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COMPARATIVE EFFICIENCY OF DIFFERENT TRAP TYPES IN CAPTURING PHYLLOPHAGOUS INSECTS IN THE PĂDUREA VERDE FOREST (WESTERN ROMANIA)

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Abstract. *The study was carried out in the Pădurea Verde Forest (Timiș, Western Romania), a mixed deciduous woodland dominated by oak species. Its purpose was to compare the efficiency of several trap types in capturing flying phyllophagous insects in marginal forest habitats. Four types of traps were used: yellow-green sticky panels, box-type pheromone traps, roof-type (Delta) pheromone traps, and ICCRR pheromone traps. Monitoring took place between July and September 2025, with 20 observation points distributed across seven sectors along the southern forest margin. Captures were collected biweekly, and species identification was performed in the Entomology Laboratory. Results indicated that ICCRR and sticky traps recorded the highest mean number of captures, while box and roof traps showed moderate efficiency. Among the captures were forest-specific, polyphagous, and agro-horticultural pest species, ranging from hemipterans (aphids and leafhoppers) to large and small lepidopterans (moths and butterflies, both diurnal and nocturnal). The temporal dynamics revealed a distinct peak in insect activity during mid-to-late August, followed by a decline in September. The results confirm that pheromone-based and color-attractive traps complement each other, providing reliable tools for monitoring phyllophagous insect populations in forest-edge ecosystems, and supporting integrated pest management strategies in forest environments, especially those with deciduous forests.*

Keywords*: pheromone traps; sticky panels; phyllophagous insects; forest-edge ecosystems; insect monitoring; Pădurea Verde Forest*

INTRODUCTION

Deciduous forests host a rich diversity of invertebrates, among which phyllophagous insects (those feeding on leaves) play a dual role: they contribute to the cycling of organic matter and to ecosystem dynamics (HWANG ET AL., 2024), but can also cause significant damage to the regeneration and health of forest stands when their populations exceed tolerance thresholds (HILMERS ET AL., 2023).

The forest edge, representing the transitional zone between shrub and tree vegetation and the adjacent open habitat, is a particularly complex ecological space. In this area, the abundance, structure, and dynamics of species differ significantly from those found within the forest interior, as a result of microclimatic changes, resource availability, and trophic interactions characteristic of edge effects (MURCIA, 1995). Therefore, assessing the efficiency of various types of traps placed along the forest edge is essential both for monitoring insect fauna and for implementing effective strategies of integrated pest management (DE MICHELE AND GROZEA, 2018), since the structure and composition of edge vegetation strongly influence insect distribution and activity (HARPER ET AL., 2005).

Comparative studies on capture techniques represent a fundamental tool for understanding the efficiency of different types of traps used in monitoring phyllophagous insects in forest ecosystems. Trap types such as chromatic traps, pheromone or food-attractant traps, Malaise traps or pitfall traps may provide different estimates of species abundance and diversity, depending on their mechanism of attraction and functional characteristics (SOUTHWOOD & HENDERSON, 2000).

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The efficiency of a trap is influenced by several design-related factors, including size, shape, color, and type of attractant, as well as by its placement, such as height above ground, orientation, and proximity to structural elements of the habitat (MUIRHEAD-THOMSON, 2012). In addition, local conditions such as vegetation composition, humidity, and seasonal variability can significantly affect capture rates and the taxonomic composition of collected samples (TURCHIN & ODENDAAL, 1996; SCHMIDT ET AL., 2016).

In the deciduous forests of western Romania, dominated by oak species (Quercus robur, Q. cerris, Q. rubra) and including other hardwood species such as *Fraxinus excelsior*, *Acer campestre*, *Acer platanoides*, *Tilia sp.*, *Ulmus campestris*, *Juglans nigra* and *Robinia pseudoacacia*, communities of actively flying phyllophagous insects can be effectively monitored by traps placed along the forest edge.

Among the main leaf-feeding defoliators, *Lymantria dispar* L. (the gypsy moth) and *Operophtera brumata* L. (the winter moth) are considered the most significant species causing extensive defoliation of oak foliage. The larvae of both species feed on leaves during successive developmental stages, reducing the photosynthetic surface and negatively affecting tree growth and vitality (BOUKOUVALA ET AL., 2022; SARVAŠOVÁ ET AL., 2020).

