Canarian Islands endemic pollinators of the Laurel Forest zone

Conservation plan 2023–2028

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MAIISG IUCN SSC Mid Atlantic Islands Invertebrate Specialist Group
buglife

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Luxembourg: Publications Office of the European Union, 2023

PDF ISBN: 978-92-68-01057-0 doi: 10.2779/75306 KH-07-23-141-EN-N

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Design and layout: Imre Sebestyén jr. / UNITgraphics.com

Picture credits on cover page: *Pieris cheiranthi* © Asociación ZERYNTHIA

Recommended citation: Yeray Monasterio León, Carlos Ruiz Carreira, Ruth Escobés Jiménez, Javier Almunia, Martin Wiemers, Ante Vujic, Craig Macadam, Julia Raser, Axel Hochkirch (2023). *Canarian Islands endemic pollinators of the Laurel Forest zone - Conservation plan 2023-2028*. Publication prepared for the European Commission within the framework of the contract No 07.0202/2020/839411/SER/ENV.0.2

Contents

Lasioglossum chalcodes in Tenerife © Domingo Sosa

Introduction

This document was drafted within the framework of an EU funded project, Action Plans for conservation of threatened pollinator species in the EU, launched by the European Commission in the context of the implementation of the EU Pollinators Initiative[1]. The objective of the project was to develop three EU Species Action Plans for the most threatened pollinator species, by building on existing experience and using the European Red List as a reference. The methodology to develop these action plans is based on the Guidelines for Species Conservation Planning (IUCN SSC, 2017), developed by the former IUCN SSC Conservation Planning Sub-Committee, as well as the CPSG Conservation Planning Principles and Steps (CPSG, 2020), developed by IUCN SSC Conservation Planning Specialist Group (CPSG).

Over the course of the project, the experts shortlisted 15 species candidates for an action plan. This list was verified during a dedicated workshop on 18 June 2021. After the validation of the selection, three conservation action plans were selected, including the Canary Islands multi-species action.

Background on the Canary Islands

The Canary Islands are part of the Mediterranean/Atlantic Hotspot of Biodiversity (Myers *et al.,* 2000) and home to numerous endemic species, including many insects (Juan *et al.,* 2000; Triantis *et al.,* 2010). They consist of eight inhabited islands: La Graciosa, Lanzarote, Fuerteventura, Gran Canaria, Tenerife, La Gomera, La Palma and El Hierro (Del Arco Aguilar, Rodríguez Delgado, 2018). The archipelago is located west of the Moroccan coast between 13°20´and 18°10´W and 27°37´and 29°25´N and belongs to the biogeographic region of Macaronesia together with the Azores, Madeira, Selvagens and Cape Verde (Del Arco Aguilar & Rodríguez Delgado, 2018). The Canary Islands are well known for their high degree of endemism with 45% of the arthropod species being endemic (Triantis *et al.,* 2010). The highest species numbers are found on the central Canary Islands (Tenerife and Gran Canaria), due to the islands being older, their larger size and altitudinal gradients. The vegetation of the central and western Canary Islands is largely shaped by altitudinal belts, with strong variation according to the exposure of the slopes. The northern slopes are generally cooler, more humid and have more rainfall, while the southern slopes are warmer and drier (Figure 1 and Figure 2); (Del Arco Aguilar & Rodríguez Delgado, 2018). The Canarian laurel forests represent relics of a forest type that was widespread in the Mediterranean 20 million years ago (Morales *et al.,* 1996). This ecosystem is particularly important in terms of biodiversity and endemism, and plays an important role for threatened insect species, including pollinators like *Pieris cheiranthi*, *Gonepteryx cleobule*, *Lasioglossum chalcodes* and *Heringia adpropinquans*.

1 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0395

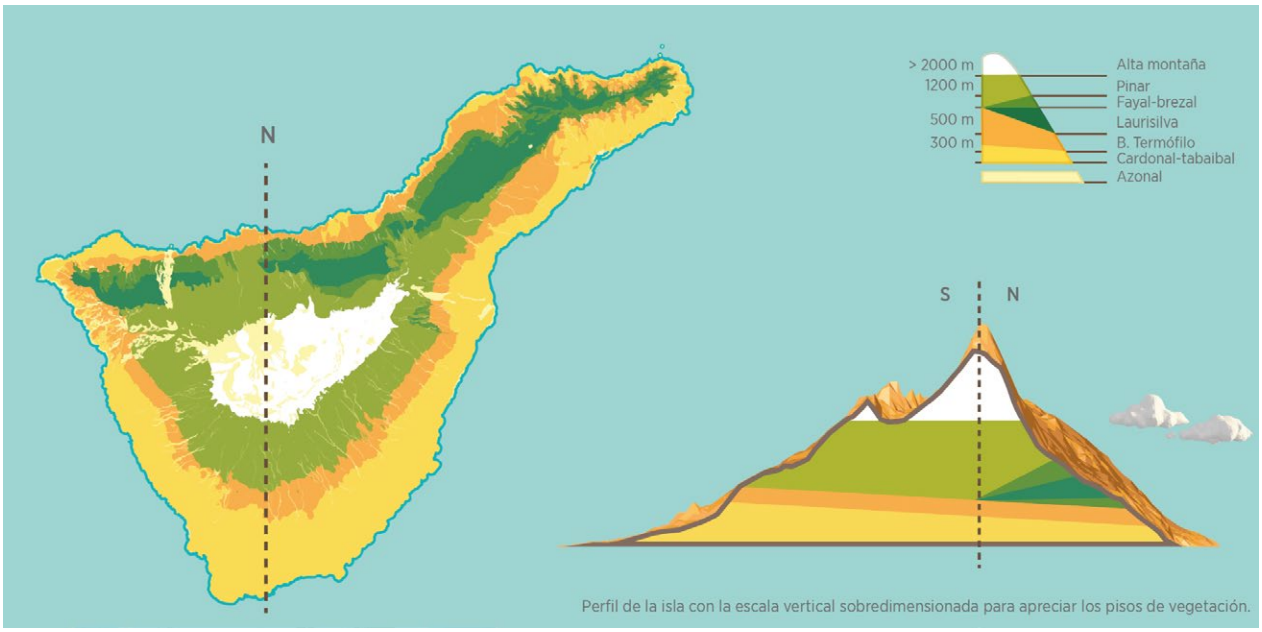


Figure 1 Altitudinal vegetation belts of Tenerife (Gobierno de Canarias, Consejería de Educación, Universidades y Sostenibilidad)

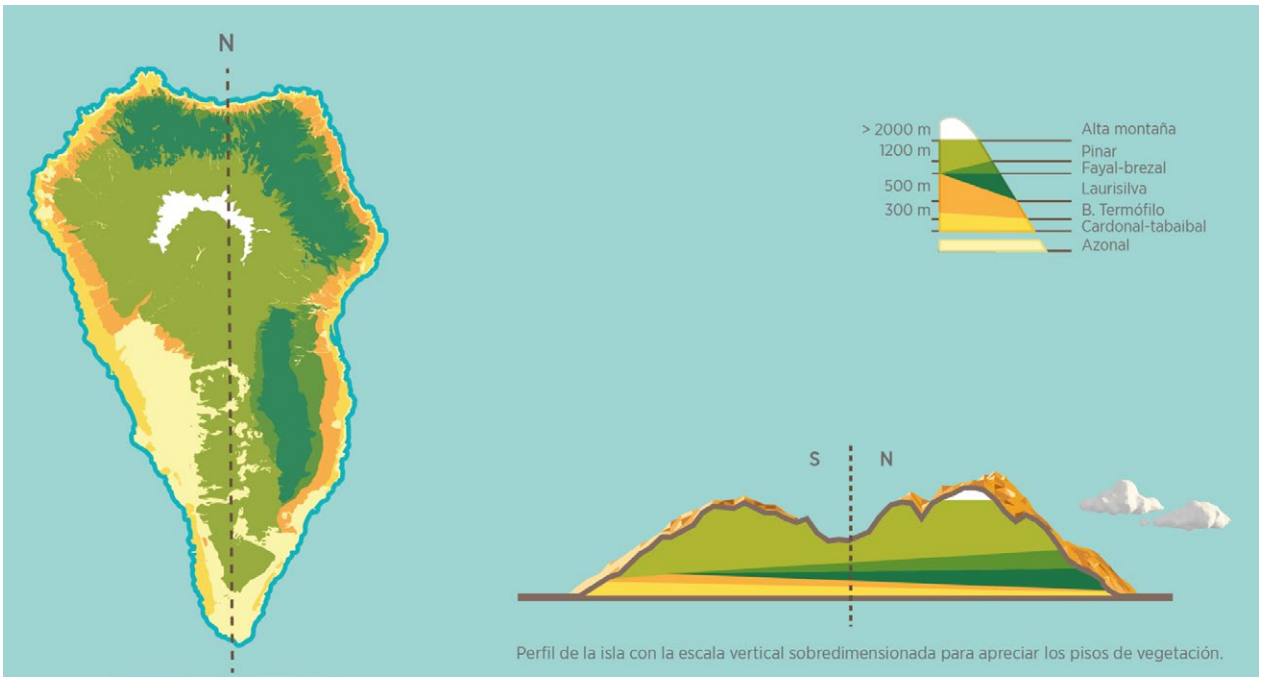


Figure 2 Altitudinal vegetation belts for La Palma (Gobierno de Canarias, Consejería de Educación, Universidades y Sostenibilidad)

The Canary network of protected areas (Figure 3) occupies 40.4% of the islands' surface area (Del Arco Aguilar & Rodríguez Delgado, 2018); 89% of Protected Natural Areas were declared as Special Areas of Conservation (SAC) under the Habitats Directive and have consequently specified protection measures in addition to the recovery or conservation of species (Del Arco Aguilar & Rodríguez Delgado, 2018). The most important conservation legislation started in 1989 with the national Law of Conservation of Natural Reserves and Wild Flora and Fauna (Del Arco Aguilar & Rodríguez Delgado, 2018). The current legislation is Law 42/2007, of 13 December, on Natural Heritage and Biodiversity, last amended on 31 December 2020. The network of protected natural areas (Figure 3) contains large parts of the laurel forests.

