ID 46268-1 - Tosatto Martina L.

Progress Report March 2026

Project: The impact of different types of artificial lights on nocturnal pollination by hawkmoths in Argentina: insights for urban planning and biodiversity conservation.

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Performed activities

- **Progress of Key Outcome 1: Field Sampling Activities**

Field sampling associated with Key Outcome 1 was conducted between October 2025 and March 2026 to evaluate the effects of different artificial lighting technologies on the reproductive success of hawkmoth-pollinated plants and their interactions with nocturnal pollinators (Figure 1). Sampling sites were selected based on records from the citizen science project *"Protejamos la Noche"* and the availability of hawkmoth-pollinated plants.

At each site, data were collected from individual plants located in close proximity to light sources or in the dark. Reproductive success was assessed by recording data from up to three inflorescences per individual, distinguishing among flowers, fruits, and floral scars (i.e., abscission marks left by flowers or fruits on the inflorescence axis). These data will be used to estimate reproductive success (e.g., fruit set) in subsequent analyses. To assess pollination success, up to five flowers per individual were collected and subsequently analyzed in the laboratory. Floral traits were measured (stigma, anther, and floral tube length), and the flowers were examined under a stereomicroscope to detect the presence of hawkmoth scales as an indirect indicator of visits by nocturnal pollinators during the previous night (Figure 2). Both variables were measured on the same set of individuals, ensuring correspondence between reproductive success and pollination data.

Figure 1. Field sampling for Key Outcome 1 aimed at evaluating the effects of different artificial lighting technologies on the reproductive success of hawkmoth-pollinated plants and their interactions with nocturnal pollinators. From left to right, the panels show examples of fieldwork, artificial light sources

together with spectral characterization, and a hawkmoth-pollinated plant species, *Ertythrostemon gilliesii*, growing under artificial lighting.

