# Darwin Fellowship - Final Report

*Due within one month of the end date of the Fellowship (maximum6 pages)*

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|---|---|
| Darwin Fellowship reference | DPLUS 171 |
| Name of Darwin Fellow | Nicole Mavrovounioti |
| Lead organisation | Joint Services Health Unit, British Forces Cyprus |
| Fellow's organisation(s) | Enalia Physis Environmental Research Centre, UKCEH – UK Centre for Ecology and Hydrology, SBA Environmental Department |
| Fellow's role within their organisation | Organization of workshops regarding the importance of pollinators and their role held at Akrotiri Environmental Centre<br>Undertaking ecological surveys within the SBA of Akrotiri regarding several flora species of the Red Book of Cyprus. |
| Start/end dateof Fellowship | 01/05/2022 – 30/04/2024 |
| Location | Cyprus (UK OT) |
| Darwin Fellowship grant value (£) | £32,760 |
| Type of work (e.g. research, training, if other please specify) | Research & raising awareness |
| Main contact in UK organisation | af.martinou@gmail.com |
| Author(s) and date | Kelly [redacted], Marc [redacted], Pantelis [redacted], Nicole [redacted] 23/04/24 |

## 1. Background

- Briefly describe your involvement in the Darwin project before the start of your Fellowship. If you were not involved with a specific project, please explain your involvement in the implementation of the key biodiversity conventions, agreements and treaties relevant to Darwin.

In 2020 and 2021 I co-organized or participated in several workshops aiming at highlighting the importance of pollinators and their role held at Akrotiri Environmental Education Centre and from 2011 to 2015 I have undertaken ecological surveys within the SBA of Akrotiri regarding several flora species of the Red Book of Cyprus.

- Describe the aim and objectives of the Fellowship, and programme of work.

The Akrotiri Peninsula hosts one of the largest and most ecologically complex ecosystems in Cyprus, supporting rare, vulnerable and endangered flora and fauna species. In total, Akrotiri Peninsula hosts 30 plant species included in the Red Flora Book of Cyprus.

This fellowship I contributed to the conservation of 25 rare and endangered flora of the Red Flora Book of Cyprus within the SBA of Akrotiri, Cyprus and aimed at raising awareness regarding their importance and recording the diversity of their pollinators.

The objectives were:

- To Establish a baseline of the distribution, population, reproduction biology and threats for each target plant species
- To create Distribution maps of the target plant
- To study the diversity of pollinators of each flora species
- To collect genetic material of target plants to be stored in appropriate banks
- To propose wider conservation measures and promote awareness of the significant flora species
- To prepare seedlings of the target plants to offer to the public and organizations during the dissemination events

- Briefly describe the roles of the Leadand Fellow's institutions.

The fellow was responsible for undertaking research under the leadership of Dr Martinou (Head Entomologist, JSHU, Enalis Physis), Mr Charilaou (Head SBAA Environment Department) and Dr Botham (Ecologist and Scientist, UKCEH).

The supervisors were mentoring this fellow and were responsible for my supervision to ensure the success of the fellowship. Also, from the beginning of this fellowship, meetings were organised once a month with my supervisors regarding assessing the progress of the fellowship.

- If you have undertaken a formal course of training, please provide a brief explanation of the course and a link to the course website if available.

  N/A

## 2. Achievements

- Summarise the work undertaken during your Fellowship. What were the main activities undertaken? Highlight any work undertaken but not originally planned and explain why this happened. Highlight any problems encountered and how they were overcome.

**Output 1: Establish a baseline of the distribution, population, reproduction biology and threats for each target plant**

### 1.1 Literature review on the distribution, population, reproductive biology and threats of the target plant

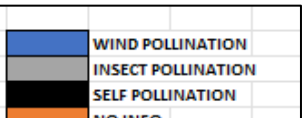
This activity was completed in September 2022. The distribution and population status of all of the target plant species as well as the threats they face were obtained via a literature review of the Red Book of Flora of Cyprus. The main pollination mechanisms for each species were also recorded in this review. Also, according to literature review - 12 of the target plant species were insect pollinated, 6 were wind pollinated, 2 were insect and wind pollinated, 1 was insect pollinated and self-pollinated, 1 was wind pollinated and self-pollinated, 2 were insect, wind and self-pollinated and for 1 plant there was no available information regarding its reproductive biology.