Figure 3 Protected Area Network of the Canary Islands (red: Parque Rural, green: Reserva Natural Especial, yellow: Parque Natural, orange: Parque Nacional, dark blue: Monumento Natural, light blue: Paisaje Protegido). (Gobierno de Canarias, Consejería de Educación, Universidades y Sostenibilidad)

Status review

Canary Islands Large White (*Pieris cheiranthi*)

Species description

Systematics / taxonomy

The Canary Islands Large White (Figure 4), *Pieris cheiranthi* (Hübner, 1808), is endemic to the Canary Islands. It belongs to the family Pieridae, subfamily Pierinae (Dapporto *et al.,* 2019). Its closest relatives based upon a recent phylogeny (Figure 5), (Dapporto *et al.,* 2019) are the Madeiran endemic *Pieris wollastoni* (Butler, 1886) and the Large White *Pieris brassicae* (Linnaeus, 1758) (Figure 6), a widespread Palearctic species. The latter species is found from North Africa to the Himalayas and single specimens have been recorded on the eastern Canary Islands (Wiemers, 1995), which are not inhabited by *P. cheiranthi*. The species status of *Pieris cheiranthi* has been confirmed by an allozyme study (Geiger & Scholl, 1985) as well as a study of the mitochondrial phylogeny (Dapporto *et al.,* 2019); (Figure 5).

P. cheiranthi has two subspecies: *P. cheiranthi cheiranthi*, described from Tenerife (Figure 7) and *P. cheiranthi benchoavensis* (Figure 8), described from La Palma (Pinker, 1968). Rose (1976) points out that two different morphs are present on La Palma: one with smaller specimens than those from Tenerife and with less developed black spots and the other barely indistinguishable from the ones found on Tenerife. The smaller specimens are similar to hybrids between *P. cheiranthi* and *P. brassicae* (Wiemers, 1992). Some authors have suggested that the extinct population of La Gomera could also be ascribed to the La Palma subspecies.

Figure 4 Pieris cheiranthi cheiranthi from Tenerife. (Photo: Martin Wiemers)

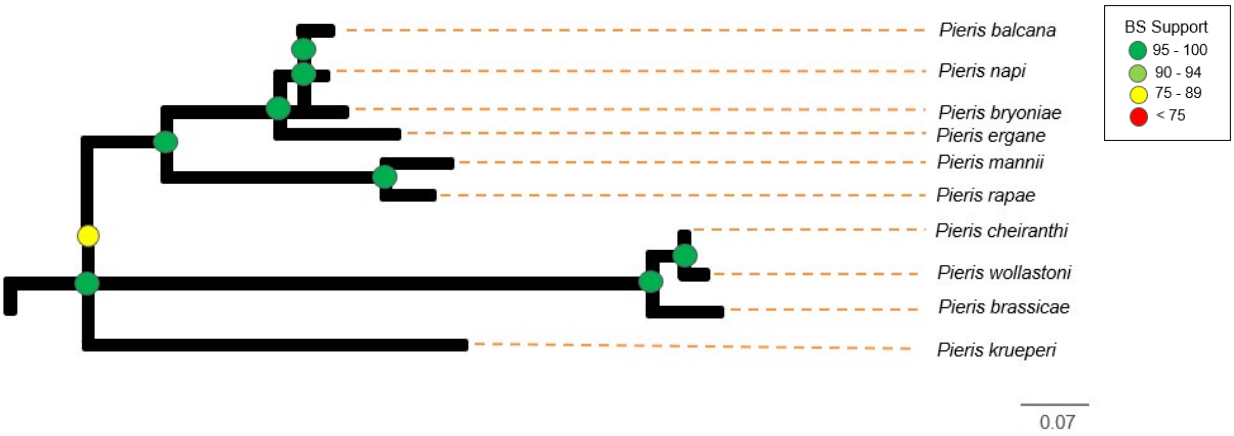


Figure 5 Excerpt of the Pieris branch of a multi-locus phylogenetic tree for all European butterfly species (Based on Dapporto et al., 2019)

Figure 6A-D Comparison of the morphology of P. cheiranthi (left) male and female (female above) and P. brassicae (right) male and female (female above). (Photos: Yeray Monasterio)

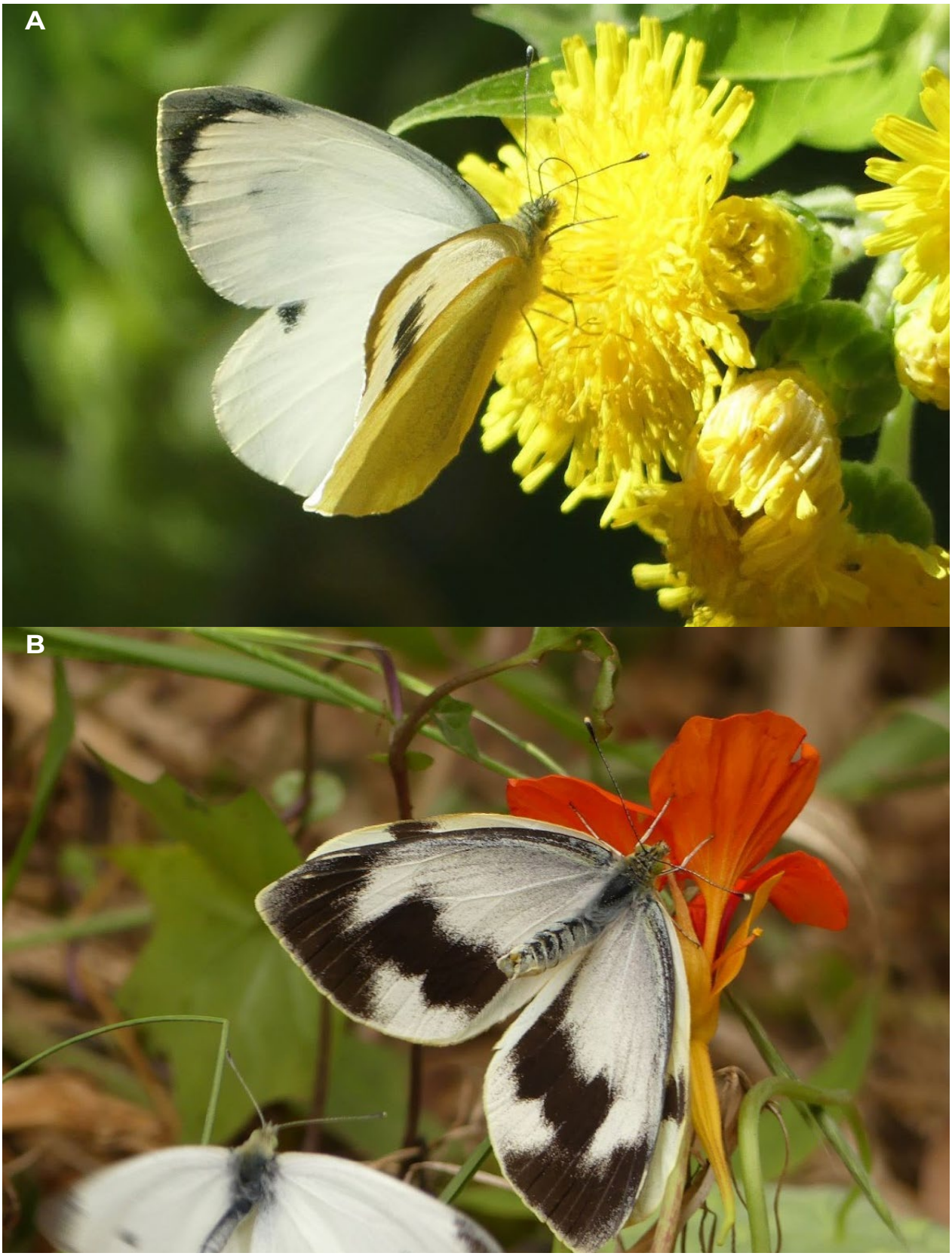


Figure 7A-B Pieris cheiranthi cheiranthi from Tenerife. (Photos: Yeray Monasterio)

Figure 8A-B Pieris cheiranthi benchoavensis from La Palma. (Photos: Yeray Monasterio)

The early egg stages of *P. cheiranthi* differ from *P. brassicae* (Eitschberger & Wiemers, 1991). The yellow eggs of *P. cheiranthi* (Figure 9) have "13–14 longitudinal ribs (17–18 in *P.* brassicae) and about eight of them reach the micropyle zone (this is not the case in *P. brassicae*)". The caterpillars of *P. cheiranthi* (Figures 10–13) are greenish grey and specimens from La Palma have a yellow touch (Wiemers, 1995). Contrary to *P. brassicae*, the black markings of *P. cheiranthi* are more regular and smaller and the hair is shorter (Wiemers, 1995). *P. brassicae* caterpillars have a broad black band around the triangular front which is almost missing in *P. cheiranthi* (Figure 12). The pupa of *P. cheiranthi* (Figure 14) has reduced markings and long lateral spines compared to Central European *P. brassicae* (but quite similar to Mediterranean *P. brassicae*) (Wiemers, 1995).

Figure 9 Eggs of Pieris cheiranthi benchoavensis (La Palma) on Crambe sp. (Photo: Yeray Monasterio)

Figure 10 First instar larvae of Pieris cheiranthi benchoavensis (La Palma) on Crambe sp. (Photo: Yeray Monasterio)

Figure 11A-B Pieris cheiranthi cheiranthi developed caterpillar. (Photos: Yeray Monasterio)

Figure 12 Comparison between Pieris cheiranthi (above) and Pieris brassicae caterpillars. (Photo: Yeray Monasterio)

Figure 13 Pieris cheiranthi cheiranthi pre-pupa. (Photo: Yeray Monasterio)

Figure 14 Pieris cheiranthi cheiranthi pupa. (Photo: Yeray Monasterio)

Biology and ecology

Pieris cheiranthi is listed as Endangered on the IUCN Red List of Threatened Species (van Swaay *et al.,* 2010b). The species is multivoltine with seven to eight (not well separated) generations per year, and therefore, all stadia are present throughout the year (Tolman & Lewington, 2012; Wiemers, 1995). The species lives at elevations between 100 and 2,100 metres in deeply excavated barrancos in laurel forest and wet cliffs (van Swaay *et al.,* 2010b). The species prefers cool, moist and shaded locations (Tolman& Lewington, 2012). During the night the butterflies rest in tall herbs (> 1 m), shrubs, exposed or off host-plants (Middleton-Welling *et al.,* 2020a, b).