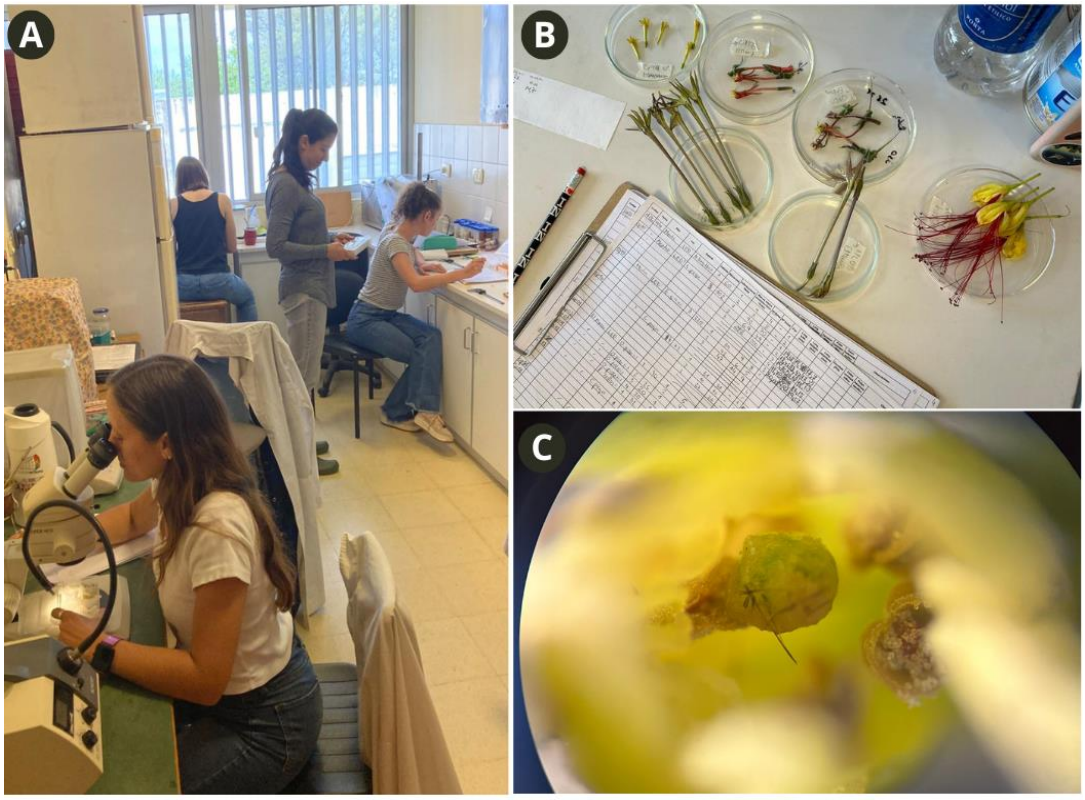

Figure 2. Laboratory sample processing, including measurement of floral part lengths and storage of stigmas in 70% ethanol (A–B). Detection of hawkmoth scales on the stigmas of *Cestrum parqui* flowers (C).

A total of 193 individuals belonging to eight plant species were analyzed across 25 sampling sites (Figure 3). These sites were categorized according to lighting technology: eight sites with modern technologies (LED), nine sites with older technologies (such as sodium vapor and metal halide lamps), and eight sites in darkness (control conditions). Species representation varied across lighting conditions, some species occurred across all treatments, whereas others were restricted to specific light environments. Species abundance was uneven, *Nicotiana longiflora* was among the most represented (13% under both LED and older technologies, and 6% under darkness), followed by *Oenothera picensis*, which showed relatively high representation, particularly under older technologies (11%), and *Cestrum parqui*, which was consistently recorded across all lighting conditions (6–9%). There was a tendency for higher numbers of individuals under dark conditions for several species (see Figure 4). This pattern is expected, as dark sites tend to be less urbanized and disturbed and therefore more likely to support native vegetation, including hawkmoth-pollinated plant species. In contrast, illuminated sites are generally associated with higher levels of urbanization, which may reduce vegetation cover. Moreover, by disrupting nocturnal pollination, light pollution may indirectly impair the reproduction of hawkmoth-pollinated plant species, thereby reducing their occurrence in light-polluted sites. These relationships will be further explored in subsequent analyses.

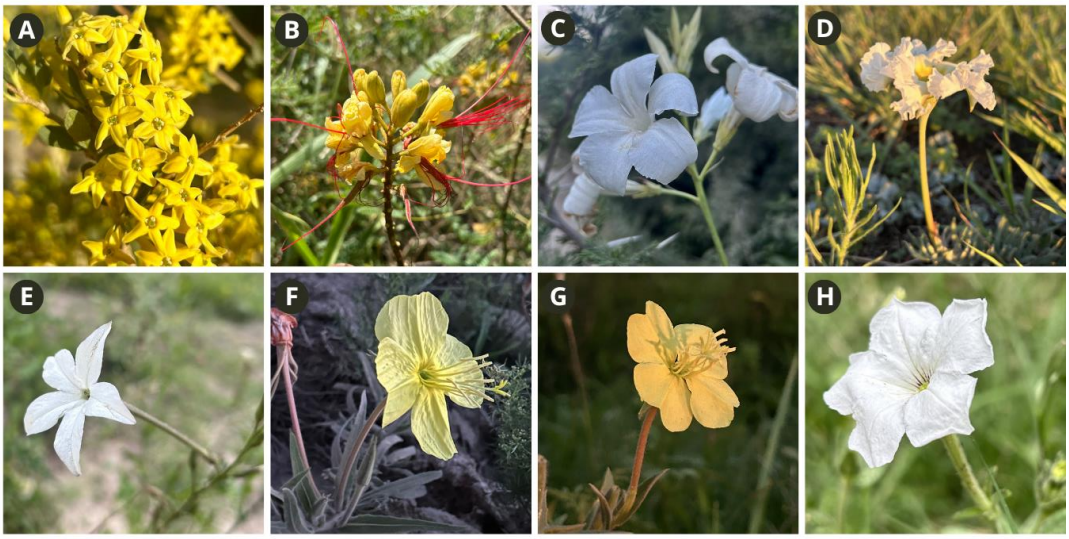

Figure 3. Hawkmoth-pollinated plant species recorded during the field samplings: (A) *Cestrum parqui*, (B) *Erythrostemon gilliesii,* (C) *Mandevilla laxa*, (D) *Mandevilla petraea*, (E) *Nicotiana longiflora*, (F) *Oenothera affinis*, (G) *Oenothera picensis*, (H) *Petunia axillaris.*

