LIFE22-NAT-ES-LIFE Phoenix
LIFE Phoenix **Restoration and improvement of Priority Habitat 9370*** **"Palm groves of *Phoenix*"**
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Palm Grove Management Plan in Gran Canaria.
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Palm Grove Management Plan: Gran Canaria

Restoration and improvement of Priority Habitat 9370*
"Palm groves of *Phoenix*"

LIFE PHOENIX / LIFE22-NAT-ES-LIFE Phoenix

Compiled by: GESPLAN, CGC, GOBCAN, ICIA and ULPGC.
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1. INTRODUCTION

Endemic palm groves in Europe of genus *Phoenix* create important natural and semi-natural ecosystems with an outstanding ecological and socio-economical value that are only present in Spain (with *Phoenix canariensis* in the Canary Islands) and Greece (with *P. theophrasti* in Crete). Their uniqueness justify the inclusion in Annex I of the EU Directive 92/43 and the designation as Priority Habitat 9370* "Palm groves of *Phoenix*", with a total of only 53 Natura 2000 sites designated for its conservation at the EU level.

Both species, and the habitat they configure, face similar conservation problems in both regions. The main shared threats are related to climate change effects, pests and invasive plant species. Other important issues are more directly linked to human activities, with different level of importance depending on the region: in Gran Canaria, hybridisation with *P. dactylifera* due to past bad practices; in Crete, overgrazing and tourist visitor pressure, while hybridisation and pests are mainly considered through a precautionary approach.

Phoenix canariensis is probably one of the most representative endemic plant species of the Canary Islands, also declared as a vegetal symbol of the archipelago by the regional Government (Law 7/1991, 30th april). While better known for its worldwide horticultural interest, it should be emphasised that the naturally occurring groves represent the most important genetic reservoir of the species. Thus, any improvement in the management of Priority Habitat 9370* is necessary and will contribute to its conservation.

The overall aim of LIFE Phoenix is to improve the conservation status of Habitat 9370* on the islands of Gran Canaria and Crete by tackling their most important risks and threats. In this sense, this Palm Grove Management Plan represents the main document synthesising the guidelines to implement a comprehensive conservation strategy for this habitat in Gran Canaria.

This Management Plan is also conceived as a "living document" for the duration of the LIFE Phoenix project; therefore it is intended to be regularly updated in line with an adaptive management approach.

2. BACKGROUND

At present, *Phoenix canariensis* occurs sparsely and unevenly across the entire archipelago, being especially abundant in La Gomera and Gran Canaria islands. In the same way as for the whole Canarian thermophilous woodland, natural palm groves suffered severe fragmentation in the 15th century due to the expansion of agriculture. Currently, they are mainly restricted to the bottom of ravines and slopes with high moisture, in addition to remnants strongly linked to the agricultural landscape.

In the Canary Islands, Habitat 9370* covers a total estimated surface of 1,784 Ha, of which 590 Ha (33.1%) are included within 47 SACs. On the island of Gran Canaria this habitat is present in 574.6 Ha, of which only 158.6 Ha (27.6%) are under EU protection in 9 SACs. This represents a small coverage within EU protected areas, considering the global relevance of the species and, in particular, in the Canary Islands.

The two Natura 2000 sites selected for the LIFE Phoenix project in Gran Canaria include 51.08 Ha (32.2%) of the total surface on the island under EU protection. More precisely, the 4 target palm groves in Gran Canaria represent 45 Ha (28.4%) of this habitat under EU protection on the island. In SAC Güigüí, the two target palm groves comprise around 28 Ha, while the other two selected in SAC Fataga total some 17 Ha.

The populations of *P. canariensis* are showing a slowly increasing trend due to progressive abandonment of agriculture and human works in the bottom of ravines that affects water availability. However, this priority habitat still faces important threats in the Canary Archipelago. Within the selected target sites for Gran Canaria, which include some isolated natural palm groves of high ecological importance, the following problems are considered the most urgent to be addressed:

a) Climate Change: in particular higher risk of wildfires and, on the other hand, drop of groundwater availability and recurrence of droughts, as a consequence of variations in the rainfall regime, decreasing trend in precipitation and effective evapotranspiration increase. In Gran Canaria, 8 big forest fires have occurred in only 12 years (2007-2019) and some 32,000 Ha have been affected since 2000. In August 2024, a fire affected an area of 18 Ha of palm grove habitat in the Fataga ravine, located 5 km north of one of the LIFE Phoenix project areas. The temperature throughout the Canary Islands has been rising steadily and estimated linear trends for temperature are generally between 2 and 4 ºC/100 years. In this context, the risks for a natural palm grove will be an increase in the number and intensity of forest fires, a worsening of the health status of the palm grove (with delayed flowering and germination, and less growth of individuals) which will lead to lower production in general, changes in phenology, composition of plant and animal communities, as well as an increase in damage caused by pests.

b) Pests and invasive alien species (IAS): infection by the insect *Diocalandra frumenti* has become a major threat in the Canary Islands, with a very significant increase in Gran Canaria where, in just 7 years (2011-2018), the number of affected palm groves had increased by 50%. Specimens infected by *D. frumenti* are considerably damaged and affected by other lethal diseases such as *Fusarium oxysporum* f. sp. *canariensis* or *Ceratocystis* (*Thielaviopsis*) *paradoxa*. On the other hand, some invasive plant species (mainly *Arundo donax, Pennisetum setaceum –Cenchrus setaceus–, Acacia spp., Opuntia spp. and Agave spp.*) are also constraining the development of the natural palm groves. Dense and impenetrable reedbeds of *A. donax* suffocating palm groves are present in some 646 Ha of ravines across Gran Canaria, representing fire hazard severity zones which can function as fire propagation corridors. In some points, reedbed coverage exceeds 90% of the range of Habitat 9370* and displaces other native species.

c) Hybridisation: it is a much extended problem in Gran Canaria due to past reiterated bad practices in the ornamental, touristic and agriculture sectors, and to the relatively easy hybridisation mechanism (through wind-blown pollen) between *P. canariensis* and *P. dactylifera*. *P. dactylifera* is listed as IAS in the Canary Islands and its possession, transport and trade has been prohibited in the archipelago since 2013. Data from the Atlas of the palm groves of Gran Canaria show that 172 (68.8%) out of the total 250 palm groves counted on the island were classified as pure *Phoenix canariensis* palm groves, compared to 78 populations that seem to contain some “non-Canarian” specimens. However, in a much more detailed survey carried out recently in 10 natural palm groves in Gran Canaria, 5 of them (all located in the north of the

island) were found to present a high or medium risk of hybridisation due to the presence of date palms or hybrids in the vicinity. On the other hand, in 5 palm groves located mainly in the south of the island, the risk of hybridisation was low or null.

3. DESCRIPTION OF THE PROJECT SITES

In the Canary Islands, Habitat 9370* is represented by the association *Periploco laevigatae-Phoenicetum canariensis* and it is *Phoenix canariensis* which characterises this community. It can be observed in almost monospecific formations, where the only arboreal element is the palm tree, or with tree elements of the thermophilic forest, such as wild olive trees (*Olea cerasiformis*), junipers (*Juniperus turbinata ssp. canariensis*), cornical (*Periploca laevigata*), mastic trees (*Pistacia atlantica*), balo (*Plocama pendula*), tasaigo (*Rubia fruticosa*) and dragon trees (*Dracaena draco*). It is a priority habitat that develops generally in alluvial areas, in the lower areas of ravine beds and on slope landslides, always in environments with a certain amount of soil moisture. These formations can be found in watercourses close to the sea, although in areas not directly influenced by sea breezes. In ravines where there is no water flow, they are located at the bottom, while in those where there is water flow, the palm groves are located behind a first line of tamarisk (*Tamarix canariensis*) or willow (*Salix canariensis*); in more degraded areas, the first line is occupied by the invasive common reedbed (*Arundo donax*).

In some localities the palm groves are altered by the presence of date palms, with results not only for the plant community, but also with repercussions on the offspring through genetic hybridisation. On the other hand, the reduction in the availability of water, especially in the case of semi-natural palm groves (with important presence of IAS), increases the number of individuals that endure considerable water stress, thus some end up dying. Finally, the presence of phytophagous pests such as the palm weevil (*Diocalandra frumenti*) is affecting a considerable number of specimens.

3.1 SAC ES7010008 Güigüí

The SAC has a highly eroded relief with numerous ravines that cross more than 1,000 m in height in a short distance, rising and flowing within this protected area. This reserve is home to an interesting example of “cardonal-tabaibal” community (*Euphorbia spp.*) and important remnants of thermophilic forests. The peculiar orography of old ravines is a representative formation of the island's geology, which in Güigüí forms a landscape of great beauty. Throughout the area there are scattered giant cactus (*Euphorbia canariensis*) and, in certain areas, good populations of endemic palm trees (*Phoenix canariensis*), mastic trees (*Pistacia atlantica*) and sweet tabaiba (*Euphorbia balsamifera*).

The project area is coincident with the beds of some ravines where there are good palm groves and wild olive groves accompanied by mastic trees. There is an abundance of endemic species, such as the “tajinaste” (*Echium decaisnei ssp. decaisnei*, *Echium onosmifolium ssp. spectabile*) and the “cabezón” (*Cheirolophus falcisectus*), the latter of which is exclusive to the protected area. The coastal cliffs are suitable for nesting seabirds such as petrels and shearwaters and endangered birds of prey, such as the osprey (*Pandion haliaetus*) and Barbary falcon (*Falco pelegrinoides*), have occasionally been seen flying over the area.

The SAC covers a total surface of 2,897.70 Ha, of which 30.78 Ha (1.1%) corresponds to priority Habitat 9370* "Palm groves of *Phoenix*". The target project area in Güigüí (28 Ha) is 100% occupied by Habitat 9370* and it also represents 17.65% of the total EU protected surface for this habitat in Gran Canaria. The population size of *P. canariensis* is approximately 465 individuals in this particular area, which also holds some of the last remnants of genetically pure populations of the species in the island.

Habitat 9370* is distributed in ravine beds (mainly on the western slope) in Güigüí Grande, Güigüí Chico and Los Calderillos ravines. These palm groves have a somewhat impoverished structure due to the presence of reed beds of *Arundo donax* and the coincidence with former cultivation areas. According to the SAC Management Plan, this habitat has a significant representativeness (C), a relative surface area of between 0-2% (C) and an intermediate conservation status (C). Its overall assessment is considered significant (C). There are no indications that significant changes in community density and composition have occurred during past assessments over 20 years (1994-2012).

Pressures and threats include: non intensive grazing; IAS and allochthonous species like herbivores, *Penissetum setaceum* and *Arundo donax*; and parasitism and pests. LIFE Phoenix will contribute to the following aspects of the 2016 SAC Management Plan:

Conservation Objective 5: To maintain the current favourable conservation status in terms of distribution and ecological functions of the natural habitat 9370* Palm groves of *Phoenix*, with an area in optimum condition of at least 30.78 Ha (1.1% of the SAC).

Action 1.5: Monitoring of the conservation status of habitat 9370*. The situation of its characteristic species should be reflected, as well as the presence and magnitude of the impacts that could affect its conservation status.

Action 3.1: To quantify the population of palm trees within the SAC, by means of an inventory and mapping of each of its specimens. Biometric data should also be recorded, as well as their health status (presence of pests, degree of sensitivity to them, etc.).

Action 4.2: To promote regular phytosanitary monitoring of palm trees, in order to carry out early detection of different pathogens, especially *Rhynchophorus ferrugineus* and *Diocalandra frumenti*, as well as other pathogens considered.

Action 7.2: To propose a plan for the control and/or eradication of IAS and proceed with its implementation.

The project area is composed of 2 natural palm groves which jointly add up to 28 Ha. The main use in both palm groves is nature conservation (95%) and only in very reduced scattered areas some farming activity can be detected (5%). In the Güigüí Grande ravine there were agricultural practices in the past, as evidenced by the deteriorated terraces on its banks and the presence at its mouth of the remains of a warehouse belonging to the Fyttes company, dedicated to the export of tomatoes. At present, only one family is known to live permanently in this ravine, which cultivates an area of no more than one hectare and has about twenty head of goats. The beach of Güigüí Chico has a relatively large number of hikers who come down from the peaks along different routes into the interior of the ravine.

Other protected plant species present in the SAC:

- *Limonium sventenii**: Annex II Habitats Directive, priority species; Annex I Bern Convention; Spanish Catalogue of Threatened Species ("vulnerable"); Canary Islands Catalogue of Protected Species ("vulnerable"). Population in the SAC: 119 ind. in 2015.
- *Lotus callis-viridis:* Annex II Habitats Directive; Annex I Bern Convention; Spanish List of Wild Species under Special Protection Regime; Canary Islands Catalogue of Protected Species ("special protection"). Population in the SAC: 265 ind. in 2015.
- *Juniperus cedrus ssp. cedrus:* Spanish Catalogue of Threatened Species ("vulnerable").
- *Crambe scoparia:* Spanish List of Wild Species under Special Protection Regime; Canary Islands Catalogue of Protected Species ("endangered").
- *Cheirolophus falcisectus:* Spanish Catalogue of Threatened Species ("endangered"); Canary Islands Catalogue of Protected Species ("endangered").
- *Dorycnium broussonetii:* Canary Islands Catalogue of Protected Species ("endangered").
- *Vicia filicaulis:* Canary Islands Catalogue of Protected Species ("especial protection").
- *Descurainia artemisioides:* Canary Islands Catalogue of Protected Species ("of interest for the Canarian ecosystems").
- *Echium triste ssp. triste:* Canary Islands Catalogue of Protected Species ("especial protection").

Bird species included in Annex I of the Birds Directive present in the SAC:

- *Calonectris borealis:* Annex II Bern Convention; Spanish List of Wild Species under Special Protection Regime ("special protection").
- *Falco pelegrinoides:* Annex I CITES Convention; Annex II Bern Convention; Spanish Catalogue of Threatened Species ("endangered"); Canary Islands Catalogue of Protected Species ("endangered").
- *Charadrius alexandrinus:* Annex II Bern Convention; Spanish Catalogue of Threatened Species ("vulnerable"); Canary Islands Catalogue of Protected Species ("vulnerable").
- *Sterna hirundo:* Annex II Bern Convention; Spanish List of Wild Species under Special Protection Regime ("special protection").
- *Bucanetes githagineus amantum:* Annex II Bern Convention; Spanish List of Wild Species under Special Protection Regime ("special protection"); Canary Islands Catalogue of Protected Species ("of interest for the Canarian ecosystems").

Other protected animal species present in the SAC:

- *Chalcides sexlineatus:* Spanish List of Wild Species under Special Protection Regime; Canary Islands Catalogue of Protected Species ("especial protection").
- *Gallotia stehlinii:* Spanish List of Wild Species under Special Protection Regime; Canary Islands Catalogue of Protected Species ("especial protection").
- *Tarentola boettgerii:* Spanish List of Wild Species under Special Protection Regime; Canary Islands Catalogue of Protected Species ("especial protection").
- *Hypsugo savii:* Annex IV Habitats Directive; Spanish List of Wild Species under Special Protection Regime; Canary Islands Catalogue of Protected Species ("especial protection"). U1 unfavourable-inadequate conservation status in Macaronesia.
- *Pimelia granulicollis:* Spanish Catalogue of Threatened Species ("endangered"); Canary Islands Catalogue of Protected Species ("endangered").
- *Buteo buteo ssp. insularum:* Spanish List of Wild Species under Special Protection Regime.

- *Falco tinnunculus ssp. canariensis:* Spanish List of Wild Species under Special Protection Regime.
- *Asio otus ssp. canariensis:* Spanish List of Wild Species under Special Protection Regime.
- *Anthus berthelotii spp. berthelotii:* Spanish List of Wild Species under Special Protection Regime.
- *Motacilla cinerea ssp. canariensis:* Spanish List of Wild Species under Special Protection Regime.
- *Phylloscopus canariensis ssp. canariensis:* Spanish List of Wild Species under Special Protection Regime.
- *Sylvia melanocephala ssp. leucogastra:* Spanish List of Wild Species under Special Protection Regime.
- *Parus teneriffae ssp. hedwigii:* Spanish List of Wild Species under Special Protection Regime.

Map 1A. Location of target palm groves in SAC Güigüí.

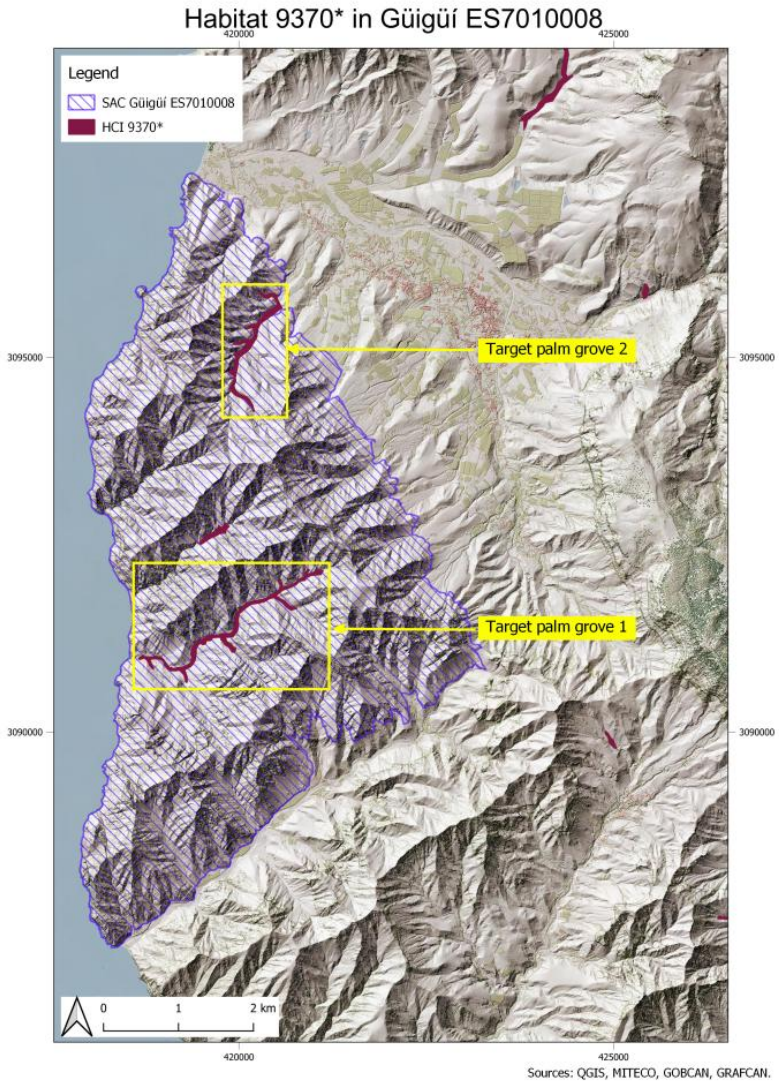



Figure 1. Cuermeja (left) and Guguy Grande (right) palm groves in SAC Güigüí.

3.2 SAC ES7010025 Fataga

The SAC is made up of a peculiar geomorphological unit. It is home to natural habitats in a good state of conservation, such as palm groves and escarpment habitats. Also remarkable are species such as the evergreen (*Limonium preauxii*) or the "ruda" (*Ruta oreojasme*), as well as the presence of junipers (*Juniperus turbinata* ssp. *canariensis*), which are rare and unique natural elements in Gran Canaria.

The main ravine, of large dimensions, is open to the south, with a wide bed and steep slopes, where erosion has shaped a unique landscape with a bed that is sometimes very narrow between sharp ridges. The materials where the ravine is incised belong to the oldest series on the island. The vegetation is dominated in the lower part by abundant "tabaibales" (*Euphorbia spp.*) and some "cardonales" (*Euphorbia canariensis*), especially on the crests. The bed of the ravine is characterised by the existence of magnificent palm groves, sometimes invaded by allochthonous reedbeds (especially in the vicinity of the villages of Arteara and Fataga). In some sections of the ravine there is some permanent water, where hydrophilic communities are found.

The SAC covers a total surface of 2,725.90 Ha, of which 20.30 Ha (0.7%) corresponds to EU Priority Habitat 9370* "Palm groves of *Phoenix*". The target project area is 100% occupied by this type of habitat, in this case composed of two seminatural populations of *P. canariensis*, accounting for approximately 710 individuals. Despite representing important populations in terms of genetic quality, these two palm groves are connected to farming areas and are expected to suffer some degree of hybridization. In addition, at least the southern population is also affected by the pest *Diocalandra frumenti*.

Habitat 9370* is distributed discontinuously along the course of the Fataga ravine, in the middle and upper sections of the basin, mainly occupying the bottom of slopes and ravines with sufficient soil moisture, and developing on fairly consolidated alluvial soils with good groundwater availability. The best examples are associated with fertile areas near the ravine, while isolated Canary Island palm trees are abundant in almost the entire area of the SAC. In a large part of its area of distribution, the coverage of the invasive common reed (*Arundo donax*) is very significant and is indicative of a certain degree of habitat degradation. According to the SAC Management Plan, the habitat has a good representativeness (B), a relative surface area of between 0-2% (C) and a good conservation status (B). The overall assessment of the habitat is considered good (B). There are no indications that significant changes in community density and composition have occurred during past assessments over 17 years (1998-2015).

Pressures and threats include: paths, tracks and bike trails; diffuse pollution of groundwater; plant IAS like *Arundo donax* (severe); hybridisation with *Phoenix dactylifera*; and parasitism and pests (severe). LIFE Phoenix will contribute to the following aspects of the 2016 SAC Management Plan:

Conservation Objective 3: To improve the current conservation status of the natural habitat 9370* Palm groves of *Phoenix* to a favourable assessment of its ecological structure and functions, with an area in optimum condition of at least 20.3 Ha (0.7% of the SAC).

Action 1.3: Identification, characterisation and geo-referencing on a detailed cartography of the phytosociological associations corresponding to the habitat 9370* Palm groves of *Phoenix*.

Action 2.3: Monitoring of the conservation status of the natural habitat 9370* Palm groves of *Phoenix* and their characteristic species, taking into account biological parameters with relevance for conservation (density, structure, productivity, recruitment rate, age structure, etc.), as well as the presence and magnitude of impacts and threats that could affect their conservation status.

Action 4.1: Assessment of the impacts of livestock farming on habitats and species of community interest.

Action 6.3: Development of control tasks and, as far as possible, eradication of invasive alien species populations that compromise protected natural values, following the most appropriate methodologies depending on the species.

Action 9.2: Restoration of areas potentially suitable for the development of habitats of community interest.

The project area includes two semi-natural palm groves located within SAC ES7010025, which jointly add up to 17 Ha. The main use in the area considered and around both palm groves is nature conservation (90%), followed by farming (10%). The Fataga ravine is a semi-natural area that encompasses two inhabited villages: Fataga and Arteara. In their vicinity there are crops, especially orchards and fruit trees (orange and avocado trees), and livestock, although this is less important. The road that crosses the ravine from north to south is highly used by tourists; although it has almost no adequate facilities (only a viewpoint and a few restaurants), it is nevertheless an important route connecting the southern tourist area with the centre of the island. In certain areas, aggregate and stone quarrying has taken place in the bed of the ravine, and it is very impacting at the southern limit of the protected landscape.

Other protected plant species present in the SAC:

- *Teline rosmarinifolia* ssp. *rosmarinifolia**: Annex II Habitats Directive, priority species; Annex I Bern Convention; Spanish List of Wild Species under Special Protection Regime ("special protection"); Canary Islands Catalogue of Protected Species ("vulnerable").
- *Helianthemum tholiforme:* Spanish Catalogue of Threatened Species ("endangered"); Canary Islands Catalogue of Protected Species ("endangered").
- *Dracaena tamaranae:* Spanish Catalogue of Threatened Species ("endangered"); Canary Islands Catalogue of Protected Species ("endangered"); IUCN Red List ("critically endangered").

Bird species included in Annex I of the Birds Directive present in the SAC:

- *Bucanetes githagineus amantum:* Annex II Bern Convention; Spanish List of Wild Species under Special Protection Regime ("special protection"); Canary Islands Catalogue of Protected Species ("of interest for the Canarian ecosystems").

Other protected animal species present in the SAC:

- *Graptodytes delectus:* Canary Islands Catalogue of Protected Species ("vulnerable").
- *Hypsugo savii:* Annex IV Habitats Directive; Spanish List of Wild Species under Special Protection Regime; Canary Islands Catalogue of Protected Species ("especial protection").

Map 1B. Location of target palm groves in SAC Fataga.