## Distribution of the target plant species in the island

| Plant Species | Population in the island / Location |
|---|---|
| *Taraxacum aphrogenes* | 30,000 / 8 locations: Akrotiri penisula, Episkopi bay, Paphos, Akamas, Latsi |
| *Coronilla repanda subsp. repanda* | 10,800 / Akrotiripenisula, St. Georgios, Argaki Diplarkakou |
| *Urtica membranacea* | 2,700-3,000 / 4 areas: Lefkosia,Fasouri, Vrisoules, Agio Nikolao Amoxostou |
| *Ophrys kotschyi* | 1,800 / Mammari, Akrotiri peninsula, Mitsero, Alambra, Akama, Pentadaktylo, Karpasia |
| *Serapias parviflora subsp. Parviflora* | 52 / Akrotiri village |
| *Lotus cytisoides* | 1,300 / 3 locations: Ladys mile, Agios Nikolaos, Episkopi bay |
| *Isolepis cernua* | 250 / Akrotiri Salt lake |
| *Convolvulus lineatus* | 2,000 / Akrotiri peninsula |
| *Cladium mariscus* | 2,000 / Akrotiri Salt lake |
| *Linum maritimum* | 1,400 / Akrotiri Salt lake, Akrotiri Marsh |
| *Silene microsperma subsp. Cypria* | 5,500 / Trikazi, Salamina |
| *Juncus maritimus* | 500 / Akrotiri Penisula |
| *Centropodia forskalii* | 508 / Tunnel beach Episkopi |
| *Crepis pusilla* | 13,000 / Episopi, Akama, Polemidia, Sotira |
| *Ifloga spicata* | 600 / Tunnel beach Episkopi, Salamina |
| *Neurada procumbens* | 1,850 / Episkopi, Amathounta |
| *Salvia dominica* | 350/ Kourio, Highway Limassol-Paphos |
| *Stipagrostis lanata* | 3,360 / Tunnel beach Episkopi |
| *Helianthemum kahiricum* | Unknown / Akrotiri penisula, Akrotiri forest |
| *Juncus littoralis* | 3,000 / Akrotiri Slat lake,Troodos |
| *Triplachne nitens* | 4,000/11 locations: Akamas to Akrotiri, Cape Greco, Salamina, Agia Eirini |
| *Cynanchum acutum* | 1,200 / 3 locations: Poli Chrysoxous, Aglatzia, Akrotiri penisula |
| *Mentha aquatica* | 700 /Akrotiri Marsh |
| *Schoenoplectus tabernaemontani* | 200 / Akrotiri Marsh |
| *Euphorbia hirsuta* | Unknown / Akrotiri Marsh |

## Type of pollination of the target plant species

| Plant Species | Type of Pollination |
|---|---|
| *Taraxacum aphrogenes* | |
| *Coronilla repanda subsp. repanda* | |
| *Urtica membranacea* | |
| *Ophrys kotschyi* | |
| *Serapias parviflora subsp. Parviflora* | |
| *Lotus cytisoides* | |
| *Isolepis cernua* | |
| *Convolvulus lineatus* | |
| *Cladium mariscus* | |
| *Linum maritimum* | |
| *Silene microsperma subsp. cypria* | |
| *Juncus maritimus* | |
| *Centropodia forsskalii* | |
| *Crepis pusilla* | |
| *Ifloga spicata* | |
| *Neurada procumbens* | |
| *Salvia dominica* | |
| *Stipagrostis lanata* | |
| *Helianthemum kahiricum* | |
| *Juncus littoralis* | |
| *Triplachne nitens* | |
| *Cynanchum acutum* | |
| *Mentha aquatica* | |
| *Schoenoplectus tabernaemontani* | |
| *Euphorbia hirsuta* | |




## Output 2: Distribution maps of target plants

### 2.1 On site visits to find the locations of the target plants and record geolocation

The location of the target plant species has started in May 2022 and completed in April 2024, where 24 plant species were successfully located and mapped during their flowering season. Unfortunately, the *Cynanchum acutum* was not found, since it is disappeared possibly due to hydrological changes in the area.