In forest stands where oak species dominate (approximately 69% of composition), the simultaneous use of pheromone, chromatic, and interception traps is justified for a comparative assessment of the abundance and diversity of flying phyllophagous insects (BRÖCKERHOFF, 2023). Pheromone traps, in particular, have proven useful for monitoring the flight of L. dispar and O. brumata, providing valuable information for assessing defoliation risk and for implementing appropriate control measures (BĂLĂCENOIU ET AL., 2024).

Through this study, we aim to compare the efficiency of several types of commercially available traps, placed along the marginal areas of a deciduous forest, in capturing flying phyllophagous insects.

MATERIAL AND METHODS

Study site

The Green Forest, designated as the study site, is located in the western part of Romania and consists mainly of deciduous tree species, with oak (*Quercus spp.*) as the dominant genus, along with black walnut (*Juglans nigra*), ash (Fraxinus excelsior), maple (*Acer spp.*), Turkey oak (*Quercus cerris*), sycamore (*Acer platanoides*), and black locust (*Robinia pseudoacacia*). Although it is classified as a deciduous forest, it also includes a small proportion of Scots pine (*Pinus sylvestris*), representing approximately 0.45% of the total stand composition, according to data provided by the Timiș Forest District (ACHIM AND BUZATU, 2018).

The forest covers an area of about 5.6 hectares and is administratively part of the municipality of Timișoara.

Trap types and installation points

In the southern part of the forest, which was divided into seven sectors, four types of traps were installed, five of each type, resulting in one trap at each of the twenty pre-established observation points (Figure 1).

The traps, purchased from various online suppliers, included yellow-green sticky panels for capturing Hemiptera, Coleoptera, and small Lepidoptera; box-type pheromone traps for large Lepidoptera; roof-type pheromone traps (Delta) for medium-sized Lepidoptera; and Kit pheromone traps (ICCRR), mainly used for agro-horticultural Lepidoptera species.

Selection of the study area and observation frequency

The traps were installed from the forest edge towards the interior, maintaining a distance of 50 m from the margin and covering the entire southern peripheral area. Trap readings and replacements were carried out every two weeks during the July-September monitoring period. Species quantification and identification (PALAGESIU ET AL., 2000; GROZEA, 2015) were performed in the Laboratory of Phytosanitary Diagnosis and Expertise and in the Entomology Laboratory (from ULST) (Figure 1), both equipped with performance analysis instruments.

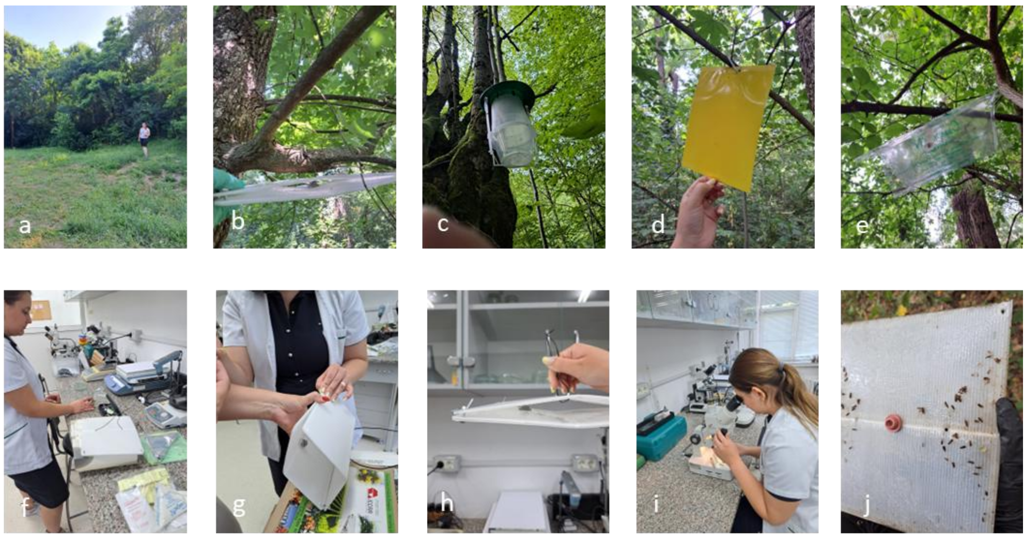

Figure 1. Trap placement in the Green Forest; a, landscape next to the forest, near an observation point; b, pheromone Kit trap location (ICCRR), c, box-type pheromone trap; d, colored sticky panel trap location; Delta type pheromone trap; e-h, trap preparation at the Laboratory; detailed observations for insect species identification

