Circum-situ conservation

at Anjar Archeological Site

(*Iris antilibanotica)*

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Iris antilibanotica

The rainbow goddess in Anjar archeological site

Table of Contents

List of Figures 4
List of tables 4
Abbreviations 4
Introduction 5
Iris antilibanotica translocation in Anjar archeological site 7
Germination of *Iris antilibanotica* in Jouzour Loubnan Seed Bank 8
Species introduction 9
Analysis 12
Recommendation 14
Communication material 16
References 18

List of Figures

Figure 1 The IUCN redlist status for Iris antilibanotica 5
Figure 2 Iris antilibanotica blooming in Khraybet baalbak in May 2020 6
Figure 3 Locations of introduction in Anjar archeological site 7
Figure 4 Germination of Iris antilibanotica in Jouzour Loubnan laboratory before being translocated on site 8
Figure 5 Iris antilibanotica mature rhizomes translocation from Khraybet Baalbak 9
Figure 6 Iris antilibanotica mature rhizomes introduction in Anjar archeological site 11
Figure 7 Iris antilibanotica seedlings introduction in Anjar archeological site 11
Figure 8 Iris antilibanotica translocated rhizome in Anjar archeological site. December 2020 (left picture); April 2021 (right picture) 12
Figure 9 Iris antilibanotica blooming in Anjar archeological site (April 2021) 13
Figure 10 Iris antilibanotica flower 15
Figure 11 Iris antilibanotica panel installed in Anjar archeological site 16
Figure 12 World Heritage Day workshop at Anjar archeological site 17

List of tables

Table 1 Information on the different introductions in all locations 10

Abbreviations

CEPF	Critical Ecosystem Partnership Fund
CR	Critically endangered
IUCN	International Union for Conservation of Nature and Natural Resources
%	Percentage

Introduction

The *Iris* species are geographically restrained due to their dispersion mode. *Iris antilibanotica* is considered to be endemic to a small area of the Anti-Lebanon Mountains and was considered extinct. This species is listed under critically endangered (CR) of the IUCN Redlist (Figure 1). Fortunately, one last remaining population was found in the backyard of a private property in Khraybet Baalbak, eastern Lebanon.

Figure 1 The IUCN redlist status for Iris antilibanotica

Under the framework of the project entitled "Conserving and Valorizing the Unique Botanical Heritage of Lebanon » funded by the Critical Ecosystem Partnership Fund (CEPF) #108497 and implemented by the Faculty of Science - Saint Joseph University, we have applied a new conservation technique called *Circum-situ,* to conserve the endemic and threatened species while shedding light on the importance of Lebanon's cultural heritage.

The offered approach scheme focuses on the conservation, in archeological sites, of endemic species present in the same bioclimatic zones as their natural habitats. Archeological sites are already protected areas therefore the threats on the plant species are minimized. In addition, the main species to introduce is herbaceous without a deep root system so it would not be damaging any important ruins. The areas where these plants were introduced were agreed upon with the regional director of the Bekaa Region-General directorate of Antiquities Dr. Raffi Gergian, so that the most sensitive areas were avoided as well as the ones with cultural property. This introduction will shed light to the public and local community to these endemic plants that are an integral part of our cultural heritage.