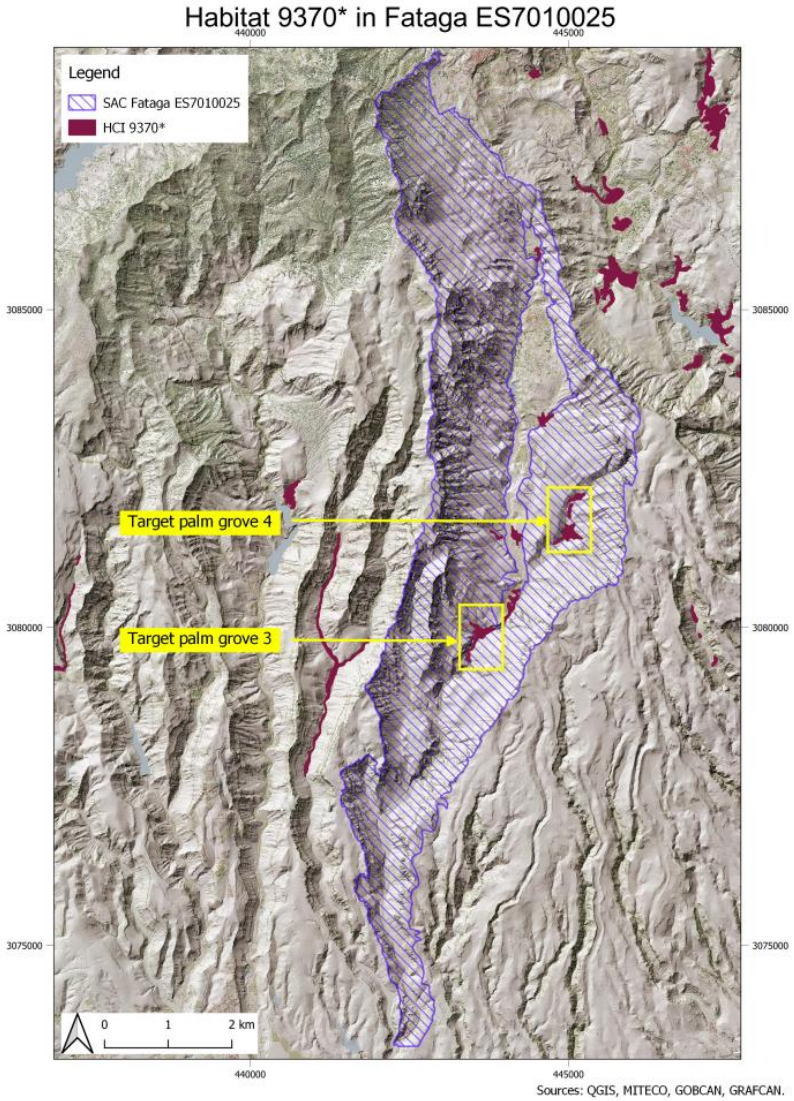



Figure 2. Caserones (left) and Los Aserraderos (right) palm groves in SAC Fataga.

4. NEW BASELINE STUDIES

4.1 Soils & Hydrology

The soil and hydrology assessments were carried out from March to July 2024. Field campaigns to characterise the hydrological system and soil properties included soil and water sampling, in situ parameter measurements and field observations mainly related to geology and hydrology.

In each palm grove, soil profiles were selected at a maximum distance of 2 m from the trunk of palm trees in good health conditions and at heights between 4 and 10 m. At each point, a sample of the top soil layer (0-0.30 m) was taken to carry out physic-chemical analysis. In total, five sampling points were selected in the largest palm grove (Guguy Grande), named as corresponding to samples GG1-GG5 and three points in the rest of the palm groves identified as GC1-GC3, FA1-FA3, FC1-FC3 (Figure 3). Due to the abundance of coarse material, only in cases where it was feasible, samples of undisturbed soil were taken in metal cylinders to determine physical parameters related to water movement through the soil.

GG1	GG2	GG3	GG4	GG5

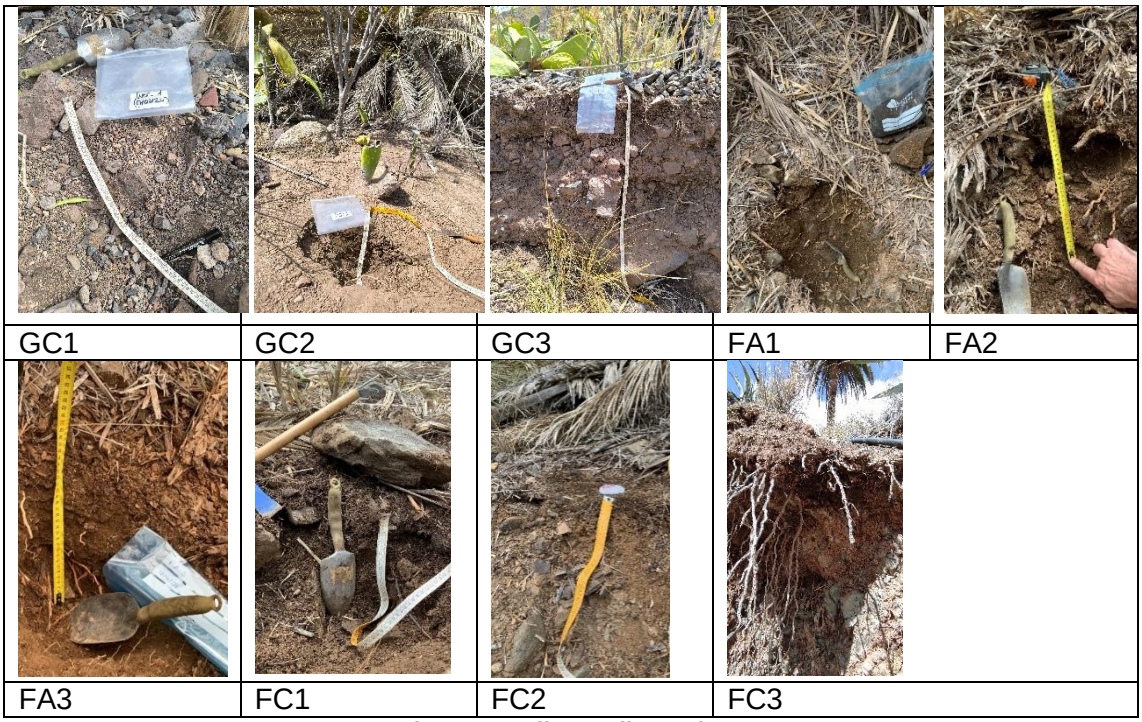


Figure 3. Soil sampling points.

The soil samples were pre-treated and analyzed according to the standard methods of the Soil Survey Staff (USDA) at the Agroalimentary and Phytopathological Laboratory of the Council of Gran Canaria and the Agronomy Laboratory of the Faculty of Veterinary of the University of Las Palmas de Gran Canaria. The parameters analyzed included granulometric composition (clay, silt and sand content), coarse element content (diameter < 5 cm and > 2 mm), soil moisture, bulk density, saturated hydraulic conductivity (Ks), pH for 1:2.5 soil:water, Electric Conductivity for soil:water 1:5 (EC), Organic Carbon (OC), Total Nitrogen (Ntot), Sodium (Na), macronutrients: Potasium (K), Calcium (Ca), Magnesium (Mg) and Biodisponible Phosporous (POlsen) and micronutrients: Fe, Cu, Mn and Zn, limestone and nitrates.

The soils have a variable texture, from sandy loam to clay loam, as described in a previous study (PalmHybrid Project). The high presence of coarse elements determines a low water retention capacity in the soil, which is critical for the survival of the palms if they do not have a constant source of water (Table 1).

Table 1. Granulometric composition (clay, silt and sand content), coarse element content (diameter < 5 cm and > 2 mm).

		GG1	GG2	GG3	GG4	GG5	GC1	GC2	GC3	FA1	FA2	FA3	FC1	FC2	FC3
Sand		69	63	72	87	64	39	51	59	74	69	32	59	38	47
Silt		15	19	16	8	18	54	27	26	10	18	35	13	23	32
Clay	%	15	19	13	5	18	8	22	15	16	13	32	29	39	21
Texture		SL	SL	LS	S	SL	StL	CL	SL	LS	SL	SL	SL	L	CL
Coarse element		58	65	56	53	52	58	35	73	45	58	57	57	63	67
	SL: Sandy Loam			LS: Loamy Sand			S: Sandy			CL: Clay Loam			L: Loamy		

As for the bulk density (Table 2), two values of less than 0.9 g/cm^3 were measured in the FC palm grove, abnormally low values indicating the possible presence of sandy soil, and another value of 1.31 g/cm^3. In the FA palm grove, a sandy loamy soil was sampled, with a high

presence of coarse elements (1.66 g/cm^3), which determines its low water retention capacity. This condition is critical for the survival of the specimens if they do not have a constant source of water available. In line with this idea, the Ks values determined in the laboratory, although scarce, show a tendency towards high to moderate hydraulic conductivities, conditioned by the presence of coarse elements.

Table 2. Soil moisture, bulk density and saturated hydraulic conductivity (Ks) at sites where available.

		GG5	FA2	FC1	FC2	FC3
Soil moisture		1,63	2,82	27,28	19,98	13,66
Bulk density	g/cm^3		1,66	0,86	0,84	1,31
Ks 23ºC	cm/d	20182	46		14820	13500
	m/s	0,00234	0,005		0,0017	0,0016
Ks 10ºC	cm/d	14300	31		10420	9480
	m/s	0,00166	0,004		0,0012	0,0011

Although Gilman and Watson (1994) mention that the Canary Island palm requires well-drained soils, other authors point out that it tolerates waterlogging, since the main condition for its natural distribution is its strong need for soil moisture, since it is mainly found where there is water in the subsoil: ravine bottoms, parts of slopes close to them, or even being able to grow in completely flooded areas such as dams and ponds (Sosa et al., 2021). Therefore, all the textures analysed, together with the high presence of coarse elements, represent a favourable environment for their growth and development, provided that there is a constant supply of water, which, as mentioned at the beginning of this section, was observed during the sampling.

Table 3 shows the results of the chemical parameters analysed for the 4 palm groves studied. The results of the multivariate analysis of the chemical parameters between the different palm groves show that P Olsen is the only variable that shows significant differences at 5% between the palm groves, with significantly higher values for Güigüí than for Fataga.

Table 3. Main chemical parameters for the soil samples.

Sample Code	pH 1:2.5	EC 1:5	OM (%)	NT (%)	K (meq/100g)	Ca (meq/100g)	Mg (meq/100g)	Na (meq/100g)	P Olsen (mg/Kg)	NO_3 (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Mn (mg/Kg)	Zn (mg/Kg)
GG1	7.8	0.4	1.3	0.1	5.4	7.5	5.1	0.8	8.0	41.0	0.6	8.8	20.2	0.8
GG2	7.9	0.3	2.9	0.2	4.1	11.1	8.1	1.0	9.0	14.0	0.5	3.9	16.1	1.0
GG3	7.9	1.1	1.0	< 0.05	1.5	8.9	6.9	2.6	9.0	23.0	0.4	2.7	10.1	0.4
GG4	8.3	0.3	0.1	< 0.05	0.7	4.7	3.2	1.2	2.0	45.0	0.3	4.4	3.7	0.2
GG5	8.4	1.4	1.1	< 0.05	2.6	17.6	7.6	8.4	6.0	47.0	0.8	3.3	6.4	0.1
GC1	7.9	0.9	0.5	< 0.05	0.6	4.9	3.5	1.7	5.0	48.0	0.3	5.2	6.2	0.5
GC2	9.1	0.2	1.1	0.1	1.4	16.9	7.4	2.2	7.0	14.0	0.8	2.6	13.4	0.4
GC3	7.0	0.2	0.9	0.1	0.6	8.8	6.4	0.7	18.0	36.0	1.6	19.3	27.3	0.4
FA1	7.7	0.1	0.4	< 0.05	1.4	8.1	4.1	0.2	0.5	37.0	3.7	8.9	2.2	0.7
FA2	7.5	0.2	1.4	0.1	1.4	9.2	5.5	0.2	1.1	24.0	4.2	23.3	2.3	0.9
FA3	7.2	0.2	2.1	0.1	3.2	12.1	8.3	0.4	0.7	25.0	5.8	47.1	2.8	1.5
FC1	6.5	0.2	4.0	0.2	2.5	9.1	4.2	0.6	0.3	52.0	16.2	47.5	4.9	0.9
FC2	5.2	0.2	2.9	0.1	1.1	6.3	2.9	0.5	0.6	39.0	49.7	163.0	3.9	0.7
FC3	7.7	0.2	0.6	< 0.05	3.1	11.9	7.0	0.1	0.7	19.0	3.0	23.4	1.8	1.2

As can be seen in Fig. 4, the soils of the palm groves in this study have low salinity values for a soil-water ratio of 1:5. Expressed as saturated extract, the average salinity is less than 2 dS/m. There is little literature on the salinity tolerance of this species, although some authors mention the tolerance of the date palm (*Phoenix dactylifera* L.) to saline and alkaline soils (Chao and Krueger, 2007). The samples with the highest salinity are those closest to the coast (GG), where the effect of sea spray may be important. Studies mention the moderate tolerance of this species to the effects of sea spray (Gilman and Watson, 1994). The values in Fig. 4 are consistent with those obtained in a previous study of palm groves on the island of Gran Canaria, except for one palm grove which had salinity levels of up to 9 dS/m (PALMHYBRID Project). As expected, the results for Na content coincide with the salinity values obtained.

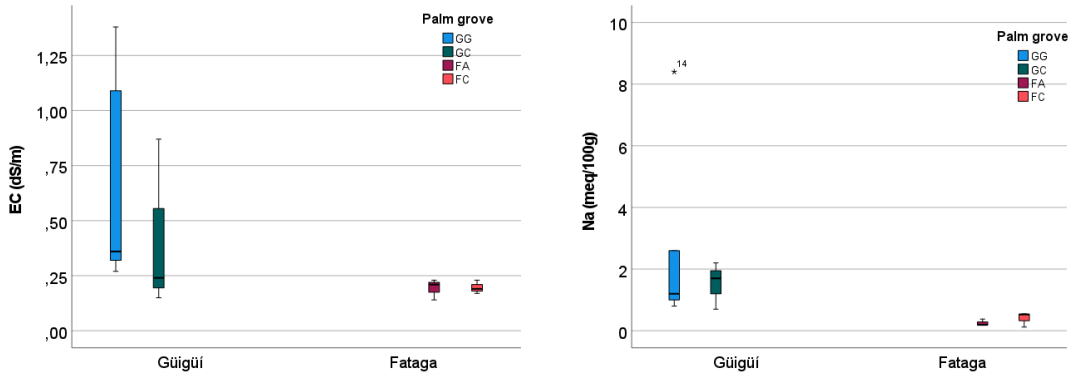


Figure 4. EC 1:5 (dS/m) and Na (meq/100 g) in each palm grove.

OM is a fundamental parameter in the assessment of soil fertility as it determines its physical, chemical and biological properties. The C/N ratio expresses the degree of development of this OM, with higher values for recently incorporated materials and lower values for already humified OM (this process remains active at values above 15 and slows down at values close to 10). Fig. 5 shows the OM content (%) and the C/N ratio of the samples from the palm groves in this study. It can be seen that 3 of the palm groves have an average OM content of less than 2%, while the FC palm grove has an average value close to 3%. Therefore, increasing the OM content of the soils of the 3 palm groves would improve their water and nutrient retention capacity. Moreover, as in a previous study carried out on palm groves in the Canary Islands (PALMHYBRID Project), all the palm groves have very different values, which makes it difficult to show significant differences between them.

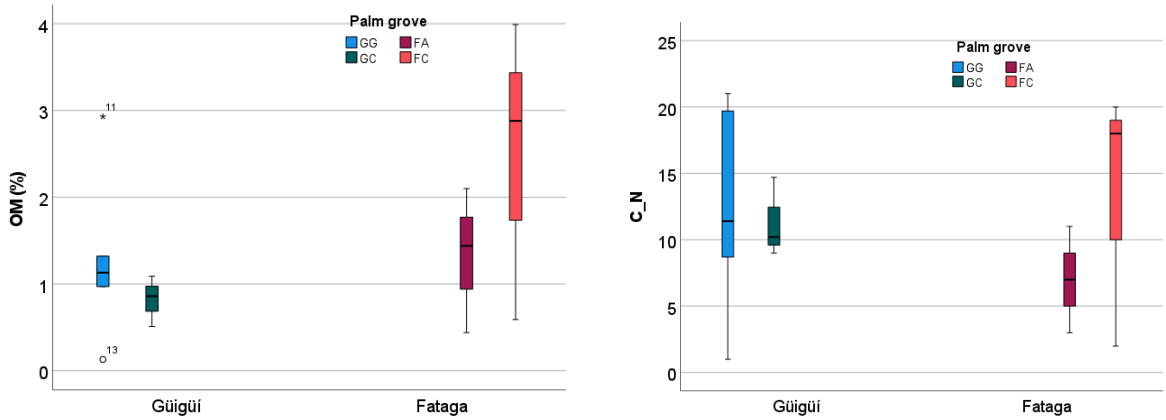


Figure 5. Organic Mater content (OM) and C/N relation for the soil samples.

Three palm groves have average C/N values close to 10, indicating that the humification process is stable, while the FC palm grove has a value that indicates intense microbiological activity (MMARMA, 2010), where induced N deficiencies may occur due to consumption by soil microorganisms. Both parameters indicate a normal development of the humification process, which could be improved by the addition of OM with a high humic value. In the case of the FC palm grove, it is necessary to supply additional N with the amendments.

The sampled soils of Güigüí have a basic pH (close to 8), while those of Fataga have a slightly basic pH (FA: 7.5) or slightly acidic pH (FC: 6.5) (Fig. 6). Therefore, the G soils may have greater difficulties in absorbing both P and metals, while the FC palm grove has optimal bioavailability. Despite these good values of P bioavailability in relation to pH, the soils of Fataga have very low P contents (Fig. 6), with significant differences with respect to G, whose values are already at the limit of poor soils (INIA, 2009). The values in this study are different from those obtained in a previous study (PALMHYBRID Project), which showed highly variable values, but higher than those presented in this report.

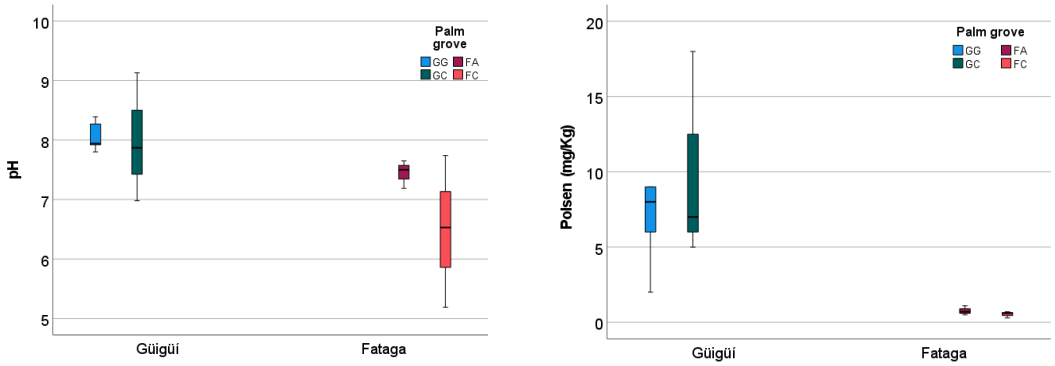


Figure 6. Values of pH and P Olsen (mg/Kg) for soil samples.

In natural soils, N is mainly supplied as organic N from residues and legumes. Organic N is the soil's N reserve and is subsequently converted to nitrate, which is the predominant form of N uptake by roots. Nitrate is not stored in the soil, so its excess can lead to contamination of surface waters and aquifers. A balance between the two forms ensures normal plant growth. Figure 7 shows total N (organic N, ammonium and nitrate) and nitrate levels in the palm groves analysed. The behaviour of total N is similar to that of OM, whose high variability does not allow significant discrimination between the palm groves. The GG and FC palm groves have highly variable values, while GC and FA have more stable contents. N levels are low and there is a risk of N deficiency (Brady and Weil, 2017). Although the organic N supply is the main source of nitrate, all the palm groves show similar nitrate concentrations, with values between 25 and 40 mg/kg being in the range of optimum values (Brady and Weil, 2017), thus ensuring a good supply of this nutrient to the palms.

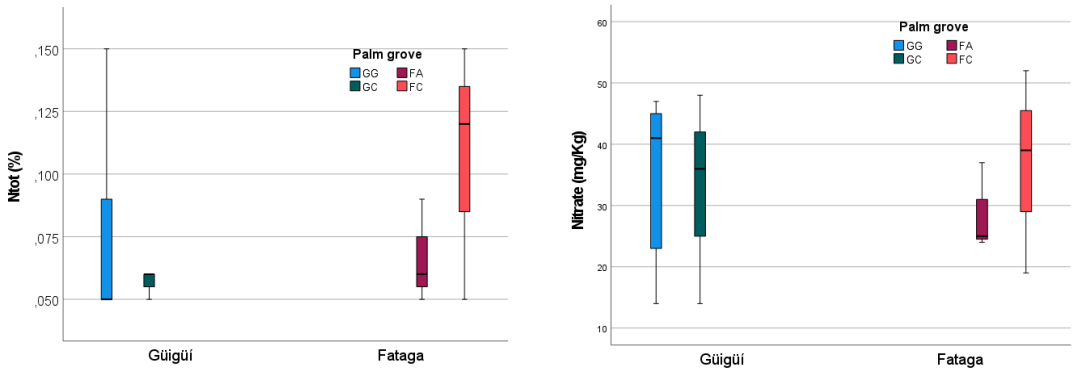


Figure 7. Total N (%) and nitrate (mg/kg) in the palm groves analysed.

K is an element that is rapidly transformed into its inorganic and bio-available form, a form that is well adsorbed in the soil and forms part of its reserve. Although the high variability of the values prevents significant differences from being observed (Table 3), all the palm groves analysed have high (GC) or very high (GG, FA and FC) K values according to the interpretations of agricultural soil fertility given by Marschner (2012). It can therefore be concluded that this nutrient is not a limiting factor for normal tree growth.

The soils sampled have high Ca and Mg values (Table 3, optimum or excess values), which coincide with the pH values measured. It is only in the palm groves with abnormally high values that it is necessary to take into account their effect in reducing the assimilability of P. The ratios calculated for K/Mg and Ca/Mg are less than 0.5 and 10 respectively, so there is no need to apply magnesium amendments (MMARM, 2010).

As shown in Table 3, the soils of all the palm groves show values ranging from optimum to surplus for Fe, Cu and Mn, so it is not foreseeable that these nutrients will act as limiting factors. With regard to Zn, the soils are on the borderline of being considered poor in Güigüí and optimal in Fataga. Therefore, the palm groves do not show marked deficiencies in any of the micronutrients analysed.

Regarding the geology context, Güigüí and Fataga ravines are located at the oldest and less permeable geological formations of Gran Canaria (Figure 8). Specifically, Miocene Basalts and phonolites respectively. However, despite the general low permeability of these materials, the presence of fissures allows preferential flows sometimes intercepted with high impermeable layers of calcined soils conformed during the pass of lava flows. Consequently, water seeps and springs emerge from perched aquifers and can give rise to small torrents of surface water if are not piped to supply nearby houses. These groundwaters together with rainwater can flow through alluvial materials of the ravine or slope debris, conforming a sub-alveolar watershed that can provide a constant source of water for the palm trees, which furthermore are characterized by a phreatophyte behavior.

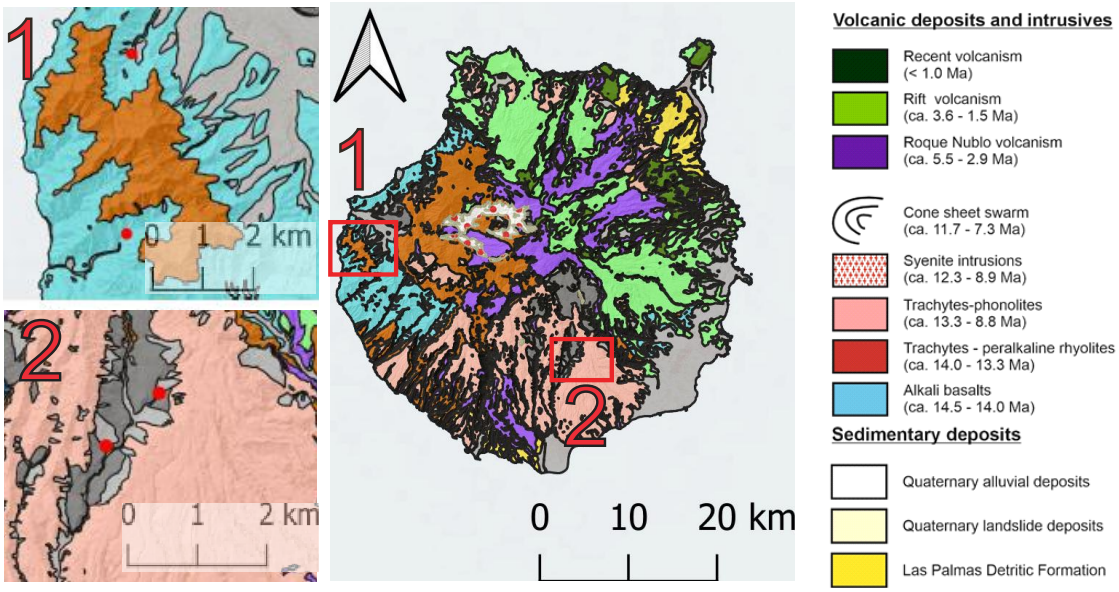


Figure 8. Geology map of Gran Canaria (Pérez-Torrado et al., 2011) and locations of the water sampling points in red points (1: Güigüí, 2: Fataga).

A common factor observed of all the target palm groves was the presence of water conducted by pipes from water springs or running in small intermittent torrents provided by springs located at headwaters of ravines or seepages. In Güigüí and Cuermeja water samples were taken in small torrents and seepages located at a wall of fissured geological formation disposed above impermeable materials (ochre). In Caserones and Fataga tap water from a spring located nearby was sampled. Fataga also presented water intakes from the alluvial materials through small pools that reach the piezometric level at shallow depth. Chemical properties of water samples are presented in Table 4.

