RECOVERY PLAN FOR THE THREATENED FLORA OF THE TEIDE NATIONAL PARK
I. *Cistus osbaeckiaefolius* WEBB EX CHRIST. AND *Helianthemum juliae* WILDPRET

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ABSTRACT. After a brief introductory outline of the Recovery Plan for the Threatened Flora of the Teide National Park, the present contribution concentrates on giving the results of the trials referring to the reproduction "ex situ" and subsequent reintroduction into their natural habitat of *Cistus osbaeckiaefolius* Webb ex Christ and *Helianthemum juliae* Wildpret. In addition, graphical data concerning their germination behaviour, iconography of the seeds and seedlings and a revised chorology of these two canarian endemics are also presented.

RESUMEN. Previa introducción al contenido del Plan de Recuperación de la Flora Amenazada del Parque Nacional del Teide, se abordan los resultados de su ejecución con las especies *Cistus osbaeckiaefolius* Webb ex Christ y *Helianthemum juliae* Wildpret. Se aportan datos referentes al comportamiento germinativo, cartografía e iconografía de estos endemismos canarios en peligro de extinción así como las experiencias adquiridas en la reintroducción de ejemplares obtenidos "ex situ" a su hábitat natural.

INTRODUCTION

Since the introduction of the Law for the Conservation of Natural Areas and Wild Flora and Fauna, a National Catalogue of Species (Royal Decree

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439/90) has been drawn up in Spain and the possibility has now arisen for the Autonomic Governments to create their own catalogues. These should include those species in danger of extinction, those sensitive to any alteration of their habitat or those of special interest. This new framework perceives positive and active protection measures in the form of "Plans for Recuperation,Conservation or Management" which allow for the maintenance of these species at an adequate conservation level.

The Committee for Threatened Plants, established by IUCN in 1974, established the "List of Rare, Threatened and Endemic Plants of Europe" (COUNCIL OF EUROPE 1983). Later, a team of Spanish botanists updated this list (Barreno, 1984) confirming -as in the original publication- that the Canary Archipelago constituted the region of Europe with the greatest number of species in danger of extinction (127 taxa "E") and one of the most important regions with vulnerable species (119 taxa "V").

With the celebration of the International Congresses, promoted by the "Viera y Clavijo" Botanical Gardens in 1985 and the Córdoba Botanical Gardens in 1988, the awareness was shown for the urgent need to actively initiate Recovery Plans in Spain for the flora in danger of extinction. More recently, the Iberomacaronesia Association of Botanical Gardens has initiated fruitful contacts with ICONA (National Institute for the Conservation of Nature) with a view to establishing a narrow form of collaboration in the field of the recovery of threatened species.

Teide National Park. The Recovery Plan

The Teide National Park, established in 1954 on the island of Tenerife, encompasses an area of 13,500 hectares that exhibits a singular representation of the shrub and xerophytic vegetation of the Supracanarian Zone. Its excellent state of conservation together with its exceptional richness and singularity, convinced the Council of Europe to award the Park in 1989 with the maximum category of the Diploma of Europe. The Park harbours 50 of the species endemic to the Canaries, 27 of which are exclusive to the island. Amongst these, eight species are in danger of extinction (E) and eleven in a vulnerable situation (V).

According to the criteria of the U.S. Fish & Wildlife Service, a Recovery Plan is a "guide which justifies, delimits and programmes those actions necessary to restore and assure a species as a self-viable component of its ecosystem". Without doubt, the most effective means of avoiding the extinction

of particular species is the setting out and execution of these plans, within which consideration should be given for the wellbeing of species habitat, the eradication of introduced elements and the reintroduction of individuals obtained "ex situ". An interesting article concerning the methodology employed in these plans has recently been written by Machado (1989).

At the moment in Spain, the basic norms for the Recovery Plans at the National Parks have recently been established and ICONA has been applying them in relation to various floral species of the Canary Islands, having incresed the populations of at least five threatened taxa in the Garajonay National Park (Bañares 1990a,b).