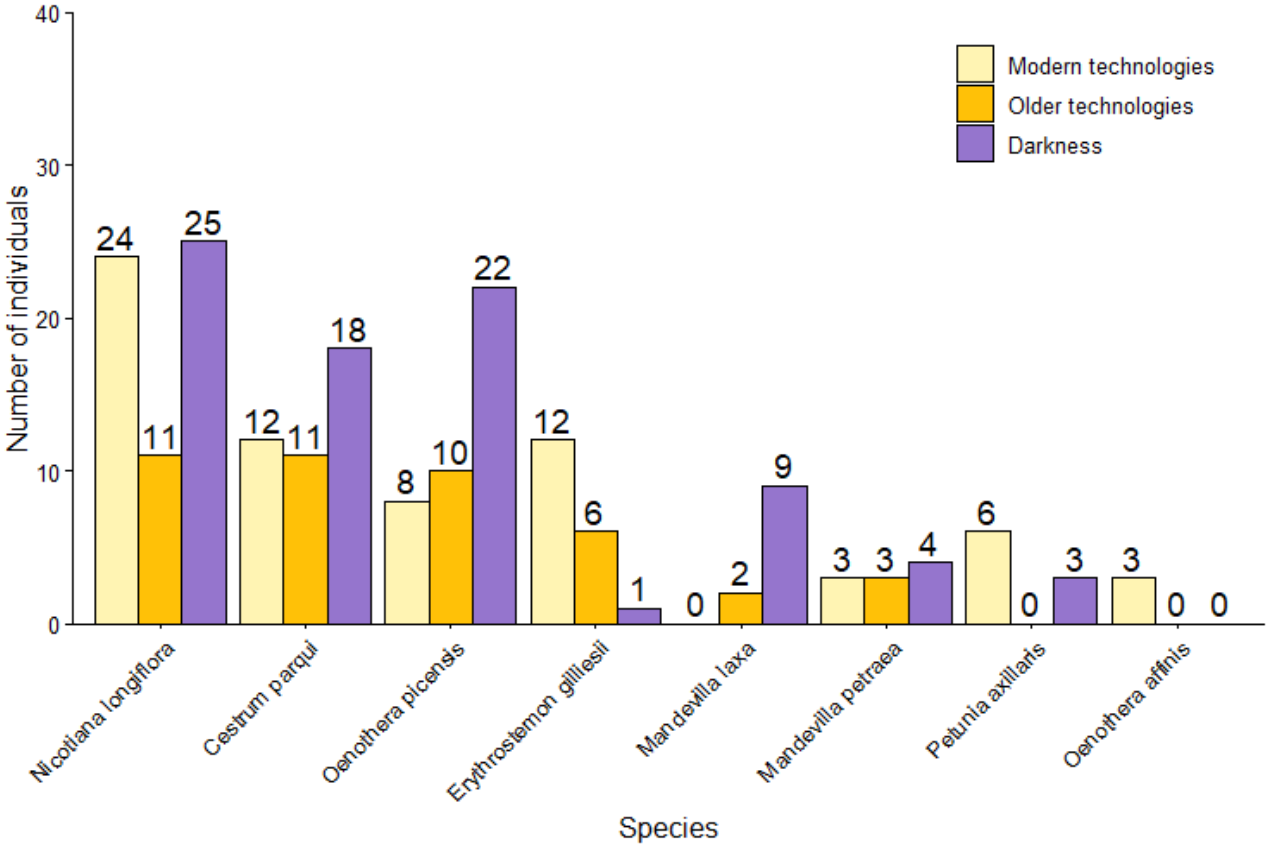

Figure 4. Number of individuals recorded per hawkmoth-pollinated plant species under different light conditions. Bar colors represent the different light treatments. Numbers above bars indicate the number of individuals recorded, and species are ordered from most to least abundant based on total counts across light conditions.

