Conservation program for threatened ferns of caves of the Valencian Community

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Introduction

For more than two decades, the El Palmar Aquaculture Centre (CAEP) that belongs to the Valencian Regional Government (GVA), has been carrying out conservation actions on threatened Pteridophytes of the Valencian Community (Eastern Spain).

In the Valencian Community there is a large number of underground cavities, caves and chasms which, thanks to their environmental characteristics, mainly light and humidity, are home to different species of ferns adapted to this type of ecosystem. As a result of their rarity and limited distribution, some are threatened. This is the case of *Asplenium marinum*, *Phyllitis sagittata* and *Phyllitis scolopendrium*, included in the Valencian lists of protected species of flora and fauna, the first two being classified as Endangered Species (EP) and the third as a Non-Cataloged Protected Species (PNC).

The main objective is to improve the conservation status of threatened cave Pteridophytes through the replication of new populations and the reintroduction of specimens in population reinforcements.

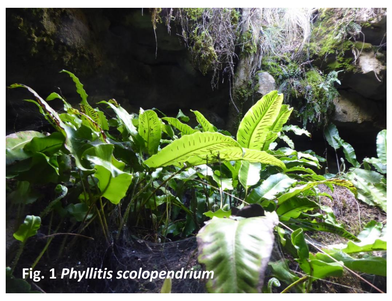


Fig. 1 *Phyllitis scolopendrium*

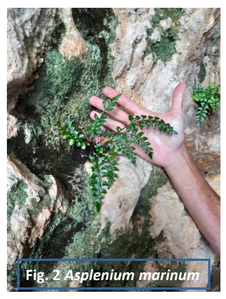


Fig. 2 *Asplenium marinum*

Fig. 3 *Phyllitis sagittata*

a) Tracking, census and mapping of populations

Project's first phase has consisted of field tracking and census of known populations, as well as review of bibliographic citations of these three species. The results currently indicate the existence of a single natural population of *Asplenium marinum*, one of *Pyllitis sagittata* and 22 populations of *Pyllitis scolopendrium*.