### 2.2 Data analysis, mapping on arcGIS

The data analysis and the mapping on GIS has been successfully completed in April 2024.

**Output 3: Study the diversity of pollinators of each flora species**

### 3.1 On site visits for data collection and identification of pollinators of each target flora species:

Non-destructive techniques were used as much as possible by taking pictures or identifying pollinators on site. Pollinators not possible to identify in the field were collected with a net and taken back to the JSHU laboratory for identification. Pollinators were identified at species level where possible. During the period May 2022 – April 2024, pollinators were recorded from in total 7 plant species by taking pictures and/or videos and were identified,

### 3.2 List of pollinators and photo records for each of the target plants

The below table indicates the number and identification of pollinators and other insect visitors for the 7 plant species.

| Plant ID | Order | Family | Subfamily | Genus | Species | Date |
|---|---|---|---|---|---|---|
| *Taraxacum aphrogenes* | Hymenoptera | Andrenidae | Chlorandrena | *Andrena* | | 27/2/2022 |
| *Taraxacum aphrogenes* | Hymenoptera | Halictidae | Halictinae | *Lasioglossum* | | 15/2/2024 |
| *Convolvulus lineatus* | Coleoptera | Melyridae | Dasytinae | | | 3/6/2022 |
| *Convolvulus lineatus* | Coleoptera | Bupestridae | | | | 3/6/2022 |
| *Convolvulus lineatus* | Coleoptera | Tenebrionidae | | *Trachyderma* | | 3/6/2022 |
| *Convolvulus lineatus* | Hymenoptera | | | | | 3/6/2022 |
| *Convolvulus lineatus* | Coleoptera | Bruchinae | | | | 3/6/2022 |
| *Convolvulus lineatus* | Diptera | Syrphidae | | *Sphaerophoria* | *scripta* | 18/6/2023 |
| *Convolvulus lineatus* | Hymenoptera | Megachiliidae | | | | 18/6/2023 |
| *Euphorbia hirsuta* | Coleoptera | Cantharidae | | *Rhagonycha* | *fulva* | 5/9/2022 |
| *Euphorbia hirsuta* | Hymenoptera | | | | | 5/9/2022 |
| *Euphorbia hirsuta* | Hymenoptera | | | | | 19/9/2023 |
| *Euphorbia hirsuta* | Hymenoptera | | | | | 19/9/2023 |
| *Linum maritimum* | Lepidoptera | Hesperiidae | | *Carcharodus* | *alceae* | 3/6/2022 |
| *Linum maritimum* | Hymenoptera | Halictidae | Halictinae | *Lasioglossum* | | 28/5/2022 |
| *Linum maritimum* | Hymenoptera | Halictidae | Halictinae | *Lasioglossum* | | 28/5/2022 |
| *Linum maritimum* | Diptera | | | | | 28/5/2022 |
| *Linum maritimum* | Hymenoptera | | | | | 3/6/2023 |
| *Linum maritimum* | Diptera | Syrphidae | | *Syritta* | *pipiens* | 3/6/2023 |
| *Linum maritimum* | Diptera | Tachnidae | | | | 3/6/2023 |
| *Linum maritimum* | Coleoptera | Alticini | | | | 3/6/2023 |
| *Linum maritimum* | Diptera | Syrphidae | | | | 3/6/2023 |