Statistical analyses

Statistical analysis was performed using descriptive parameters (mean and standard deviation) to compare the efficiency of trap types and to evaluate temporal variations in insect captures across the monitoring period.

RESULTS AND DISCUSSIONS

In Sector 1, the four trap types exhibited distinct capture efficiencies over the monitoring period. ICCRR pheromone traps recorded the highest mean capture rate (50 ± 25.8 individuals), followed by yellow-green Sticky traps (23.7 ± 9.9). Roof-type traps (13.2 ± 2.8) and Box-type traps (11.2 ± 6.1) were less effective overall.

The temporal trend indicated a sharp increase in captures from mid-July, with a clear peak in August, particularly in ICCRR and Sticky traps. A marked decline was observed in September, suggesting reduced flight activity of phyllophagous insects toward the end of the vegetation season.

These results confirm the superior sensitivity of ICCRR traps and the consistent reliability of Sticky traps for monitoring flying phyllophagous species in the forest-edge environment. (Figure 2).

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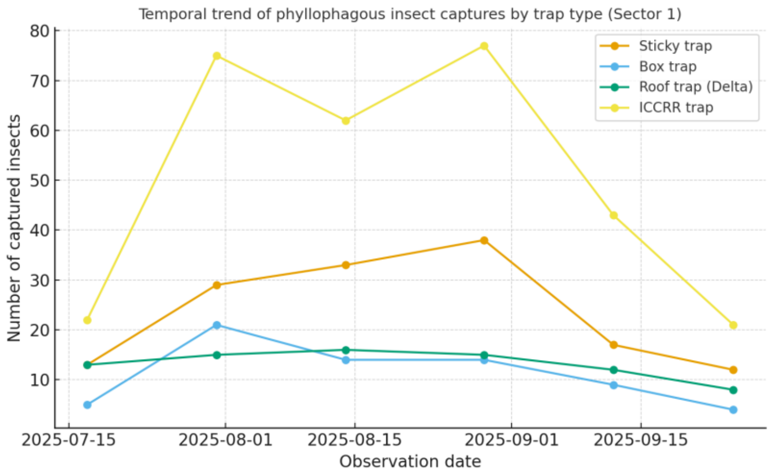

Figure 2. Temporal trend of phyllophagous insect captures recorded by four trap types (Sticky, Box, Roof, and ICCRR) in Sector 1 of Pădurea Verde Forest, during the July-September 2025 monitoring period

In Sector 2, ICCRR pheromone traps again proved to be the most efficient, with an average of 21.2 ± 8.9 captured individuals, followed by Sticky traps (10.7 ± 6.6). Box traps (3.5 ± 2.3) and Roof traps (7.5 ± 3.1) recorded lower capture rates.

The temporal pattern showed an increase in captures from mid-July, reaching a maximum in late August (37 individuals in ICCRR traps), followed by a general decrease in September. These results support the consistency of ICCRR and Sticky traps as effective monitoring tools for flying phyllophagous insects in the marginal forest area (Figure 3).

In Sector 3, ICCRR and Sticky traps showed comparable performance, with mean capture values of 16.2 ± 6.6 and 15.8 ± 8.0, respectively. Roof-type traps (13.0 ± 4.7) demonstrated intermediate efficiency, while Box-type traps (7.5 ± 4.3) recorded the lowest capture rates.

The capture dynamics indicated increasing insect activity from mid-July to late August, followed by a pronounced decline in September. These results confirm the mid-summer flight peak of phyllophagous species and the consistent reliability of ICCRR and Sticky traps for monitoring purposes (Figure 4).