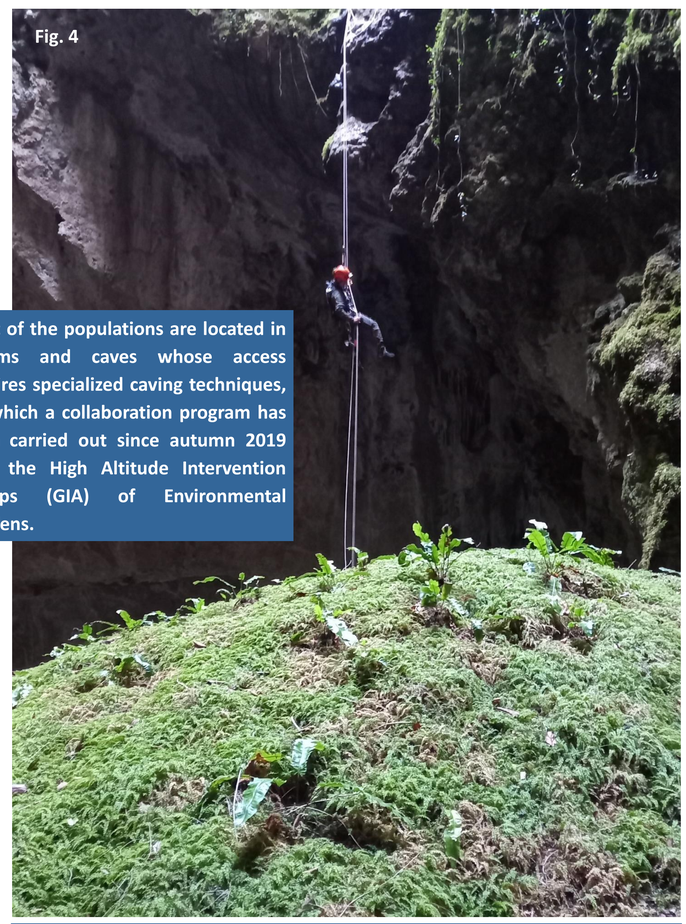


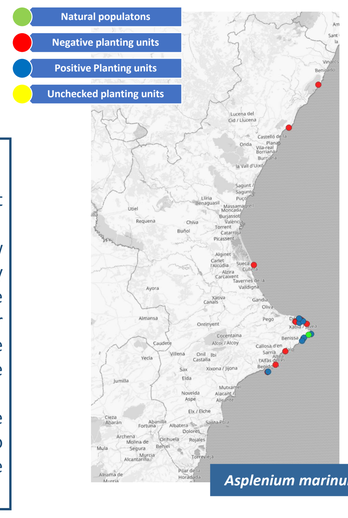
Fig. 4

Most of the populations are located in chasms and caves whose access requires specialized caving techniques, for which a collaboration program has been carried out since autumn 2019 with the High Altitude Intervention Groups (GIA) of Environmental wardens.

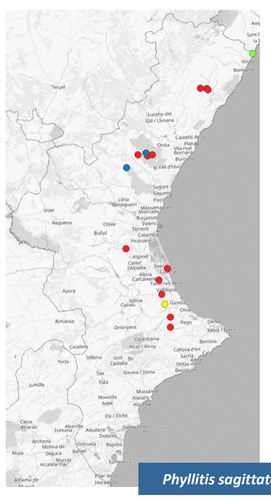
Fig 4. Avenc Ample. Phyllitis scolopendrium census.

Table 1: Populations and censuses on threatened ferns in the Valencian community

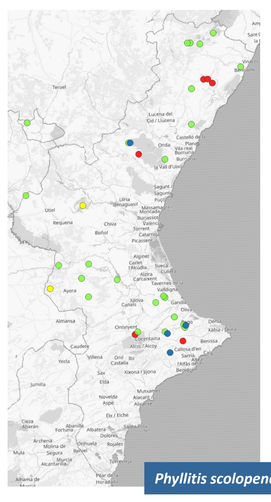
N.º Pop	Census populations	PV	Census results (Number of individuals)														
			1999	2003	2009	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Asplenium marinum																		
1	Cova del Llop Marí	A	15	11		17		21		17	15	15	12	11		8	9	9
Phyllitis sagittata																		
4	Sol de Riu. Pozo.	C						93	99	95	117	132	46	76	147	129		102
	Cova del Frare	C								Extinct								
	Montaña de Cullera	V									1	1	1	1	0	0	0	0
	Cova de les Calaveres	A								Extinct								
Phyllitis scolopendrium																		
27	Mina Virgen del Amparo	C							23				24			19		
	Mas de l'Ereta. Pozo	C									45		42			64		
	El Collet, Pozo	C							7							4		
	Forat d'en Ferràs	C				56							29					
	Sima de la Higuera	C				40							24			23		
	MRF Molí de la Torre	C												78	65	105		
	Nevero Mas de Colomé	C														16		
	Pou del Mas de Querol	C			12												not tracked	
	Font de Sant Pere	C			1												not tracked	
	Avenc del Simarró	V				20								27				
	Pozo del Moro	V				142									553			
	Cueva del Frontón	V				34										33		
	Sima Casa La Línea	V											23					
	Sima las Grajas	V				70									103			
	Cova de les Graelles	V				4								3				3
	Sima portillo	V				60										30		48
	Sima Aldaia	V												1				
	Avenc de Quatretonda	V												4				
	Avenc Llengua de Cérvol	V												8				
	Sima la Diabla	V														2		
	Cova de l'Aigua	V														0		
	El Condoig	A				7	4										3	
	Avenc Ample	A				80								336				360
	Barranc del Assut	A											37					
	Avenc Estret	A													3			3
	Avenc del Mig	A													0			
	Cova del Somo	A													0			



Asplenium marinum



Phyllitis sagittata



Phyllitis scolopendrium

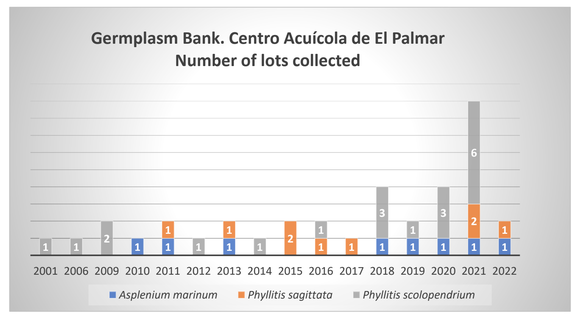
b) Propagation and cultivation

Plant germination and cultivation tests have been carried out in the facilities of the El Palmar Aquaculture Centre of the three species using spores collected from natural populations.