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|---|---|---|---|---|---|---|
| *Linum maritimum* | Neuroptera | Ascalaphidae | | *Libelloides* | *macaronius* | 31/5/2022 |
| *Linum maritimum* | Lepidoptera | | | *Polyommatus* | *icarus* | 28/5/2022 |
| *Linum maritimum* | Lepidoptera | | | *Pontia* | *dapladice* | 3/6/2022 |
| *Mentha aquatica* | Odonata | | | *Crocothemis* | *erythraea* | 5/9/2022 |
| *Mentha aquatica* | Hymenoptera | Apocrita | | | | 5/9/2022 |
| *Mentha aquatica* | Diptera | Syrphidae | | *Syritta* | *pipiens* | 5/9/2022 |
| *Mentha aquatica* | Hymenoptera | Apidae | | *Apis* | *mellifera* | 16/9/2022 |
| *Salvia dominica* | Diptera | Tabanidae | | | | 8/3/2023 |
| *Salvia dominica* | Diptera | Syrphidae | | | | 8/3/2023 |
| *Lotus cytisoides* | Hymenoptera | Apidae | | *Apis* | *mellifera* | 28/3/2024 |

**Photos of the target plants and their pollinators and other insect visitors**

*Linum maritimum* and *Pontia daplidice*

*Taraxacum aphrogenes and Lasioglossum*

*Lotus cytisoides and Apis mellifera*

*Libelloides macaronius*

*Linum maritimum and a female Polyommatus Icarus*

*Convolvulus lineatus and Acmaeoderella*

*Linum maritimum and Carcharodus alceae*

*Taraxacum aphrogenes and Andrena*

**Output 4: Collection of genetic material of target plants to be stored in appropriate banks**

**4.1 Collect genetic material from the target flora species during the fruiting season and collaborate with the Department of Forests to have access to the data**

The genetic material was collected from in total 24 plant species between May 2022 and April 2024 and was provided to the Department of Forests for storage and preservation. Seeds and saplings of some of the target plants were planted on 06th April 2023 in a conservation area in the Eucalyptus forest at Akrotiri.

**Planting *Euphorbia hirsuta* and *Mentha aquatica* at Eukalyptus forest on 06th April 2023 in collaboration with the Department of Forests and SBA**

**Output 5: Propose wider conservation measures and promote awareness of the significant flora species**

### 5.1 Creation of information sources (e.g. e-leaflets and project website) to raise public awareness regarding the importance of conservation of the significant flora species and updating of project website and social media

The project was disseminated in social media and dissemination events, where the importance of these plants and the diversity of their pollinators was promoted and emphasized.

### 5.2 Report conservation measures from literature and on site surveys for the report

In collaboration with the Department of Forests and SBAs, the main conservation measures included: 1) Storage and preservation of the target plant species at Amiantos and Fasouri seed bank, 2) Planting the target plant species in botanical gardens 3) Planting the target plant species in several locations (Eucalyptuss forest, Lady's mile beach, St. George area, Akrotiri Marsh, Kourio, Dekelia) 4) Fencing where possible the endangered plant species so that to be protected from human/vehicle trampling.

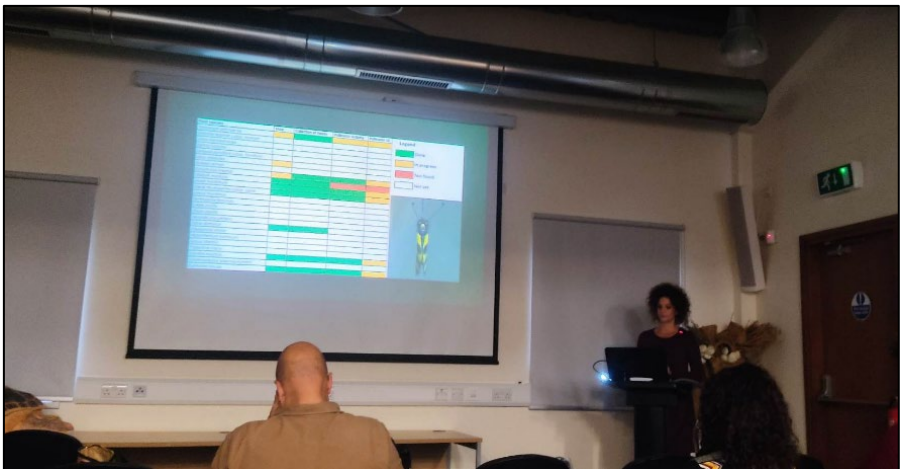
### 5.3 Organisation of dissemination events to promote awareness regarding the importance of conservation of rare and endangered flora species and their pollinators

