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B.2.1. Monitoring report Nectar Index and Parasitizing

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LIFE PROJECT NAME or Acronym
LIFE Oak Processionary

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1. Context

This report is a result of Action B.2 Roadside management. It is a combination of report 'Monitoring report Nectar Index' and the 'Monitoring report Parasitizing'. This report covers the whole project research period (2020 to 2024).

Research has shown that well-managed road verges can support a greater variety of plants (Jakobsson et al. 2018). Other studies reported that more plant and flower diversity can help control pest species naturally, by attracting insects that prey on or parasitize those pests (Tschumi et al. 2016, Albrecht et al. 2020). Several insect species are known to parasitize the Oak Processionary Caterpillar (OPC) (de Boer and Harvey 2020), with parasitism rates as high as 90% reported in the Netherlands (Zeegers 1997, Zwakhals 2005).

Recent online articles suggested that making road verges more natural and increasing flower abundance could attract more OPC parasitoids, potentially boosting parasitism rates (van Deijk 2019, Bos 2020). However, these early claims were based on limited data.

2. Objectives

Current roadside conditions in Flanders and the Netherlands often lack the natural features and flower diversity needed to support insects that parasitize the Oak Processionary Caterpillar. Our goal was to demonstrate that more natural road verges—with greater flower abundance and variety—can significantly increase parasitism rates in OPC populations. To test this, we monitored vegetation and parasitism levels at 56 sites across participating provinces, representing a wide range of naturalness. Based on our findings, we expect that parasitism rates will be higher in the natural road verges, clearly outperforming less natural sites.

3. Experiment setup

In 2020, we selected 56 roadside locations across participating provinces in the Netherlands and Flanders, representing a broad range of naturalness. To measure naturalness, we used three indicators:

- Species richness in the herb layer
- Herb layer cover
- The Nectar Index, which reflects food availability for the parasitoids

In short, more natural road verges have more herb species that cover a larger area of the road verge and produce more flowers which results in a higher nectar index.

Each test site consisted of a row of 15 oak trees spaced 6–10 meters apart. The Oak Processionary Caterpillar (OPC) populations at these sites were allowed to develop naturally, without insecticides or other control measures. Routine roadside maintenance continued under local municipalities, often through subcontractors. To inform the public, all sites displayed information boards about the LIFE project and its management approach. From 2021 to 2024, we monitored both the roadside vegetation and the parasitism rates of OPC nests to assess the impact of road verge naturalness on biological control.

3.1 Site characteristics

3.1.1 Vegetation relevés

Each sample site was visited annually between late May and early June to record vegetation data. We measured:

- The number of herb species present
- Percentage cover of the herb layer
- Average vegetation height
- Percentage cover by grasses

The main natural enemies of the Oak Processionary Caterpillar are Tachinid flies and Ichneumonid wasps. These insects have short mouthparts, so they cannot access nectar in deep flowers. While we calculated a nectar index based on pollinator resources (mainly for bees and butterflies with longer mouthparts), this may not fully reflect food availability for OPC parasitoids.

Plants from the daisy/aster (Asteraceae) and umbellifer (Apiaceae) families provide shallow flowers, which are suitable for Tachinid flies. Therefore, we also measured the percentage cover of these families. In addition, we recorded the cover of brambles, as a small pilot study suggested their presence might influence OPC parasitism rates.

Figure 1: Impressions of one of the test locations

3.1.2 Nectar index

The nectar index (FLORON 2025), developed by FLORON, Floristisch Onderzoek Nederland) is a tool that measures the value of a roadside for pollinators. It works by assessing the flowers present and scoring them based on their nectar production. The nectar production data for each plant species comes from the British AgriLand Nectar Database (Environmental Information Data Centre 2025). For each site, the nectar value of all flowering plants is combined with their abundance, and the result is classified into five categories from 1 (No or very little nectar) to 5 (High nectar availability). In short, the nectar index provides a clear indication of how attractive a roadside is for pollinators.

3.1.3 Landscape variables

The surrounding landscape can influence both the distribution of herbaceous plants and the presence of OPC parasitoids. To account for this, we measured the percentage cover of forests, farmland, meadows, and urban areas within a 1,000-meter radius around each sample site. We also recorded the exact latitude and longitude of each location to identify potential geographic trends, such as east–west or north–south differences.

3.1.4 Vegetation data preparation

Many of the roadside habitat variables we measured were strongly correlated (Figure 2). To simplify and avoid overlap, we applied a multifactor analysis to create new composite variables that are independent of each other.