The propagation behaviour is similar for the three species, the main difference being the speed of maturation of the sporophytes. The most suitable germination conditions are 20ºC temperature with a photoperiod of 14 hours of light, in nutrient medium (Dyer, 1979). For cultivation and growth, standard sterilized peat-based substrate, airtight containers, stable humidity and temperature conditions and irrigation with distilled water until saturation are used.

Fig. 5

Fig. 6



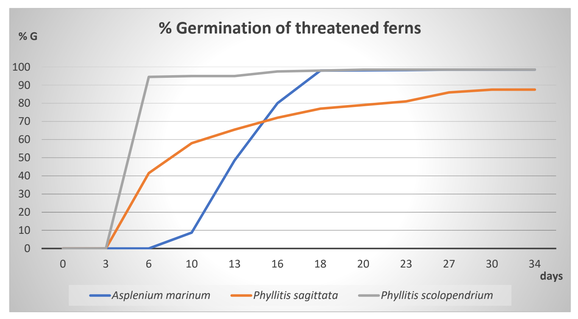


Fig. 7

Fig. 8

Fig. 9

Fig 5. Fern cultivation facilities at the El Palmar Aquaculture Centre.
Fig 6. *Asplenium marinum*. Cultivation at the El Palmar Aquaculture Centre.
Fig 7 & 8. *Asplenium marinum*. Spore treatment for conservation.
Fig 9. Propagation of *Asplenium marinum* in Dyer culture medium.

c) Conservation Actions. Fern Plantation

The fern recovery project begins with the search of caves, chasms, shelters, etc. throughout the Valencian territory suitable for planting.

Several plantation sites have been selected for each species with the aim of establishing new populations. The natural conditions of each site have been taken into account so that they were as similar as possible to the populations of origin. The main characteristics of the selected recovery areas are places sheltered from the intense sun and strong summer temperatures, high environmental humidity and sufficient water supply necessary for the subsistence of these ferns. That is why many of these areas are located in caves, where the environmental microclimatic conditions are more stable.

For the plantations, specimens approximately two years old have been used, still small in size to facilitate their adaptation and growth. Sowing of spores and planting of prothalles have also been carried out. The places chosen have been cracks and ledges, if possible with some substrate and in areas with water seepage or visible humidity.

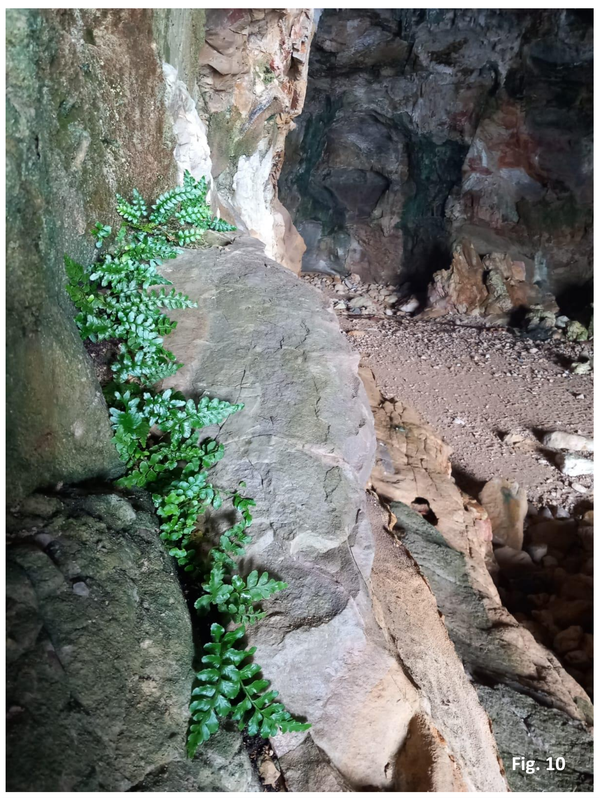


Fig. 10

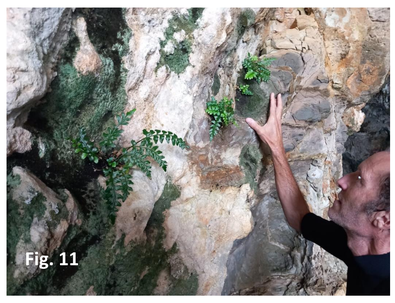


Fig. 11

Fig. 12

Fig 10, 11 & 12. Cova del Timó. Review of *Asplenium marinum* plantations.