The primary habitat is made up of deep and humid ravines with the presence of monteverde vegetation. In these environments, caterpillars mainly feed on *Crambe* spp. (Figure 15 and Figure 16). This habitat has a total area of 1,449 ha in Tenerife, where only 19% corresponds to laurel forest. Caterpillars feed on *Crambe monteverde, Crambe santosii* and *Descurainia millefolia*. Acosta-Fernández (2009) suggests the possible use of *Lobularia canariensis*, but this hypothesis still needs to be tested. The caterpillars feed on the leaves after the plant has flowered once (Middleton-Welling *et al.,* 2020a, 2020b). The arrival of the nasturtium (*Tropaeolum majus*, Figure 17) on the Canary Islands has favoured colonisation of the secondary habitat of *P. cheiranthi* outside ravines, taking advantage of urban and agricultural environments. This invasive plant of South American origin grows widely in the north of Tenerife, where the microclimatic characteristics favour the butterfly to thrive in anthropised environments. Parasitism rates of *P. cheiranthi* are particularly high in this secondary habitat. The eggs are deposited in batches of 5–50 eggs depending on the plant size (Middleton-Welling *et al.,* 2020a, b ; Wiemars, 1995). Wiemers (1995) found a large batch of eggs on the cultivated *Brassica oleracea* (cabbage plant) in a garden in the Laurel Forest zone, suggesting that other Brassicaceae may occasionally be chosen as host plants.

The species is linked to humid and shady slopes and ravines, often characterised by the existence of monteverde vegetation. In these environments, butterflies tend to fly at the boundary between shady areas and those where sunlight hits. Although specimens have been observed at elevations well above their optimal habitat (up to 2,100 m in Tenerife), it can generally be defined as a relatively sedentary species, closely linked to its habitat.

Figure 15 Crambe sp. from Tenerife. (Photo: Yeray Monasterio)

Figure 16 Crambe sp. from La Palma. (Photo: Yeray Monasterio)

Figure 17 Nasturtium (Tropaeolum majus) on Tenerife. (Photo: Yeray Monasterio)

*Figure 18 Distribution of Crambe species on the Canary Islands. X : C. sventenii, * : C. scaberrima, * : C. laevigata, * : C. gomerae, * : C. gomerae subsp. hirsuta, * : C. microcarpa, * : C. feuillei, o : C. scoparia, o : C. pritzelii, o : C. tamadabensis, o : C. arborea, o : C. strigosa, o : C. wildpretii, o : C. santosii. (Soto Medina, 2015 https://accedacris.ulpgc.es/handle/10553/24500)*

Functions and values

Butterflies are among the most suitable flagship species among insects with a similar flagship potential as birds (Oberhauser & Guiney, 2009). Even though their pollination services may be limited (Ollerton, 2017), they are frequently regarded as prominent pollinators by the public. Due to their popularity, butterfly conservation has a huge potential in Europe and conservation action plans exist already for numerous species. The popularity of butterflies is also illustrated by the high number of specialised conservation NGOs, such as Butterfly Conservation Europe, the Swallowtail and Birdwing Conservation Trust, etc. In Spain, the Asociación Española para la Protección de las Mariposas y su Medio ZERYNTHIA specialises in the conservation of butterflies and moths.

P. cheiranthi is protected in the autonomous community of the Canary Islands through Annex I of Law 4/2010, of 4 June, of the Canary Catalogue of Protected Species. The subspecies *P. cheiranthi cheiranthi* (Tenerife) is classified as 'in danger of extinction', while the La Palma population is not protected. It is also a key element in the management of various protected natural areas where it exists, many of them included within the Natura 2000 Network.

Historical account

Figure 19 shows the historical records of *P. cheiranthi* from La Palma, La Gomera and the north of Tenerife. The records from Gran Canaria (Higgins & Riley, 1970) are doubtful (Wiemers, 1995) and not considered here. In the evaluation for its inclusion in the Catalogue of Threatened Species of the Canary Islands (File Piecheche 11/2009) the area of occupancy was estimated at 3.75 km², equivalent to 15 squares of 500 x 500 metres based on the information available in the Canary Islands Biodiversity Database (2008 version). This report estimates a 90% reduction in its area of occupancy during the last 30 years.

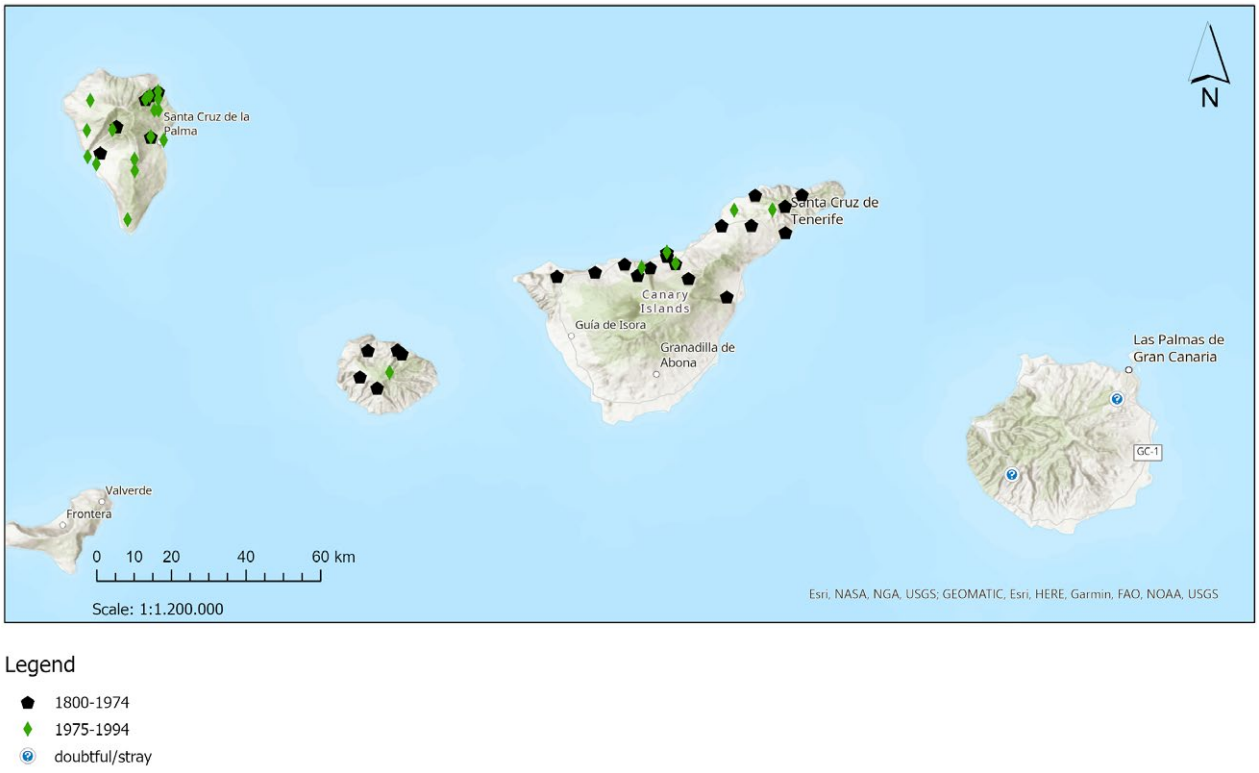


Figure 19 Historical records (1800–1994) of Pieris cheiranthi on La Palma, La Gomera, Tenerife and Gran Canaria (from west to east). (Adapted from Wiemers, 1995)

A review of the bibliography of a period of 130 years (1889–2018) provides data assignable to 66 UTM squares of 1x1 km, which implies a historical area of occupancy of about 66 km² on Tenerife. 34 squares correspond to the period between 1889 and 2000, 22 squares to 2001–2010, and 30 squares to 2011–2018. Only 45 of these grids are located in their primary habitat. The rest could be considered unique, rambling or isolated specimens.

Current distribution and demography

P. cheiranthi occurs in the north of Tenerife and one locality in the south of Tenerife (Barranco del Infierno) (Figures 20–22). On La Palma it is widespread and far more common than on Tenerife (van Swaay *et al.,* 2010b). On La Gomera the species had not been found after 1975 and was thought to be regionally extinct (Tolman& Lewington, 2012, van Swaay *et al.,* 2010b ; Wiemers, 1995). In 2013, a small population (12 fresh butterflies) was reported from near Agulo (Wolfgang Wagner), but further searches by other lepidopterologists (Manuel Arechavaleta in 2015, Martin Wiemers in 2017, Dulce Plasencia and Francisco Damián Alfonso in 2019) were

unsuccessful. The existing population in Teno (Tenerife) is separated from Agulo (La Gomera) by a distance of 35 km. Therefore, it seems reasonable to think of a temporary settlement as a result of a dispersion event. The estimated area of occupancy (AOO) is ca. 350 km², the extent of occurrence (EOO) less than 5,000 km².

The number of locations is less than or equal to five (van Swaay *et al.*, 2010b).

Currently the ZERYNTHIA Association carries out a butterfly monitoring programme in the Canary Islands (Figure 23). The results will make it possible to analyse population trends on Tenerife and on La Palma more thoroughly in the future.