In Sector 4, the average number of captured individuals varied among trap types, with Sticky and ICCRR traps showing the highest efficiency (26.2 ± 10.2 and 25.7 ± 10.1, respectively), followed by Box traps (21.3 ± 8.9) and Roof traps (16.7 ± 7.2).

The temporal pattern revealed a clear increase in captures from mid-July to late August, when maximum values were recorded (43 individuals in Sticky traps, 42 in ICCRR traps). Although captures declined in September, insect activity remained notable, indicating an extended flight period of phyllophagous species in this area of Pădurea Verde Forest (Figure 5).

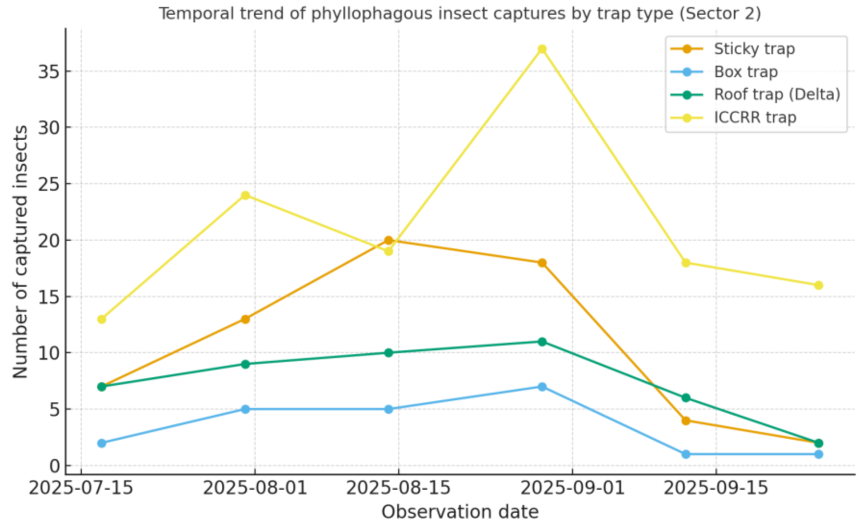

Figure 3. Temporal trend of phyllophagous insect captures recorded by four trap types (Sticky, Box, Roof, and ICCRR) in Sector 2 of Pădurea Verde Forest, during the July-September 2025 monitoring period

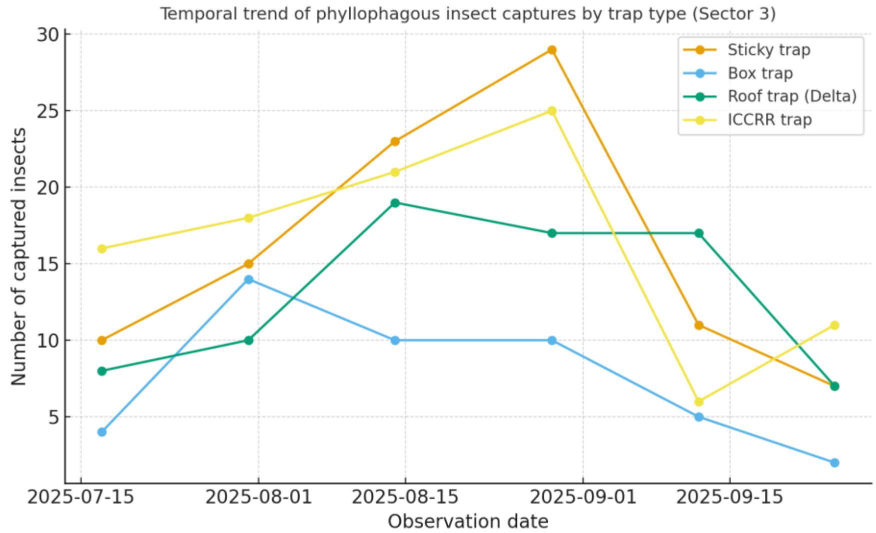

Figure 4. Temporal trend of phyllophagous insect captures recorded by four trap types (Sticky, Box, Roof, and ICCRR) in Sector 3 of Pădurea Verde Forest, during the July-September 2025 monitoring period