Fig 13. Avenc Estret. Plantation of *Phyllitis scolopendrium.*

Fig. 13

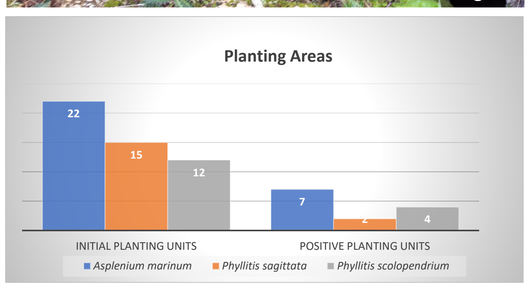


Table 2: Threatened fern plantations in the Valencian Community

Natura 2000	Initial planting units	Total number of planted individuals	Positive planting units	plantation year	Number of individuals planted	Results 2023 (number of individuals)
Asplenium marinum						
Cap de Cullera	1	36	0	2015		0
Litotal de Benicasim	1	18	0	2015		0
Montgó	10	246+sowing	Cova Tallada	2015-2022	100+sowing	14 (14%)
			Cova Gamell	2022	34	12 (50%)
			Les Rotes	2022	29	5 (17%)
Penya-Segats de la Marina	4	162+sowing	Cova Timó	2021-22	110+sowing	71 (65%)
			Cova Testos	2022-23	19+sowing	7 (37%)
			Cova de les Cendres	2020	3	1 (33%)
Serra d'Irta	2	43	0	2015-19		0
Serra Gelada i litoral de la Marina Baixa	4	22+sowing	Cova Fenolla	2020	4	1 (25%)
TOTAL	22	527	7			111
Phyllitis sagittata						
Serra d'Espadá	4	122+sowing	Bco de Aguas Negras	2022-23	23+sowing	2 (9%)
Serra d'en Galcerán	3	16	0	2017		0
Serra Calderona	1	16+sowing	Rambla de los Pajaricos	2022	16+sowing	7 (44%)
L'Albufera	1	2	0	2017		0
Serra de Corbera	1	29	0	2016-17		0
Serra de La Safor	1	9	0	2019		0
Serres del Montduver i Marxuquera	2	4+sowing	Font del Lloret (Bco dels Lledoners)	2020-21	4	not reviewed
Cova de les Meravelles	1	3	0	2016		0
Vall de la Marina	1	6	0	2020		0
TOTAL	15	207	2			9
Phyllitis scolopendrium						
Aitana, Serrella i Puigcampana	1	319	MRF Passet de la Rabosa	2008-12	319	21 (7%)
Serra de Mariola i el Carrascal de la Font Roja	1	62	0	2003-17		0
Valls de la Marina	2	143+sowing	El Condoig	2012	117	population reinforcement
			Avenc Estret	2020-23	26+sowing	4 (15%) population reinforcement
Cueva Negra-Ayora	1	25	Cueva Negra	2017-18	25	not reviewed
Sierra del Negrete	1	36	Bco de la Hoz	2023	36	not reviewed
Serra d'Espadá	1	8	0	2019		0
Serra d'en Galcerán	3	14	0	2017		0
Fuera RN2000	2	18	Sima la Higuera	2005	13	population reinforcement
TOTAL	12	630	4			25

Conclusions

- The conservation program for threatened Pteridophytes in the Valencian Community is allowing progress in specialized knowledge of propagation, cultivation and translocation techniques in the natural environment of 3 species of threatened ferns.
- The monitoring units for the 3 taxa have been updated, with the work carried out on prospecting and tracking of populations with old bibliographic citations being very significant, as well as the census of almost all natural populations existing today.
- For the species *A. marinum* and *P. sagittata*, in danger of extinction and with a single natural population, it has been possible to establish, for the moment, 7 new units for the first and 2 for the second.
- The number of introductions of *P. scolopendrium* is lower than in the case of the other two ferns because its best state of conservation does not require as much effort.
- The germination protocols obtained give high values in all three cases, 98% for *A. marinum* and *P. scolopendrium* and 87% in *P. sagittata*.
- 37 lots of different spores have been collected.

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