Table 4. Chemical properties of water samples with concentrations expressed in mg/L.

Sample	CE (µS/cm)	pH	CO_3^{-2}	HCO_3^-	Na	K	Ca	Mg	Cl	NO_3	SO_4
GG_T	1700	8.24	2.2	190	240	8.5	40	34	390	12	55
GG_s	1700	8.75	12	120	220	9.8	44	35	410	16	59
FA	700	7.9	<20	120	130	4.5	<5	<5	130	13	24
FC	1300	7.9	<20	110	210	6.7	31	22	300	29	85
GC	5700	8	<20	480	860	21	130	130	1500	23	210

In general, the sampled waters are chlorinated-sodium with significant bicarbonate and calcium contents (Fig. 9). To gain a deeper understanding of groundwater chemistry and estimate the available reserve volumes, it is recommended to conduct an inventory of groundwater points.

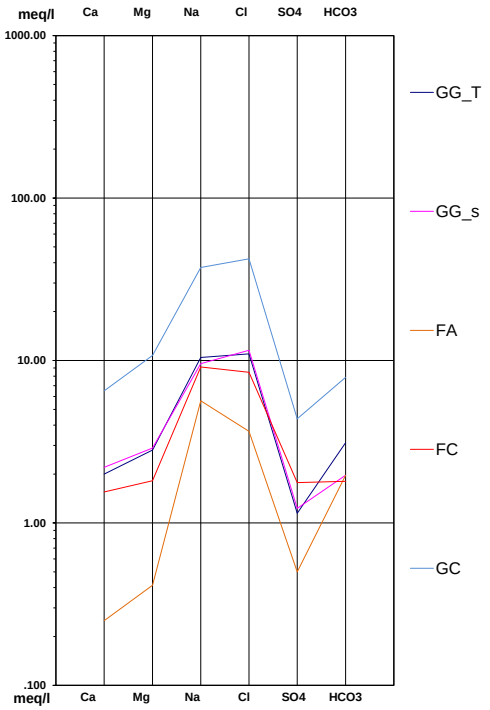


Figure 9. Schoeler Berkaloff Diagram for the water samples (GG_T: torrent of the Güigüí Ravine, GG_s: seepage water in the Güigüí Ravine, GC: torrent of the Canales Ravine, FA: spring water at Fataga ravine, FC: tap water from a spring water located at Canales Ravine.

4.2 Genetic context & Hybridisation

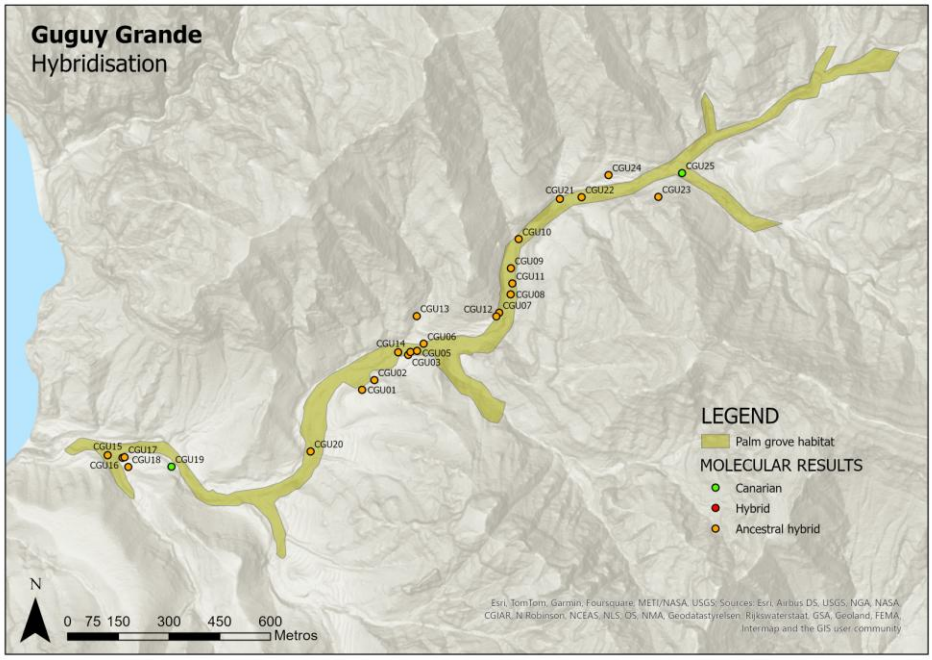
The fact that both species (*Phoenix canariensis* and *P. dactylifera*) hybridise and that the hybrids are viable, makes it necessary to carry out a prior identification in the palm groves and differentiate those possible hybrid specimens from the genetically pure specimens. To do this, several visual surveys were carried out in the four palm groves under study and samples were collected, focusing on those individuals with morphological characteristics and traits typical of a hybrid specimen. During the visits to the palm groves, and for each specimen, we observed and recorded the morphological characteristics of both species and collected samples of specimens that might have intermediate morphologies, as described in the "Protocol for the collection of leaf samples from *Phoenix* specimens for genetic analysis", elaborated in the framework of the LIFE Phoenix project.

Samples were collected between January and July 2024 in the four target palm groves (Maps 2A-2D) and a total of 96 specimens were analysed, obtaining samples of between 23 and 25 specimens from each population (Figure 10).

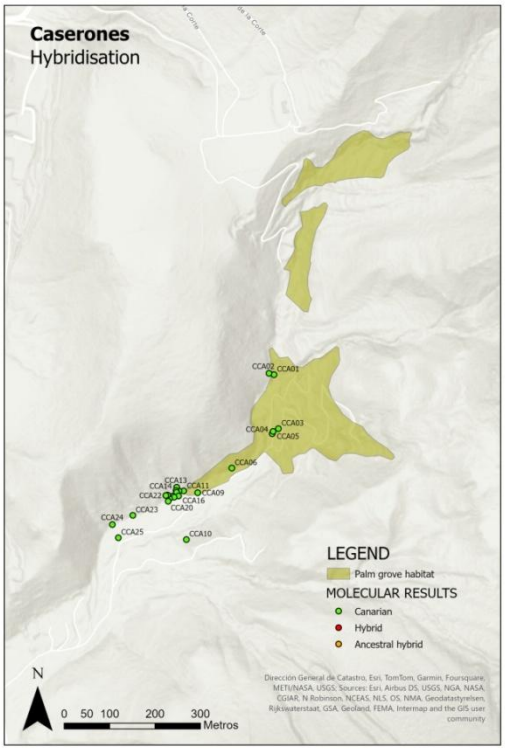
Each individual was assigned an identification code and different biological, morphological and geographical attributes and properties were noted down, including the approximate height of the specimen, the geographical coordinates using GPS, gender identification (male, female or undetermined) and whether the morphological features were characteristic of a canary, hybrid or date specimen. The number of specimens collected according to sex and for each population is shown in Figure 10.

Map 2A. Location of the specimens sampled in Cuermeja palm grove (the different morphological types identified as "Canarian" or possible hybrids are shown).

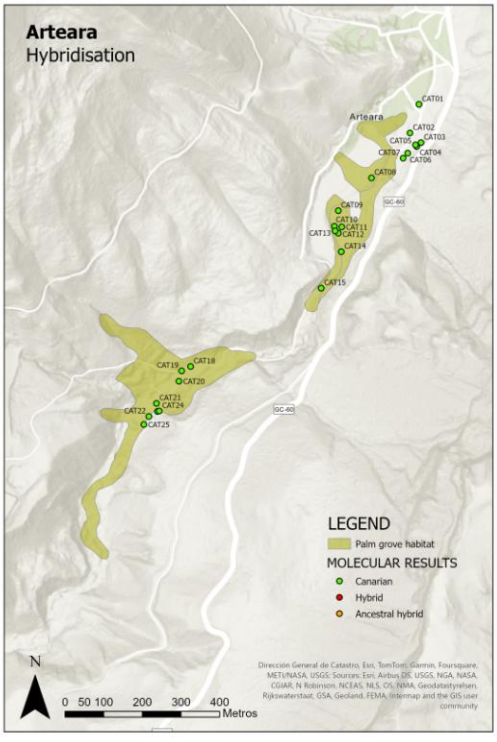
Map 2B. Location of the specimens sampled in Guguy Grande palm grove (the different morphological types identified as "Canarian" or possible hybrids are shown).



Map 2C. Location of the specimens sampled in Caserones palm grove (the different morphological types identified as "Canarian" or possible hybrids are shown).



Map 2D. Location of the specimens sampled in Arteara / Los Aserraderos palm groves (the different morphological types identified as "Canarian" or possible hybrids are shown).



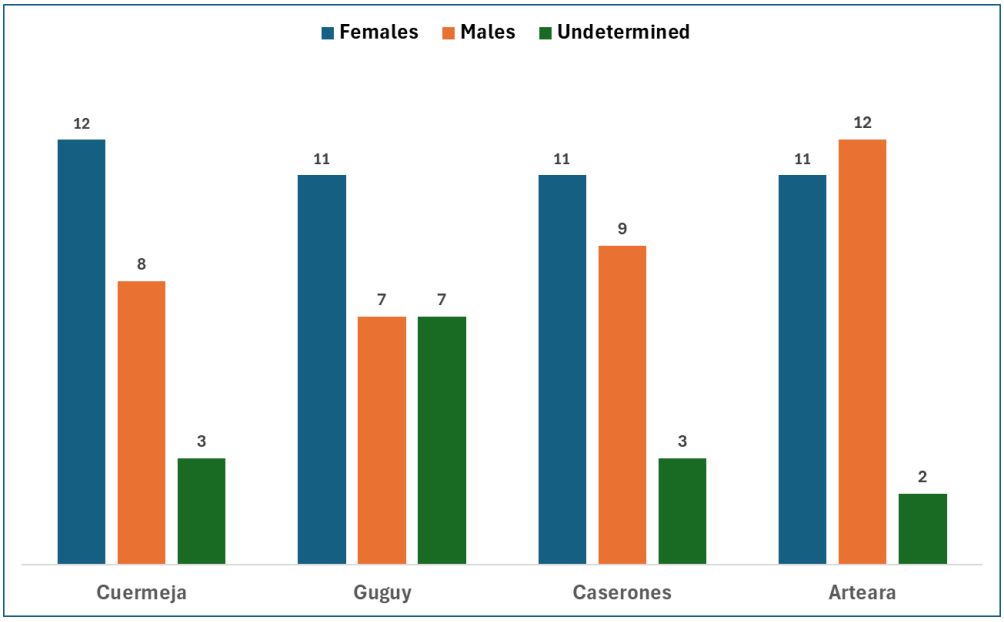


Figure 10. Number of palm specimens analysed according to sex, in each palm grove.

The results showed firstly that none of the specimens analysed were identified morphologically or molecularly as *Phoenix dactylifera*, but all were Canary and hybrid specimens. Most of the specimens studied were genetically *Phoenix canariensis*, especially in three of the four target palm groves of this project. Thus, all the specimens analysed from Caserones and Arteara were identified as pure *Phoenix canariensis*, with the Canary Nuclear Genotype (CNG) and the chlorotype Clp266. In the population of Cuermeja, a single specimen was identified as CCU-06, which showed hybrid genetic characteristics. The rest of the specimens in the latter population were also pure Canaries.

However, in Guguy Grande palm grove, 87% of the specimens analysed were characterised and detected as hybrids as they harboured the Clp242 chlorotype corresponding to *Phoenix dactylifera* Occidental. However, many of these hybrid specimens also harboured the CNG and were therefore classified as “ancestral hybrid specimens”. We are inclined to think that they are in fact ancestral hybrids, whose primary parents were a female *P. dactylifera* (Clp242) and a male *P. canariensis* (Clp266). Consequently, current individuals were then generated by continuous crossbreeding by several generations of backcrossing to the more abundant pure *P. canariensis* palms, diluting the original hybrid signal in the nuclear genome but maintaining the Clp242 chlorotype by maternal chloroplast inheritance. The discordance among the nuclear and plastid genes is very common in hybrid lineages, a process referred to as “chloroplast capture”, which would perfectly explain these results. Of all hybrids detected, 12 are females and 6 are males.

Table 5. Number of specimens according to their molecular characterisation in each palm grove.

	Cuermeja	Guguy Grande	Caserones	Arteara
Pure Canaries	23	2	23	25
Hybrids	1	23	0	0

4.3 IAS: Pest surveillance (*Diocalandra frumenti*)

Several phytosanitary surveys were carried out in the palm groves targeted by the project during March and April 2024, in order to locate the presence of *Diocalandra frumenti* and find out the degree of affection in the event of a positive result. Secondly, during the preparation of this study a methodology has been developed to facilitate prospecting and recording the results obtained in the field with an IT application (including GIS functions), which facilitates the consultation of data.

The palm groves examined have been Guguy Grande, Guguy Chico and the perimeter area (from Cuermeja to Tasartico) in SAC Güigüí, as well as Los Aserraderos and Caserones in SAC Fataga. Prior to the field work, a comprehensive review was conducted of previous assessments in Gran Canaria (years 2011, 2014, 2016, 2018 and 2020) by the Regional Government of the Canary Islands.

Field surveys include walks through the palm grove in search of symptoms of the insect's presence. Once a large number of palms trees have been surveyed in a given polygon, the most representative of the overall phytosanitary situation are selected in order to record established parameters in individual field sheets. In this way, the number of palm trees surveyed is greater than the number of records made.

The methodology for field research consists of visual inspection of external symptoms (leaf bases perforated by larvae; exit holes of the imago in the rachis of the leaves; dead and broken leaves; presence of the insect) and internal damages (galleries inside the rachis; presence of larvae and pupae; necrotic tissues).

Figure 11. Exit holes of the imago (left); longitudinal galleries with presence of larvae (right).

In parallel to the inspection of *Diocalandra frumenti*, two other types of diseases have been assessed:

a) *Fusarium oxysporum f. sp.canariensis:* symptoms include asymmetrical drying of leaflets, dead leaves, dark lines or areas along the rachis and, above all, discolorations of the vascular bundles and associated tissues. However, the visual diagnosis must be confirmed by a diagnosis made in a plant pathology laboratory.

b) *Phoenicococcus marlatti:* This insect is most often found on the inside of shoots, forming colonies covered with masses of wax. The adult female (ovoid, red, 1.5 mm long) is the best

stage for identification, both in the field and in the laboratory. The legs are stunted and remain attached to the plant tissue, surrounded by a dense cottony secretion that discolours over time.

Table 6. Parameters recorded during the field surveys for Diocalandra frumenti.

Code	Different correlative codes for each palm tree surveyed.
Date	dd-mm-yyyy format.
Height	<5m, 5-10m, >10m.
Palm tree crown	Degrees occupied by the green leaves of the palm tree (90°, 180°, 360°).
Broken leaves	Presence of broken leaves near the base of the frond.
Diocalandra frumenti	Presence or absence.
Affected whorls	Number of whorls (leaf wheels) with green leaves affected by the insect.
Degree of affection	Number of whorls affected: 1 (mild), 2 (moderate), 3 (severe).
Other pests and diseases	Presence or absence of *Phoenicococcus marlatii* and *Fusarium oxysporum*.
Sex	Male or female (if possible to determine).
Observations	Any information of interest not covered in the previous points.

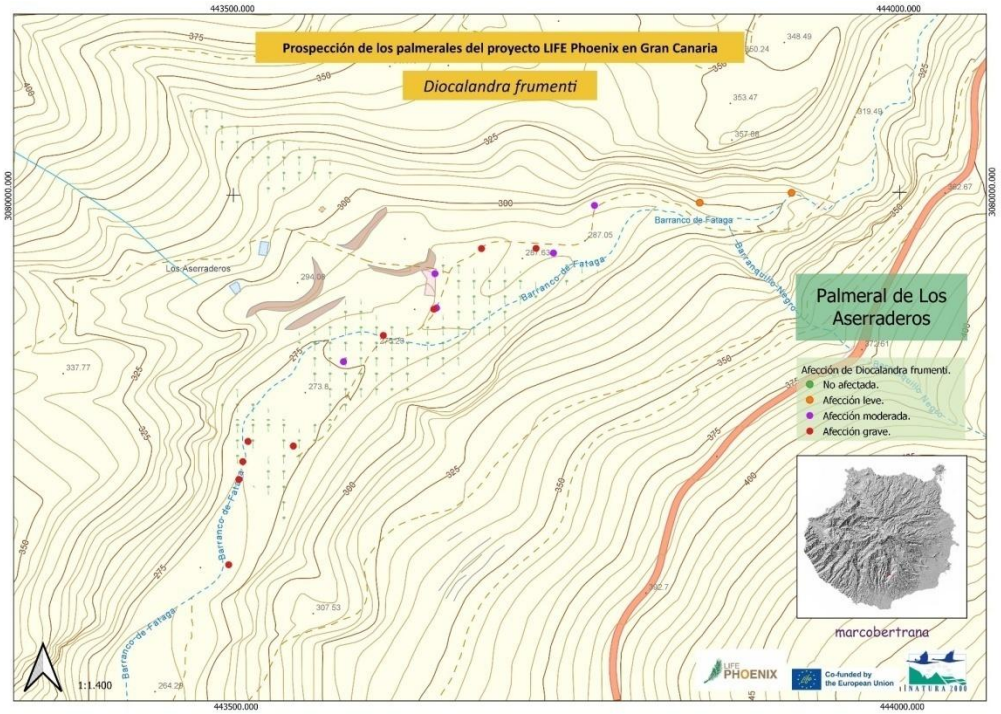
The results obtained include a total of 170 palm trees surveyed (with their corresponding field sheets) over the course of 10 field trips carried out between March and April 2024.

The following survey areas were established for both SACs:

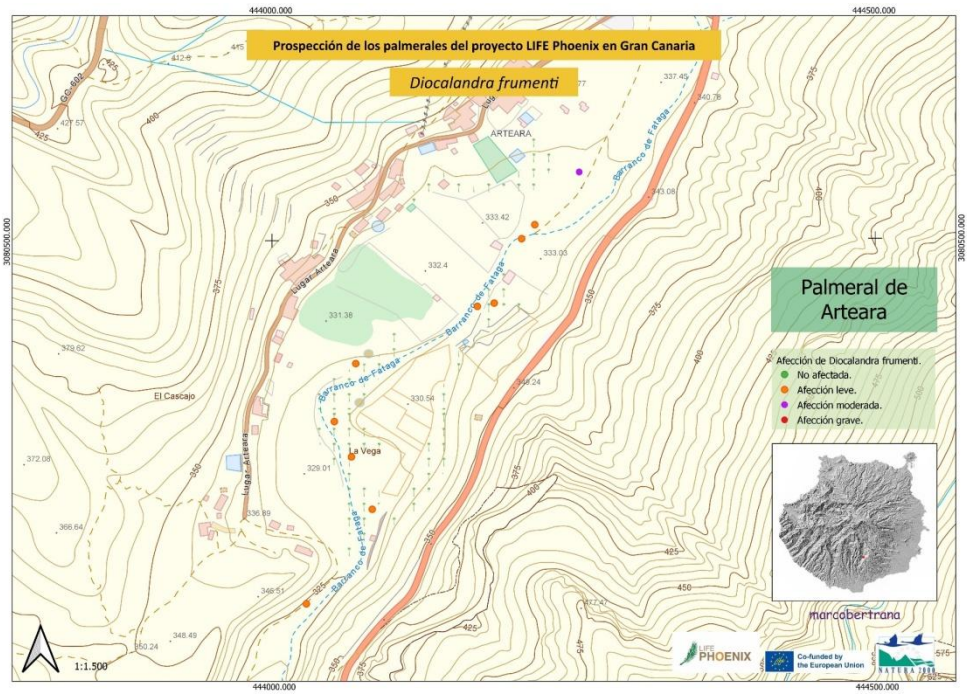
- Fataga: Caserones and Los Aserraderos.
- Güigüí: Guguy Chico, Guguy Grande and the perimeter area (from Cuermeja to Tasartico).

The presence of *D. frumenti* was confirmed in 44 specimens distributed throughout all the target palm groves, with the exception of Guguy Chico. However, for the first time, the presence of affected palms was detected in Guguy Grande.

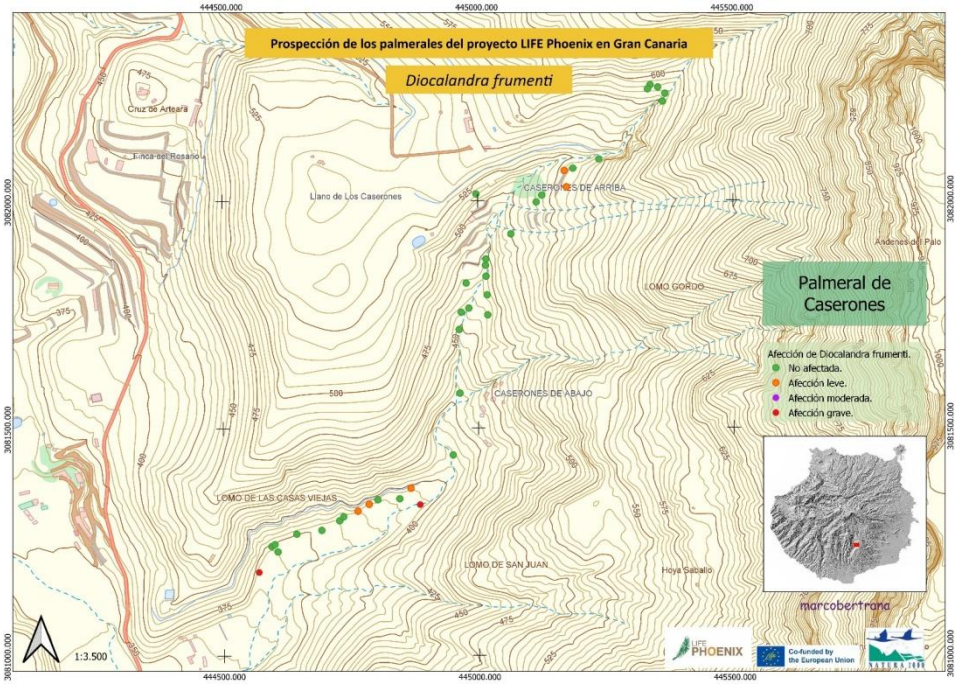
Map 3A. Results of Dicalandra frumenti prospection in Los Aserraderos palm grove.



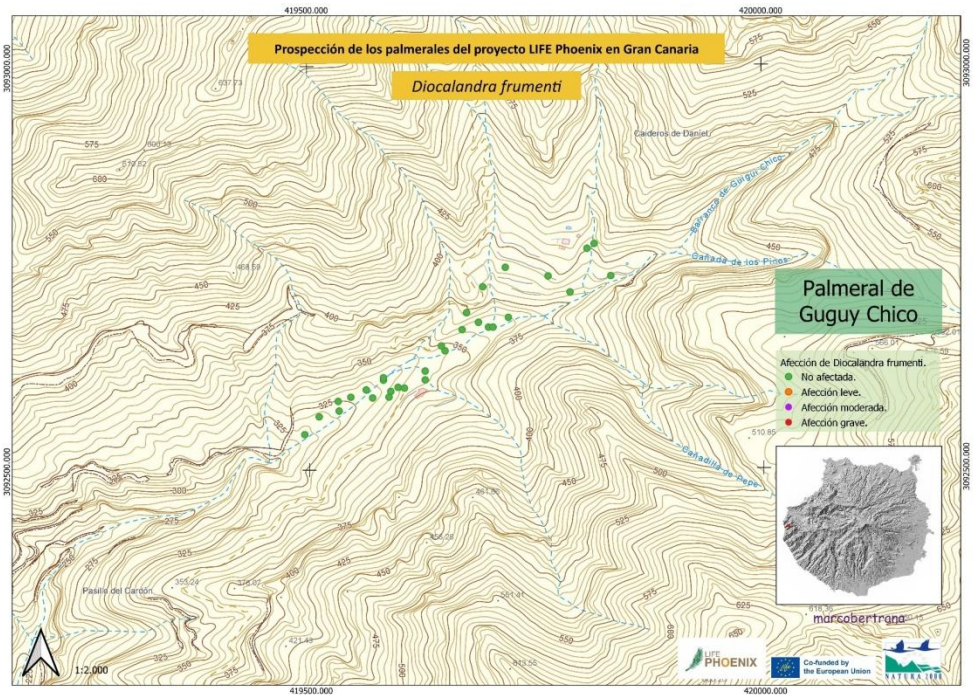
Map 3B. Results of Dicalandra frumenti prospection in Arteara palm grove.