Figure 2 Iris antilibanotica blooming in Khraybet baalbak in May 2020

Iris antilibanotica translocation in Anjar archeological site

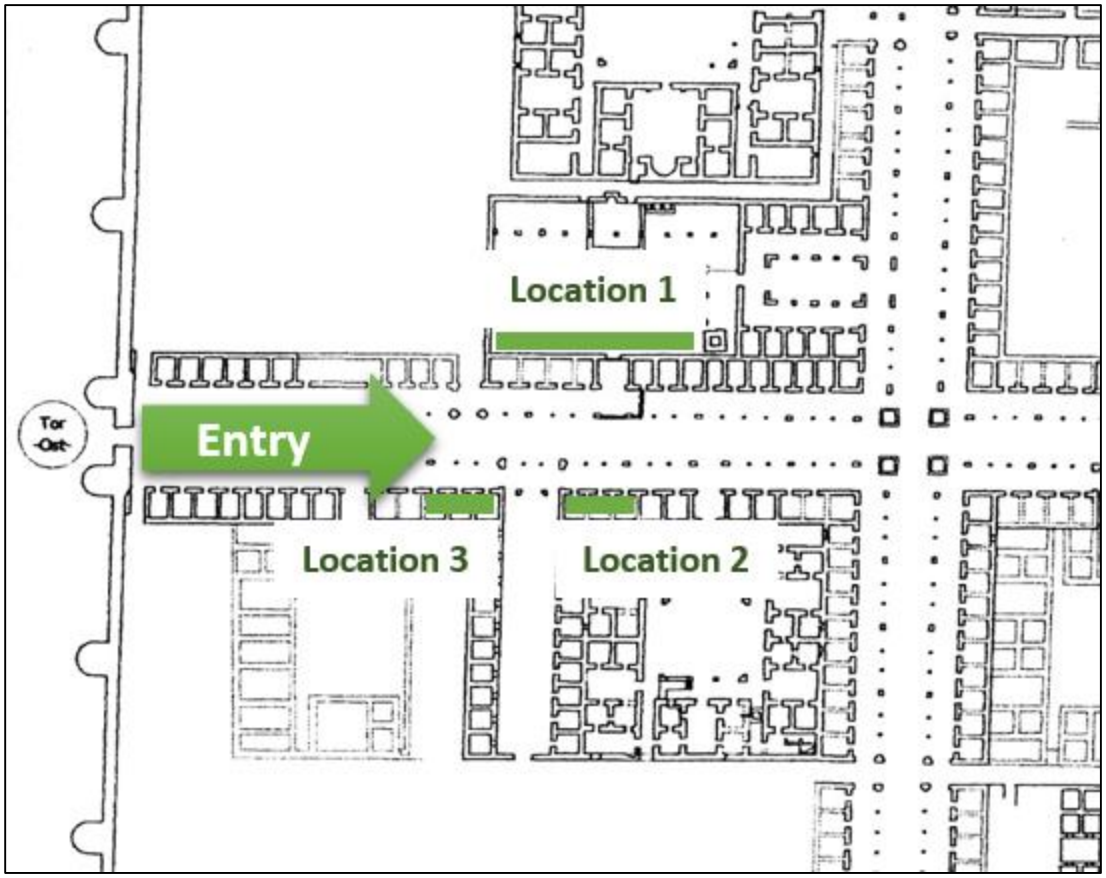

Figure 3 Locations of introduction in Anjar archeological site

Many translocations were conducted onto Anjar archeological site: three lots of seedlings' introduction, one lot of seeds introduction and one lot of rhizomes translocation, distributed in three locations (Figure 3).

The *Circum-situ* conservation approach was implemented through different genetic materials:

- Seedlings germinated beforehand in Jouzour Loubnan Seed bank;
- Seeds collected from the last remaining population *of Iris antilibanotica* in Khraybet Baalbak;
- Rhizomes of *Iris antilibanotica* individuals, taken directly from site and translocated onto Anjar archeological site.

Germination of *Iris antilibanotica* in Jouzour Loubnan Seed Bank

The germination of *Iris antilibanotica* seeds was conducted following the germination protocol that was developed specifically for the *Iris* species in the content of the previous project funded by the Critical Ecosystem Partnership Fund #63257.

Figure 4 Germination of Iris antilibanotica in Jouzour Loubnan laboratory before being translocated on site.

Species introduction

A total number of 57 seedlings were then introduced on December 2019, October 2020, December 2020 and February 2021 in location 1 (14 seedlings), location 2 (16 seedlings), location 3 (16 seedlings) and location 3 (11 seedlings) respectively.

Furthermore, 100 seeds were dispersed in location 2 (50 seeds) and location 3 (50 seeds) on February 2021.

Concerning the rhizome translocation, 2 rhizomes were translocated directly from the Khraybet Baalbak site onto location 2 and 3 in Anjar archeological site in December 2020. Two new rhizomes were also added in May 2021. These rhizomes are part of large individuals that are still present in the Kharybet Baalbak (Table 1).

Figure 5 Iris antilibanotica mature rhizomes translocation from Khraybet Baalbak

Table 1 Information on the different introductions in all locations

#Introduction number	Type of genetic material introduced	Date of introduction	Seeds collected	Number of individuals	Age of Individuals	Area	Number of Viable individuals	Survival rate (%)
1	Seedlings	December 2019	Khraybet baalbak 2017	14	7 months	1	5	36
2	Seedlings	October 2020	Khraybet baalbak 2017	16	9 months	2	11	69
3	Seedlings	December 2020	Khraybet baalbak mix 2017-2020	16	3 months	3	5	31
4	Seeds	February 2021	Khraybet baalbak mix 2017-2020	50	_	2		NE
5	Seeds	February 2021	Khraybet baalbak mix 2017-2020	50	_	3		NE
6	Seedlings	February 2021	Khraybet baalbak mix 2017-2020	11	5 months	3		NE
7	Rhizomes	December 2020	Khraybet baalbak 2020	2	Mature	2-3		100
8	Rhizomes	May 2021	Khraybet baalbak 2021	2	Mature	2-3		100

Figure 6 Iris antilibanotica mature rhizomes introduction in Anjar archeological site

Figure 7 Iris antilibanotica seedlings introduction in Anjar archeological site

Analysis

Taking into account different criteria such as the survival rate, age of the genetic material introduced and its origins, it could be noted that the older the seedlings, the higher is the survival rate. In fact, the survival rate of 9-month-old seedlings was reported as 69%. However, seedlings of 3 months old had a survival rate of 31%.