Additionally, light-trap sampling was conducted across multiple sites within the Córdoba province to characterize the local hawkmoth community (Figure 5). Each site included two experimental plots representing contrasting lighting conditions: plots exposed to artificial illumination (including both modern and older technologies) and plots under natural darkness.

Figure 5. Nocturnal sampling using a light trap. Top right: specimen of *Hyles lineata* observed during sampling.

A total of 207 hawkmoth individuals belonging to 11 species were recorded. Species abundance was highly uneven under both conditions, with *Manduca diffissa* being the most frequently recorded species in both light and dark conditions (58% of total records), followed by *Lintneria maura* (15%) and *Manduca paphus* (10%).This pattern indicates a skewed species abundance distribution, characterized by a small number of dominant species with medium to long proboscides and several less frequent species with both short and long proboscides (Figure 6). A marked disparity was also observed between lighting conditions, with a higher number of individuals recorded in dark plots (76%) compared to illuminated plots (24%). This pattern was consistent across most species, particularly the most abundant ones (e.g., *M. diffissa* and *L. maura*). Several species were recorded exclusively in dark plots, suggesting a potential influence of artificial light on species presence or activity (Figure 6).

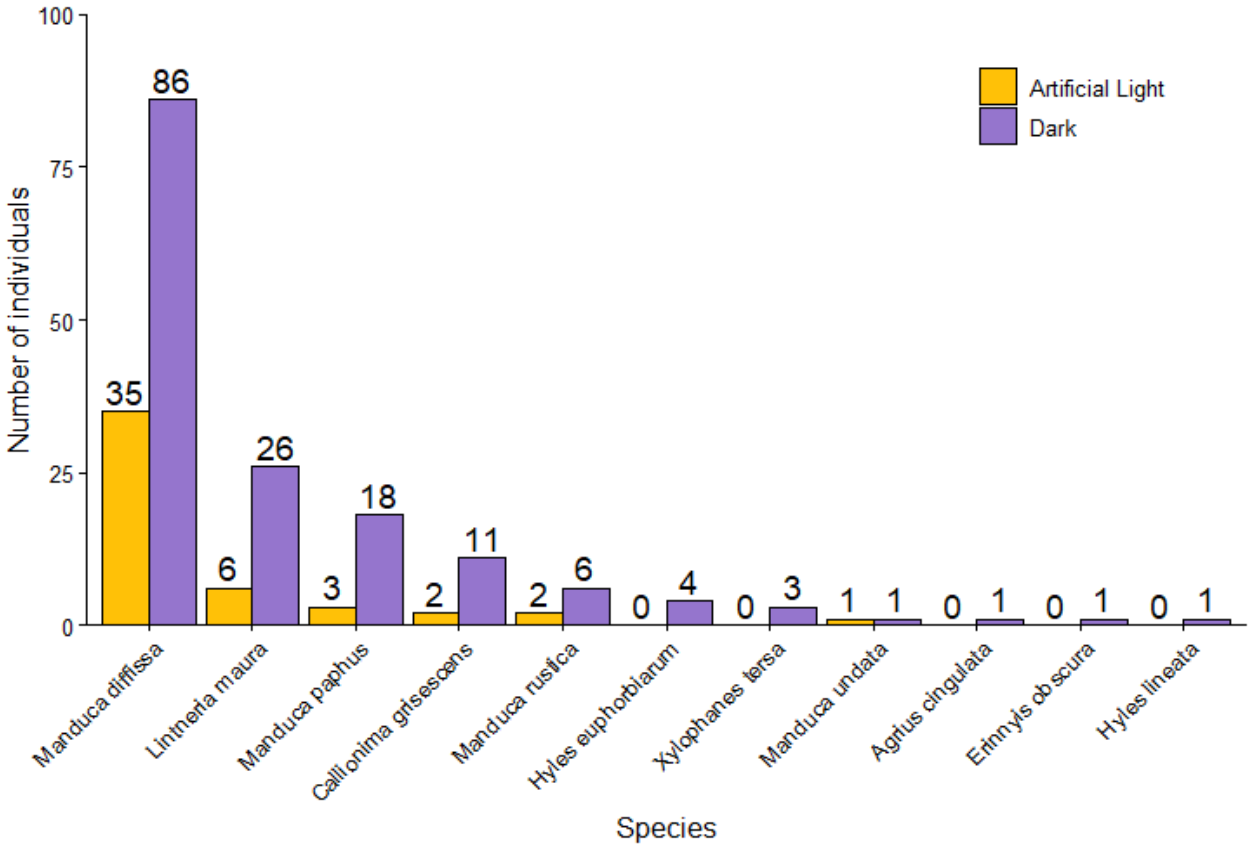

Figure 6. Number of individuals per species in light and dark conditions. Numbers above bars indicate the number of hawkmoth individuals recorded, and species are ordered from most to least abundant based on total counts.

- **Key Outcome 2 Completion: Citizen Science Results from *"Protejamos la Noche"***