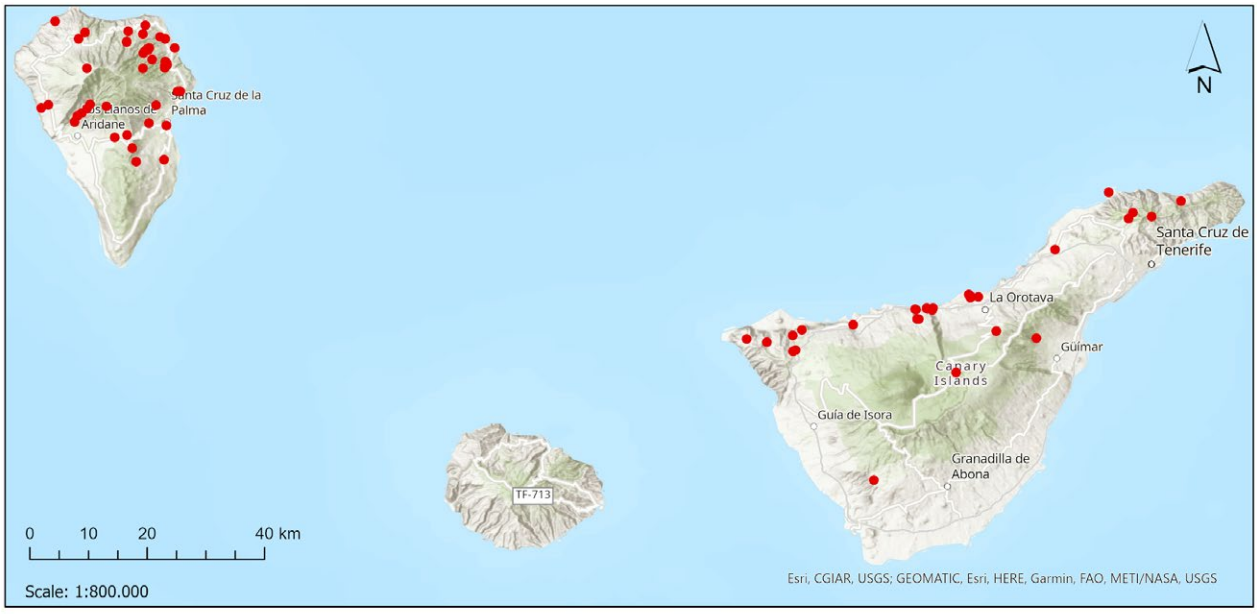


Figure 20 Recent records (1999–2021) of Pieris cheiranthi. (The data are based on: Escobés R, iNaturalist, Monasterio León Y, observation.org, Wiemers M. and ZERYNTHIA Association)

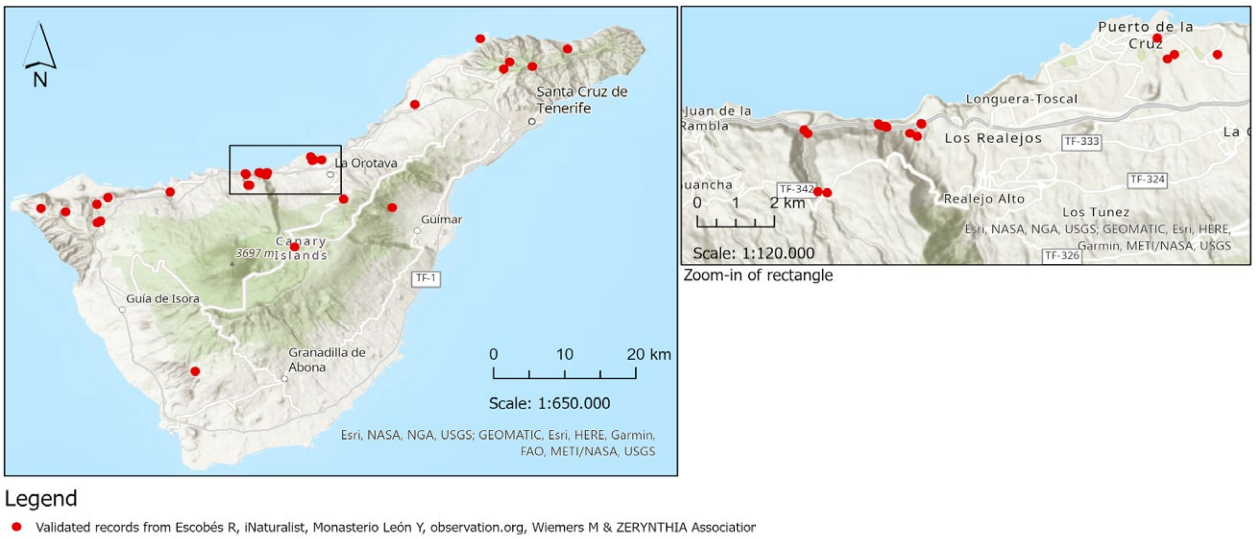


Figure 21 Recent records (1999–2021) of Pieris cheiranthi on Tenerife. (The data are based on: Escobés R, iNaturalist, Monasterio León Y, observation.org, Wiemers M and ZERYNTHIA Association)

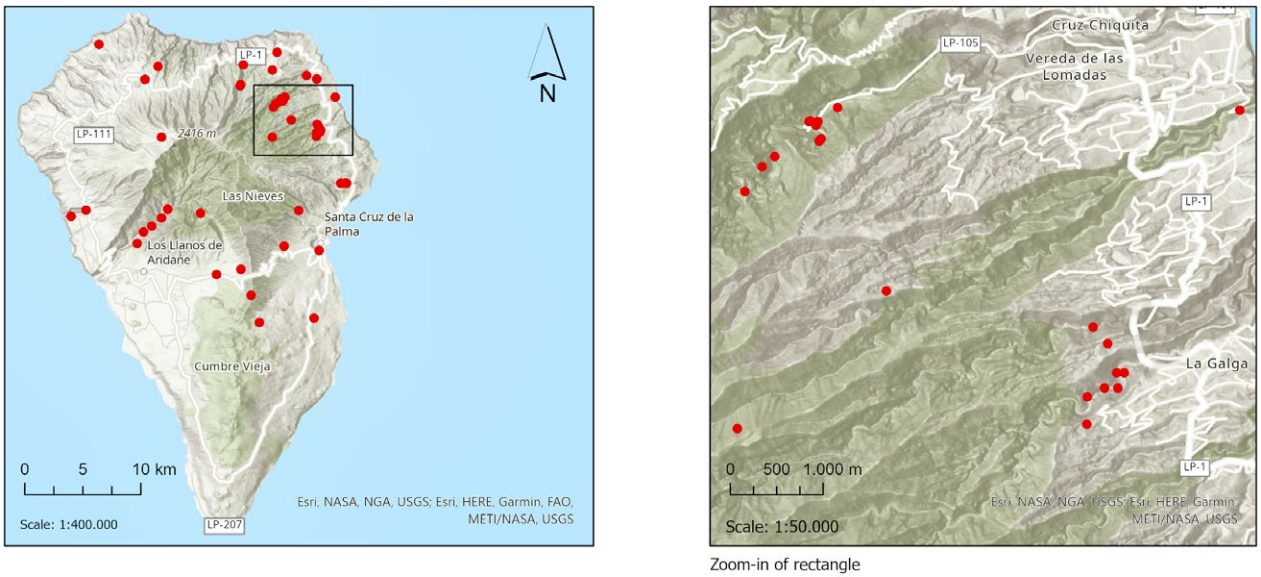


Figure 22 Recent records (1999–2021) of Pieris cheiranthi on La Palma. (The data are based on: Escobés R, iNaturalist, Monasterio León Y, observation.org, Wiemers M and ZERYNTHIA Association)

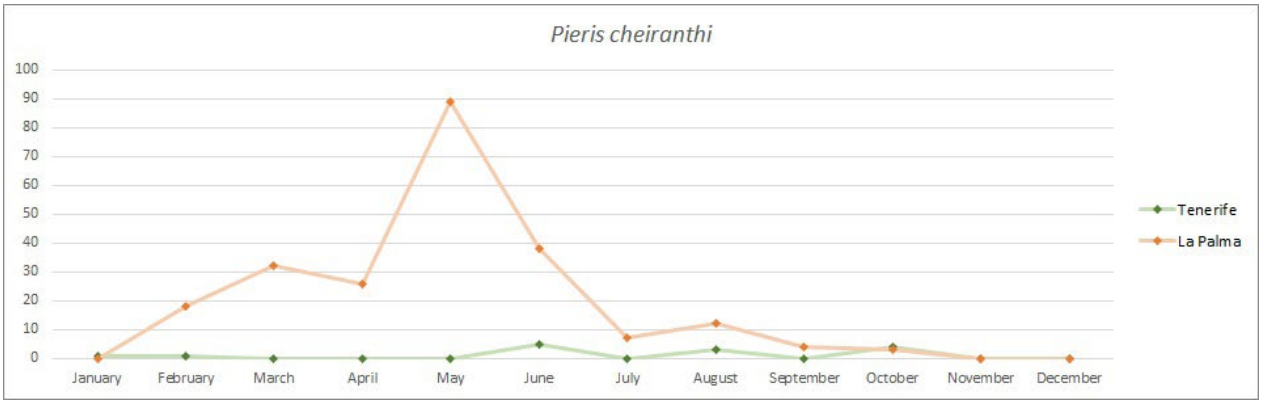


Figure 23 Phenology and abundance of Pieris cheiranthi in Tenerife and La Palma from data obtained by volunteers in the monitoring programme carried out by the ZERYNTHIA Association with the support of the island councils. The data for Tenerife cover the period 2017–2021. The data for La Palma reflect only the year 2021. (Graphic: Ruth Escobés. https://www.asociacion-zerynthia.org/seguimiento-diurnas)

Habitat and resource assessment

The Canarian laurel forest is a unique habitat of numerous Canarian endemic species. Annual rainfall in the forest is between 500 and 1,200 mm, the average annual temperature is between 13 and 18°C, frost only occurs near the highest elevations (Del Arco Aguilar & Rodríguez Delgado, 2018). Fernández-Palacios *et al.,* (2011) emphasise that the laurel forest occupies only 12.5% of its potential area in Macaronesia (Table 1). Within the former range of *P. cheiranthi*, large areas of laurel forest are still found on La Palma (6,000 ha), La Gomera (4,600 ha) and Tenerife (4,000 ha). However, this represents just 30% of the original cover on La Palma, 52% on La Gomera and 10% on Tenerife (Table 1). Deforestation has probably started with human land use during the first millennium BCE on the Canaries. In the 15th century, most of the laurel forest (especially on Gran Canaria) disappeared due to agriculture (Fernández-Palacios *et al.,* 2011).