The Recovery Plan for the Threatened Flora of the Teide National Park (Bañares, 1988), arose in July 1988 under the patronage of the Park itself, being characterized as a Special Plan deriving from the Master Plan for Use and Management (Royal Decree 2423/84). The Plan suggests the following lines of action:

I. Recovery and conservation of the genetic resources of the Park's threatened species, promoting germoplasm banks.
II. Experimentation with alternative means of reproduction and mass propagation of the species "ex situ".
III. Preservation of collections in the nurseries of ICONA and promotion of their conservation in botanical gardens.
IV. Transplanting material obtained "ex situ" in the species potential habitat.
V. Promotion of an intensive publicity campaign stressing the importance of our flora and the urgent need to protect it.
VI. Coordination with other institutions for the establishment of the priorities for protection and recovery.
VII. Promoting the legal protection of taxa included in the plan.

The above-mentioned Plan has established that the species listed below are in need of the application of a Recovery Plan. Each taxon has been assigned the threat category (E, in danger of extinction; V, vulnerable) together with their corresponding insular distribution (T, Tenerife; P, La Palma; H, Hierro; C, Gran Canaria). Those taxa endemic to the supracanarian vegetation zone are indicated by a (+) and those which are confined exclusively to the Teide National Park and its immediate surroundings, with an (*).

Aeonium smithii (Sims) Webb et Berth	(V)(T)
Bencomia exstipulata Svent	(E)(T,P)(+)
Carex paniculata L. ssp. *calderae* (Hansen) Luceño et Castroviejo	(V)(T)(+)(*)
Cerastium sventenii Jalas	(V) (T,H,P)
Cistus osbaeckiaefolius Webb ex Christ	(E)(T)(+)(*)
Descurainia gonzalesii Svent	(V)(T)(+)
Echium auberianum Webb et Berth	(E)(T)(+)(*)
Echium wildpretii Pers. et Hook fil. ssp. *wildpretii*	(V)(T)(+)
Gnaphalium teydeum Knapp	(E)(T)(+)(*)
Helianthemum juliae Wildpret	(E)(T)(+)(*)
Monanthes brachycaulon (Webb et Berth.)Lowe var. *nivata* Svent.	(E)(T)
Monanthes niphophila Svent.	(E)(T)
Sideritis eriocephala A.Marrero ex L.Negrín et Pérez	(V)(T)(+)
Sideritis oroteneriffae L.Negrín et Perez var. *oroteneriffae*	(V)(T)
Sideritis soluta Clos ssp. *soluta*	(V)(T)
Silene nocteolens Webb et Berth.	(V)(C,T)
Stemmacantha cynaroides (Chr. Sm. in Buch) Ditteich	(E)(T)(+)(*)
Viola cheiranthifolia Humb. et Bonpl.	(V)(T)(+)(*)

Having evaluated in the above-mentioned Plan the urgent priority for the conservation of these species -according to the criteria of Bramwell & Rodrigo (1984), and that of Machado (*op.cit*)- the decision was taken to initiate the work with the taxa *Cistus osbaeckiaefolius* and *Helianthemum juliae*. Consequently, the aim of this communication is to present the results of the activities undertaken so far in relation to the restoration of these two species. In this aspect, we will present descriptions of the seeds and seedlings, ecological and chorological data accompanied by updated distribution maps. In addition, we will mention the results of the different germination trials "ex situ" and the reintroduction of individual plants into their potential habitat.

MATERIALS AND METHODS

Germination Trials

Seeds were collected at selected sites within the National Park and the germination trials were performed during the normal period of seedling development in their natural surroundings without any previous storage.

The nurseries were located in a glass greenhouse situated in the potential release area of Las Cañadas at an altitude of 2200 metres above sea level, adjacent to the Park's Visitors Centre.

The seeds were firstly subjected to the "water test" in order to determine their fertility; subsequently they were submitted to an anti-fungal treatment (1 gr/l BENOMILO 50%) for three hours and then grouped into 2 lots of 200 for sowing. One group was treated with gibberellic acid (GA_3) (15 mg in 100 ml of water) for 24 hours, while the other received no treatment whatsoever (Control Treatment).

The samples were then placed in seed trays (containing soil from the species habitat plus 35% fertilized peat) and subsequently watered by absorption, adding a dose of fungicide, every 15 days.