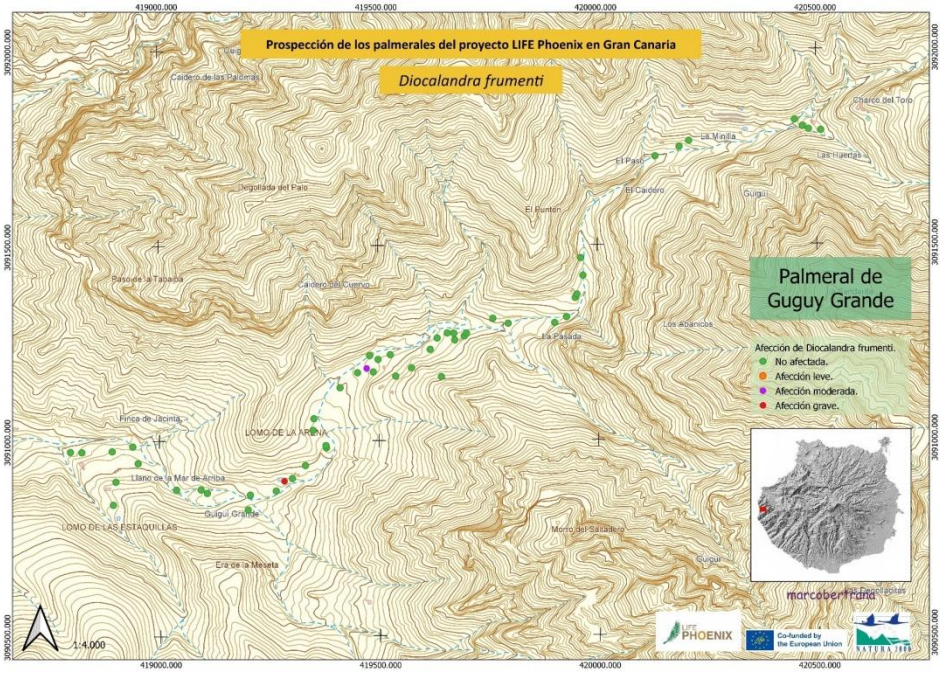
Map 3C. Results of Dicalandra frumenti prospection in Caserones palm grove.



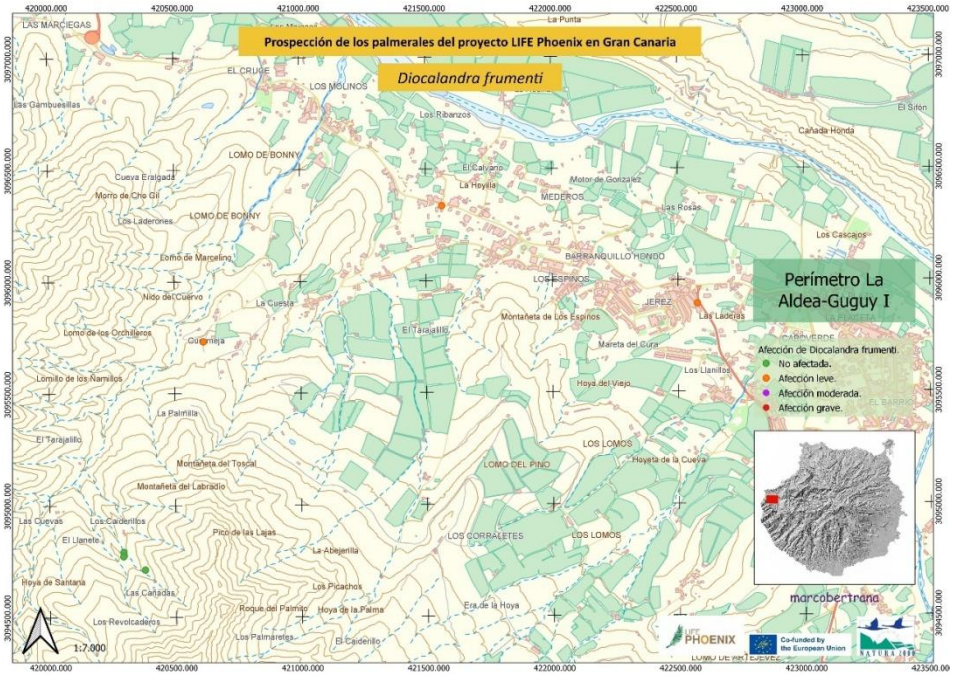
Map 3D. Results of Dicalandra frumenti prospection in Guguy Chico palm grove.



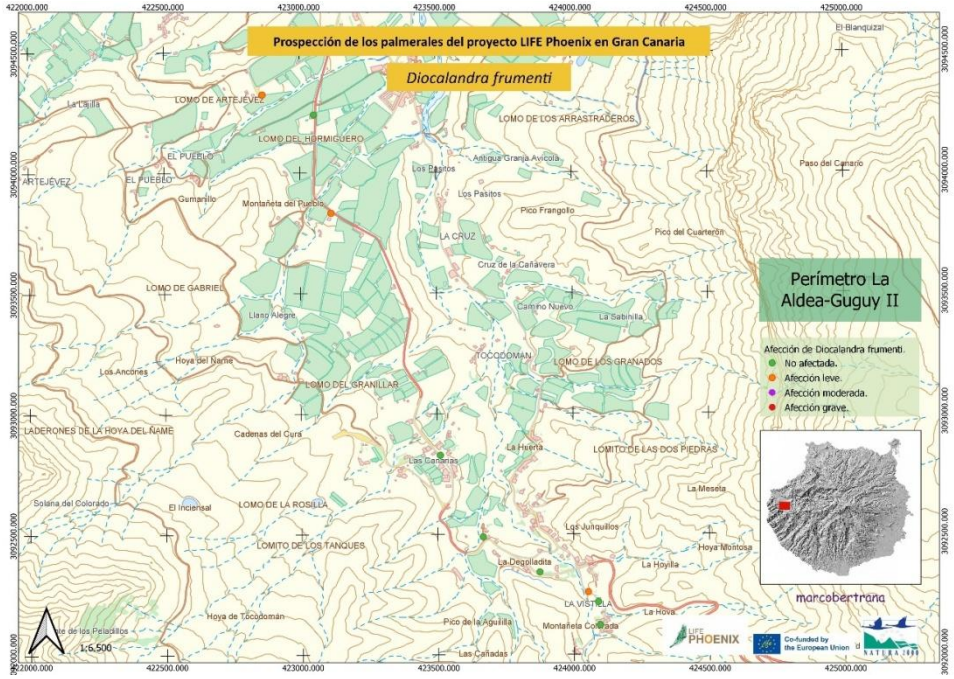
Map 3E. Results of Dicalandra frumenti prospection in Guguy Grande palm grove.



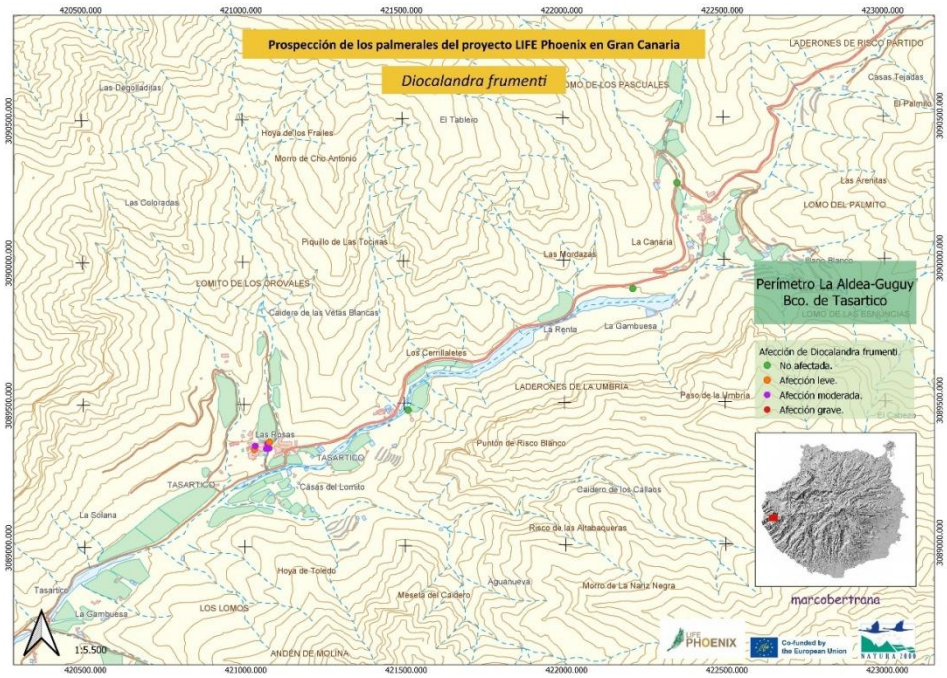
Map 3F. Results of Dicalandra frumenti prospection along the perimeter La Aldea-Guguy I.



Map 3G. Results of Dicalandra frumenti prospection along the perimeter La Aldea-Guguy II.



Map 3H. Results of Dicalandra frumenti prospection along the perimeter La Aldea-Tasartico.



4.4 IAS: Invasive vegetation

The assessment of the impact of invasive vegetation in the project areas has been carried out by means of two complementary procedures:

On the one hand, from December 2023 to April 2024, various field trips were carried out for an updated reconnaissance of the problems addressed by the project. Taking advantage of these field trips, a series of parameters were recorded at the most representative points of each palm grove in order to characterise the impact caused by exotic vegetation, as shown in table 2.

On the other hand, after obtaining high quality aerial images from the Council of Gran Canaria, the production of which depends on the public company GRAFCAN, a detailed mapping layer of invasive vegetation has been prepared for each of the four palm groves targeted by the project. This type of desk work complements the field surveys with a geo-referenced database that allows to extract information on the real surface affected, as well as to plan subsequent control and eradication actions.

In general, the most abundant invasive species in all the palm groves is by far the giant reed (*Arundo donax*). *Opuntia maxima*, *Agave Americana* and *Cenchrus setaceus* are found as secondary species in specific locations.

Los Aserraderos palm grove is the one with the highest level of invasive vegetation, with reed beds occupying 90% of the potential palm grove habitat at some points. The stands of Caserones and Guguy Grande suffer an intermediate degree of disturbance and, in the case of

the latter, water springs have allowed a significant development of reedbeds in localised sections. Finally, Cuermeja palm grove has the lowest incidence of invasive vegetation.

Table 7. Data summary of field surveys on plant IAS.

Position	15º49'00''W 27º56'39''N
SAC	Güigüí
Name	Guguy Grande (Zamora)
Date	13/12/2023
Time	10:00h
IAS	***Arundo donax;*** *Cenchrus setaceus, Opuntia spp.*
Surface	Moderate
Density	High (60-80%)
Height	3-4 m
Condition	Vigorous
Distance to palm grove	Inside
Endemic spp.	*Plocama pendula, Olea cerasiformis, Convolvulus floridus, Echium spp., Euphorbia spp., Salvia canariensis, Lavandula spp.*
Observations	Presence of water courses

Position	15º49'24''W 27º56'27''N
SAC	Güigüí
Name	Guguy Grande (lower zone)
Date	13/12/2023
Time	12:00h
IAS	***Arundo donax***, ***Cenchrus setaceus;*** *Agave spp., Opuntia spp.*
Surface	Moderate
Density	High (60-80%)
Height	3-4 m
Condition	Vigorous
Distance to palm grove	Inside
Endemic spp.	*Salix canariensis, Tamarix canariensis, Plocama pendula, Euphorbia spp., Salvia canariensis, Lavandula spp.*
Observations	Presence of water courses

Position	15º34'21''W 27º50'32''N
SAC	Fataga
Name	Los Aserraderos
Date	19/12/2023
Time	9:50h
IAS	***Arundo donax;*** *Opuntia spp., Agave spp.*
Surface	High
Density	Very high (80-90%)
Height	3-4 m
Condition	Very vigorous
Distance to palm grove	Inside
Endemic spp.	*Salix canariensis, Chamaecytisus proliferus, Plocama pendula, Echium decaisnei, Bituminaria bituminosa, Periploca laevigata, Ceballosia fruticosa, Asparagus spp., Salvia canariensis, Artemisia thuscula, Hyparrhenia spp.*
Observations	Presence of water courses; close to cultivated plots

Position	15º33'32''W 27º51'28''N
SAC	Fataga
Name	Caserones de Abajo (upper zone)
Date	19/12/2023
Time	11:30h
IAS	***Arundo donax;*** *Cenchrus setaceus, Agave spp., Opuntia spp.*
Surface	High
Density	High (60-80%)

Height	3-4 m
Condition	Vigorous
Distance to palm grove	Inside
Endemic spp.	*Plocama pendula, Chamaecytisus proliferus, Echium decaisnei, Salvia canariensis, Hyparrhenia spp.*
Observations	One livestock farmer (Antonio) willing to collaborate in preventive grazing

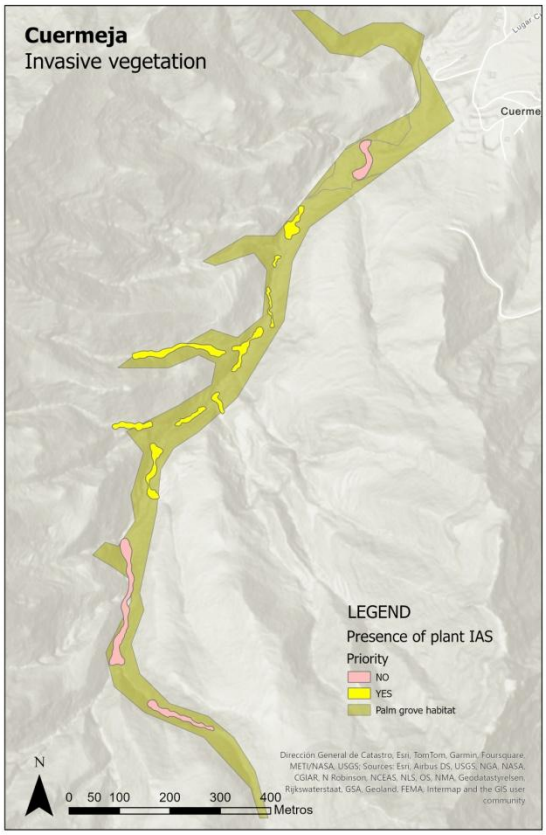
Position	15º33'36''W 27º51'22''N
SAC	Fataga
Name	Caserones de Abajo (lower zone)
Date	19/12/2023
Time	12:10h
IAS	*Opuntia spp., Arundo donax, Agave spp.*
Surface	Moderate
Density	Low (20-40%)
Height	1-2 m
Condition	Weak
Distance to palm grove	Disperse (several meters)
Endemic spp.	*Lavandula minutolii, Campylanthus salsoloides, Euphorbia regis-jubae, Ceballosia fruticosa, Plocama pendula, Kleinia neriifolia*
Observations	

Position	15º48'42''W 27º58'48''N
SAC	Güigüí
Name	Cuermeja
Date	08/02/2024
Time	9:00h
IAS	***Arundo donax**, Opuntia spp., Agave spp.*
Surface	Moderate
Density	Moderate (40-60%)
Height	2-3 m
Condition	Intermediate
Distance to palm grove	Mainly disperse, inside in some points
Endemic spp.	*Withania aristata, Echium spp., Ceballosia fruticosa, Convolvulus floridus, Bituminaria bituminosa, Tamarix canariensis, Neochamaelea pulverulenta*
Observations	Presence of intermittent water courses; goat traces

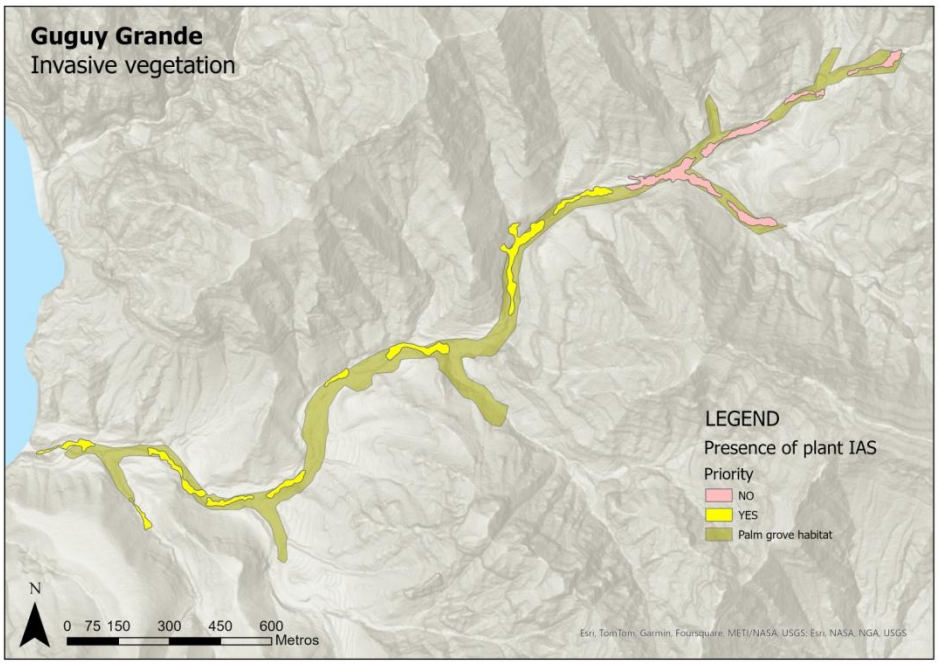
Position	15º34'07''W 27º50'41''N
SAC	Fataga
Name	Arteara / Los Aserraderos
Date	10/04/2024
Time	9:30h
IAS	***Arundo donax;** Opuntia spp., Agave spp.*
Surface	High
Density	Very high (80-90%)
Height	3-4 m
Condition	Very vigorous
Distance to palm grove	Inside
Endemic spp.	*Salix canariensis, Chamaecytisus proliferus, Plocama pendula, Echium decaisnei, Bituminaria bituminosa, Periploca laevigata, Ceballosia fruticosa, Asparagus spp., Salvia canariensis, Artemisia thuscula, Hyparrhenia spp.*
Observations	General reconnaissance transect; large accumulations of plant debris near the population centre of Arteara; presence of water courses; close to cultivated plots

Figure 12. Presence of invasive vegetation in Cuermeja (upper left), Guguy Grande (upper right), Caserones (lower left) and Los Aserraderos (lower right) palm groves.

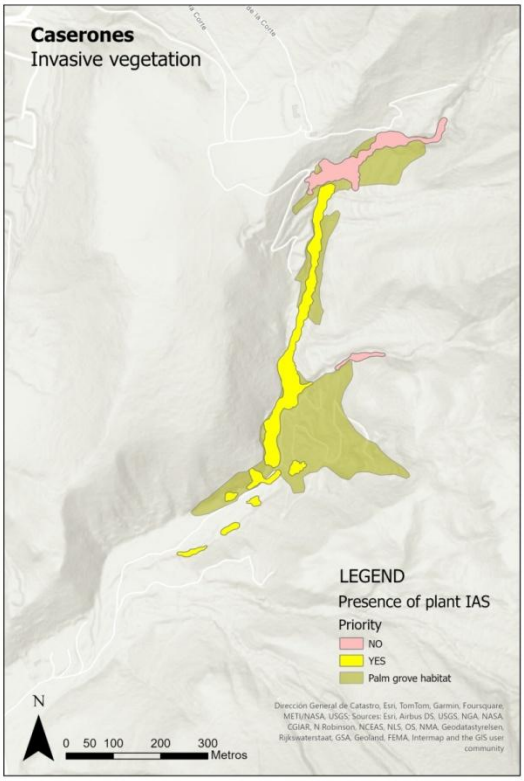
Map 4A. Surface affected by invasive vegetation in Cuermeja palm grove.



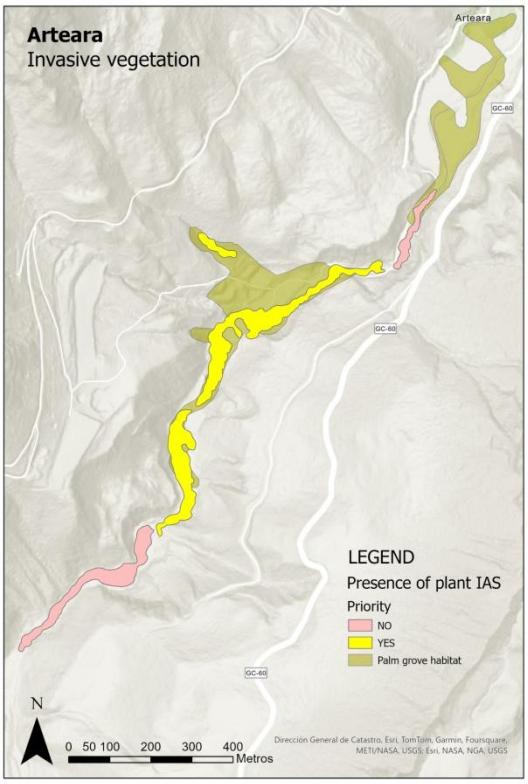
Map 4B. Surface affected by invasive vegetation in Guguy Grande palm grove.



Map 4C. Surface affected by invasive vegetation in Caserones palm grove.



Map 4D. Surface affected by invasive vegetation in Arteara / Los Aserraderos palm groves.



4.5 Specific biodiversity indicators: Pollinators

A study on the diversity and abundance of the pollinator community has been carried out from the 24th of February to the 6th of April 2024, prior to the implementation of the restoration measures, which will be used for comparison with the situation at the end of the project. Preliminary results indicate higher diversity and abundance in the better-preserved plots versus disturbed plots, but the results are not statistically significant and should be taken as trends. A spider genus not known for the Canary Islands and two possible new species are cited, as well as four species of pollinators not known for Gran Canaria and 23 new pollinators not previously cited in the intervention areas.

The assessment was focussed on certain groups specialised in pollination, namely bees, butterflies and some families of flies. Among them bees have an outstanding importance, with more than half of the species exclusive of the Canary Archipelago; this represents 17% of the European endemic species. A "BACI" (Before-After Control Impact) standardised experimental design was carried out, comparing relatively well-conserved plots (control plots) with other disturbed plots, dominated by exotic flora, where ecological restoration measures need to be implemented (treatment plots).

The study has included the four target palm groves of the project in Gran Canaria: Cuermeja and Guguy Grande in SAC Güigüí and, in the case of SAC Fataga, the other two palm groves

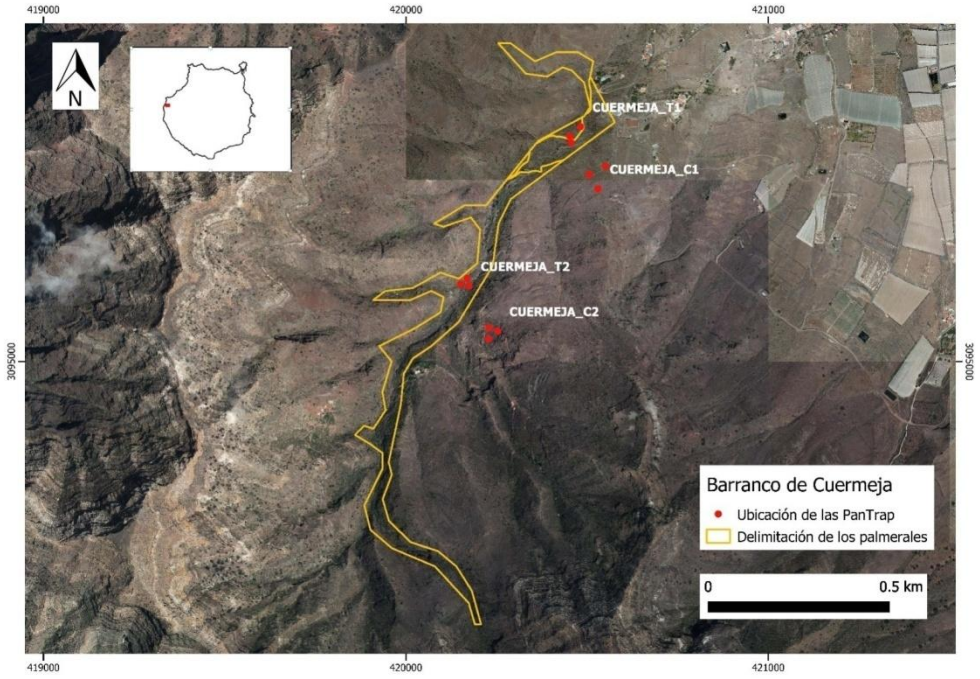
have been grouped, given their proximity. In each location, a total of four 50x50 m survey plots have been established (two control plots and two treatment plots), taking into account representativeness and similarity criteria.

The overall sampling methodology combines both, passive (visual census in flowering plants over 5 minutes) and active methods (using 3 triplets of pan-traps with white, blue and yellow colours in each plot from 10:00h to 16:00h). These methods were completed with punctual sampling transects over 15 minutes, in which every pollinator in a 2 m range from the observer is recorded, following the indications of the European Butterfly Monitoring Scheme (eBMS).