The first composite factor is closely linked to herb species richness, herb cover, nectar index, and the presence of plants from the daisy/aster (Asteraceae) family. This factor serves as a practical "naturalness index." Sites with a higher naturalness score have more herb species, greater vegetation cover, more flowers producing nectar, and a higher proportion of daisy-family plants—key indicators of a healthy, biodiverse road verge.

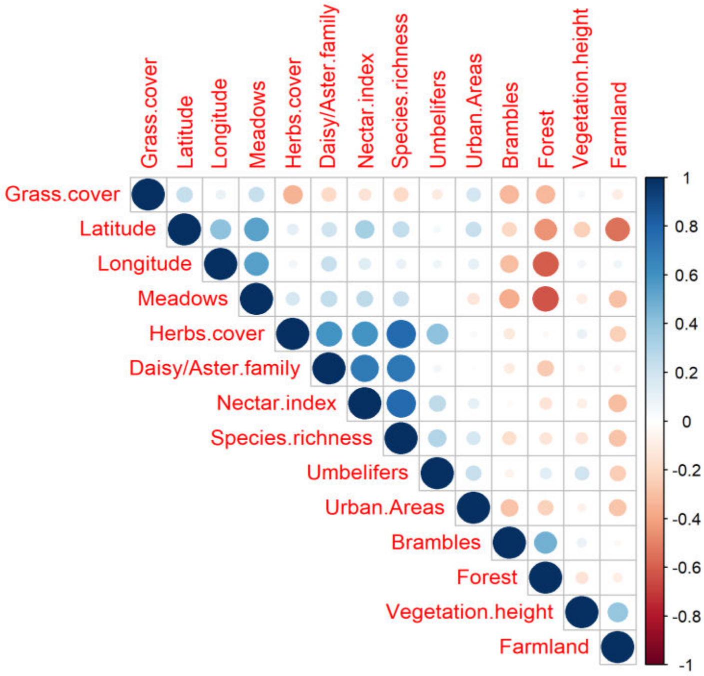

Figure 2: Correlations among the measured road verge and landscape variables. Blue = positive correlated, red = negative correlated. The size of the circle indicates the strength of the correlation.

The second composite factor reflects a landscape gradient. It is positively associated with forest cover and bramble presence, and negatively with meadow cover, grass cover, and geographic position (longitude and latitude). In practical terms, this factor represents a shift from more forested areas in the northeast of the study region to more open, meadow-rich landscapes in the southwest. Brambles are more common in forested zones, while grasses dominate in meadow areas.

The third factor is linked to vegetation height and the presence of umbellifer plants. These three factors will be used to examine whether parasitism rates in Oak Processionary Caterpillar nests are influenced by environmental conditions.

3.2 Parasitisation level

Each year, at every study site, we collected three Oak Processionary Caterpillar (OPC) nests and brought them to the laboratory for analysis. Larger nests were prioritized to ensure a more accurate estimate of parasitism levels. Each nest was placed in a separate cardboard box sealed with mesh (Figure 4). When insects began to emerge, the mesh was replaced with a dark cloth and a funnel leading to a jar containing alcohol. Emerging moths and parasitoids naturally moved upward into the jar. At the end of the process, the boxes were opened to check for any parasitoids that had emerged but did not reach the jar. All parasitoids and moths were identified and counted to calculate the parasitism rate for each nest.

In addition, we estimated OPC population size at each site by counting the number of nests in the trees using binoculars during annual surveys.

Table 1: Correlation between the measured road verge and landscape variables and the 3 new variables obtained with multifactor analysis.

Variable	Naturalness	Forest - Meadow	Dim.3
Species Richness	0.89		
Nectar index	0.80		
Herbs Cover	0.75		
Daisy/Aster family	0.74		
Forest		0.74	
Rubus		0.70	
Latitude		-0.47	
Longitude		-0.48	
Meadow		-0.57	
Grass Cover		-0.68	
Umbellifers			0.68
Vegetation Height			0.56
Farmland			
Urban			

Figure 3: Collecting nests.

Figure 2: Rearing cages in the lab.

3.3 Roadside management

To assess whether the vegetation management at our test sides affects the naturalness and/or parasitisation rate we recorded which techniques were used.

4. Results

Over the four-year study, we collected and reared 339 Oak Processionary Caterpillar nests. From these, we recorded 20,754 Tachinid flies, 201 Ichneumonid wasps, and 7,337 moths. This clearly shows that Tachinid flies are the dominant parasitoids compared to wasps. Parasitism rates varied widely—from 0% to 100%—with an overall average of 73%, indicating that natural control can be highly effective under the right conditions.