The count of seedlings was carried out periodically until there were no signs of fresh germination. From the data obtained it was possible to calculate the germinative capacity (%G), the germination value (GV) (Czabator, 1962) and Kotowski's coefficient of velocity (KCV) (Kotowski, 1926).

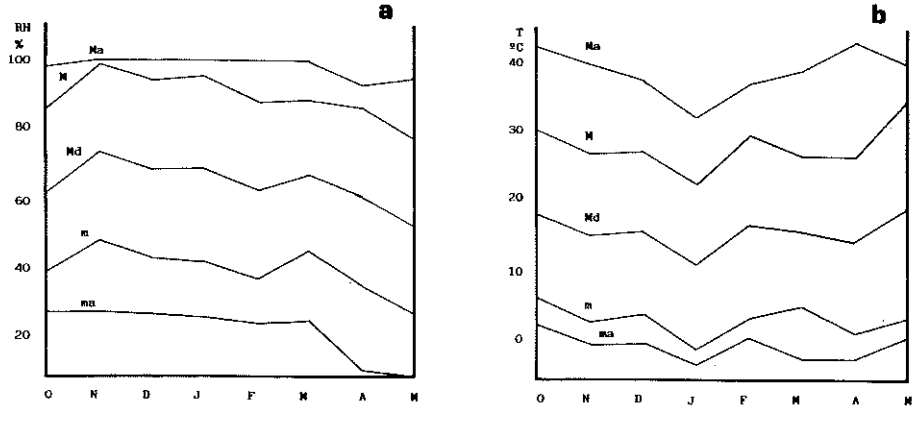

Figure 1. (a): RELATIVE HUMIDITY (%). (b): TEMPERATURE (ºC). Greenhouse at Las Cañadas del Teide (2.200 m above sea level). Period from Oct. 1989 - May 1990. (Ma, absolute maximum; M, maximum average; Md, absolute average; m, minimum average; ma, absolute minimum).

Climatological Data

In order to monitor climatological conditions during the period of, and at the location of the germination trials, a thermohygrograph was installed inside the greenhouse. The corresponding data are presented in Figure 1.

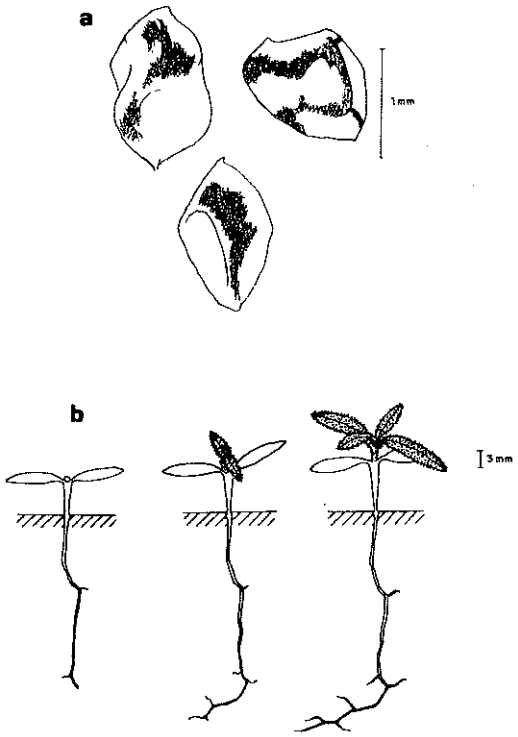

Figure 2. *Cistus osbaeckiaefolius* Webb ex Christ. (a): seeds. (b) development of seedlings.

CISTUS OSBAECKIAEFOLIUS Webb ex Christ, Spic. Can. in Engl. Bot. Jahrb. IX (1988)

This is a taxon endemic to the high altitudes of Tenerife, forming part of the scrub that characterises the vegetation of cliffs and scree slopes in the dominion of *Spartocytision nubigeni* Esteve 1969. Its chorology has recently been updated by Bañares *et al.* (1992), having localized 250 plants distributed

throughout three localities (Riscos de Magdalena, 2150 m above sea level, N-NW; Llano de las Mesas 2300 m, S; La Fortaleza 2000 m, S).