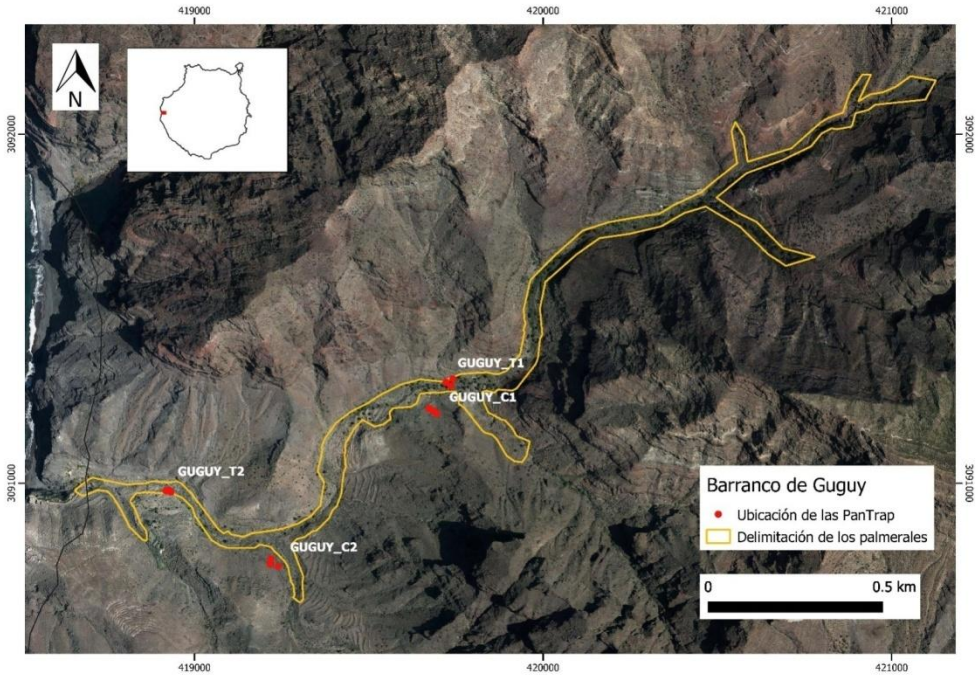
Although the vast majority of the specimens was identified *in situ*, material collected through pan-traps and some of the less common species were identified through desk work using binocular loupes, specialised literature, dichotomous keys and collections of reference material.

The results of the field work have been notably influenced by a prolonged drought affecting Gran Canaria (especially the south of the island); this has meant that the vegetation in the study areas was very dry and with very little flowering.

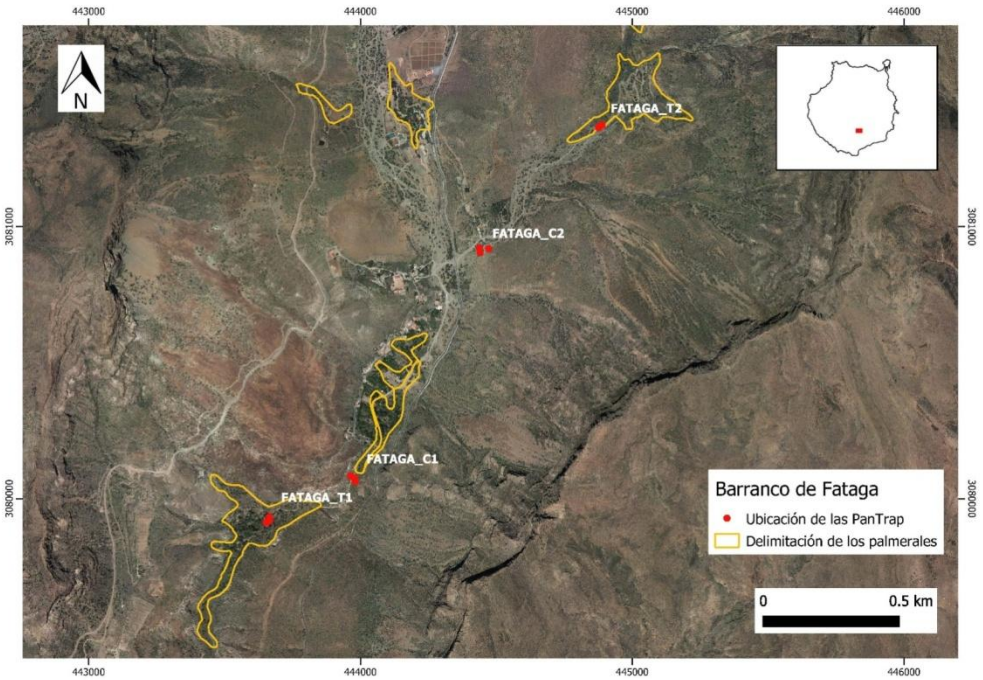
Map 5A. Sampling plots (C - control; T - treatment) in Cuermeja ravine.



Map 5B. Sampling plots (C - control; T - treatment) in Guguy Grande ravine.



Map 5C. Sampling plots (C - control; T - treatment) in Fataga ravine.



A total of 315 interactions of 46 different pollinator species were observed. Wild bees were the most diverse and abundant group with 25 species (214 specimens), followed by flies with 16 species (60 specimens) and butterflies with 5 species (41 specimens). The five most abundant pollinator species were: *Anthophora orotavae* (18%, 56 individuals), *Hylaeus hohmanni* (6.3%, 20 individuals), *Lasioglossum brevicorne* (6.3%, 20 individuals), *Anthophora alluaudi* (5.7%, 18 individuals) and *Phthiria simonyi* (5.4%, 17 individuals). These five species accounted for 42% of the total number of pollinator individuals.

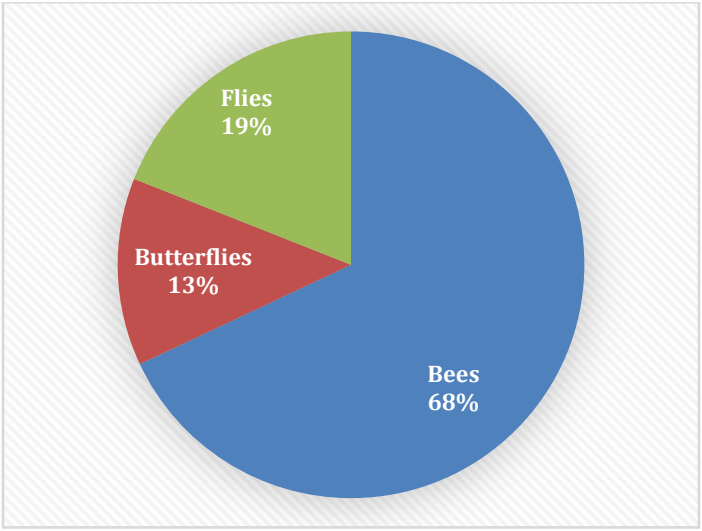


Figure 13. Abundance of pollinators (% per total number of interactions).

Control plots appear to have greater diversity per census than treatment plots. The clearest case occurs in Fataga, with the highest degree of disturbance; in the opposite case is Guguy Grande, with apparently less disturbance. This is due to the fact that native flora harbours a greater diversity of pollinators than introduced flora, which excludes many native species.

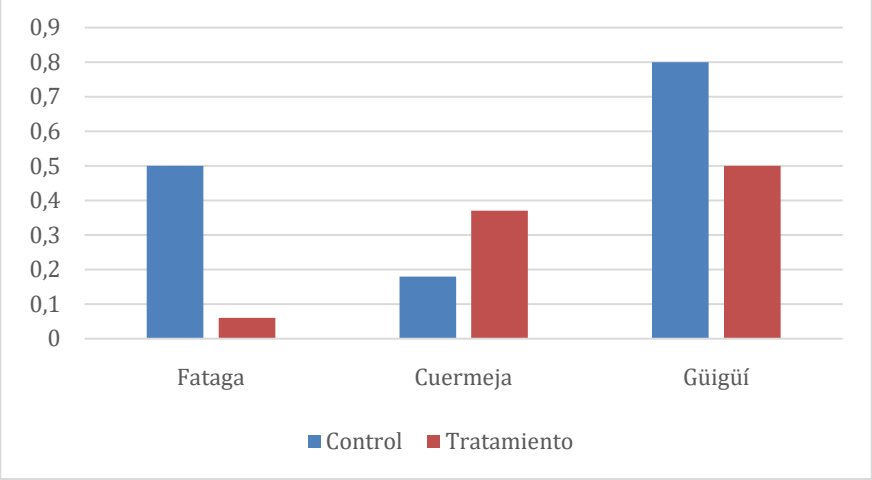


Figure 14. Diversity of pollinators per census in each location.

Abundance is a parameter very much affected by the lack of floral resources. The fact that there were few plants in flower has caused a call effect that may have affected the results obtained. Even so, in Guguy Grande there are practically no differences between the treatments, as in

both the diversity of flowering plants and their number were very similar. On the other hand, in Fataga the control plots obtained three times as many pollinators per census, most probably again due to the high degree of disturbance observed in the treatment plots.

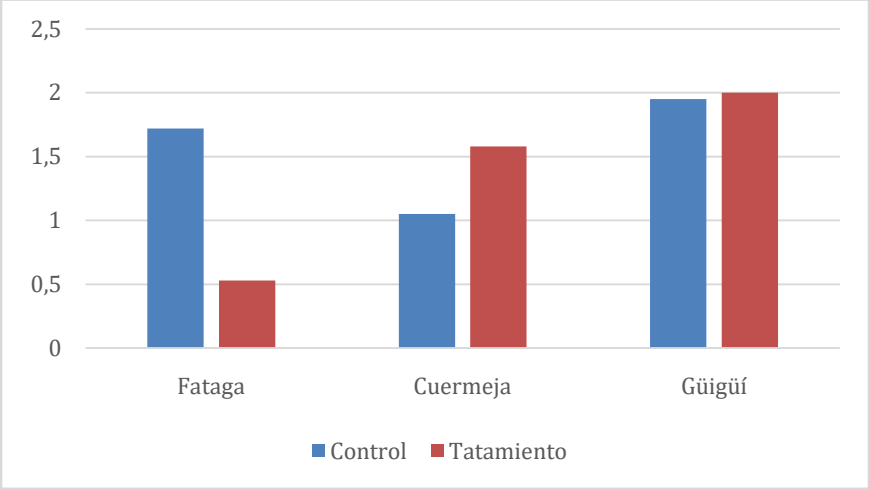


Figure 15. Abundance of pollinators per census in each location.

These trends for diversity and abundance seem to be different in Cuermeja ravine, where the treatment plots are more diverse than the control plots. In addition, the former had very few flowering plants and this might have led to a call effect reflected in the censuses.

5. HABITAT RESTORATION PLAN

5.1 Climate Change mitigation.

Among the range of ecological restoration objectives considered for the project´s palm groves, the mitigation of climate change effects represents an important line of collateral action. Depending on the possibilities and means available, this is intended to be carried out in a more localised manner in some cases (e.g. mulching and organic improvement of the soil) or more extensively in others (e.g. reforestation), also including intermediate situations (e.g. eradication of exotic vegetation and preventive grazing).

The common thread of all tasks under the umbrella of climate change mitigation is based on increasing soil moisture, improving soil condition and preventing forest fires. In this sense, the following concrete actions are proposed:

a) **Improvement of the soils and hydrology of the intervened ravines** in the most degraded sections. This will include the conservation of natural alluvial sediments and soils by reducing soil erosion, increasing infiltration and stabilising banks. In addition, the application of mulch (and, if possible, organic amendments) is also considered. Finally, the reforestation works with endemic species will facilitate soil and moisture retention. The study of the soils in which the specimens grow shows that there are no limiting factors for the growth and development of these palms, except the need to have access to a constant source of water. In fact, this species is tolerant to many environmental factors. However, in order to improve the condition of the

palm groves in the medium and long term, it is recommended to 1) Guarantee access to water by studying the origin and availability of the water flows found. 2) Carry out a soil and climate study on the risk of flooding as a result of changes in rainfall due to climate change. This study will serve as a basis for designing and implementing, if necessary, measures to increase drainage to prevent erosion. 3) Implement actions to reduce competition for water, mainly by eliminating invasive species. 4) Improve the water and nutrient retention capacity of the soil by combining the addition of organic matter sources with a high humification capacity, a balanced C/N ratio (including the use of artificial N inputs in palm groves with a high C/N ratio) and a high P content, and combining this measure with 5) Maintain and promote soil formation on the original materials, applying measures to prevent erosion by creating a vegetation cover (reforestation) with low-growing endemic species that prevent the run-off of materials. All these measures must be applied simultaneously to take advantage of their synergy and to avoid new risks, such as: i) the removal of the current cover could increase the speed of water during extreme rainfall events and favour soil loss by erosion, so it must be replaced by planting or transplanting native species; or ii) to ensure the effect of the addition of organic matter, its permanence in the soil must be guaranteed, preventing it from being washed away by erosion control measures.

b) **Removal of dead wood and invasive vegetation**, which pose a potential risk as they constitute fire propagation corridors along ravines. Detailed information on this aspect is provided in section 5.4.

c) **Preventive grazing**, in coordination with some local farmers and shepherds who have their activity near the project´s areas of intervention. This pilot action is proposed as a supporting method contributing to control invasive vegetation. At the same time, the temporary relocation of livestock is expected to have a positive effect in terms of soil fertilizing. Project partners are already in contact with some farmers/shepherds from both target SACs, in order to assess the most practical approach and possible real impact of this action within the context of this project.

5.2 Hybridisation control.

Based on the genetic study carried out with samples from the four target palm groves, the following strategy is proposed, to be regularly adapted throughout the project duration according to the results of further field surveys and specific studies:

a) Removal of the only hybrid specimen found in Cuermeja (and ideally any specimens of *Phoenix dactylifera* in case they are found in surrounding areas or private properties), in order to fully reduce hybridisation risk in this palm grove.

b) Further search and localisation of specimens of *P. dactylifera* in the surroundings of Arteara, in case such specimens are in close proximity to the palm groves under study (Caserones and Los Aserraderos), in order to get collaboration from private owners to promote their removal and substitution with *P. canariensis*.

c) Removal of all individuals of *P. dactylifera* already detected in Guguy Grande, as well as others which could be detected during the whole project duration.

d) Further study of the abundant ancestral hybrids found in Guguy Grande (in parallel with other possible projects and funding opportunities) in order to assess their heritage, landscape and cultural values.

e) Carry out periodic inspections in Guguy Grande for the annual study of the phenology of hybrid specimens, assessing the distances at which they are located from the core populations of pure *Phoenix canariensis*. It would be important to analyse the degree of overlap between the flowering of hybrid and pure specimens, as well as to analyse the role of birds (blackbirds in particular) in the possible dispersal of hybrid fruits and seeds throughout the palm grove.

f) Implementation of a long-term strategy (including also the After-LIFE period and beyond) in Guguy Grande to promote the gradual replacement of ancestral hybrids for pure specimens of *P. canariensis*: control of hybrid offspring and inflorescences; selective removal of hybrid specimens; reinforced planting of treated seeds of *P. canariensis* in strategic areas within ravine beds, etc.

g) Delimitation and proposal of Critical Conservation Areas for *P. canariensis* within the target palm groves at the end of the project, based on all the field surveys carried out throughout the life of the project.

Maps on this aspect are included in the annexes.

5.3 Pest control and eradication: *Diocalandra frumenti*.

In this action, after review of the first sampling data on the pathogen in the two study areas, the following tasks are proposed in order to promote a complete strategy encompassing prevention, early detection, control and/or eradication, as well as monitoring:

a) Regarding the Fataga site (including Caserones, Arteara and Los Aserraderos palm groves), which has many specimens affected by *Diocalandra frumenti*, massive trapping will be done using traps baited with pheromones and kairomones. Such trapping shall be carried out on a rotational basis and shall be accompanied by the elimination of severely attacked specimens which serve as a reservoir for the pest.

b) With respect to the Güigüí site (including Cuermeja, Guguy Chico and Guguy Grande palm groves), where the harmful organisms have been detected visually, the affected specimens of *Phoenix canariensis* will be eliminated and a trapping network will be placed to detect other possible affected individuals.

c) On the perimeters of both study areas, a network of traps will be established to prevent the natural advance of the pest. Likewise, treatments with phytosanitary products authorized in Spain will be applied by endotheraphy techniques in affected specimens located on agricultural land.

The traps to be used are of very high specificity and have already been tested previously by experts included in the project, so no effect on other faunal groups is foreseen. Likewise, the precision of the endotherapy techniques envisaged ensures their effect only on the specimens

to be treated. As for the elimination of the dead specimens or those seriously affected by *D. frumenti*, scrupulous protocols will be followed for the treatment of the waste, allowing their reuse as mulch only if the phytosanitary conditions allow it.

Maps on this aspect are included in the annexes.

5.4 Control and eradication of invasive vegetation.

This action will primarily focus on the control of *Arundo donax* in the four target palm groves in Gran Canaria, since its negative effect is double: not only has a suffocating effect for the palm tree populations and the rest of the habitat´s keystone species, but also represents a major fire hazard factor, their reedbeds acting as dangerous fire propagation corridors along the ravines.

On a secondary level, some punctual interventions are also planned to control the other main exotic plants detected, assuming no significant damage to the soil. Those secondary species are: *Cenchrus setaceus*, *Agave spp.* and *Opuntia spp*.

Specific management protocols for each of the species (already developed within the framework of the LIFE Phoenix project) will be followed at all times. These protocols include all the relevant aspects to be taken into account: description and ecology of the species, main vectors of introduction, different control methods (prioritising mechanical and manual control), tools and materials, optimal working period, waste management, monitoring and prevention of reintroduction.

Given the remoteness of the project areas in Gran Canaria, interventions will primarily consist of manual elimination (with the aid of basic tools like scissors, hoe or saw) or mechanical control (with the aid of light machinery like backpack brushcutter or light saw machine).

Regular maintenance works and rapid reforestation with autochthonous species will be carried out in order to avoid re-colonisation by IAS. In most cases, only seeds and reproductive parts of the plants (carefully cut to avoid dispersal) will be properly treated *in situ* (neutralisation, isolation and/or burial) or transported to landfill in sacs. The rest of the plant debris will be grinded on site and reused as a mulch layer, reducing transport impacts and generating ecological benefits for the habitat: minimisation of IAS re-sprout, regulation of soil temperature and moisture, provisioning of organic matter, etc.

Whenever possible, roots and rhizomes will be treated on site (through repeated cuts and/or coverage with geotextile or plastic) without uprooting, so that the soil is not damaged. IAS control will be done during the most suitable time periods for each species, according to their reproductive and vegetative phases. Chemical methods with permitted herbicides will be discarded in order not to affect groundwater or other autochthonous plants. Their use could only be considered in punctual situations, with a much localised application (through injection or with a brush), to avoid re-sprout of certain species and always as a complementary action to manual or mechanical methods.

The estimated surface where control of exotic vegetation will be developed is shown in Table 8.

Table 8. Estimated intervention surface with direct elimination or control of plant IAS.

Palm grove	Priority areas	Secondary areas	TOTAL
Cuermeja	0.82 Ha	0.62 Ha	**1.44 Ha**
Guguy Grande	2.61 Ha	1.91 Ha	**4.52 Ha**
Caserones	1.93 Ha	1.02 Ha	**2.95 Ha**
Los Aserraderos	3.24 Ha	1.59 Ha	**4.83 Ha**
TOTAL	**8.60 Ha**	**5.14 Ha**	**13.74 Ha**

Maps on this aspect are included in the annexes.

5.5 Ex-situ conservation.

A germplasm bank will be created with seeds of the purest strains from approved seed sources of *Phoenix canariensis*, located within or near the project intervention areas. The specific protocol elaborated as part of the project's preparatory actions will be followed at all stages. It is expected to collect a total of around 4,000 seeds from the two project sites.

The main tasks will involve: Preparation of the fruits, disinfection and drying of the seeds, for subsequent storage for 4 months in chambers with controlled ventilation and humidity; final storage in the germplasm bank, in airtight containers at 4ºC with silica gel.

The same protocol will be used to implement the production of genetic-quality palm trees to be used during the reforestation works of the LIFE Phoenix project, as well as to provide material for future plantations in Gran Canaria. In this sense, the main goal is to ensure a production capacity of around 2,500 seedlings of *P. canariensis* by the end of the project.

The necessary adaptations (in terms of space and materials) will be developed in the nurseries of the Council of Gran Canaria and, if needed, also within the facilities of the Canary Islands Botanic Garden, in order to ensure the long-term performance of both the germplasm bank and the production of quality palm trees.

Suitable spaces and sites have also been designated for the growth and acclimatisation of the plants prior to their use in plantations.

5.6 Reforestation works.

This action has been planned in order to fulfil two parallel objectives: a) allow for the genetic enrichment of the target palm groves with new genetic-quality palm trees of *Phoenix canariensis*; b) improve the diversity and abundance of other keystone species native to the habitat 9370*.

The methods to be used will include traditional reforestation with seedlings in all plantation plots and, within the most vulnerable areas, individual protectors against herbivores will be also employed for an estimated number of 5,000 plants. In the case of *Phoenix canariensis*, manual planting of previously treated seeds will also be tested and, initially, population reinforcements will be carried out using germplasm from the same palm grove.

External water supply has been foreseen, through the installation of temporary water storage and irrigating systems. The use of punctual water springs will be also taken into account upon consensus between local farmers and the different competent administrations. The tanks to be installed will hold sufficient water capacity for several irrigations of 3 litres per plant. In addition, a network of longitudinal pipes will be set up to allow the irrigation of each of the plants by means of manual hoses.

The reforestation effort in Gran Canaria represents an estimated total number of 20,000 individuals, including a selection of endemic species (see Table 9) adapted to the specific environmental conditions of the different planting plots. Given their protection status, the production and planting of four of these species (*Dorycnium broussonetii, Cheirolophus falcisectus, Echium onosmifolium ssp. spectabile* and *Teucrium heterophyllum ssp. brevipilosum*) will require specific authorisation by the Government of the Canary Islands.

Seed sources located within or near the project intervention areas have been already defined for each species, in order to use the most appropriate plant material.

In order to minimise their impact, all soil preparation, hollowing and planting work shall be carried out by hand or by hand machine (brushcutter, earth auger machine).

Table 9. List of selected endemic species and numbers considered for reforestation works.

Endemic species	Endemicity	Nº in SAC Güigüí	Nº in SAC Fataga	Total
Dracaena tamaranae	EGC	475	530	1,005
Juniperus cedrus	N	100	0	100
Juniperus turbinata ssp. canariensis	N	525	700	1,225
Olea cerasiformis	EC	525	850	1,375
Phoenix canariensis	EC	2,620	3,900	6,520
Pistacia atlantica	N	995	550	1,545
Salix canariensis	N	385	550	935
Tamarix canariensis	N	485	550	1,035
Asparagus arborescens	EC	290	0	290
Chamaecytisus proliferus ssp. meridionalis	EC	280	450	730
Convolvulus floridus	EC	290	200	490
Euphorbia aphylla	EC	885	0	885
Dorycnium broussonetii	EGC	290	0	290
Euphorbia canariensis	EC	485	390	875
Plocama pendula	EC	485	310	795
Cheirolophus falcisectus	EGC	290	0	290
Echium onosmifolium ssp. spectabile	EGC	290	0	290
Periploca laevigata	N	290	310	600
Rubia fruticosa ssp. melanocarpa	EC	290	0	290
Teucrium heterophyllum ssp. brevipilosum	EC	125	310	435
Total number		**10,400**	**9,600**	**20,000**

> 5 mt.	Tree - arborescent species
1 - 5 mt.	Shrub species
< 1 mt.	Subshrub - herbaceous species

EGC	Endemic to Gran Canaria
EC	Endemic to the Canary Islands
N	Native

Table 10. Estimated reforestation surface within each of the project´s palm groves.

Palm grove	Surface (Ha)
Cuermeja	3.6
Guguy Grande	20
Caserones	7.4
Los Aserraderos	8
TOTAL	**39**

Maps on this aspect are included in the annexes.

6. MONITORING PLAN

A set of indicators has been defined to ensure the monitoring of the different aspects considered for this Management Plan:

a) Climate Change (fire prevention; improvement of soils and hydrology): It is foreseen to repeat the study on soils and hydrology at the end of the project, including the same type of parameters. Indicators on fire prevention are related to the surface in which fire risk is reduced by preventive grazing and the elimination of dead wood and invasive vegetation.

b) Genetics and hybridisation: Indicators will measure the reduction of hybridisation risk due to the presence of non native and hybrid specimens of *Phoenix*, as well as by the delimitation and monitoring of Critical Conservation Areas (those where pure specimens of *P. canariensis* grow) within the project palm groves.

c) Pests (*Diocalandra frumenti*): The project will regularly monitor the evolution of the impact of this insect within the target palm groves, as well as the results of the trap networks, the phytosanitary treatments applied and the elimination of severely damaged palm trees. Indicators will measure the extent of these actions, the performance of the traps and the surface where the pathogen is controlled or eradicated.

d) Invasive vegetation: The main indicator regarding this issue is the surface where the target IAS are eradicated or controlled.

e) Ex-situ conservation: Indicators will allow monitoring activities such as seed collection, germplasm conservation and seedling production.

f) Reforestation: The project will regularly monitor parameters such as the reforested surface, the number of planted individuals for each of the selected endemic species, their condition and survival rates throughout the project, as well as other parameters related to the irrigations applied.

g) Biodiversity (pollinators): The study on diversity and abundance of the target groups (bees, butterflies and some families of flies) will be repeated at the end of the project, assessing the same type of parameters.

Table 11. Preliminary list of monitoring indicators.