The introduced seedlings have grown by 3 cm in comparison with their lengths during the time of the introduction.

Concerning the seeds planted in February 2021, the survival rate could have been reported inasmuch as the climate condition were stable. However, due the constant climate change, the average rainfall in 2021 was not enough to boost the development of the seeds. Therefore, the survival rate of the seeds will be determined in the end autumn season in 2022.

Figure 8 Iris antilibanotica translocated rhizome in Anjar archeological site. December 2020 (left picture); April 2021 (right picture).

The translocation of the rhizomes was reported successful since they have thrived on site and have rewarded us with beautiful flowers (Figure 8-9). In addition, following the flowers, the individuals that have completed the pollination process, have produced seed capsules, therefore indicating the establishment of a new generation of plants in the near future.

Figure 9 Iris antilibanotica blooming in Anjar archeological site (April 2021)

Recommendation

Before elaborating any recommendations, it is primordial to define the success factor of the introduction processes.

An introduction is successful when the population introduced has the ability to survive, reproduce and adapt to changing conditions.
The global strategy for plant conservation states that the population has to expand in an area, individual flowering and fruiting when a second and a third generation of plants are appearing on their own and the population gives all indication that it will persist in future generations. Further success is the population dispersing seeds and creating new subpopulation.

Based on this factor of success, recommendations are divided through three timelines: pre-introduction, introduction and post introduction.

Before proceeding with introduction, it is of high importance to ensure that the seed source material is not collected from depleted population (Godefroid *et al.,* 2011). This could cause the loss of genetic variation, an accumulation of detrimental mutations and therefore lower the survival rate.

Further introductions should solely focus on introducing seedlings rather than seeds and adults rather than transplants (Albrecht *et* Maschinski, 2012) for a better survival rate. It should also be noted that if the number of outplanted individuals is too small, the introduction would not be successful. There is not a specified number of individuals to be planted; each species has its own number that reflects its minimal viable population.

In addition, to have a better chance at survival, a high genetic variation within the population is required. To do so, each individual from Khraybet Baalbak must be represented in Anjar archeological site (preferably introduced adult seedlings) to ensure genetic diversity, promote effective pollination and seeds production.

Finally, some post introduction work must be implemented by the site committee, such as watering the plants, weed cutting, etc...

Population monitoring is also crucial as to monitor the introduced species and evaluate the success factors of the introduction. The factors evaluated could represent:

- The **abundance** by evaluation the population size, the vegetative growth, the fecundity and the establishment;
- The **resilience** by evaluation the genetic variation and;
- The **persistence** by evaluating the self-sustainability of the population.

The Faculty of Sciences of the Saint-Joseph University will continuously work with Anjar archeological site to provide the best practices on species monitoring, the most suitable indicators in the case of Iris antilibanotica and finally plan new introductions based on the lesson learned from this pioneer experience.

Figure 10 Iris antilibanotica flower

Communication material

A panel was prepared in the context of the project highlighting the importance of *Circum-situ* conservation of the endemic, rare and threatened *Iris antilibanotica*. The panel was installed in Anjar archeological site near location 3.

Figure 11 Iris antilibanotica panel installed in Anjar archeological site

The panel along with the information regarding *Iris antilibanotica* is accessible to the public through Lebanon Flora data base (www.lebanon-flora.org) and the following QR code.

On World Heritage Day on May 29, 2021, and in order to shed the light on the importance of the protection of cultural and natural heritage, a workshop took place at Anjar archeological site, hosted by the Faculty of Sciences of Saint Joseph University and Jouzour Loubnan in collaboration with the General Directorate of Antiquities. During the workshop, the visitors had the opportunity to identify the tree and plant species present on site, including the *Iris antilibanotica*, its life cycle, the importance of its protection as well as the importance of the *Circum-situ* conservation.


Figure 12 World Heritage Day workshop at Anjar archeological site

A video was also prepared to shed light on the story of *Iris antilibanotica* in its original habitat, the new conservation concept and the different introduction procedures implemented on site.

The video is also accessible to the public through the following QR code.

References

- Albrecht, M. A., & Maschinski, J. (2012). Influence of founder population size, propagule stages, and life history on the survival of reintroduced plant populations. In *Plant reintroduction in a changing climate* (pp. 171-188). Island Press, Washington, DC.

- Godefroid, S., Piazza, C., Rossi, G., Buord, S., Stevens, A. D., Aguraiuja, R., & Vanderborght, T. (2011). How successful are plant species reintroductions Biological Conservation, 144(2), 672-682.