By the end of the citizen science project, a total of 335 observations had been recorded across the province of Córdoba. Of these, 217 corresponded to modern LED lighting, while 118 corresponded to traditional technologies, such as sodium vapor, mercury vapor, and metal halide lamps. The data are unevenly distributed across the province, with a higher concentration of records in the central region, particularly in the city of Córdoba and its surrounding areas. There is also higher representation in towns in the south of the province, as well as in western and northeastern areas, although with lower data densities (Figure 7).

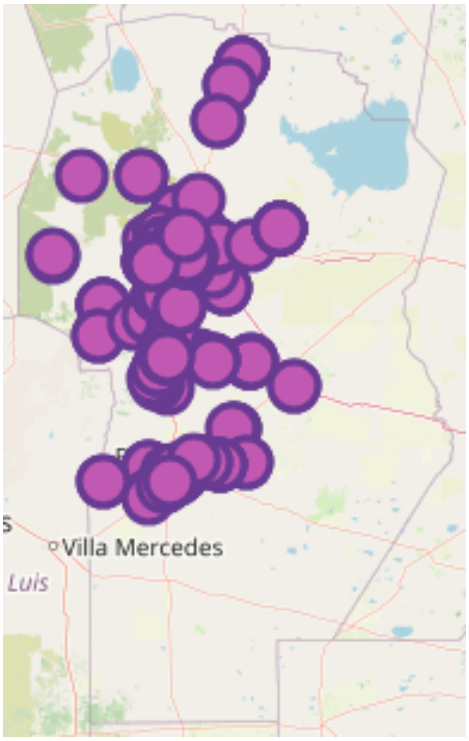

Figure 7. Spatial distribution of 335 citizen science records of lighting technologies across Córdoba province.

This distribution reflects both patterns of citizen participation and potential biases related to accessibility and population density. Despite this heterogeneity, the dataset provides a robust and representative basis for characterizing the types of lighting present across the province and for generating a vulnerability map of nocturnal pollination.

Status of Project Objectives

Key Outcome	Degree of progress	Pending activities
(1) Influence of different lighting technologies on the success of nocturnal pollination mediated by hawkmoths in the province of Córdoba, Argentina.	60%	To conduct the statistical analyses to evaluate plant reproductive success and the success of nocturnal pollination under different lighting technologies.
(2) Citizen science and outreach project	100%	
(3) Map of vulnerability of nocturnal pollination based on lighting technologies implemented in the province of Córdoba, Argentina	30%	To develop a map of nocturnal pollination vulnerability using the data already obtained from Key Outcome 2 and from the field samplings of Key Outcome 1, taking into account the types of lamps recorded in Córdoba Province.