Table 1 Potential (i.e. pre-human colonisation) and present distribution of the Macaronesian laurel forest (Fernández-Palacios et al., 2011)

Island	Potential area (thousands of ha)	Present area (thousands of ha)	Potential %
Gran Canaria	20	0.2	1
Tenerife	40	4	10
La Palma	20	6	30
La Gomera	9	4.6	52
El Hierro	6	2.5	42
Total Canaries	105	19	18
Madeira	60	15	25
Azores	200	6	3
Total Macaronesia	365	40	12.5

Wildfires regularly occur on the Canary Islands, but the fire pattern has significantly changed during the last century (Molina-Terrén *et al.,* 2016). Since the 1960s, fire intervals have become larger, but fire sizes have become much greater. Höllermann (2000) highlights that most fires have an anthropogenic origin. The peak is during the arid season from July to September. Even though the laurel forest is naturally wet and cloudy, it is also sensitive to fires due to progressive degradation and destruction (Höllermann, 2000). For example, a large wildfire in 2012 has severely affected the laurel forests of La Gomera with 750 ha being burnt (Notario del Pino *et al.,* 2015). In August 2020 there was another wildfire in Garafía (north of La Palma) that affected 1,200 ha.

Del Arco Aguilar and Rodríguez Delgado (2018) describe a predictable rise in temperature and a decrease in precipitation as a result of climate change. According to the authors, many species probably will not adapt (depending on, e.g. the species phenotypic capacity, migratory capacity, its degree of tolerance to change, longevity, production and type of diaspore, competitiveness, habitat loss, degree of fragmentation) to the new conditions. Moreover, extreme weather events (storms, droughts, heat waves) may threaten laurel forests (Del Arco Aguilar & Rodríguez Delgado, 2018). *Pieris cheiranthi* is also found in wet cliffs outside the laurel forest (Wiemers, 1995), suggesting that it is more a species of the forest edge rather than the interior. However, it still probably requires a cool and humid climate.

Threat analysis

The main threat for *Pieris cheiranthi* is the anthropogenic destruction of habitat (van Swaay, 2021a). As the species is linked to humid areas of monteverde, the degradation of its habitat is the main threat. Although the habitats with native vegetation where *P. cheiranthi cheiranthi* is found have not suffered high degradation in recent decades, some authors highlight elements such as house constructions, over-extraction of water, with the replacement of traditional water channels by plastic tubes (Rowlings, 2012; Wiemers, 2003). This reduces the availability of water for plants like *Crambe spp*. Monasterio *et al.,* (2011) detected discharges of garbage and water with possible pollutants in the Barranco de Ruíz, originating from the surrounding houses. Wildfires may also pose a substantial threat to the species (Figure 24). These are further fuelled by

climate change, which has increased the risk of droughts in the Canary Islands. Climate change might also have direct effects on the butterflies, particularly on the development of eggs and caterpillars or the availability of food plants.

The habitat in some areas has been reduced due to the planting of alien tree species, such as *Pinus radiata* and *Eucalyptus* spp., both for the exploitation of their wood and to hold the soil and prevent erosion. In Tenerife, the island council approved in 2020 a plan to remove the *Pinus radiata* from protected natural areas, so this action will allow the recovery of traditional vegetation.

A specific threat to *P. cheiranthi* is the introduced non-native parasite *Cotesia glomerata* (Braconidae, Hymenoptera) (Lozan *et al.,* 2008). The samples collected in La Palma were genetically very similar to those of the European continent, suggesting a recent introduction from Europe (Lozan *et al.,* 2008). Lozan *et al.,* (2008) studied two colonies of *P. cheiranthi*: the first colony was near La Galga (n = 30) in a marginal laurel forest. Half (n = 15) of the caterpillars were parasitised. The habitat of *C. glomerata* is linked to sunny, exposed and agricultural areas (Lozan *et al.,* 2008) which could pertain to the marginal laurel forest. The second colony of *P. cheiranthi* (n = 25) was near Los Tilos in the centre of the laurel forest and no caterpillars were parasitized. Lozan *et al.,* (2008) emphasise the coherence of the parasitised caterpillars and the habitat and its importance for the protection of the butterflies' natural habitat to avoid the distribution of *C. glomerata*. It is likely that the parasite was already introduced some decades ago as Pinker (1968) already documents the existence of high rates of parasitism (literally hundreds of pupae). In addition to the impact of this parasite, other pathogens could be introduced in the future through the import of food or other goods.

Illegal capture of specimens by collectors is usually not a significant factor for most lepidopterans, given their reproductive capacity. However, in the case of species with a very limited distribution and small population size (as in Tenerife), it does at least need to be mentioned. It is possible to find advertisements and offers of *P. cheiranthi cheiranthi* on the internet for sale, both specimens in collection and immature stages for breeding in captivity.

The early detection of possible imports of cabbage with immature stages of *Pieris brassicae* is of particular importance. This species is very common on the European continent, but has not been recorded on Tenerife so far. In the event of it accessing the island, it could compete with *P. cheiranthi* and even hybridise naturally, altering the genetics or even genetically displacing this endemic species. A similar case has occurred in Madeira with *Pararge xiphia* (similar to the Canarian *P. xiphioides*) after the accidental arrival of *Pararge aegeria* from the European continent (Bland & Lace, 2020; Jones *et al.,* 1998).

The impacts of pesticides on Canarian pollinators is inadequately understood. As the target species are affiliated with forest vegetation, direct pesticide effects are unlikely, but spill-over from adjacent agricultural areas may occur.

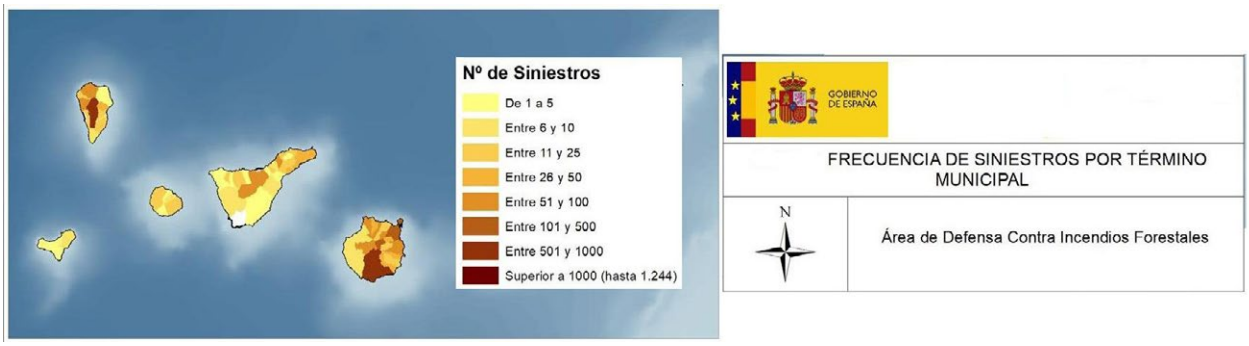


Figure 24 Historical frequency of fires in each municipality. Dark colours indicate the occurrence of a greater number of fires. (Image adapted from: Government of Spain. Forest Fire Defense Area. https://www.miteco.gob.es/es/biodiversidad/estadisticas/Incendios_default.aspx#prettyPhoto)

Table 2 Overview of the major threats to P. cheiranthi

Threat	Timing	Knowledge	Presumed impact
Water extraction	Ongoing	Low	High
Wildfires	Ongoing	Medium	Low
C. glomerata	Ongoing	Medium	High
House constructions	Past	High	Medium
Climate change	Ongoing	Medium	High
Pesticides	Ongoing	Low	Medium
Introduction of *P. brassicae*	Future	Low	High
Collection	Ongoing	Medium	Low
Introduction of new pathogenic organisms	Future	Low	Low
Habitat reduction due to the use of alien forest species or alien species	Past	High	Medium

Canary Brimstone (*Gonepteryx cleobule*)

Species description

Systematics / taxonomy

The Canary Brimstone, *Gonepteryx cleobule* (Hübner, 1831) (Figures 25–27), is another endemic butterfly species on the Canary Islands (van Swaay *et al.,* 2010a). It belongs to the family Pieridae, subfamily Coliadinae (Wiemers *et al.,* 2018). Three subspecies of *G. cleobule* have been described, but their status and validity are disputed: (1) *G. c. cleobule* Hübner, 1825 from Tenerife (Figure 25), (2) *G. c. eversi* Rehnelt, 1974 from La Gomera (Figure 27a, b) and (3) *G. c. palmae* Stamm, 1963 from La Palma (Figure 26a, b). Separate species status was proposed by Rehnelt (1974a, b, 1989) as well as Ziegler and Jost (1990), but recently this division into distinct species has been doubted (Wiemers, 1995; Wiemers *et al.,* 2018). Brunton and Hurst (1998) found some genetic differentiation between the populations on La Gomera and Tenerife/ La Palma. However, it remains unclear whether this differentiation justifies a taxonomic subdivision into separate species. In addition to *G. cleobule*, the genus contains four more species in Europe: (1) *G. rhamni* (Linnaeus, 1758), which occurs in NW Africa, Europe, Turkey to West Siberia and Mongolia; (2) *G. cleopatra* (Linnaeus 1767), which is found in NW Africa, S Europe, Turkey and the Middle East; (3) *G. maderensis* Felder, 1862, which is endemic to Madeira; (4) *G. farinosa* (Zeller, 1847), which occurs in SE Europe via W Asia to Tajikistan (Tolman & Lewington, 2012; Wiemers *et al.,* 2018). Recent phylogenetic studies (Figure 28) suggest that *G. cleobule* is closely related to *G. cleopatra* and *G. rhamni* (Dapporto *et al.,* 2019).