On 8th December 2022, in a context of a workshop regarding the Akrotiri Monitoring, the project has been presented to the audience and has been discussed, disseminated and promoted. Our Darwin dissemination event was organised on 30th March 2023 at AEEC, regarding the Biodiversity of Akrotiri Peninsula and Invasive Species. During this event, the importance of conservation of the Red Book Plants was discussed with the audience and the importance of the diversity of their pollinators was promoted and emphasised. Moreover, during the Helecos Conference in Patra, Greece, some of the results of this fellowship were presented and discussed on 5th October 2023. It has to be mentioned that some of the expenses were funded from this Fellowship instead of the second event, as proposed.

**Promoted the importance of the Red Book Plants and the diversity of their pollinators on 30th March 2023**

**Presented and discussed the main results of the fellowship during the Helecos conference in Patra on 5th October 2023**


**Promoted the importance of the Red Book Plants and the diversity of their pollinators on 08th December 2022**



### 5.4 Meeting and engaging with stakeholders from the SBAs and the Republic of Cyprus

During the events we had the opportunity to meet with stakeholders from the SBAs, Republic of Cyprus, Ministry Departments of Forest, Environment, Agriculture and Education and NGOs and had the ability to exchange knowledge and opinions.

### 5.5 UKCEH visit by Dr Marc Botham in order to design the study and plan dissemination events

Dr Marc Botham has visited us between the 17th and 25th April 2023 and we had the opportunity to discuss about the progress of my project and went out to the field in order to find and identify pollinators and other insects on the site.

**Output 6: Prepare seedlings of the target plants to offer to the public and organizations during the dissemination events**

### 6.1 Planting of selected flora species in pots to be given to the public during dissemination events

Seeds from 13 target plants were provided to the Department of Forests during September 2022 – February 2023, in order to plant them. During March 2023, 100 saplings have been grown and planted into pots, while the rest of them were kept at the Department of Forests for storage and preservation. These saplings have been planted in several appropriate locations along the island as stated at point 5.2. In April 2023, seeds from the target plant species were given to the Agricultural Research Institute in order to store them for further research. Also, during January 2024, more seeds have been given to the Department of Forests to preserve them and plant them on a lateral stage in several locations.

### 6.2 Offer seedlings of the target plants to participants of the dissemination events

During the Darwin dissemination event on 30th March 2023, 40 saplings of the target plant species were given to the participants along with information on their ecology and characteristics.

**Preparation of saplings of the target plant species**

**Saplings are ready to be given to the participants during the Darwin dissemination event on 30th March 2023**


**Output 7: Publications**

**7.1 Peer reviewed publications, open access and popular science articles**

**Manuscript:** The manuscript is being prepared and will be available online in May 2024. Once published, a small article will be published online.

**Conference proceedings:** This Darwin Fellowship was presented during the conference organised in Patra, Greece during 4-7 October 2023.