Figure 3: Ichneumonid wasp (left) and Tachinid flies (centre & right)

During the LIFE project, the overall Oak Processionary Caterpillar population declined sharply across Flanders and the Netherlands. This drop was likely driven by natural population cycles and changing weather conditions. As a result, the number of nests and sites available for research decreased significantly over time. Already in the first year, eight locations that had nests in 2020 showed none. In 2021, some sites had to be excluded because local communities applied insecticides. Consequently, the number of sites with nests fell from 43 in 2021 to just 20 in 2024, and the total number of nests dropped from 1,605 in 2021 to 202 in 2024.

Because of this sharp decline, we focused our main analysis on the 2021 dataset—the year with the most data—while also performing a combined analysis using all four years to confirm trends.

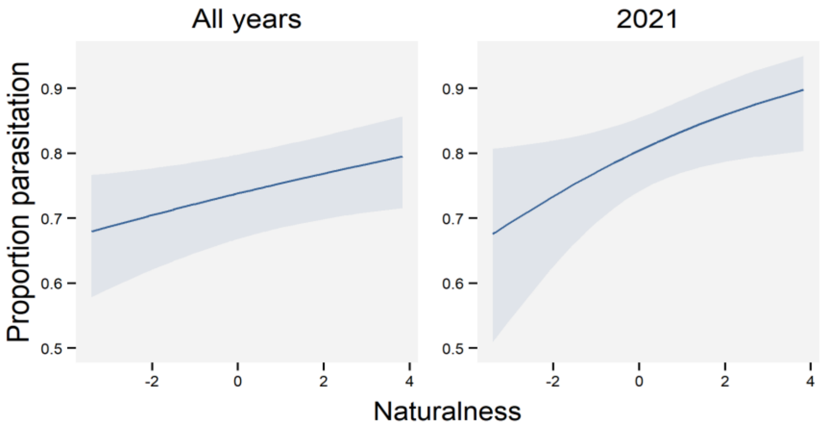

Figure 6: Relationship between naturalness of a road verge and the proportion parasitisation of the OPC nests. The mean lines are calculated based on an average value on the forest – meadow gradient.

Parasitism rates were consistently high throughout the LIFE project (Figure 6). Even at sites with the least natural roadside vegetation, the average parasitism rate was around 70%. Both analyses—one using all four years of data and another focusing on 2021—show that parasitism increases as roadside naturalness improves. The effect was stronger in 2021, with about a 20% increase, compared to just under 10% when all years were combined. This difference may be due to the larger OPC population in 2021 or the reduced dataset in later years, which limits statistical power.

Landscape context also influenced parasitism rates. Sites in forested areas had lower parasitism compared to more open landscapes with meadows (Figure 7). Because this forest–meadow gradient aligns with a north–south and east–west pattern, we cannot rule out other factors, such as climate, playing a role.

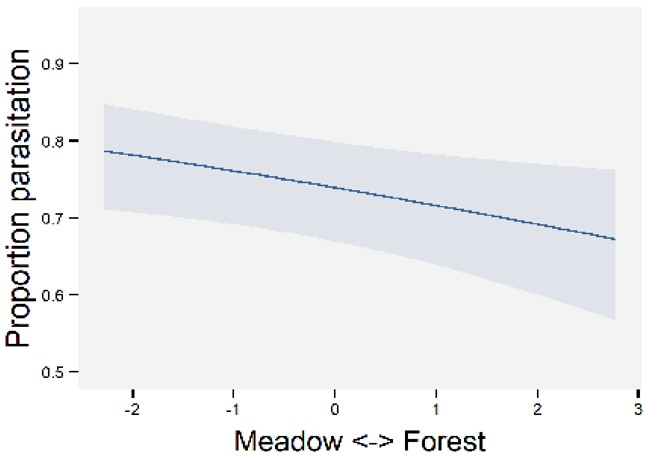

Figure 7: Relationship between landscape characteristics and parasitisation rate of OPC nests.

We studied how different ways of maintaining roadside vegetation might affect its naturalness and parasitisation rate (Table 2). Most roadsides were mowed once in autumn, usually with hay removal. Many were mowed twice—once in June and again in autumn—with hay removal each time. Frequent mowing like a lawn was only deployed once, grazing by sheep at two sites, and no maintenance at all at one site. Because these last methods were rare, we couldn't fully test their impact.