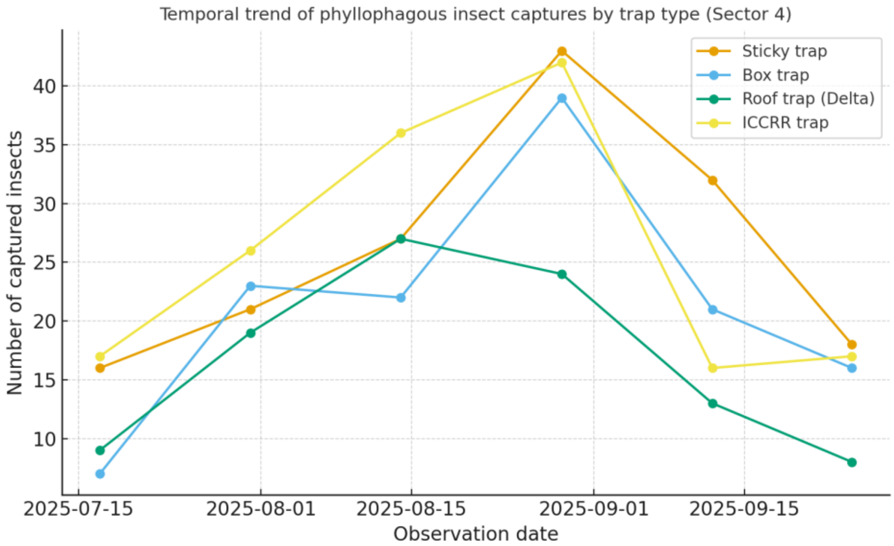

Figure 5. Temporal trend of phyllophagous insect captures recorded by four trap types (Sticky, Box, Roof, and ICCRR) in Sector 4 of Pădurea Verde Forest, during the July-September 2025 monitoring period

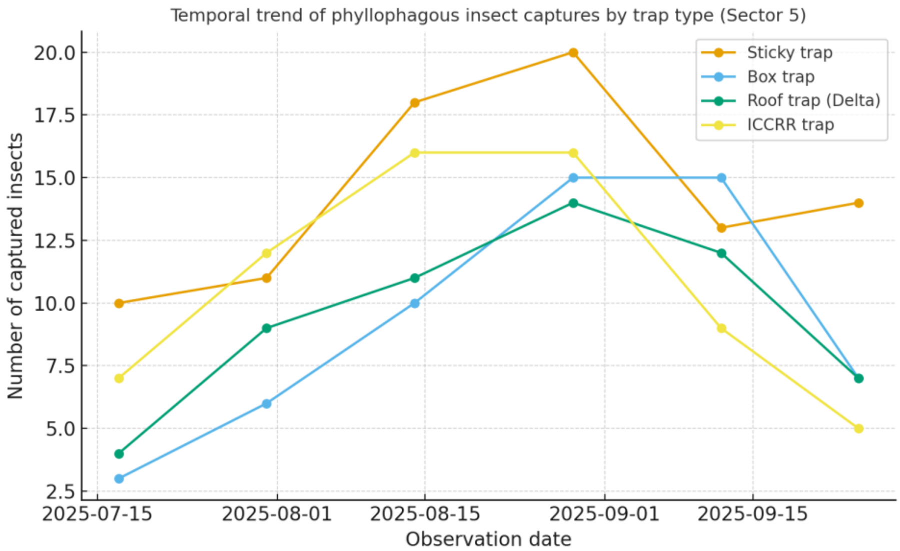

Figure 6. Temporal trend of phyllophagous insect captures recorded by four trap types (Sticky, Box, Roof, and ICCRR) in Sector 5 of Pădurea Verde Forest, during the July-September 2025 monitoring period

In Sector 5, Sticky traps recorded the highest average capture number (14.3 ± 4.0), followed by ICCRR traps (10.8 ± 4.2). Box and Roof traps showed comparable mean values (9.3 ± 4.9 and 9.5 ± 3.4, respectively).

The temporal variation indicated a moderate increase in captures from July to late August, with a slight decline in September. Although the number of insects captured was lower than in other sectors, the general pattern confirmed consistent mid-summer activity of phyllophagous insects across all trap types (Figure 6).