Figure 25 Gonepteryx cleobule cleobule (Tenerife). Male and female. (Photo: Yeray Monasterio)

Figure 26A-B Gonepteryx cleobule palmae (La Palma). (Photos: Yeray Monasterio)

Figure 27A-B Gonepteryx cleobule eversi (La Gomera). (Photos: Yeray Monasterio)

Figure 28 Extract of the multi-locus phylogenetic tree for all European butterfly species. (Based on Dapporto et al., 2019)

Even though no other *Gonepteryx* species is found on the Canary Islands, adult butterflies may be mistaken with *Catopsilia florella*. The eggs of *G. cleobule* are pale yellow with eight longitudinal ribs (Wiemers, 1995) (Figure 29). The caterpillars are green with white lateral stripes bordered ventrally by fine yellow lines (Wiemers, 1995) (Figure 30–32). The pupa is brown at the head spine, the origins of the wings and small spots across the body and the outer border of the wing sheath are visible (Wiemers, 1995). Moreover, Wiemers (1995) reports about white lateral stripes being discernible on the pupas' green basis colour.

Figure 29 Egg of G. cleobule on Rhamnus crenulata on Tenerife. (From: Lepiforum e.V., 2021) © Wolfgang Langer.

Figure 30 First instar of the Gonepteryx cleobule caterpillar on Rhamnus glandulosa (Tenerife). (Photo: Yeray Monasterio)

Figure 31 Intermediate instar of the Gonepteryx cleobule caterpillar on Rhamnus glandulosa (Tenerife). (Photo: Yeray Monasterio)

Figure 32 Fully developed caterpillar of Gonepteryx cleobule on Tenerife. (From: Lepiforum e.V., 2021) © Reiser.

Figure 33 Fully developed caterpillar of Gonepteryx cleobule on La Palma. (Photo: Yeray Monasterio)

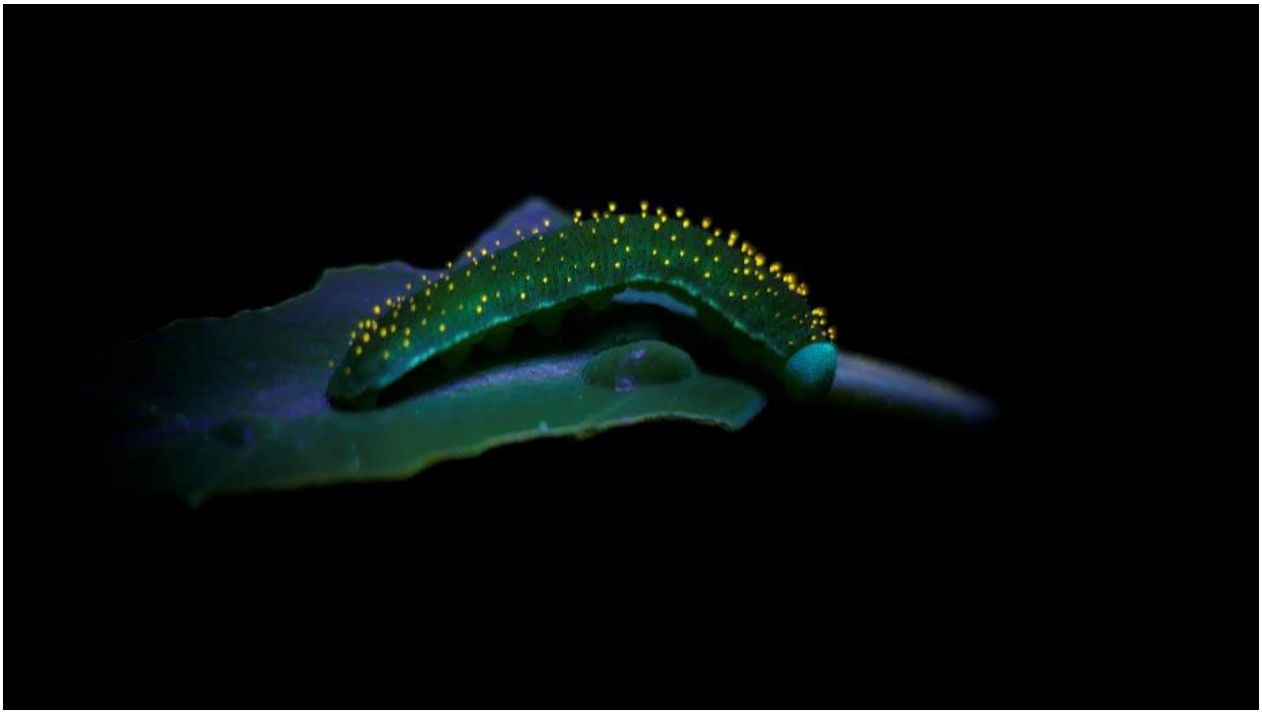


Figure 34 Response to artificial ultraviolet light of a fully developed caterpillar of Gonepteryx cleobule on La Palma. (Photo: Yeray Monasterio)

Figure 35 Pupa of Gonepteryx cleobule on La Palma. (Photo: Yeray Monasterio)

Figure 36 Rhamnus glandulosa in Tenerife. (Photo: Yeray Monasterio)

Biology and ecology

Gonepteryx cleobule is listed as Vulnerable on the IUCN Red List of Threatened Species (van Swaay *et al.,* 2010a). Its life cycle is not known completely, but the species has been recorded throughout the year (Tolman & Lewington, 2012). Wiemers (1995) concludes that the butterflies breed perennially. It is not resolved whether the species has a winter diapause and if more than one generation per year might breed (Wiemers, 1995). The adults deposit a single egg per host plant (Middleton-Welling *et al.,* 2020a, b) (Figure 29). Eggs and caterpillars feed on *Rhamnus crenulata* (endemic to the Canary Islands) and *Rhamnus glandulosa* (Rhamnaceae) (van Swaay *et al.,* 2010a; Ziegler & Jost, 1990). *Rhamnus crenulata* is found at the boundary between succulent bush vegetation and laurel forest, while *Rhamnus glandulosa* grows inside laurel forest (Wiemers, 1995) (Figure 37).

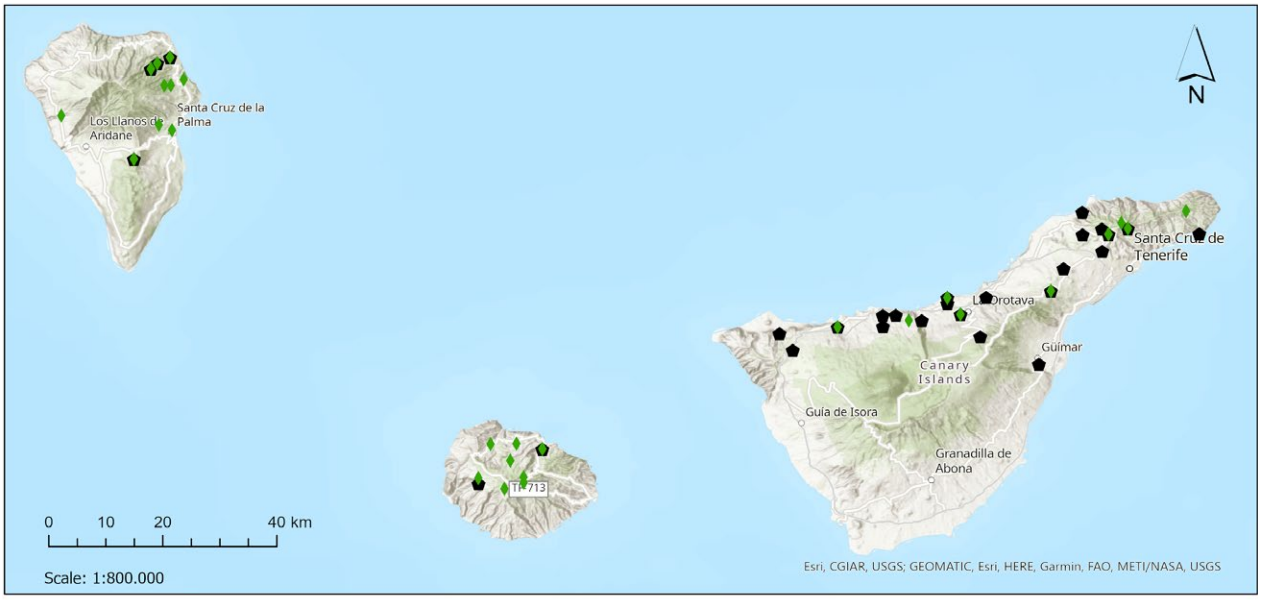
Figure 37 Egg of Gonepteryx cleobule on Rhamnus glandulosa (Tenerife). During summer G. cleobule is found at elevations between 1,000 and 1,500 m (up to 2,000 m). In winter it also occurs at lower elevations (van Swaay et al., 2010a). The species flies in bright glades in the laurel forests (Tolman & Lewington, 2012) but is also found in other forest types (van Swaay et al., 2010a). (Photo: Yeray Monasterio)

Functions and values

Even more than *P. cheiranthi*, the Canary Brimstone (*Gonepteryx cleobule*) is a suitable flagship species. This is mainly due to its beautiful coloration compared to the Canary Islands Large White. Even though it may be less threatened than *P. cheiranthi*, conservation measures for this species may also help other forest insects. As a pollinator, *Gonepteryx cleobule* visits many flowering plants and is not specialised. It can be regularly found on Arabian pea (*Bituminaria bituminosa*), but also on blackberries, thistles or sow thistles.