Indicator	Unit	Method	Frequency
Climate Change			
Surface under preventive grazing	Ha	Field monitoring and GIS cartography	Once a year
Surface where dead wood and plant IAS are eliminated	Ha	Field monitoring and GIS cartography	Every 6 months
Estimated quantity of accumulated dead wood eliminated	Tons or m3	Field monitoring	Every 6 months
Surface where mulch layer is applied	Ha	Field monitoring and GIS cartography	Every 6 months
Surface where organic amendment or livestock fertilizing is applied	Ha	Field monitoring and GIS cartography	Once a year
Hydrology and soil parameters		Field survey and lab analyses	At the end of the project
Genetics and hybridisation			
Number of non native and hybrid palm trees eliminated	Nº	Field monitoring and GIS cartography	Once a year
Surface delimitated and monitored as Critical Conservation Areas	Ha	Field monitoring and GIS cartography	Once a year
Number of new palm trees genetically analysed	Nº	Field monitoring and GIS cartography	Only if new genetic studies are considered
Number of hybrid specimens in which phenology is analyzed	Nº	Field monitoring and GIS cartography	Coinciding with flowering periods
Pests (*Diocalandra frumenti*)			
Number of damaged palm trees eliminated	Nº	Field monitoring and GIS cartography	Once a year
Number of palm trees with phytosanitary treatment	Nº	Field monitoring and GIS cartography	Once a year
Number of traps placed and monitored	Nº	Field monitoring and GIS cartography	Every 6 months
Surface controlled by trap networks	Ha	Field monitoring and GIS cartography	Every 6 months
Invasive vegetation			
Surface under plant IAS control	Ha	Field monitoring and GIS cartography	Every 6 months
Surface under plant IAS eradication	Ha	Field monitoring and GIS cartography	Every 6 months
Ex-situ conservation			
Average number of seeds of *P. canariensis* collected	Nº	Field monitoring	Once a year
Average number of seeds of *P. canariensis* treated and prepared	Nº	Nursery reports	Once a year
Number of seedlings of *P. canariensis* produced	Nº	Nursery reports	Once a year
Number of seeds of *P. canariensis* prepared and conserved in the germplasm bank	Nº	ULPGC reports	Only once

Number of plants of *P. canariensis* maintained in nursery	Nº	Nursery reports	Only once
Reforestation			
Number of seedlings of each species produced	Nº	Nursery reports	Once a year
Number of seedlings of each species planted	Nº	Field monitoring	Once a year
Average survival rate for each species	%	Field monitoring	Once a year
Surface reforested in each area of intervention	Ha	Field monitoring and GIS cartography	Once a year
Water consume (volume) for irrigations	m3	Field monitoring	Every 6 months
Biodiversity (pollinators)			
Number of different species identified (diversity)	Nº	Field survey and lab identification	At the end of the project
Number of specimens detected for each species (abundance)	Nº	Field survey and lab identification	At the end of the project

7. CONCLUSIONS

The different studies and field visits carried out as part of the preparatory actions of the LIFE Phoenix project have provided an updated picture of the different risks and threats affecting the target palm groves in Gran Canaria. Its results have been summarised in this document, which also sets out the main technical measures to be undertaken during the rest of the project's implementation period.

A part of these studies have revealed some unexpected data, as in the case of the results found in Guguy Grande palm grove on hybridisation and affection by *Diocalandra frumenti*. In this sense, some of the habitat restoration actions have been fine-tuned to address the new situations detected.

It is the intention of the project partners that this adaptive management approach will be maintained throughout the whole project duration. Therefore, this Management Plan is also intended to be updated if considered necessary.

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ANNEXES

Map 1A. Location of target palm groves in SAC Güigüí.
Map 1B. Location of target palm groves in SAC Fataga.

Map 2A. Location of the specimens sampled in Cuermeja palm grove.
Map 2B. Location of the specimens sampled in Guguy Grande palm grove.
Map 2C. Location of the specimens sampled in Caserones palm grove.
Map 2D. Location of the specimens sampled in Arteara / Los Aserraderos palm groves.

Map 3A. Results of Dicalandra frumenti prospection in Los Aserraderos palm grove.
Map 3B. Results of Dicalandra frumenti prospection in Arteara palm grove.
Map 3C. Results of Dicalandra frumenti prospection in Caserones palm grove.
Map 3D. Results of Dicalandra frumenti prospection in Guguy Chico palm grove.
Map 3E. Results of Dicalandra frumenti prospection in Guguy Grande palm grove.
Map 3F. Results of Dicalandra frumenti prospection along the perimeter La Aldea-Guguy I.
Map 3G. Results of Dicalandra frumenti prospection along the perimeter La Aldea-Guguy II.
Map 3H. Results of Dicalandra frumenti prospection along the perimeter La Aldea-Tasartico.

Map 4A. Surface affected by invasive vegetation in Cuermeja palm grove.
Map 4B. Surface affected by invasive vegetation in Guguy Grande palm grove.
Map 4C. Surface affected by invasive vegetation in Caserones palm grove.
Map 4D. Surface affected by invasive vegetation in Arteara / Los Aserraderos palm groves.

Map 5A. Sampling plots (C - control; T - treatment) in Cuermeja ravine.
Map 5B. Sampling plots (C - control; T - treatment) in Guguy Grande ravine.
Map 5C. Sampling plots (C - control; T - treatment) in Fataga ravine.

Map 6A. General view: Reforestation areas in SAC Güigüí.
Map 6B. General view: Reforestation areas in SAC Fataga.
Map 6C. Reforestation plots in Cuermeja palm gove.
Map 6D. Reforestation plots in Guguy Grande palm gove.
Map 6E. Reforestation plots in Caserones palm gove.
Map 6F. Reforestation plots in Los Aserraderos palm gove.

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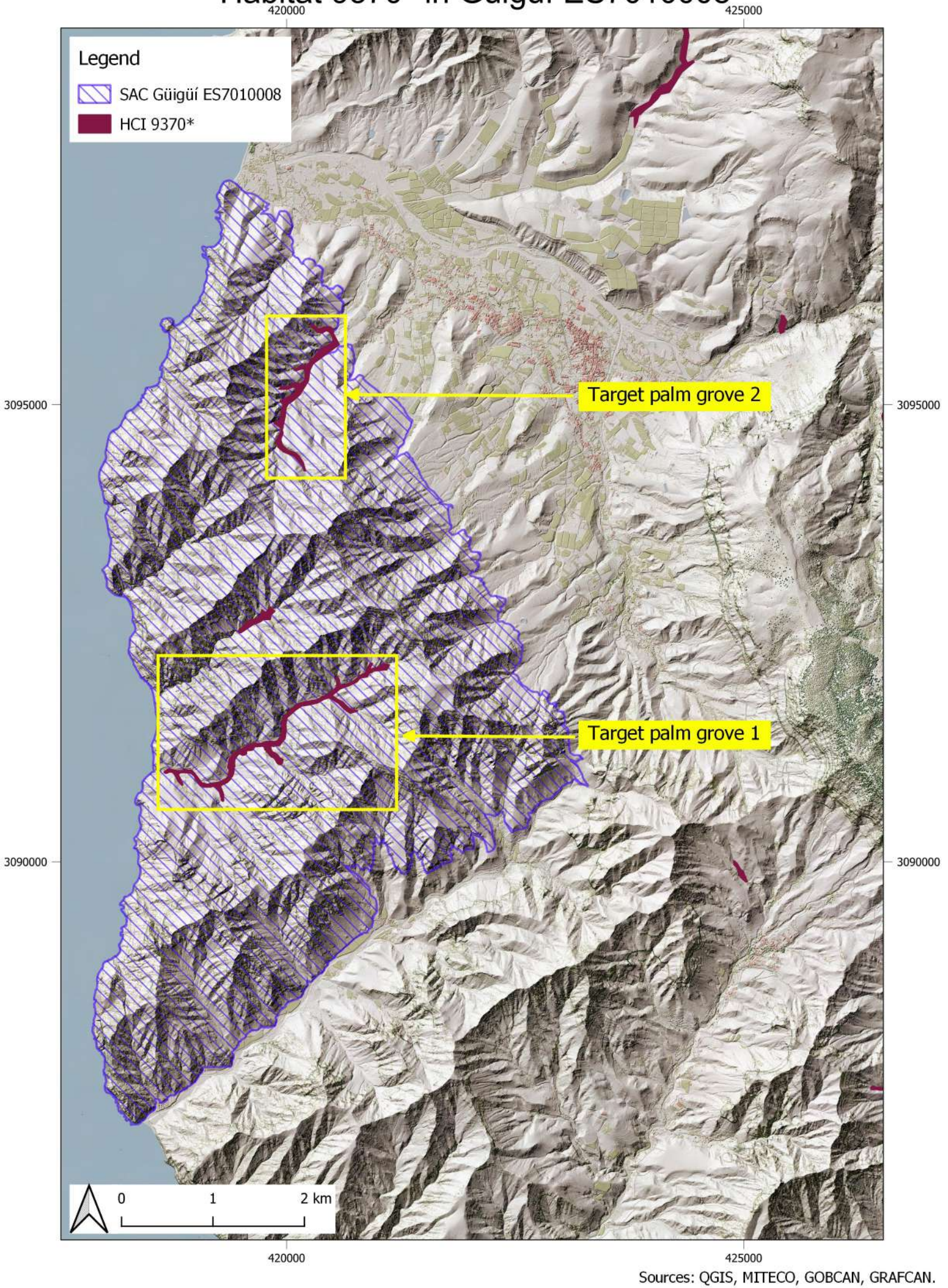
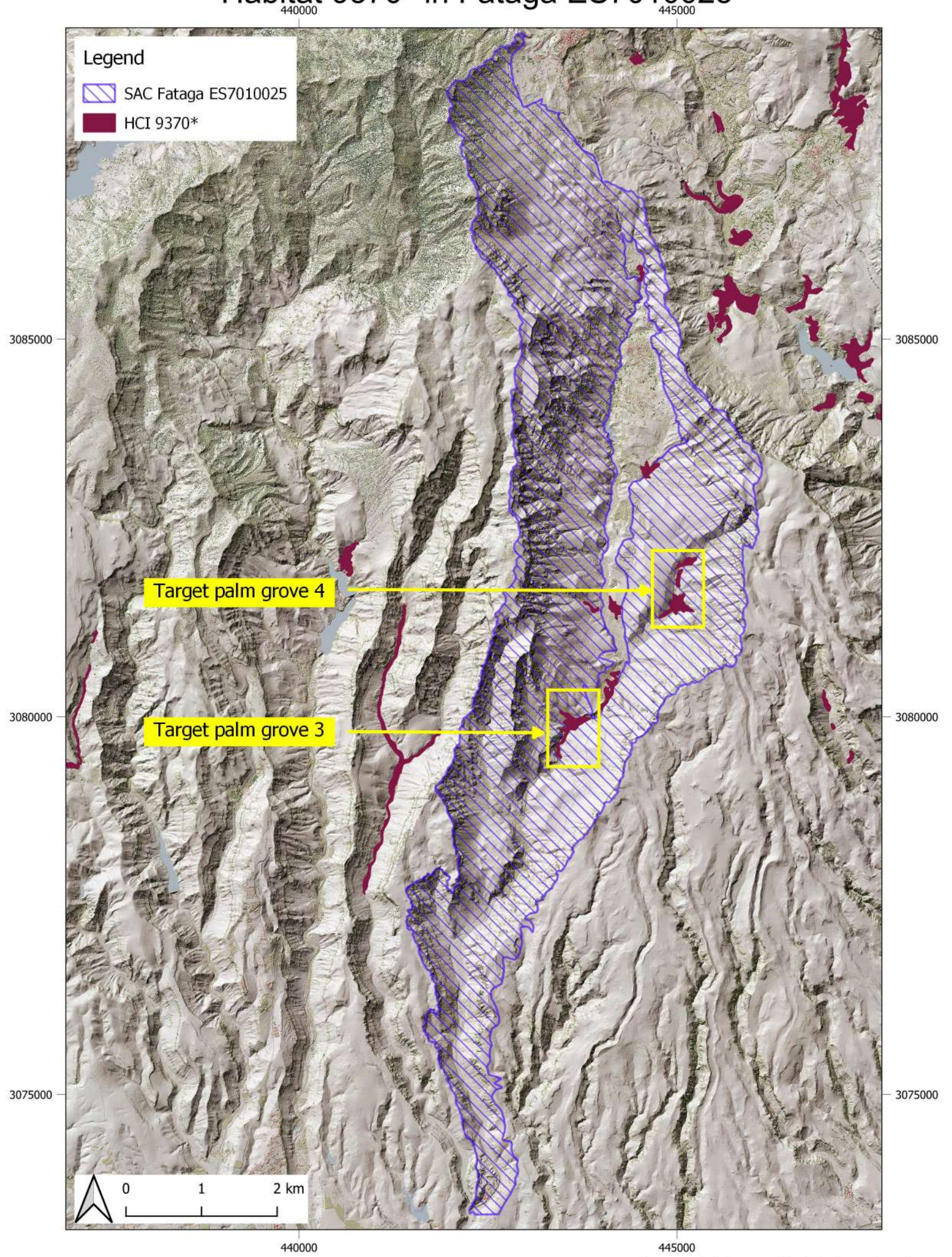
Habitat 9370* in Güigüí ES7010008



Sources: QGIS, MITECO, GOBCAN, GRAFCAN.

Habitat 9370* in Fataga ES7010025



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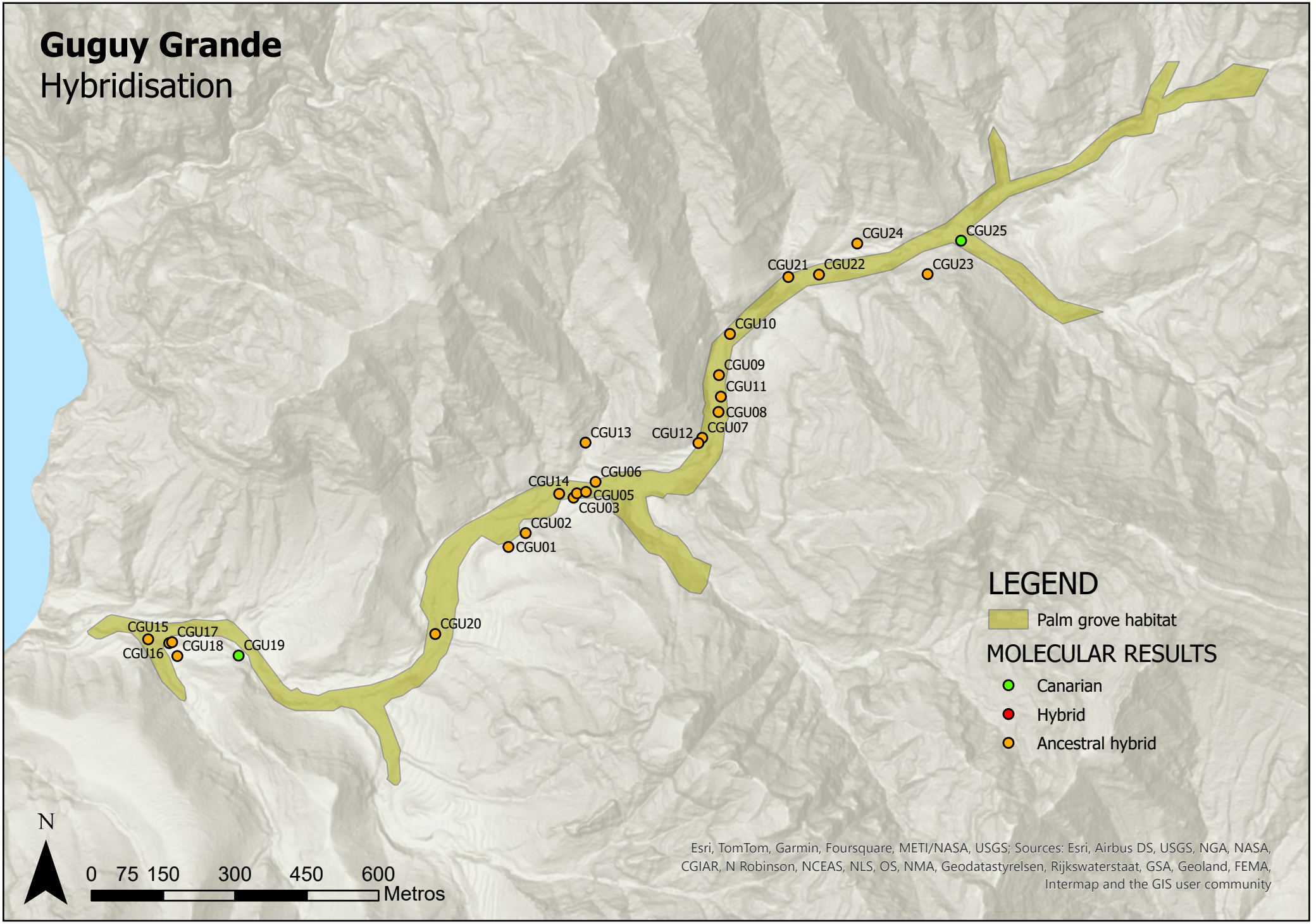
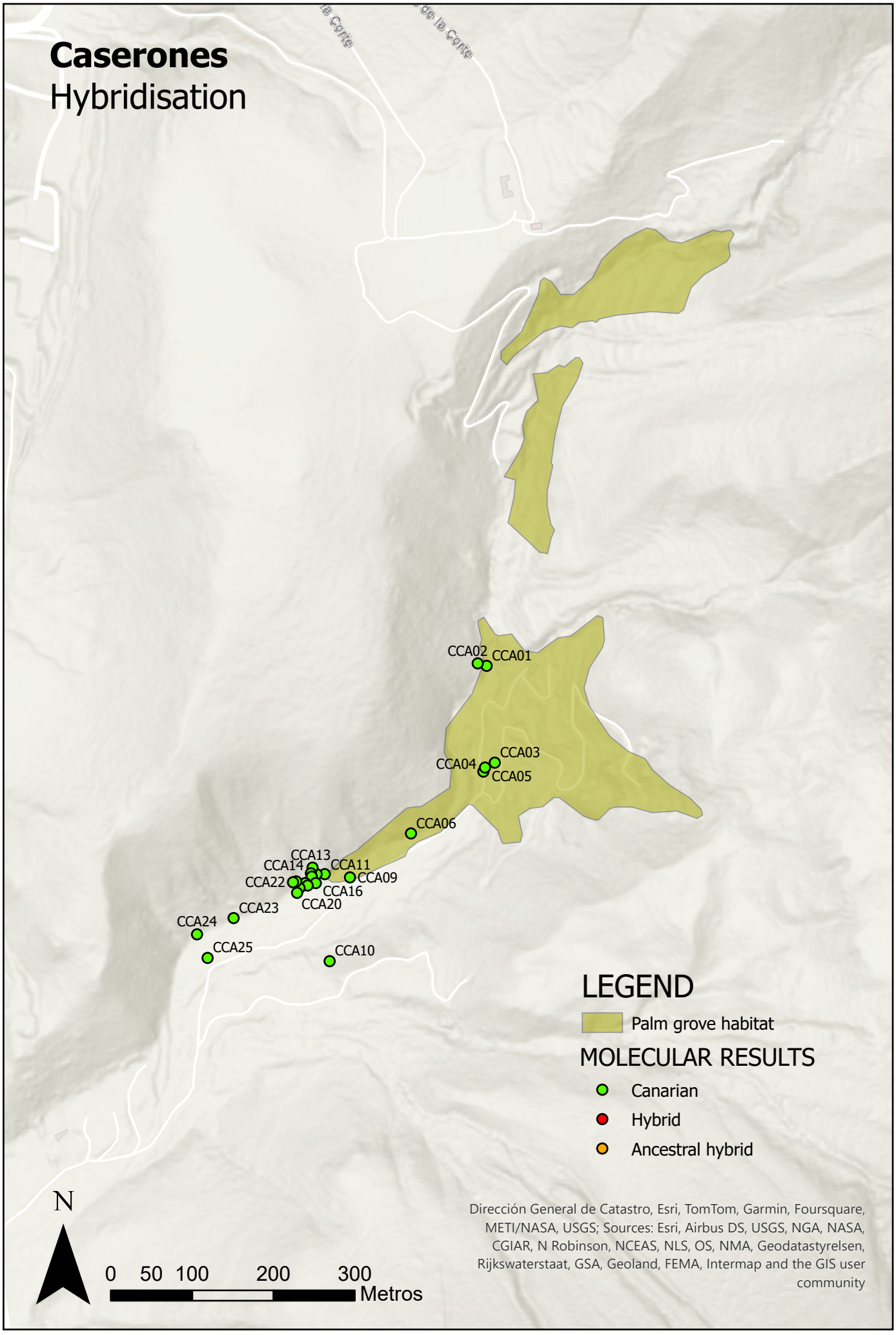
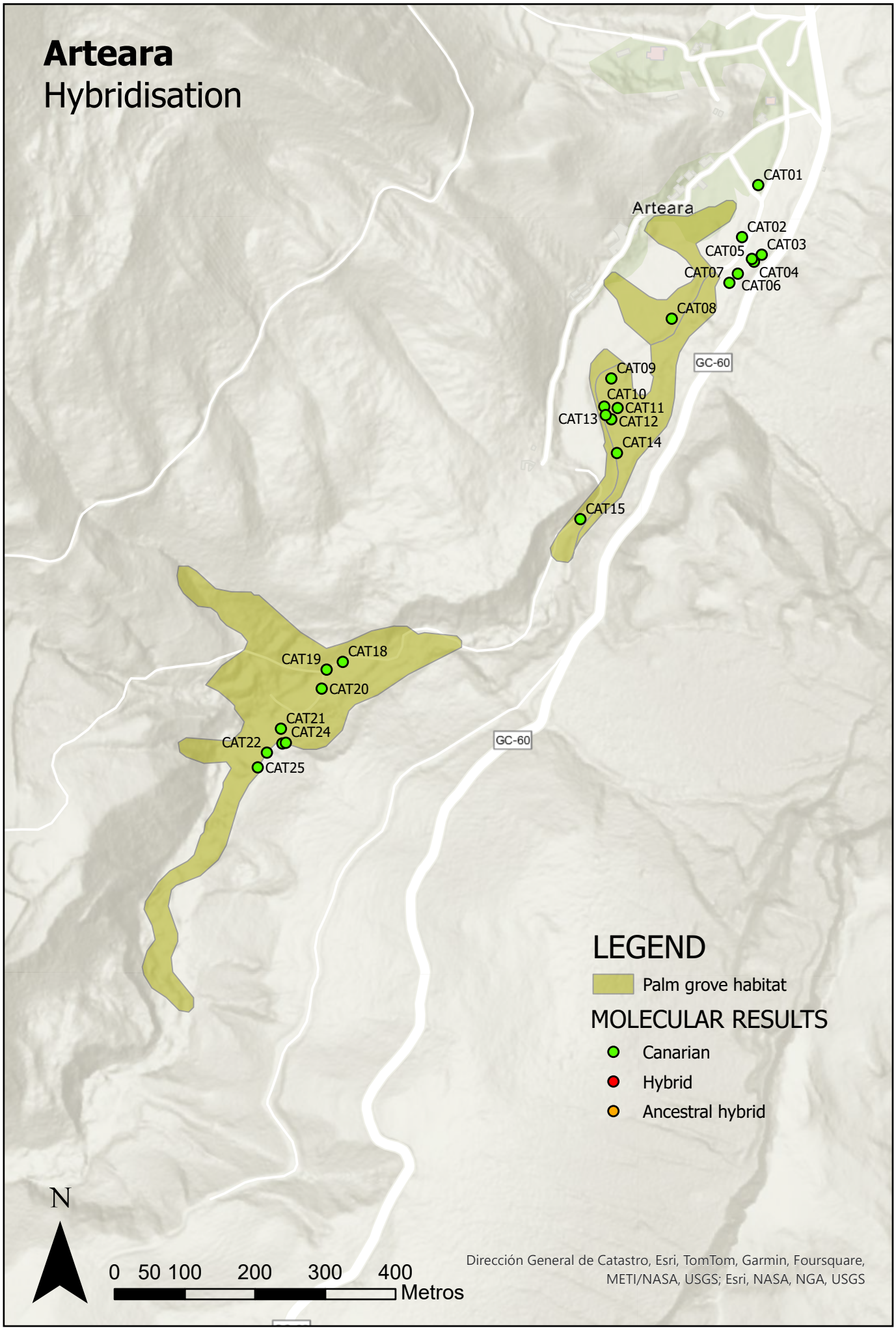
Cuermeja
Hybridisation
CCU25
CCU21
CCU24
CCU20
CCU22
CCU14
CCU18
CCU13
CCU12
CCU08
CCU09
CCU07
CCU05
CCU04
CCU06
CCU03
CCU02
CCU01
LEGEND
Palm grove habitat
MOLECULAR RESULTS
Canarian
Hybrid
Ancestral hybrid
N
0 50 100 200 300 400
Metros
Dirección General de Catastro, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS; Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community


Guguy Grande
Hybridisation
CGU24
CGU25
CGU21
CGU22
CGU23
CGU10
CGU09
CGU11
CGU08
CGU07
CGU13
CGU12
CGU06
CGU14
CGU05
CGU03
CGU02
CGU01
CGU20
CGU15
CGU17
CGU18
CGU16
CGU19
LEGEND
Palm grove habitat
MOLECULAR RESULTS
Canarian
Hybrid
Ancestral hybrid
N
0 75 150 300 450 600
Metros
Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS; Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community


Caserones
Hybridisation
CCA02
CCA01
CCA03
CCA04
CCA05
CCA06
CCA13
CCA14
CCA11
CCA09
CCA22
CCA16
CCA20
CCA23
CCA24
CCA25
CCA10
LEGEND
Palm grove habitat
MOLECULAR RESULTS
Canarian
Hybrid
Ancestral hybrid
N
0 50 100 200 300
Metros
Dirección General de Catastro, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS; Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community


Arteara
Hybridisation
Arteara
CAT01
CAT02
CAT03
CAT04
CAT05
CAT06
CAT07
CAT08
CAT09
CAT10
CAT11
CAT12
CAT13
CAT14
CAT15
CAT18
CAT19
CAT20
CAT21
CAT22
CAT24
CAT25
GC-60
GC-60
LEGEND
Palm grove habitat
MOLECULAR RESULTS
Canarian
Hybrid
Ancestral hybrid
N
0 50 100 200 300 400
Metros
Dirección General de Catastro, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS; Esri, NASA, NGA, USGS

443500.000

444000.000

3080000.000

3080000.000

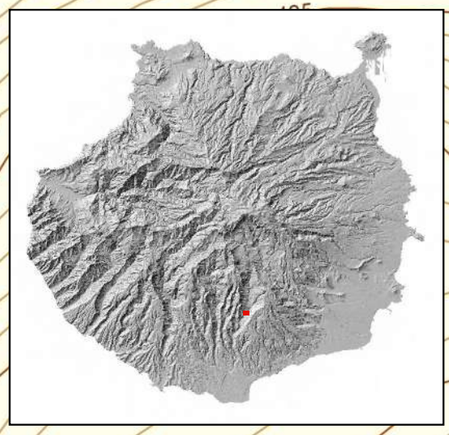
Prospección de los palmerales del proyecto LIFE Phoenix en Gran Canaria

Diocalandra frumenti

Palmeral de Los Aserraderos

Afección de Diocalandra frumenti.