Description (Figure 2)

Fruit in subcyathiform capsule, coriaceous, dehiscent, trilocular, multisperm, brown when mature. Seeds of irregular morphology, angular, ranging from dark brown to black; measuring 1.1-1.3 mm and weighing 0.12 mg. Seedlings with herbaceous hypocotyl, glabrous, reddish colour, 8-12 mm in height. Sessile cotyledons, glabrous, entire, linear-lanceolate, ranging in colour from reddish-green above to reddish below, measuring 6-9 x 2-2.5 mm. Leaves opposite, entire, linear-lanceolate, hairy, deep green on the upper surface, somewhat fainter below; measuring 6-7 x 2.5-3 mm; central nerve prominent on the upper surface.

Phenology

The species flowers in June-July and fruits from October to December. We have observed evidence of sexual propagation in cliff areas (Riscos de la Magdalena).

Germination Trials "ex situ"

Seed collection: La Fortaleza, Teide National Park. November 1989.
Water test: Positive (100%)
Nurseries (Figure 3):

	%G	GV	KCV
CONTROL TREATMENT			
(a) 6-11-1989	8	0.01	1.9
(b) 17-3-1990	25	0.69	5.70
GIBBERELLIC TREATMENT			
(c) 6-11-1989	4.5	0.004	2.38
(d) 17-3-1990	3.5	0.009	4.46

The results of germination trials demonstrated a high germinative capacity (%G), without preliminary treatment, the best results being obtained from the spring sowing (25%) (b). Furthermore, under these conditions, the GV and the KCV were also superior.

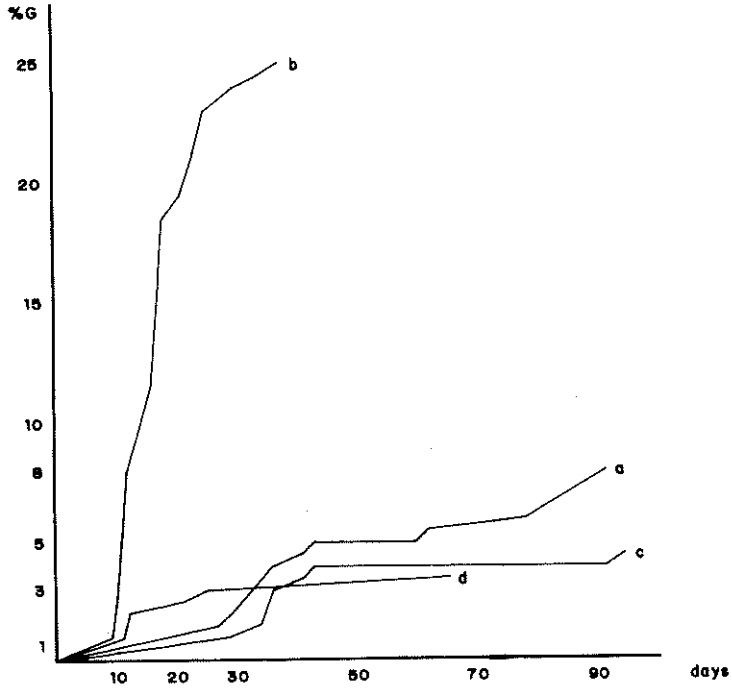

Figure 3. *Cistus osbaeckiaefolius* Webb ex Christ. GERMINATIVE CAPACITY. (a) control treatment (6-11-1989). (b) control treatment (17-3-1990). (c) gibberellic treatment (6-11-1989). (d) gibberellic treatment (17-3-1990).

In a previous study (Maya *et al*, 1988), the same experiment was performed under laboratory conditions (22 ± 2ºC), obtaining without gibberellic treatment, a slightly superior germinative capacity (37.5%) and a similarly superior KCV (8.28). Using these results and those obtained by ourselves, and following the criteria of Diehl & Mateo Box (1988), one obtains a nascence coefficient of Cn=66% from which it can be concluded that in Spring at least, in our nurseries the species displays an acceptable germinative capacity.