Historical account

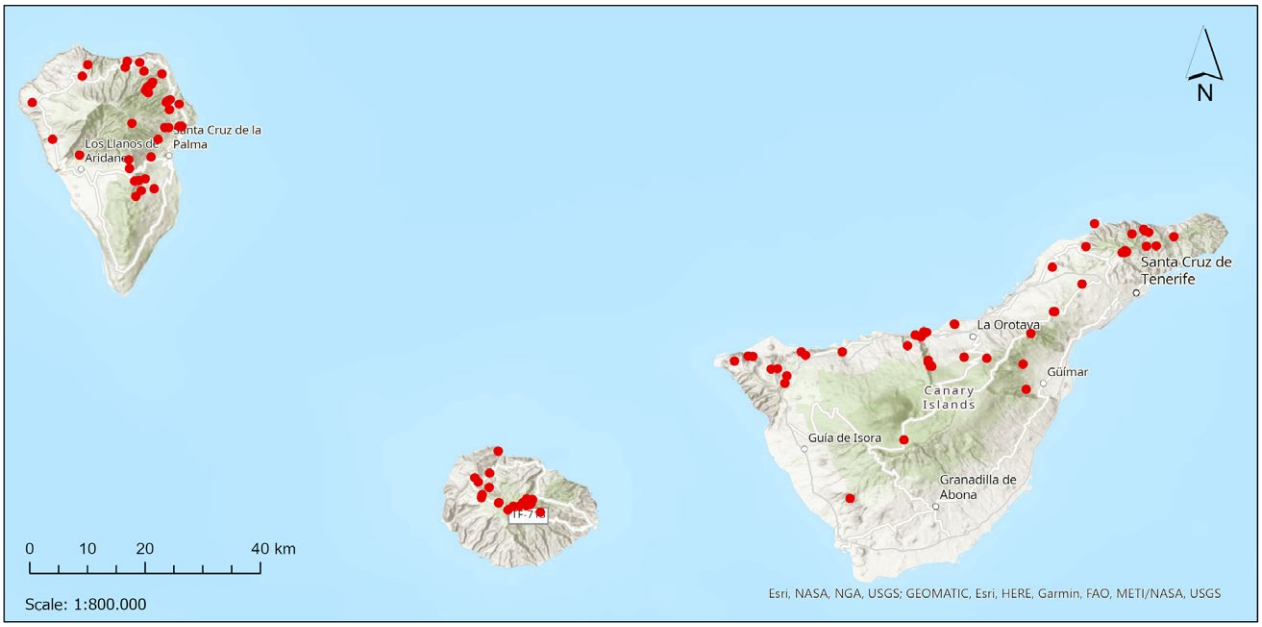
Figure 38 shows the historical distribution of *Gonepteryx cleobule*. Van Swaay *et al.*, (2010a) estimated a population decline of 10% (probably over 10 years) and inferred a continuing decline of the number of mature individuals from the reduction of the habitat.



Legend

- 1975-1994
- 1800-1974

Figure 38 Historical records (1800–1994) of Gonepteryx cleobule. (Data adapted from Wiemers, 1995))



Legend

- Validated records from Escobés R, iNaturalist, Monasterio León Y, observation.org, Wiemers M & ZERYNTHIA Association.

Figure 39 Recent records of G. cleobule (1999–2021). (The data are based on Escobés R, iNaturalist, Monasterio Léon Y, observation.org, Wiemers M and ZERYNTHIA Association)

Current distribution and demography

The current distribution of the species is shown in Figures 39–42. The extent of occurrence of *Gonepteryx cleobule* has been estimated as < 5,000 km² (van Swaay *et al.*, 2010a). The number of locations is estimated at less than ten (van Swaay *et al.*, 2010a).

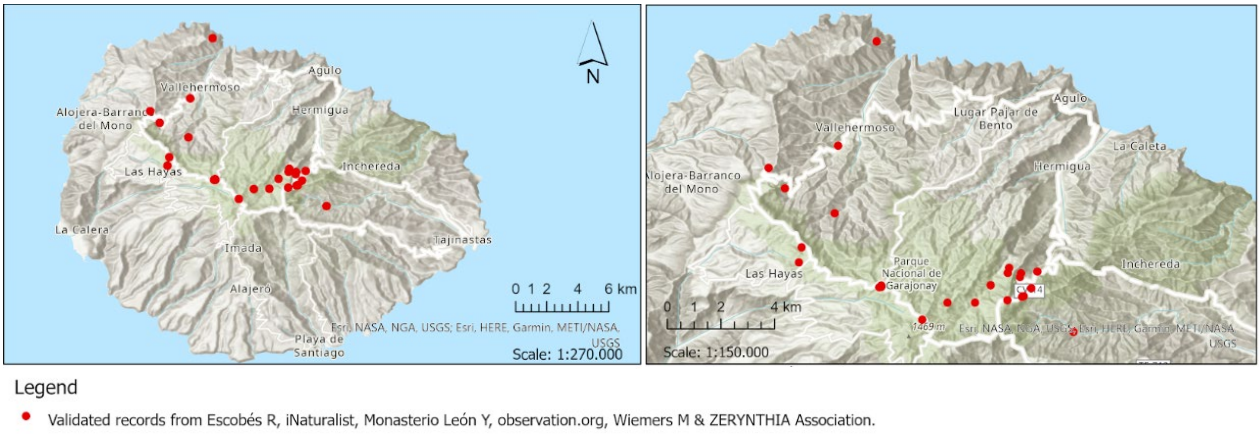


Figure 40 Current distribution of G. cleobule (1999–2021) on La Gomera. (The data are based on: Escobés R, iNaturalist, Monasterio Léon Y, observation.org, Wiemers M. and ZERYNTHIA Association)

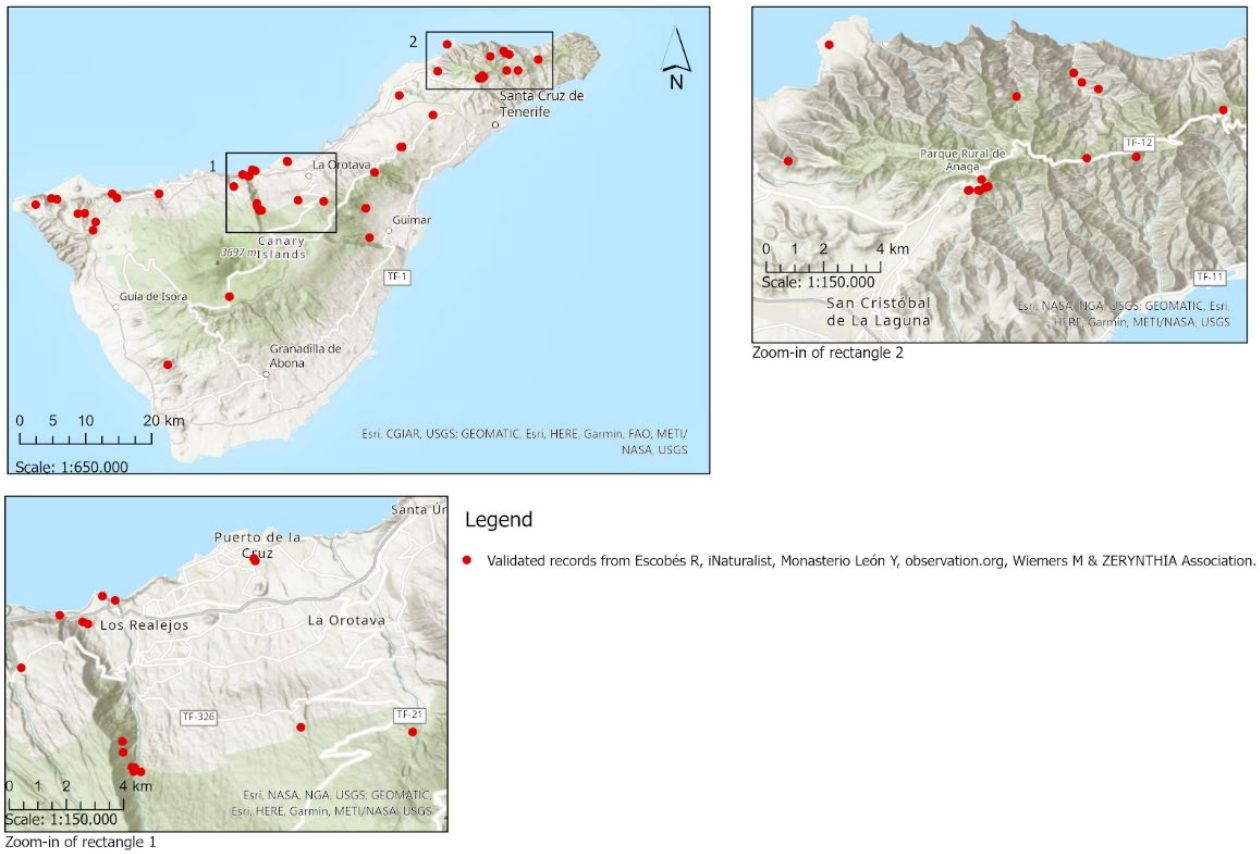


Figure 41 Current distribution of G. cleobule (1999–2021) on Tenerife. (The data are based on: Escobés R, iNaturalist, Monasterio Léon Y, observation.org and Wiemers M and ZERYNTHIA Association)

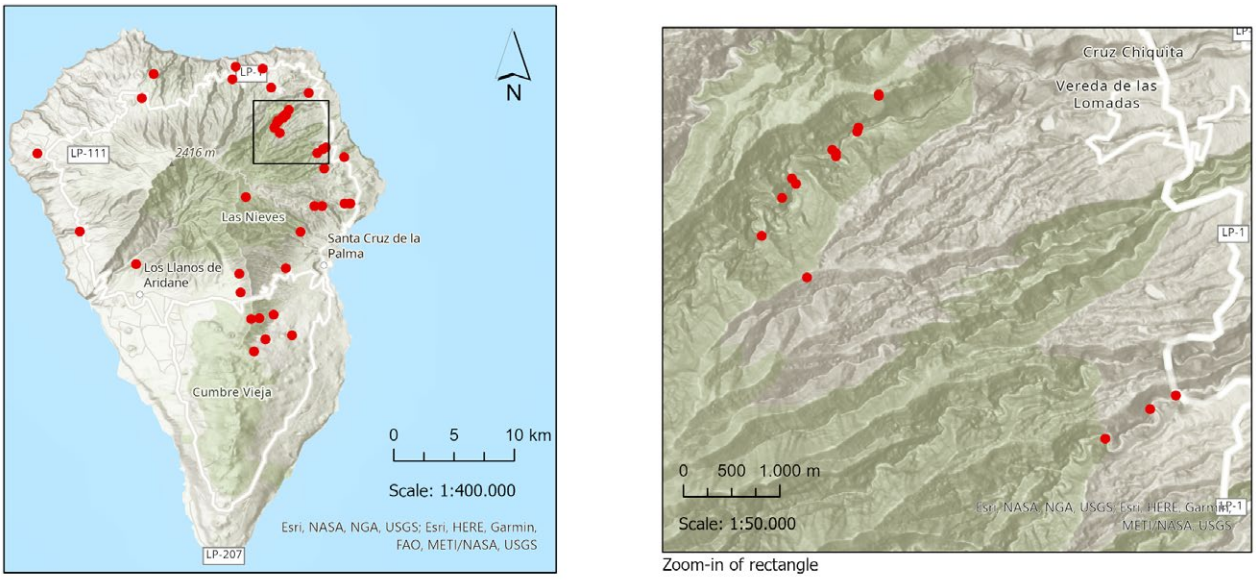


Figure 42 Current distribution of G. cleobule (1999–2021) on La Palma. (The data are based on: Escobés R, iNaturalist, Monasterio Léon Y, observation.org and Wiemers M)