- No afectada.
- Afección leve.
- Afección moderada.
- Afección grave.



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444000.000

444000.000

444500.000

3080500.000

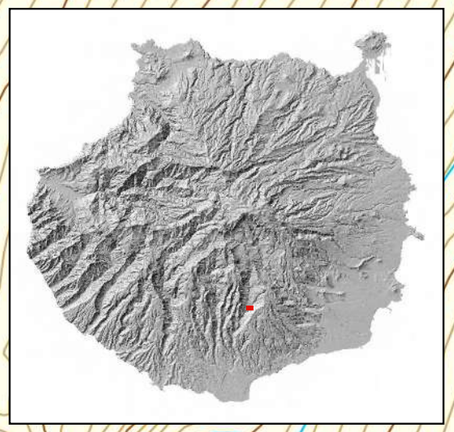
3080500.000

Prospección de los palmerales del proyecto LIFE Phoenix en Gran Canaria

Diocalandra frumenti

Palmeral de Arteara

Afección de Diocalandra frumenti.
- No afectada.
- Afección leve.
- Afección moderada.
- Afección grave.



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Prospección de los palmerales del proyecto LIFE Phoenix en Gran Canaria

Diocalandra frumenti

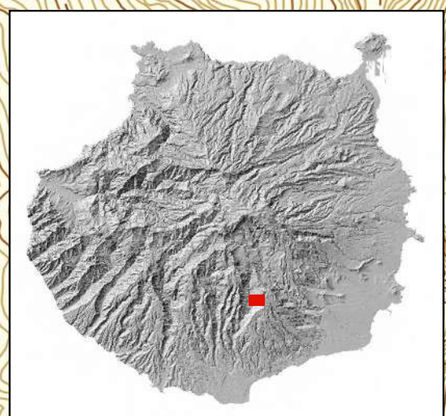
444500.000 445000.000 445500.000

3082000.000 3081500.000 3081000.000

Cruz de Arteara
Finca del Rosario
Llano de Los Caserones
CASERONES DE ARRIBA
CASERONES DE ABAJO
LOMO DE LAS CASAS VIEJAS
LOMO DE SAN JUAN
LOMO GORDO
Andenes del Palo
Hoya Saballo

Palmeral de Caserones

Afección de Diocalandra frumenti.
- No afectada.
- Afección leve.
- Afección moderada.
- Afección grave.



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Prospección de los palmerales del proyecto LIFE Phoenix en Gran Canaria

Diocalandra frumenti

419500.000

420000.000

3093000.000

3092500.000

Caideros de Daniel

Barranco de Guiguí Chico

Cañada de los Pinos

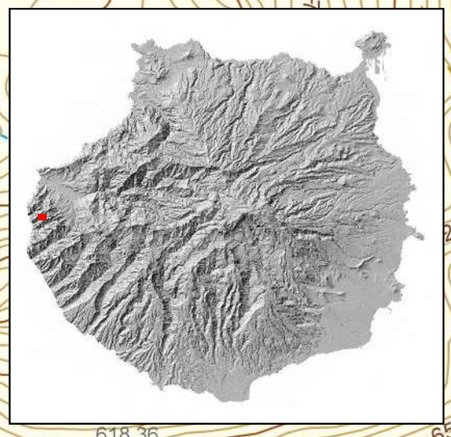
Cañadilla de Pepe

Pasillo del Cardón

Palmeral de Guguy Chico

Afección de Diocalandra frumenti.

- No afectada.
- Afección leve.
- Afección moderada.
- Afección grave.



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marcobertrana

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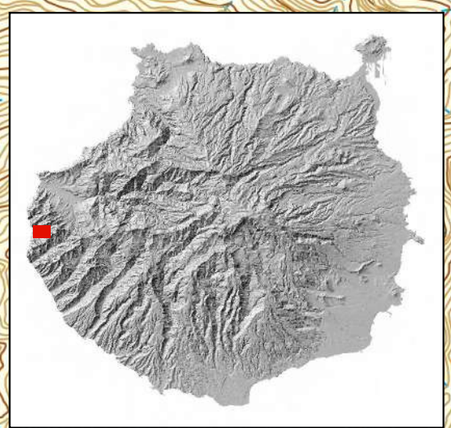
NATURA 2000

Prospección de los palmerales del proyecto LIFE Phoenix en Gran Canaria

Diocalandra frumenti

Palmeral de Guguy Grande

Afección de Diocalandra frumenti.
- No afectada.
- Afección leve.
- Afección moderada.
- Afección grave.



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NATURA 2000

Caidero-de-las Palomas
Degollada del Palo
Paso de la Tabaiba
Caidero del Cuervo
El Puntón
El Paso
La Minilla
El Caidero
Güigüí
Charco del Toro
Las Huertas
La Sandarita
Los Abanicos
La Pasada
Finca de Jacinta
LOMO DE LA ARENA
Llano de la Mar de Arriba
Güigüí Grande
LOMO DE LAS ESTAQUILLAS
Era de la Meseta
Morro del Saltadero
Güigüí
Las Degolladitas

419000.000 419500.000 420000.000 420500.000

3092000.000 3091500.000 3091000.000 3090500.000

Prospección de los palmerales del proyecto LIFE Phoenix en Gran Canaria

Diocalandra frumenti

Perímetro La Aldea-Guguy I

Afección de Diocalandra frumenti.
- No afectada.
- Afección leve.
- Afección moderada.
- Afección grave.

marcobertrana

1:7.000

LIFE PHOENIX

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Prospección de los palmerales del proyecto LIFE Phoenix en Gran Canaria

Diocalandra frumenti

Perímetro La Aldea-Guguy II

Afección de Diocalandra frumenti.
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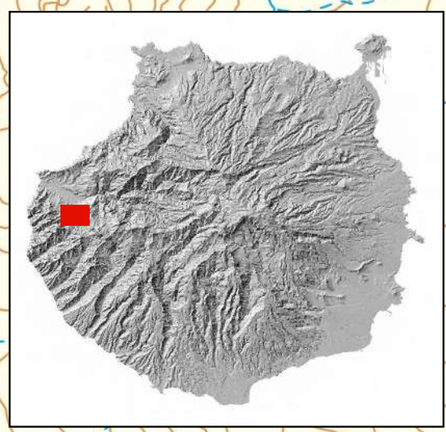
- Afección leve.
- Afección moderada.
- Afección grave.



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LIFE PHOENIX

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NATURA 2000

Prospección de los palmerales del proyecto LIFE Phoenix en Gran Canaria

Diocalandra frumenti

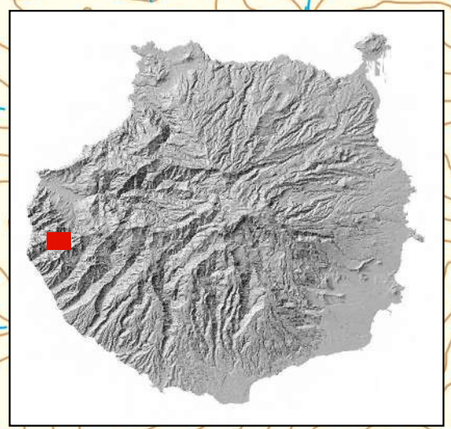
420500.000 421000.000 421500.000 422000.000 422500.000 423000.000

3090500.000 3090000.000 3089500.000 3089000.000

Las Degolladitas
Hoya de los Frailes
Morro de Cho Antonio
El Tablero
LOMO DE LOS PASCUALES
LADERONES DE RISCO PARTIDO
Casas Tejadas
El Palmito
Las Arenitas
LOMO DEL PALMITO
Las Coloradas
Piquillo de Las Tocinas
La Canaria
Las Mordazas
Llano Blanco
LOMITO DE LOS OROVALES
Caidero de las Vetas Blancas
La Renta
La Gambuesa
LOMO DE LAS ESNUNCIAS
Los Cerrillaletes
LADERONES DE LA UMBRÍA
Paso de la Umbría
El Cabezo
Las Rosas
TASARTICO
Puntón de Risco Blanco
TASARTICO
Casas del Lomito
Caidero de los Callaos
La Solana
Risco de las Altabaqueras
Hoya de Toledo
Aguanueva
Morro de La Nariz Negra
Tasartico
Meseta del Caidero
La Gambuesa
LOS LOMOS
ANDÉN DE MOLINA

Perímetro La Aldea-Guguy
Bco. de Tasartico

Afección de Diocalandra frumenti.
- No afectada.
- Afección leve.
- Afección moderada.
- Afección grave.



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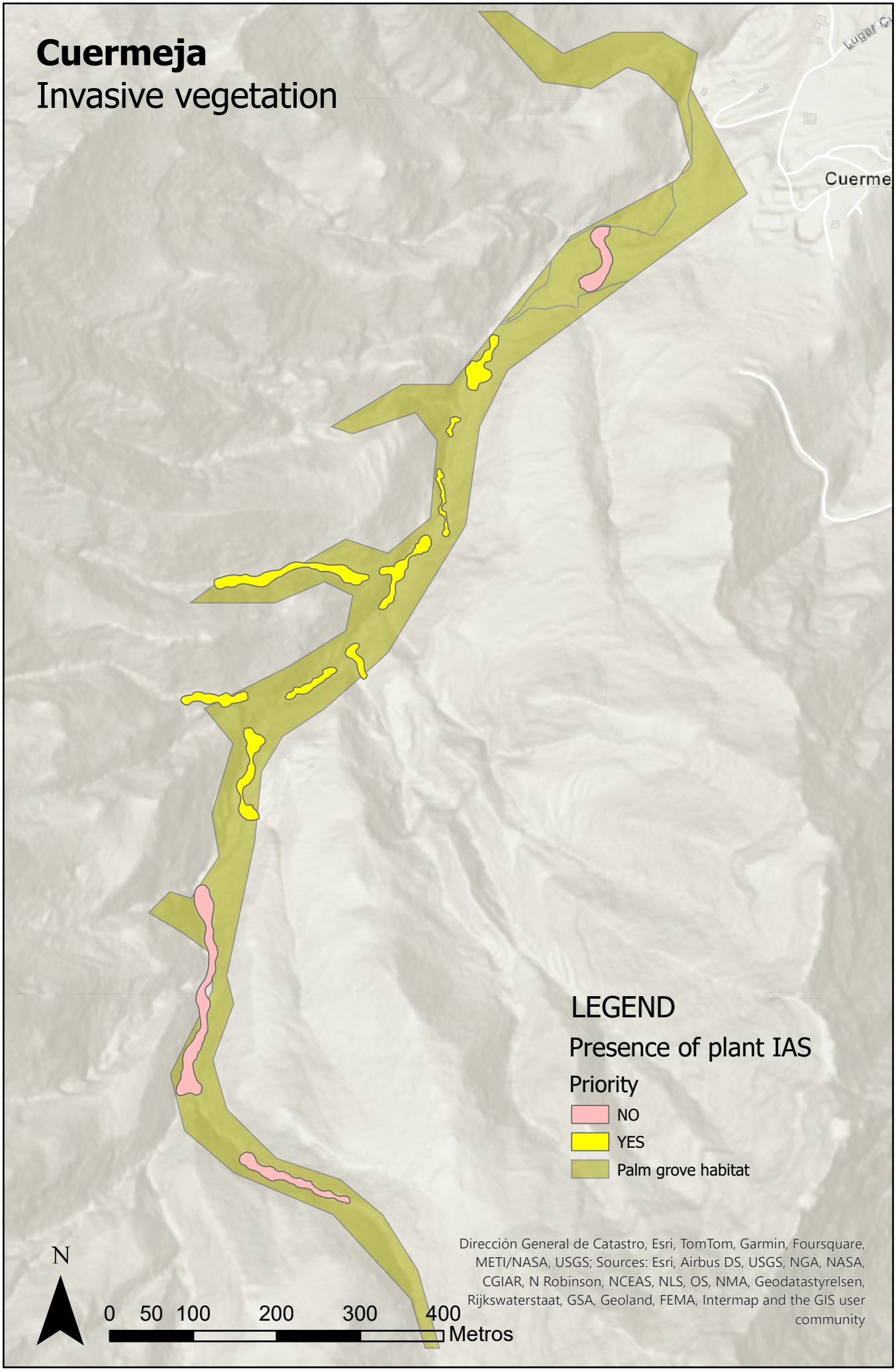
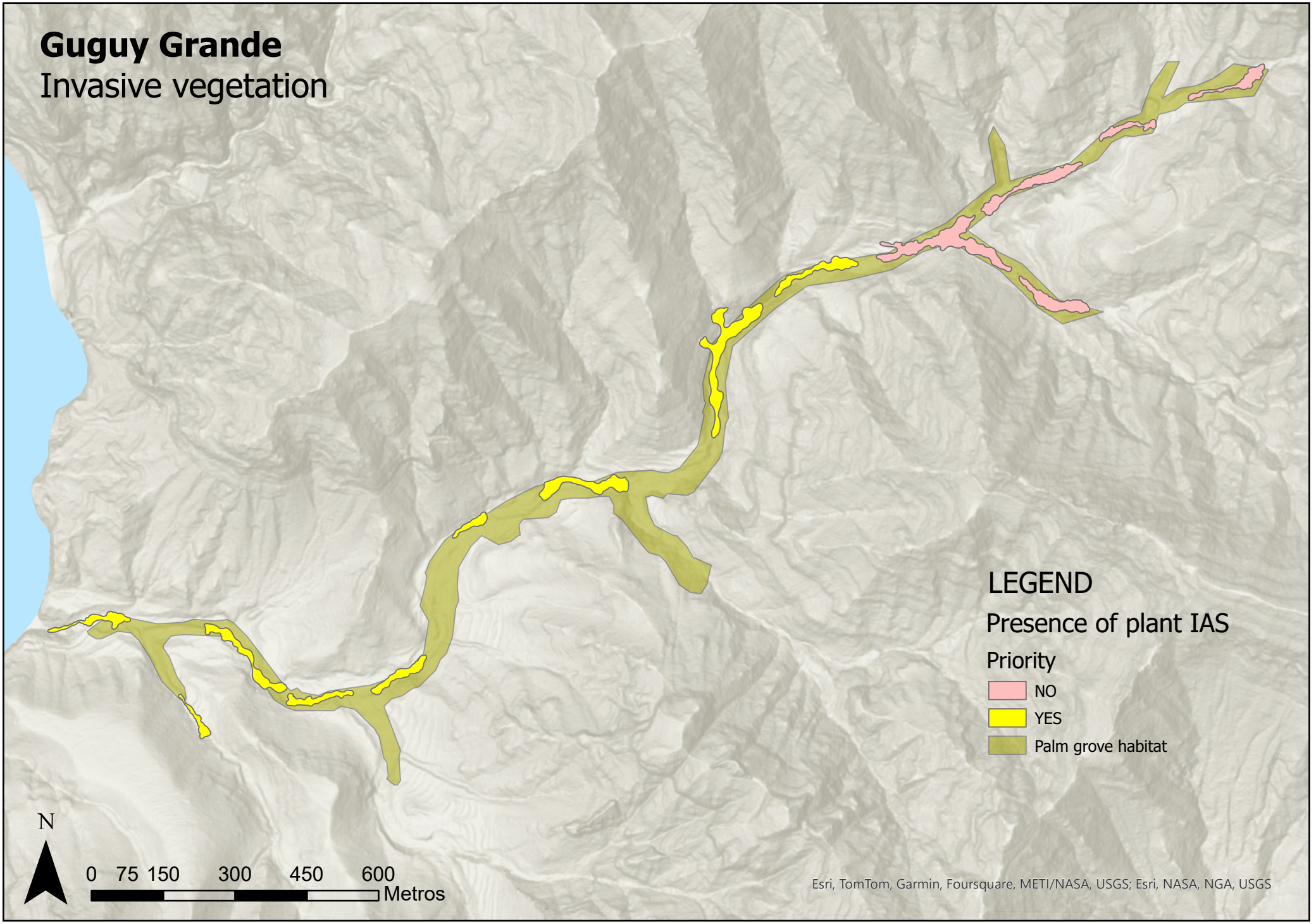
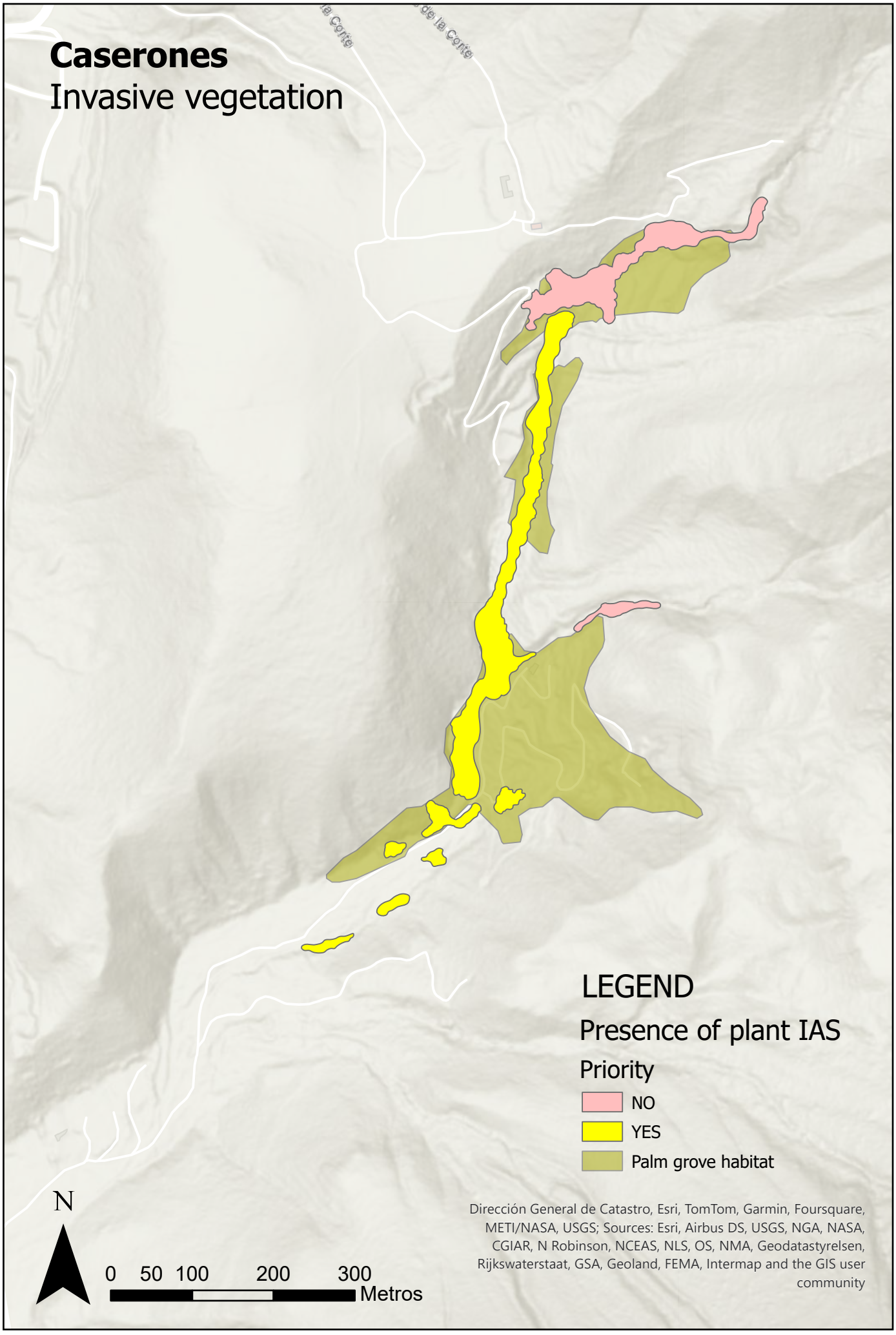
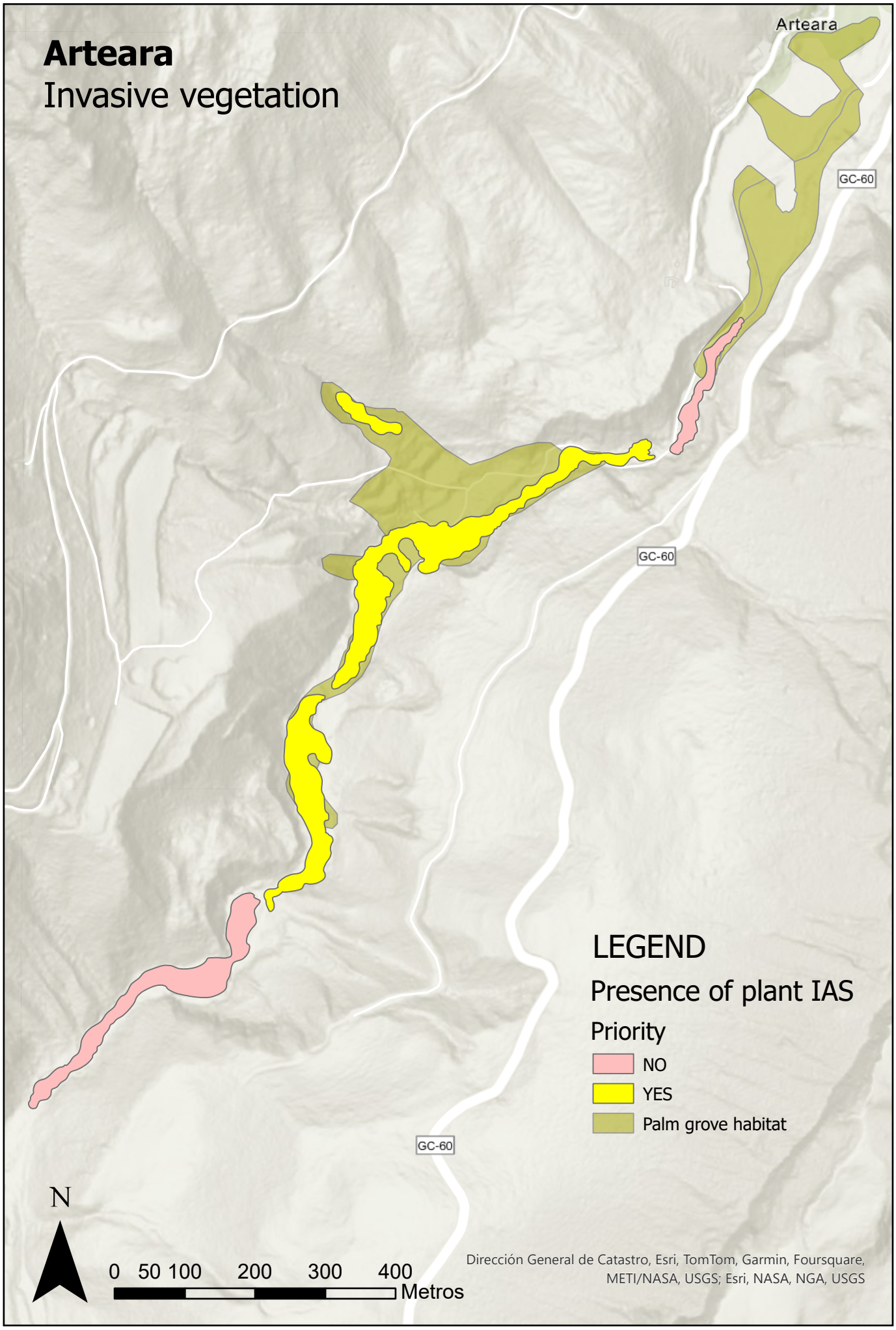
marcobertrana