Reintroduction (Figure 4)

The reintroduction of *C. osbaeckiaefolius* into natural surroundings was carried out at sites selected as potential habitats in 1988 and 1989. Up to the present a total of 300 plants have been transplanted (seedlings of 1 to 2 years) at two sites in the National Park: Zapatito de la Reina (2100 m above sea level;

N) and close to Guajara Peak (2150 m; E-SE). At both localities there exists a cohort of species and ecology similar to that found at the natural sites (Bañares *et al.*, op. cit.). At least 60% of the samples have prospered.

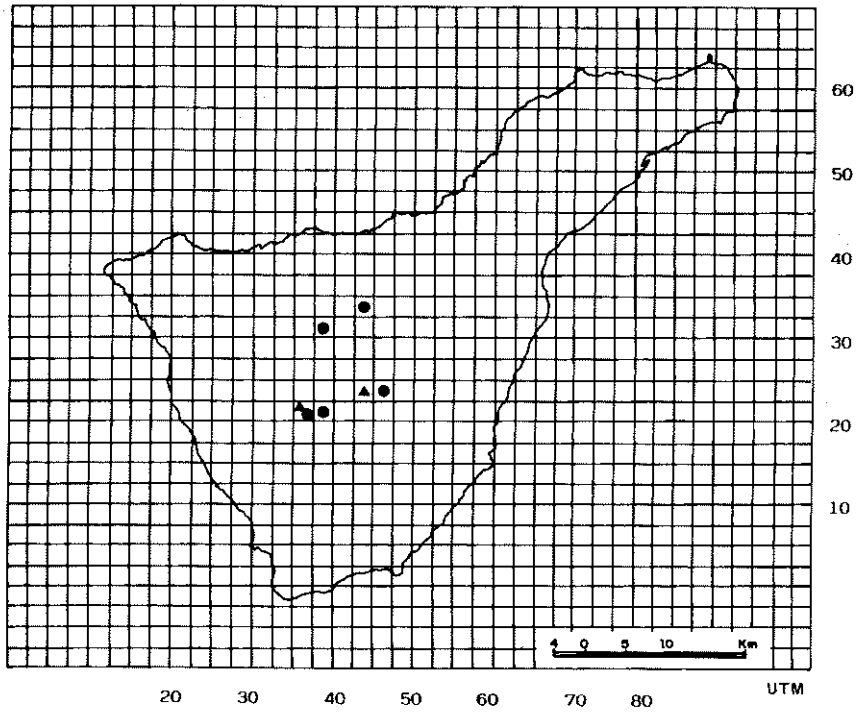

Figure 4. Tenerife. Distribution of *Cistus osbaeckiaefolius* Webb ex Christ. (●) natural populations. (▲) reintroductions.

Planting was carried out in Spring and Autumn, better results being obtained with the latter group. Nevertheless, many of the seedlings planted in Spring adapted relatively well to the arrival of Summer. Bearing in mind the fact that the rabbit (*Oryctolagus cuniculus*) is highly fond of this species, 50% of the plants were protected by individual wire mesh cylinders. However a low mortality rate was observed amongst the younger unprotected seedlings and furthermore, in those plants sufficiently lignified, extremely good rates of fresh growth were observed after having suffered earlier damage by rabbits.

Threat factors

C. osbaeckiaefolius could have been seriously affected by grazing and the collecting of firewood in Las Cañadas; both were common practises at least until the 1950's.

Today the high seminal production of the species, its germinative capacity "ex situ" and the evidence of sexual propagation "in situ", constitute reasons which make us believe that the species has prospered favourably in recent years. Nevertheless the damage caused by *Oryctolagus* to the younger plants is a cause for concern since it is more than likely hindering the plants dispersal to flatter areas. In this context it is important to mention that research work is currently being carried out to investigate the incidence of rabbits on the dynamics of colonisation of *C. osbaeckiaefolius* by means of sampling quadrats.