In Sector 6, ICCRR traps were the most efficient, capturing an average of 31.7 ± 13.3 individuals, followed by Sticky traps with 21.3 ± 9.8. Box and Roof traps showed lower means (9.2 ± 5.7 and 10.7 ± 3.1, respectively).

The capture dynamics revealed a marked increase in insect activity from mid-July to late August, peaking at 45 individuals in ICCRR traps. By mid-September, captures had significantly decreased, indicating the end of the main flight period. The results confirm the dominance of ICCRR and Sticky traps for monitoring phyllophagous insects during peak summer months in Pădurea Verde Forest (Figure 7).

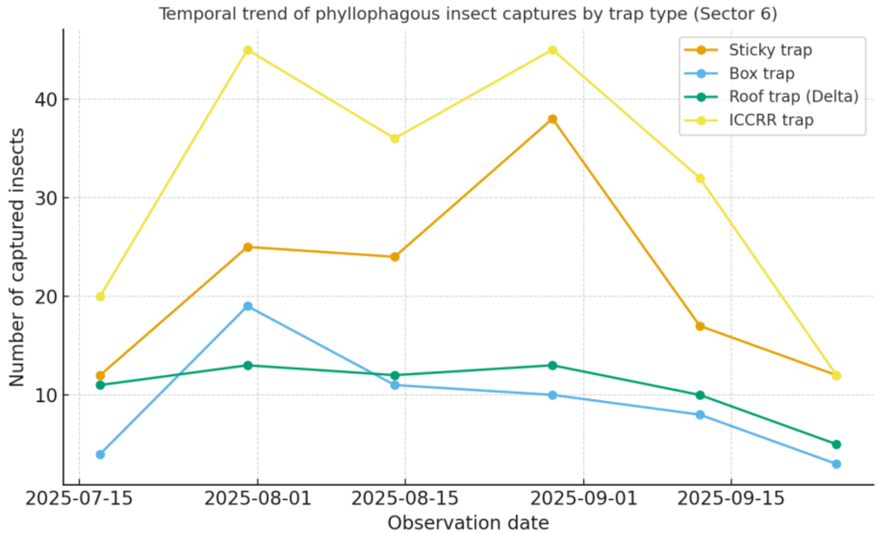

Figure 7. Temporal trend of phyllophagous insect captures recorded by four trap types (Sticky, Box, Roof, and ICCRR) in Sector 6 of Pădurea Verde Forest, during the July-September 2025 monitoring period

In Sector 7, Sticky traps recorded the highest mean capture value (11.5 ± 3.1), followed by ICCRR traps (8.8 ± 3.1) and Roof traps (8.5 ± 3.0). Box traps showed slightly lower captures (8.2 ± 4.4).

The temporal variation showed moderate insect activity from mid-July, with a small peak in late August, and stable captures in September. Compared to other sectors, the total abundance was lower, possibly due to local vegetation structure or microclimatic factors. Sticky and ICCRR traps remained the most responsive to phyllophagous insect flight dynamics in this area of the Pădurea Verde Forest (Figure 8).

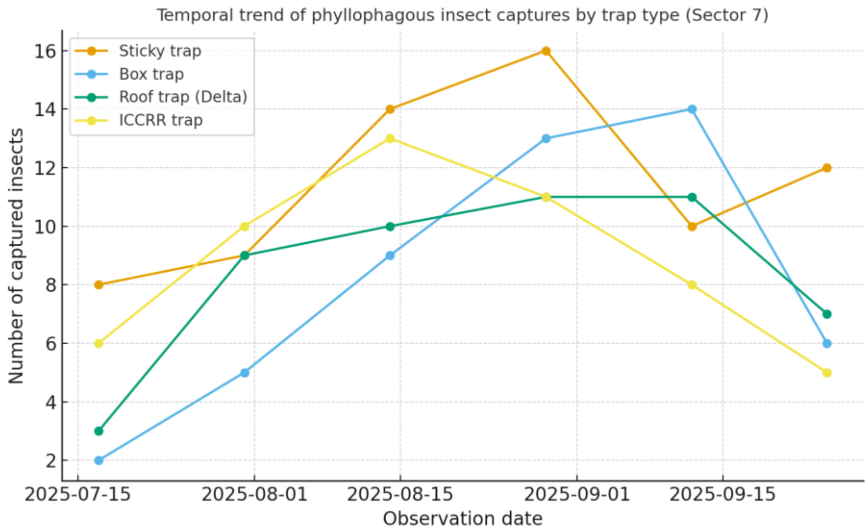

Figure 8. Temporal trend of phyllophagous insect captures recorded by four trap types (Sticky, Box, Roof, and ICCRR) in Sector 7 of Pădurea Verde Forest, during the July-September 2025 monitoring period