## Conservation and raising awareness of rare and endangered flora and their pollinators, within the Sovereign Base Areas (SBA) of Akrotiri, Cyprus

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**Keywords:** Vulnerable, Red Flora Book Cyprus

Akrotiri Peninsula hosts one of the largest and most ecologically complex ecosystems in Cyprus, supporting rare, vulnerable and endangered flora and fauna. This project (Start date: 01/05/22, End Date: 30/04/24) contributes to the conservation of 25 rare and endangered plant species included in the Red Flora Book of Cyprus, by mapping their distribution on Akrotiri Peninsula, raising awareness regarding their importance and promoting research on their population and reproductive biology. In addition, observations on the diversity of pollinators of each plant species have been undertaken and the significance of pollinators is highlighted. Moreover, the genetic material from each plant species has been collected and stored in appropriate banks for further surveys. Last but not least, the main threats of these plant species have been established and wider conservation measures have been proposed. To date, 23 plant species have been mapped within the SBA of the Akrotiri Peninsula, seeds have been collected from 20 plant species and pollinators have been recorded from 7 out of 12 insect-pollinated plant species. During September 2022 – March 2023 seeds from 13 plant species were collected and provided to the Forestry Department, from which 150 saplings have been grown and planted into pots, while the rest of them are being in storage. During the Darwin dissemination event on 30th March 2023, 40 saplings of the plant species were given to the participants along with information on their ecology and characteristics as part of an exercise raising awareness of these plants.

- What have been the main achievements of your Fellowship? How do they relate to the overall objectives of this Darwin Initiative funding scheme? Key documents should be annexed to this report.

**Manuscript in preparation** "A review of the distribution of the Red Data plants and a study on their pollinators at Akrotiri Peninsula, Cyprus", using dataset collected. This manuscript is a report on the distribution of the endangered plants found in Akrotiri Peninsula, and the interaction with their pollinators. The manuscript is in progress and will be published in May 2024. Once the manuscript is published, a small article will be uploaded in social media.

**Public engagement events** with citizen scientists recording plants and pollinators, in cooperation with Akrotiri Environmental educational centre.

**Events** on 8th December 2022, 30th March 2023 and 5th October 2023, where the importance of the Red Book Plants and their pollinators was highlighted and some of the main results were presented and discussed.

## 3. Outcome, lessons and impact

- Do you feel that the work undertaken during your Fellowship has improved skills that are relevant and important for your work in your organisation? How are you planning to apply those skills in future work?
- What arrangements have been made for your future involvement? What discussions have taken place with your original employer to ensure that your new skills are utilised?
- Has the Fellowship helped to improve your capacity to solve practical problems related to the sustainable use and/or conservation of biodiversity in your country?
- Have you had the opportunity to make contacts with other UK biodiversity institutions, intergovernmental organisations, NGOs or the private sector during your Fellowship? Will these contacts be useful for your future work, and how are you planning to maintain them?
- Any other issues emerging from your experience as Darwin Fellow that you would like to raise, or suggestions for improvements to the Darwin Initiative Fellowship scheme.

During my Fellowship I had the opportunity to meet and work with many senior scientists from Europe, but also young scientists. I am sure that these collaborations will be very useful for me in the future and that with some of those people we will continue our collaboration in other projects. I believe that this Fellowship was very useful for me, as it has improved my research skills and created to me new research question, focuses on biodiversity and drivers of ecological change. I also believe that this Fellowship helped to be better in public raise awareness and communication, which I believe that is very hard, but in the same time, is very important to work on, as citizen- scientists can provide very important data, allowing the collection of large amounts of them and covering wide areas.

Also, during my Fellowship, I expanded my knowledge in GIS and lab analysis. Furthermore, I believe that the current Fellowship helped me to improve my capacity to solve practical problems related to the sustainable use and/or conservation of biodiversity in my country and understand better the conservation actions need to put in practice in order to protect the endangered plant species. The next steps are to put these actions in practice, in cooperation with the Akrotiri Environmental Education Centre, SBA and local authorities.

## 4. Impact of COVID-19 on Fellowship

Please summarise the impact of COVID-19 on your Fellowship as well as providing an overview of how you have responded.

- To what extent has COVID-19 impacted your project?
- How have you responded? For example, by adjusting your workplan or approach to help maintain delivery.
- How did you assure the health and safety of everyone involved in the Fellowship?

- Could any of your Fellowship's expected outcomes or impacts assist with the response to COVID-19 or reduce the risk of future pandemics?

N/A