The recently introduced "Corsican Muflon" (*Ovis ammon musimon*) is another herbivore which could be damaging *Cistus osbaeckiaefolius* populations. However, studies of the animal's diet in Las Cañadas have up to the present shown that although the fruits are consumed, they are of little importance (Rodriguez Luengo, *pers. comm.*)

HELIANTHEMUM JULIAE Widpret, Vieraea 16 (1-2) (1986)

This is an endemic species of high altitudes of Tenerife being exclusively restricted to the communities of cliffs and scree slopes in the dominion of *Spartocytision nubigeni* Esteve 1969. Its chorology has recently been updated by Bañares *et al* (1992), there existing a total of 90 individuals at two sites in the National Park: Cañada de las Pilas (2200 m above sea level, W) and Risco Verde (2050 m, E).

Description (Figure 5)

Fruit in sub-spherical capsule, dehiscent, trilocular, multisperm. Light yellow seeds of an irregular angular form, with a glandulous surface, ranging from dark brown to black; measuring 1-1.2 mm in length and weighing 0.14 mg. Seedlings with reddish-brown hypocotyl, 8-15 mm in height. Oval cotyledons, entire, with prominent nervation, about 3.5-5 x 2.5-3 mm, slightly petiolate, red-green above and reddish-brown below. Leaves opposite, entire, hairy, linear-lanceolate, about 7-9 x 2.5-3 mm, with a short petiole, pinnate nervation with a prominent central nerve.

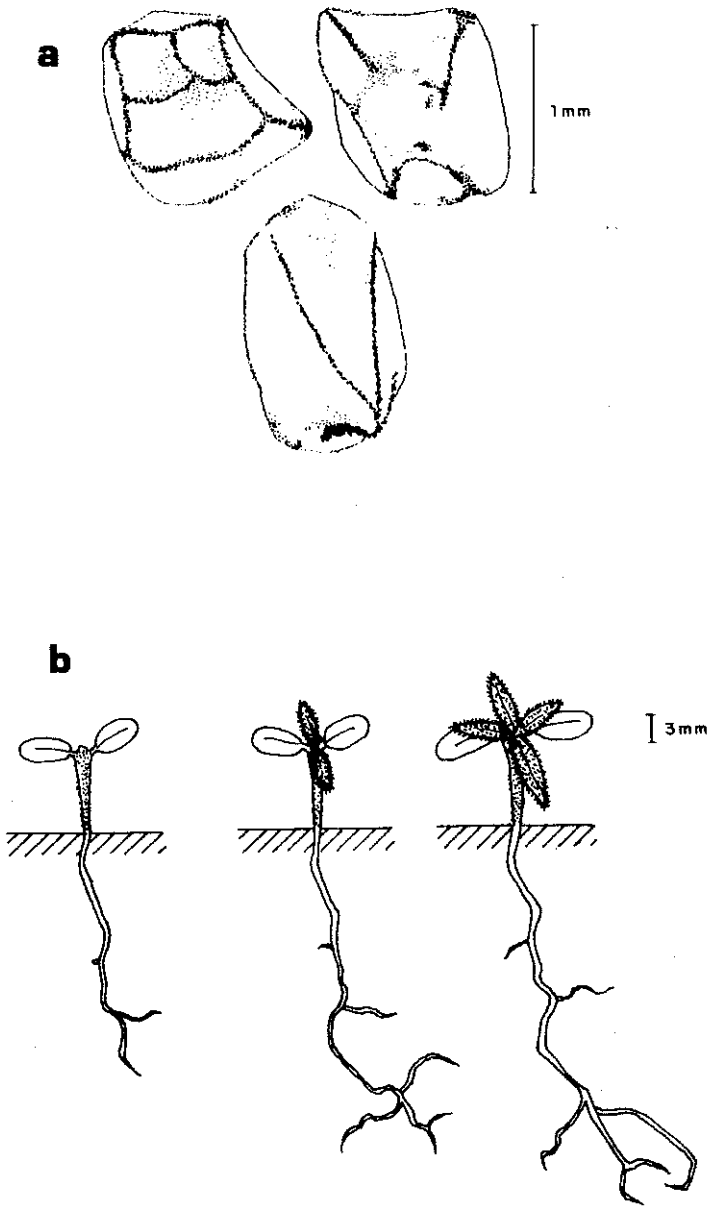

Figure 5. *Helianthemum juliae* Wildpret (a) seeds. (b) development of seedlings.