Table 2: Roadside management practices deployed at the study sites

Management	Hay removal	# Sites
Mowing twice (June - Sept-Oct)	Removed	18
Mowing once (Sept-Oct)	Removed	24
Mowing once (Sept-Oct)	Left	3
Multiple mowing	Removed	1
Sheep grazing		2
No management		1

Among the mowing methods, There was no difference between mowing once or twice with hay removal. We couldn't check what happens when mowing twice without hay removal, because no sites used that method.

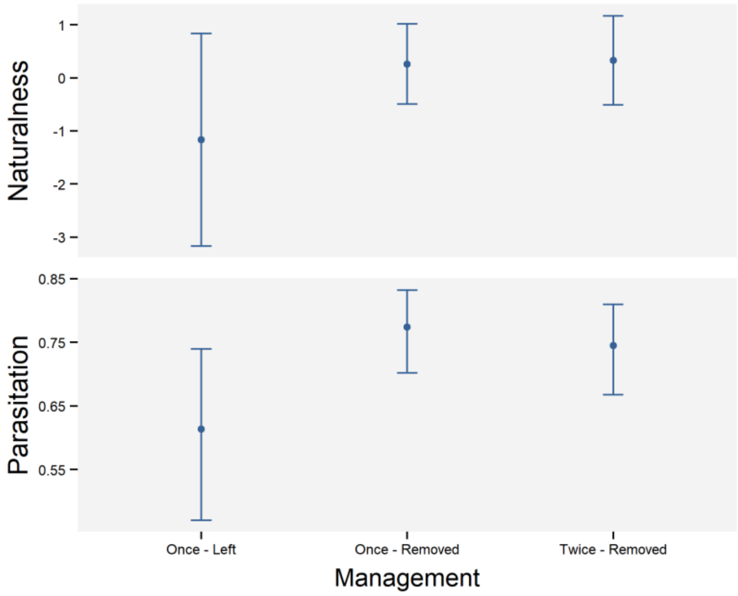

Figure 8: The effect of roadside management on the naturalness of the road verges and parasitisation rate of the OPC nests. Once = Mown once in autumn, Twice = mown twice in June and autumn, Removed = hay removal, Left = hay left on the verge.

5. Conclusions

Our results indicate that roadside verges with higher levels of natural vegetation tend to support greater parasitism of oak processionary caterpillar (OPC) nests, aligning with our initial hypothesis. The effect size, however, is moderate. In 2021, when OPC populations peaked, parasitism rates at the most natural sites were approximately 20% higher compared to sites with low or no naturalness.

Vegetation characteristics such as herb cover, species richness, and nectar availability were strongly correlated, making it difficult to isolate the most influential factor. The nectar index included flower species whose nectar is inaccessible to key parasitoids (Tachinid flies and Ichneumonid wasps). Correlations suggest that plants from the Daisy/Aster (Asteraceae) family may provide better resources for parasitoids than those from the Umbellifer (Apiaceae) family. To clarify the role of individual flower species, we are collaborating with Meise Botanical Garden to conduct pollen DNA analysis to identify which flowers are visited by parasitoids.

Although we cannot yet determine whether overall plant diversity or the abundance of specific species is most critical, the evidence clearly supports that more natural roadside vegetation enhances parasitism rates. Management practices should therefore aim to increase naturalness. Based on our limited test set, removing hay after mowing appears preferable to leaving it. A review of 54 field studies (Jakobsson et al., 2018) further supports that annual mowing—ideally twice per year—with hay removal generally promotes higher plant species richness compared to unmown verges. Timing of mowing is essential to ensure that flowers attractive to parasitoids are available during their flight period.

6. Continuation and additional research

To clarify the role of individual flower species in the attraction of parasitoids, we are collaborating with Meise Botanical Garden to conduct pollen DNA analysis to identify which flowers are visited by parasitoids. For that reason, in the spring of 2025 we collected several parasitoids from some of our test locations. The results of this study are expected in 2026.

Depending on the outcome of this (small scale) research, we could alter our recommendations for road verge management to promote specific plant species that are favoured by these parasitoids.

Since this was only a small-scale study, there are opportunities to continue this research on a larger scale with other parasitoid species and with specimens from other locations and other types of road verges.

An additional research topic is the mapping of the complete life cycle of these parasitoids. Some of these that infect OPC also have alternate intermediate hosts, which are currently unknown for the project area. If those intermediate hosts could be identified, we probably could refine our recommendations to also promote these hosts.

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