Physical inspections alone may not always reveal evidence of use by flying squirrels or other species, making trail cameras a valuable complementary method for data collection.

The study focused on footage from six trail cameras placed at nest boxes. One camera was located in a known flying squirrel nesting site, while the remaining five were positioned in dispersal corridors. The analysis used footages recorded in 2023, totaling 2257 videos.

Trail cameras were installed in the regions of Koolma, Eiga, Peressaare, and Suuressaare between 2022 and 2023. One camera near an older nest box in the Roogendiku flying squirrel habitat (Suuressaare region) has been in place since at least 2017. Trail cameras are checked several times a year to monitor battery levels and collect data from memory cards.

The footage showed that in young forest stands, a variety of species use nest boxes. According to physical inspections, the most frequent users are the great tit, wasps, pied flycatcher, and yellow-necked mouse. Trail camera recordings revealed a slightly broader range of species, including the nuthatch, great spotted woodpecker, flying squirrel, and yellow-necked mouse. Nest boxes were used for nesting (by birds, mice, and hymenopterans), roosting (mainly by tits), and food storage (by flying squirrels, mice, and Eurasian pygmy owls).

Some less common species, such as the brimstone butterfly and certain hoverflies, appear to use the nest boxes for shelter or overwintering. Observed behaviors included inspecting the box, entering and exiting, bringing in nesting materials (such as moss and leaves), feeding on or near the box, and general activity in the forest nearby.

Trail camera footage also provided additional information about mammal species in the area. The cameras recorded bears, wolves, moose, red squirrels, wild boars, and roe deer. One of the natural predators of flying squirrels, the pine marten, was seen near the nest boxes in Koolma, Peressaare, Suuressaare, and Roogendiku, indicating potential predation risk. No human disturbance was recorded by the trail cameras at any of the monitored sites.

Based on the analysis, it can be concluded that flying squirrels have not yet used the nest boxes placed in dispersal corridors, but they have repeatedly used those located in nesting areas. It is important to note that the corridors consist of suboptimal habitats for flying squirrels, and even though no physical signs of activity are left behind, the boxes might still be visited. Regardless, nest boxes in young stands increase habitat value for many other species.

It can also be concluded that hot summers significantly reduce nesting activity and the use of nest boxes.

Physical nest box inspections are labor-intensive and technically challenging. They only yield results when there are visible signs of use inside or on the box. Working with trail cameras is also time-consuming and involves several technical issues, such as battery depletion, incorrect timestamps, and duplicated file



names. The key difference is that nest box inspections are limited in scope and may miss important behavioral events, while trail cameras are capable of capturing more continuous and nuanced information.

In the long run, maintaining both monitoring methods requires substantial resources, but their combined use provides valuable insights that would otherwise be missed. Therefore, both approaches should be continued in future monitoring efforts.



Figure 7. Left: Pine marten is investigating FS nest box. Right: Female white-backed woodpecker (*Dendrocopos leucotos*) is knocking.



Nest box monitoring provides an excellent opportunity to gather educational material for schools and kindergartens. From the collected material, a small collection of bird nests was prepared for the Kilingi-Nõmme kindergarten.



Figure 8. Part of the educational material. Photo by Liisa Rennel

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