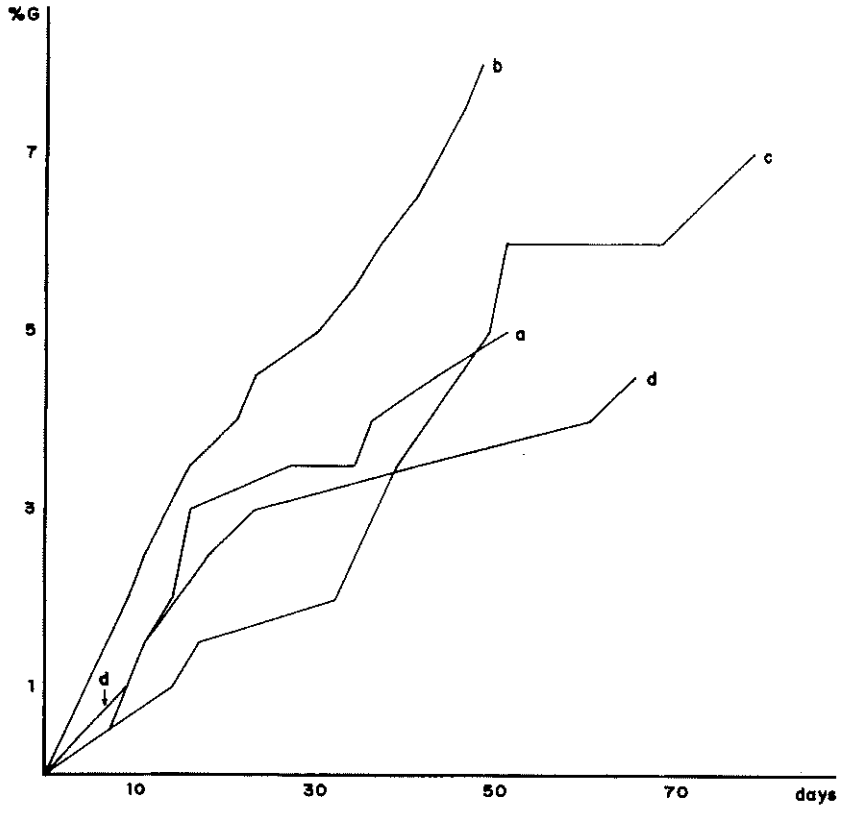

Figure 6. *Helianthemum juliae* Wildpret. GERMINATIVE CAPACITY. (a) control treatment (19-10-1989). (b) control treatment (17-3-1990). (c) gibberellic treatment (19-10-1989). (d) gibberellic treatment (17-3-1990).

Phenology

The species flowers in May-June and fruits in August. We have observed evidence of sexual propagation in cliff areas (Risco Verde).

The four sets of results obtained were very similar, showing a very low germinative capacity (%G), the best results being obtained from the Spring sowing, without preliminary treatment (8%) (b). Under these conditions the GV were slightly superior.

Germination Trials "ex situ"

Seed collection: Cañada de las Pilas, Teide National Park. August 1989.
Water test: Positive (87%)
Nurseries (Figure 6):

	%G	GV	KCV
CONTROL TREATMENT			
(a) 19-10-1989	5	0.02	4.31
(b) 17-03-1990	8	0.026	3.95
GIBBERELLIC TREATMENT			
(c) 19-10-1989	7	0.01	2.32
(d) 17-03-1990	4.5	0.009	3.54

In a previous study (Maya *et al*, 1.988) on the germinative behaviour of this species under laboratory conditions (22 ± 2ºC) better results were obtained (%G=25% ; KVC=10.9); in this experiment, inferior results were obtained with preliminary treatment with GA_3. Using these results obtained in the laboratory and those obtained by ourselves, one can deduce the coefficient of nascence, following Diehl & Mateo Box (1.988). The resulting value of Cn=32% indicates that at our nurseries, *H. juliae* exhibits quite a low germinative capacity.

Reintroduction (Figure 7)

The reintroduction of *H. juliae* into its natural surroundings was performed at localities selected as potential habitat. Up to the present a total of 300 plants have been transplanted (seedlings of 1-2 years) at two sites in the National Park: Cueva de Diego Hernandez (2050 m above sea level; W) and close to Montaña de la Grieta (2050 m; NW). At both sites there exists a cohort of species and ecology similar to that observed at the natural sites (Bañares *et al.*, op cit.). At least 40% of the plants have prospered.