LIFE PHOENIX
Co-funded by the European Union
NATURA 2000

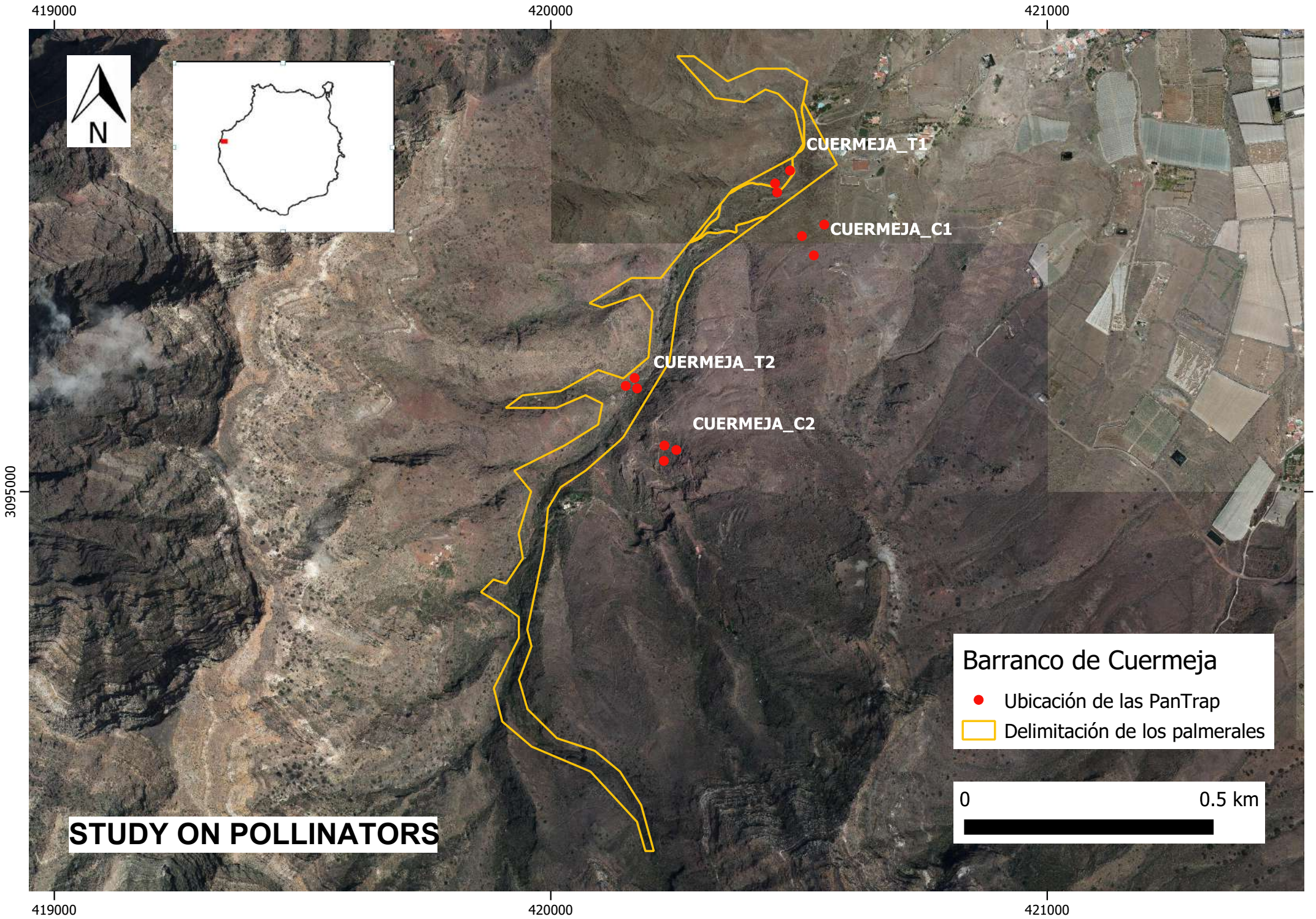

Cuermeja
Invasive vegetation
Cuerme
LEGEND
Presence of plant IAS
Priority
NO
YES
Palm grove habitat
N
0 50 100 200 300 400
Metros
Dirección General de Catastro, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS; Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

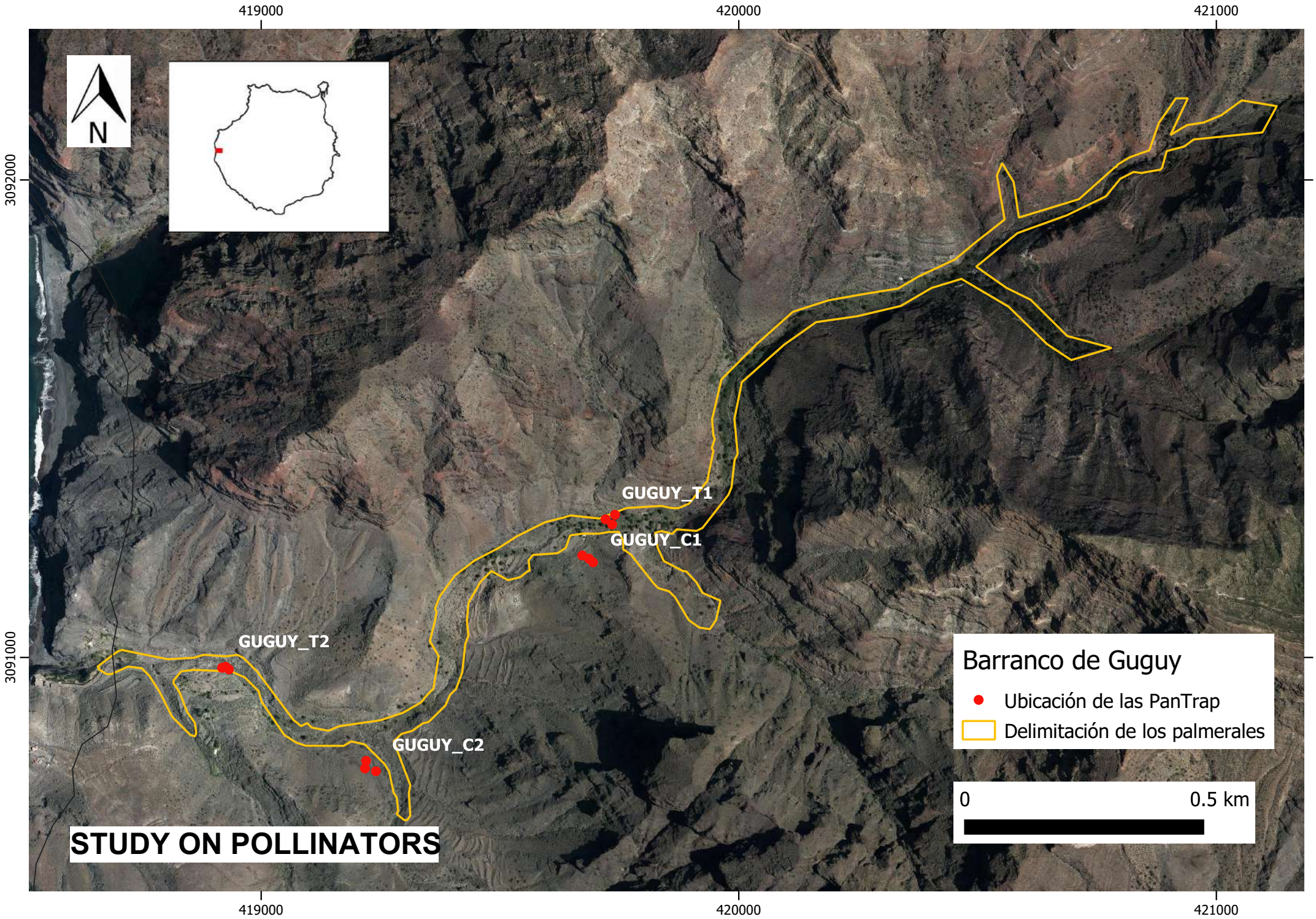

Guguy Grande
Invasive vegetation
LEGEND
Presence of plant IAS
Priority
NO
YES
Palm grove habitat
N
0 75 150 300 450 600
Metros
Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS; Esri, NASA, NGA, USGS

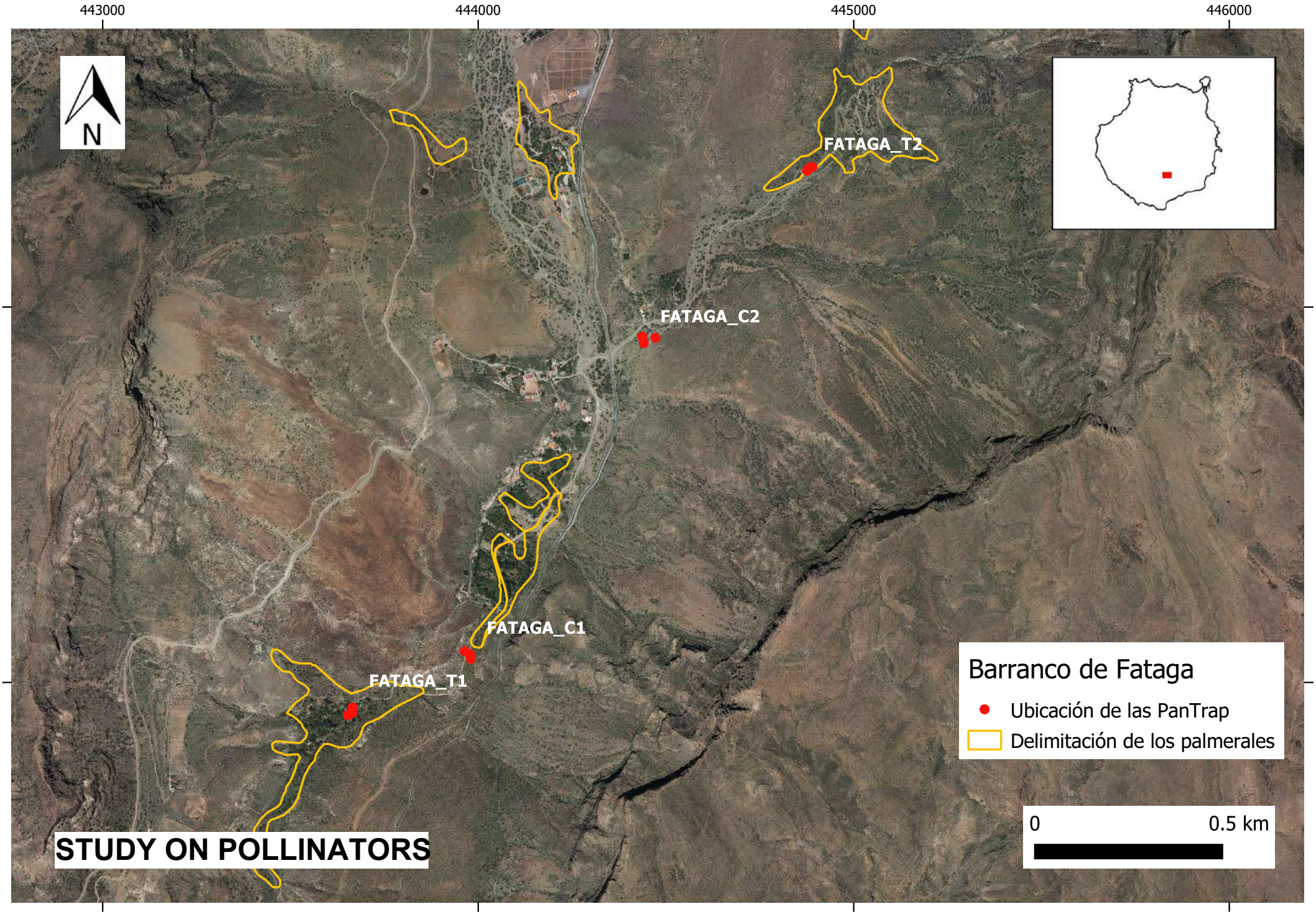

Caserones
Invasive vegetation
LEGEND
Presence of plant IAS
Priority
NO
YES
Palm grove habitat
N
0 50 100 200 300
Metros
Dirección General de Catastro, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS; Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

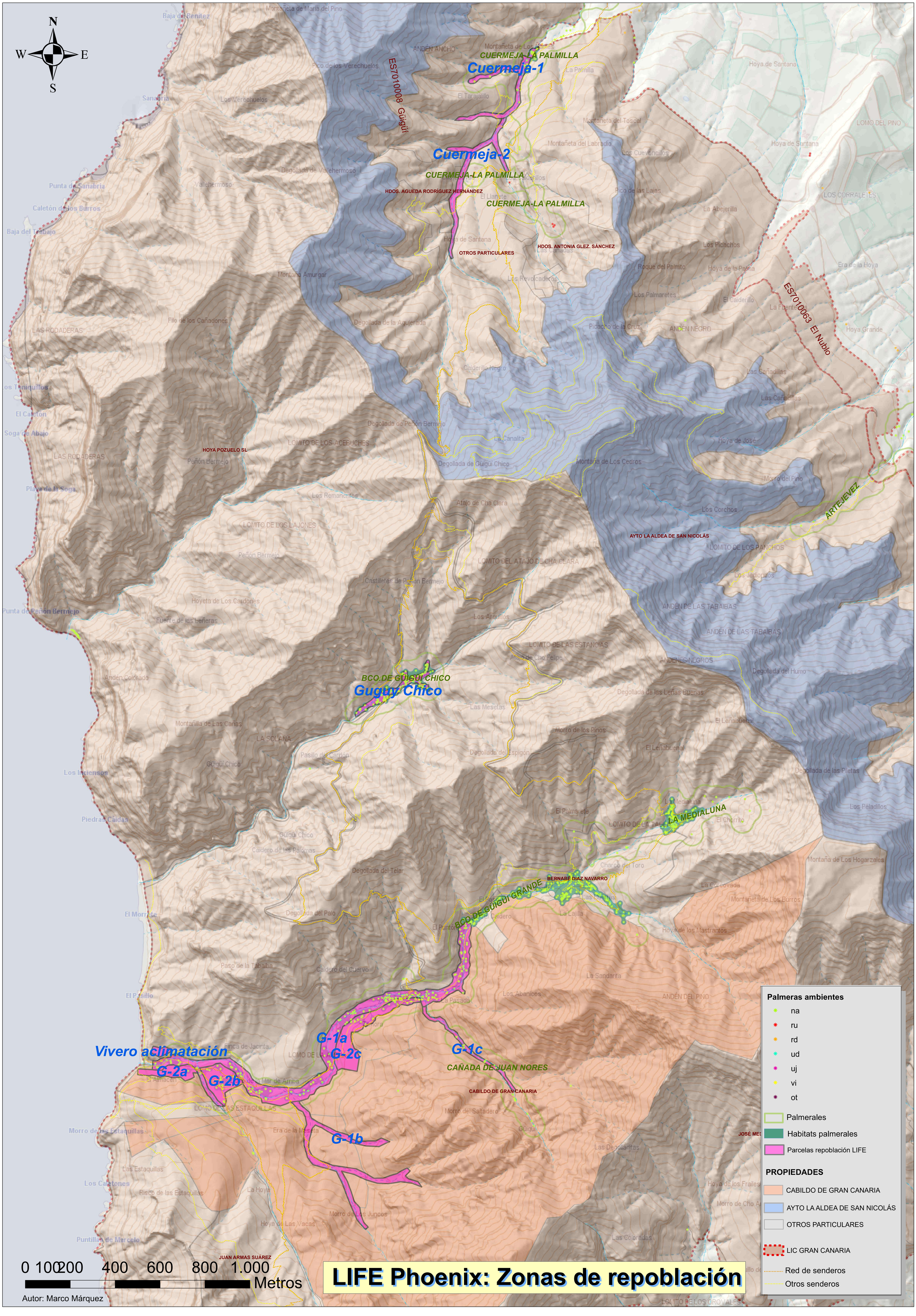


Arteara
Invasive vegetation


419000
420000
421000
3095000
N
CUERMEJA_T1
CUERMEJA_C1
CUERMEJA_T2
CUERMEJA_C2
Barranco de Cuermeja
Ubicación de las PanTrap
Delimitación de los palmerales
0
0.5 km
STUDY ON POLLINATORS


419000
420000
421000
3092000
3091000
N
GUGUY_T1
GUGUY_C1
GUGUY_T2
GUGUY_C2
Barranco de Guguy
Ubicación de las PanTrap
Delimitación de los palmerales
0
0.5 km
STUDY ON POLLINATORS


443000
444000
445000
446000
3081000
3080000
N
FATAGA_T2
FATAGA_C2
FATAGA_C1
FATAGA_T1
Barranco de Fataga
Ubicación de las PanTrap
Delimitación de los palmerales
0
0.5 km
STUDY ON POLLINATORS


N
W
E
S
CUERMEJA-LA PALMILLA
Cuermeja-1
Cuermeja-2
CUERMEJA-LA PALMILLA
CUERMEJA-LA PALMILLA
HDOS. AGUEDA RODRÍGUEZ HERNÁNDEZ
HDOS. ANTONIA GLEZ. SÁNCHEZ
OTROS PARTICULARES
HOYA POZUELO SL
AYTO LA ALDEA DE SAN NICOLÁS
BCO.DE GÜIGUI CHICO
Guguy Chico
BCO.DE GÜIGUI GRANDE
BERNABÉ DIAZ NAVARRO
LA MEDIALUNA
ARTEJEVEZ
CAÑADA DE JUAN NORES
CABILDO DE GRAN CANARIA
JUAN ARMAS SUÁREZ
Vivero aclimatación
G-1a
G-1b
G-1c
G-2a
G-2b
G-2c
ES7010008 Güigüí
ES7010063 El Nublo
Palmeras ambientes
na
ru
rd
ud
uj
vi
ot
Palmerales
Habitats palmerales
Parcelas repoblación LIFE
PROPIEDADES
CABILDO DE GRAN CANARIA
AYTO LA ALDEA DE SAN NICOLÁS
OTROS PARTICULARES
LIC GRAN CANARIA
Red de senderos
Otros senderos
0 100 200 400 600 800 1.000
Metros
Autor: Marco Márquez
LIFE Phoenix: Zonas de repoblación

ES7010010 Pilancones

N
W E
S

Caserones-1

Caserones-2

Aserradero-1

Aserradero-2

ES7010025 Fataga

ES7010055 Amurga

CNDA DE LOS CASERONES

LA BARANDILLA

ARTEARA

LOS ASERRADEROS

GITAGANA

Parcelas repoblación LIFE
Habitats palmerales
Palmerales
Zona Especial Conservación

Palmeras según ambientes

- na
- ru
- rd
- ud
- uj
- vi
- ot

Red de senderos
Otros senderos

0 50 100 200 300 400 500 Metros

Autor: Marco Márquez

LIFE PHOENIX
Zona de actuación: Bco de Fataga

LIFE Phoenix: Zonas de repoblación

Cuermeja-1

Cuermeja-2

ES7010008 Güigüí

CUERMEJA-LA PALMILLA

OTROS PARTICULARES

HDOS. AGUEDA RODRÍGUEZ HERNÁNDEZ

HDOS. ANTONIA GLEZ. SÁNCHEZ

AYTO LA ALDEA DE SAN NICOLÁS

HOYA POZUELO SL

Lomillo de los Namillos

Montañeta de Los Names

ANDÉN ANCHO

Pico de los Verechuelos

Lomito de Cha Pepa

El Tarajalillo

Cañada del Humo

Las Cuevas

El Llanete

Hoya de Santana

Los Caiderillos

La Palmilla

Montañeta del Toscal

Montañeta del Labradío

Los Cuevoncillos

Pico de las Lajas

Las Cañadas

Los Revolcaderos

Roque del Palmito

Los Palmaretes

Degollada de la Agujerada

Hoya de La Salvia

Picacho de la Cruz

Caiderillo Negro

Degollada de Peñón Bermejo

La Canalita

Degollada de Güigüí Chico

Montaña de Los Cedros

Los Remanentes

Cuermeja

Cañada de la Salvia

Cañada de Tiraflor

Cañada de Peñón Bermejo

Palmeras ambientes

- na
- ru
- rd
- ud
- uj
- vi
- ot

Palmerales

Habitats palmerales

Parcelas repoblación LIFE

PROPIEDADES

CABILDO DE GRAN CANARIA

AYTO LA ALDEA DE SAN NICOLÁS

OTROS PARTICULARES

LIC GRAN CANARIA

Red de senderos

Otros senderos

0 40 80 160 240 320 400 Metros

Autor: Marco Márquez

BERNABÉ DIAZ NAVARRO

HOYA POZUELO SL

BCO.DE GÜIGÜI GRANDE

CAÑADA DE JUAN NORES

Vivero aclimatación

G-1c

G-2c

G-2a

G-2b

G-1a

G-1b

ES7010008 Güigüí

OTROS PARTICULARES

CABILDO DE GRAN CANARIA

JUAN ARMAS SUÁREZ

0 60120 240 360 480 600

Metros

Autor: Marco Márquez

LIFE Phoenix: Zonas de repoblación

Palmeras ambientes

- na
- ru
- rd
- ud
- uj
- vi
- ot

Palmerales

Habitats palmerales

Parcelas repoblación LIFE

PROPIEDADES

CABILDO DE GRAN CANARIA

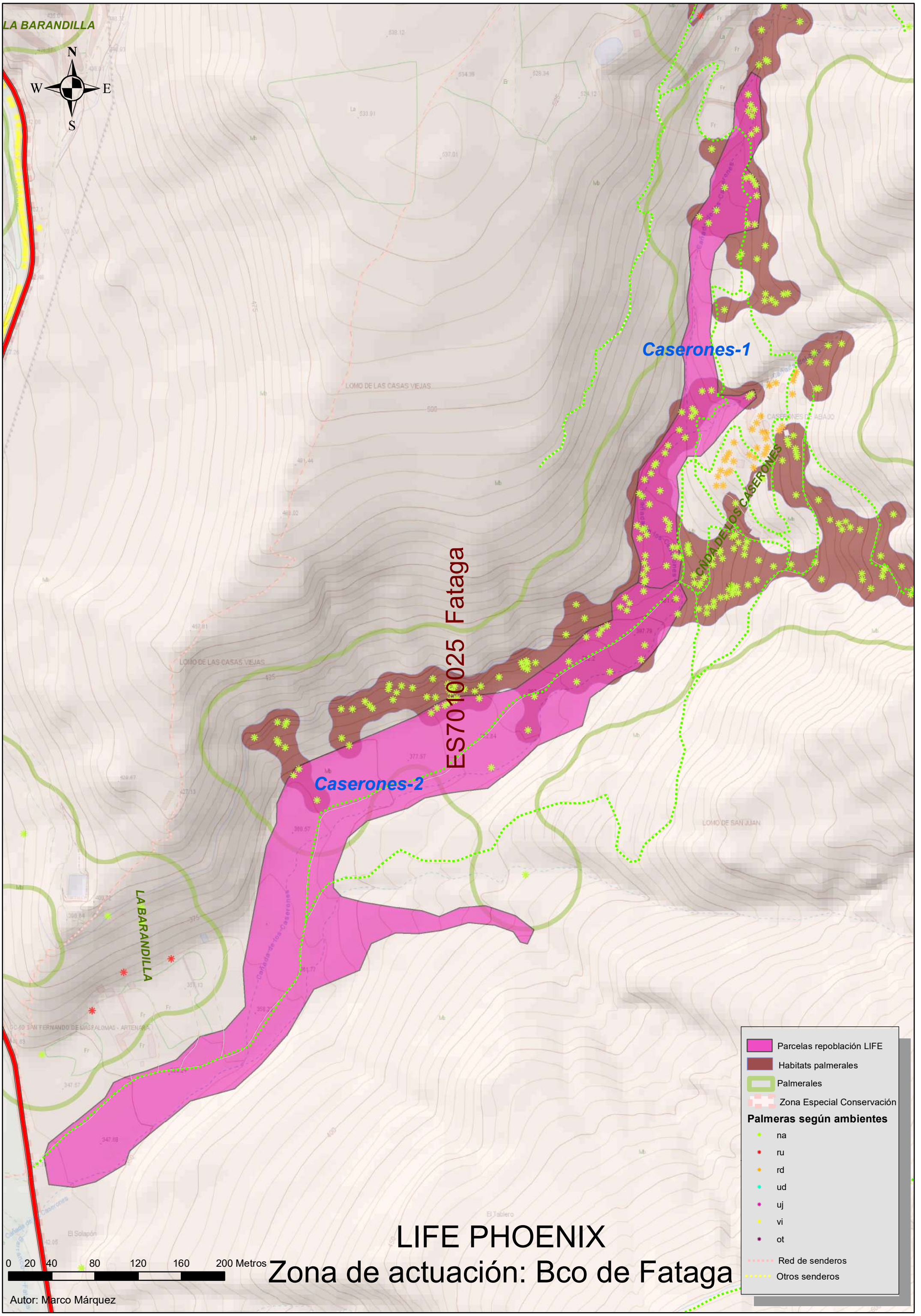
AYTO LA ALDEA DE SAN NICOLÁS

OTROS PARTICULARES

LIC GRAN CANARIA

Red de senderos

Otros senderos



LIFE PHOENIX

Zona de actuación: Bco de Fataga

Autor: Marco Márquez

ARTEARA

N
W E
S

Aserradero-1

LOS ASERRADEROS

ES7010025 Fataga

Aserradero-2

GITAGANA

0 20 40 80 120 160 200 Metros

Autor: Marco Márquez

LIFE PHOENIX
Zona de actuación: Bco de Fataga

Parcelas repoblación LIFE
Habitats palmerales
Palmerales
Zona Especial Conservación

Palmeras según ambientes

na
ru
rd
ud
uj
vi
ot

Red de senderos
Otros senderos