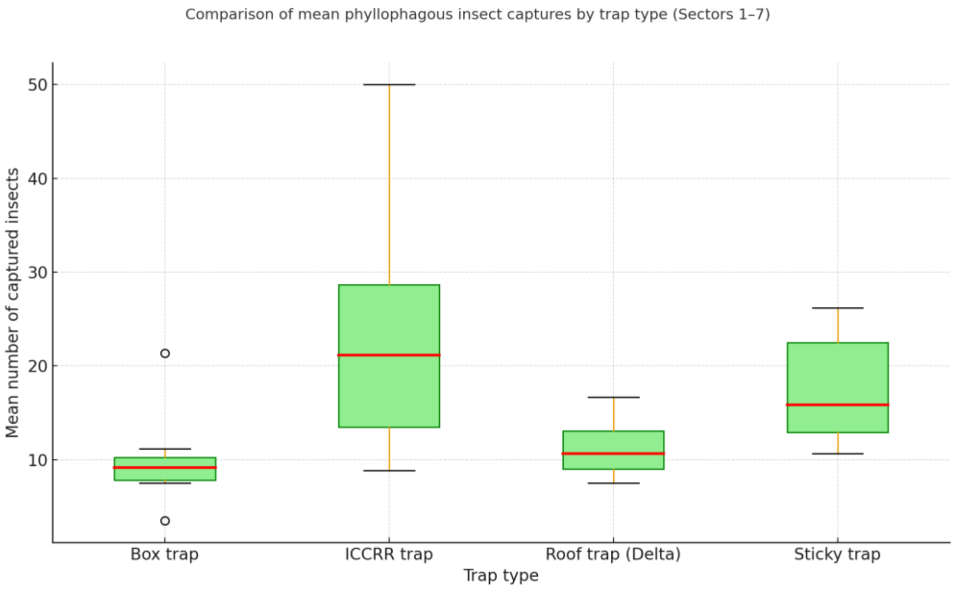

Figure 9. Boxplot comparison of mean phyllophagous insect captures recorded by four trap types (Sticky, Box, Roof, and ICCRR) across seven sectors of the Pădurea Verde Forest, during the July-September 2025 monitoring period.

The comparative boxplot analysis (Figure 9) highlights clear differences in trap efficiency across all monitored sectors. ICCRR traps exhibited the highest median capture rates and the greatest variability, indicating strong but spatially uneven attraction of phyllophagous insects. Sticky traps showed consistently high and stable performance, while Box and Roof traps recorded lower, more uniform capture values, reflecting moderate efficiency in detecting flying insect populations.

The trapped insect fauna included both forest-specific and polyphagous pest species. Among the forest pests, the most frequent were *Cameraria ohridella, Corythucha arcuata, Cydalima perspectalis, Lymantria dispar, Tortrix viridana, and Operophtera brumata.* In addition, several agro-horticultural pests were also captured, such as *Myzus persicae, Metcalfa pruinosa, Cydia pomonella, Eriosoma lanigerum,* and *Myzus cerasi.*

CONCLUSIONS

The monitoring conducted in the Pădurea Verde Forest revealed clear spatial and temporal variations in the abundance of flying phyllophagous insects. Among the four tested trap types, ICCRR pheromone traps proved to be the most efficient overall, capturing the highest number of individuals, followed closely by yellow-green sticky traps. Box and Roof traps showed lower capture rates but reflected similar seasonal patterns. In all sectors, insect activity peaked in mid-to-late August, corresponding to the main flight period of foliar pests. The consistent performance of ICCRR and Sticky traps confirms their suitability for integrated monitoring programs targeting phyllophagous insects in mixed deciduous forests.

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