Transplanting was carried out in the Spring and Autumn of 1989. Although acceptable results were obtained with the Autumn group, the same cannot be said of the Spring group that produced a high mortality owing to the fragility of the seedlings at the beginning of Summer. Approximately 50% of the seedlings were protected from rabbit predation by being covered with wire mesh cylinders. As expected, a higher mortality rate was observed amongst those seedlings not

housed in protectors, especially those in flatter areas. As with *C. osbaeckiaefolius*, the transplanted seedlings of *H. juliae* which exhibited a certain amount of lignification, produced fresh growth following earlier damage by rabbits.

Threat factors

Like other elements of the flora of Las Cañadas, *H. juliae* could have been seriously affected by grazing, a very common and widespread activity in the past.

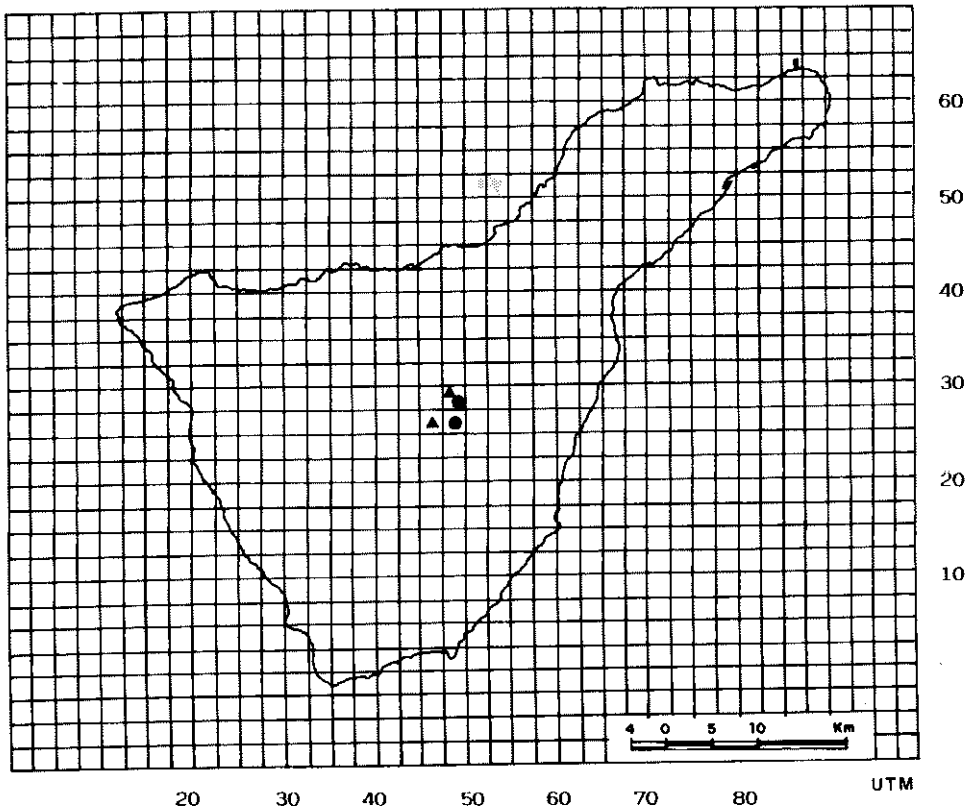

Figure 7. Tenerife. Distribution of *Helianthemum juliae* Wildpret. (●) natural populations. (▲) reintroduction.

The species scarcity could also be a consequence of its poor germination response in comparison to other elements of its natural environment with a greater germination and colonization capacity. A comparative study of the reproduction of several endemic species of the Supracanarian Zone (Real 1990), corroborates this hypothesis. On the other hand, the damage caused by rabbits to the young seedlings contributes further to the scarce occurrence of *H. juliae* and probably explains why it is currently restricted to cliff areas. In this context we are currently studying the incidence of rabbits on the dynamics of colonisation of *H. juliae* by establishing sample quadrats.

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