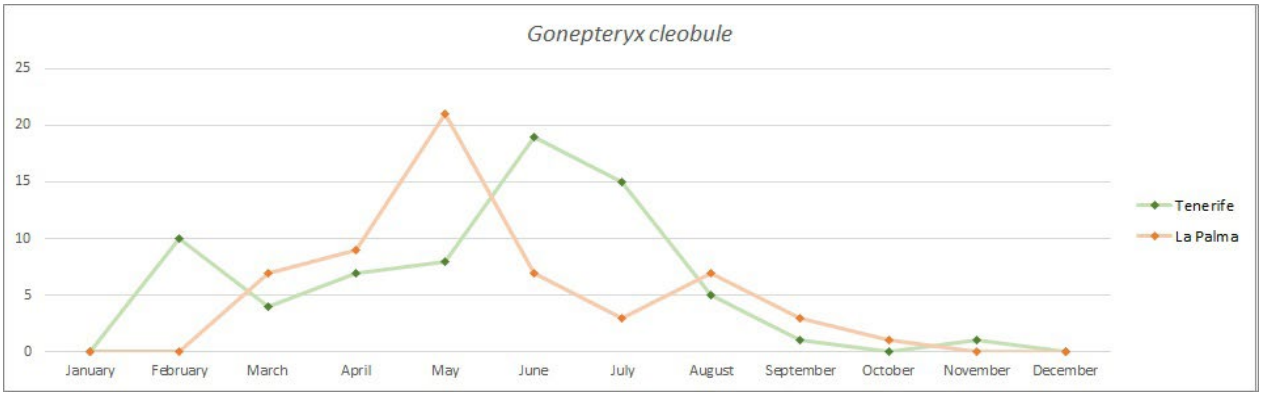


Figure 43 Phenology and abundance of Gonepteryx cleobule in Tenerife and La Palma from data obtained by volunteers in the monitoring programme carried out by the ZERYNTHIA Association with the support of the island councils. The data for Tenerife cover the period 2017–2021. The data for La Palma reflect only the year 2021. (Graphic: Ruth Escobés. https://www.asociacion-zerynthia.org/seguimiento-diurnas)

Habitat and resource assessment

Adults of *G. cleobule* can be found in different elevations and in different habitat types depending on the season (Ziegler & Jost, 1990). In spring, *G. cleobule* is found at sea level and in elevations between 500 and 1,000 m and flies in the laurel forest and along sheer, shrubby and sun-exposed rocks (Ziegler & Jost, 1990). In summer, the species occurs at higher altitudes up to 2,000 m and flies mainly in the transition area of laurel–pine forest zones (Ziegler & Jost, 1990). The Canary Pine woodland is generally drier than the Laurel Forest zone. It is characterised by a precipitation of 450–550 mm and an average temperature of 11–15°C (Del Arco Aguilar *et al.*, 2010). Pine woodlands are less threatened on the Canary Islands, even though they are also influenced by human impacts (e.g. for firewood, building timber or agriculture). Due to the forestry use of pine woodlands, they have been expanded and also planted on islands where the Canary Pine did not originally occur (e.g. La Gomera).

Threat analysis

Destruction of the laurel forests is the major threat to *G. cleobule*, even though large parts of this habitat are legally protected (van Swaay *et al.,* 2010a). Tourist resorts and illegal buildings especially alongside roads or close to settlements are impacting laurel forest habitats (van Swaay *et al.,* 2010a). Moreover, van Swaay *et al.,* (2010a) underline that accidentally and intentionally set for livestock grazing, crop planting, timber and real estate speculation impact the laurel forest. A major recent threat is the increasing number and size of wildfires. The occurrence of the larval food plants might be a bottleneck factor in some places, because they are not always common in laurel forests. Climate change might increasingly impact the habitat of the species, particularly through droughts and weather extremes, but also from habitat changes caused by the increasing temperatures. While the habitat of *G. cleobule* is not directly affected by pesticides, spill-over from adjacent agricultural areas may also impact the species.

Table 3 Overview of the major threats to G. cleobule

Threat	Timing	Knowledge	Presumed impact
Wildfires	Ongoing	Medium	Medium
Rural and tourism development	Past	High	Medium
Climate change	Ongoing	Medium	High
Pesticides	Ongoing	Low	Medium
Habitat reduction due to the use of foreign forest species or alien species	Past	High	Medium

Canarian Laurisilva Bee (*Lasioglossum chalcodes*)

Figure 44 Lasioglossum chalcodes in Tenerife. (Photo: Domingo Sosa)

Species description

Systematics / taxonomy

Lasioglossum (Lasioglossum) chalcodes (Brullé, 1839) is endemic to the central and western islands of the Canary Islands. It comprises 4 subspecies: *Lasioglossum c. chalcodes* (Brullé, 1839) distributed on El Hierro and Tenerife, *Lasioglossum c. canariense* (Ebmer, 1993) on Gran Canaria, *Lasioglossum c. caldereae* (Ebmer, 1993) endemic on La Palma, and *Lasioglossum c. gomera* (Warncke, 1975) from La Gomera.

Biology and ecology

The species has been found in a variety of habitats but appears to prefer the moist forest zone.

Functions and values

Wild bees are among the most important pollinators on our planet (Ollerton, 2017). According to Ollerton *et al.,* (2011) 78–94% of wild plants depend on pollinators. Pollination by wild insects is known to generate large economic benefits (Gallai *et al.,* 2009). Pollinators are also bioindicators of environmental stress which can reflect introduced competitors, diseases, parasites, predators, pesticides or habitat modification (Kevan, 1999). *Lasioglossum chalcodes* is polylectic and been observed visiting preferentially Asteraceae (*Andryala pinnatifida*, *Calendula* and *Senecio* sp.), Lamiaceae (mainly *Cedronella canariensis*) and Crassulaceae (*Aichryson laxum*). Due to its distribution, it is one of the pollinators of economically important crops such as apple, kiwi and vegetables. It has been recorded as one of the pollinators of apple orchards in Tenerife and La Palma (unpublished data). Adults are active throughout the year, although with a peak of abundance from December to June.

Historical account

The species is endemic to central and western Canary Islands, restricted to humid areas. It is mainly found at higher elevations on northern slopes of Gran Canaria, Tenerife, La Gomera and La Palma (Figure 45). Figure 46 shows a map of the inferred distribution based upon climate niche modelling.

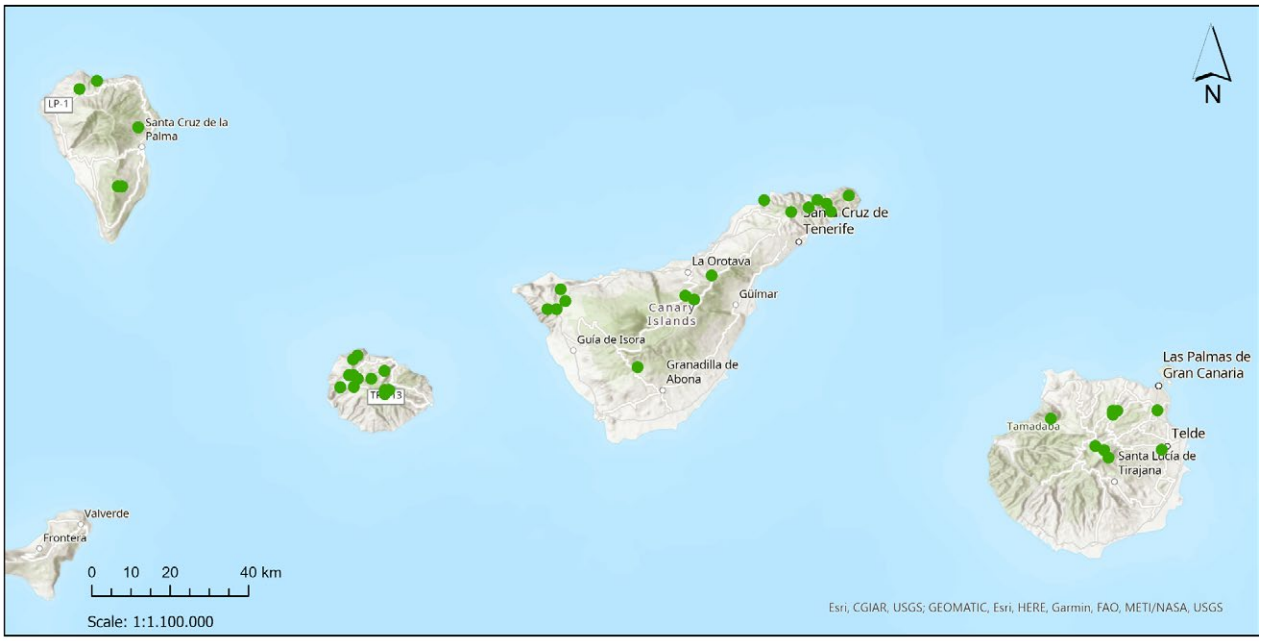


Figure 45 Historical records (1981–1990) of Lasioglossum chalcodes. (Data adapted from Hohmann et al., 1993)

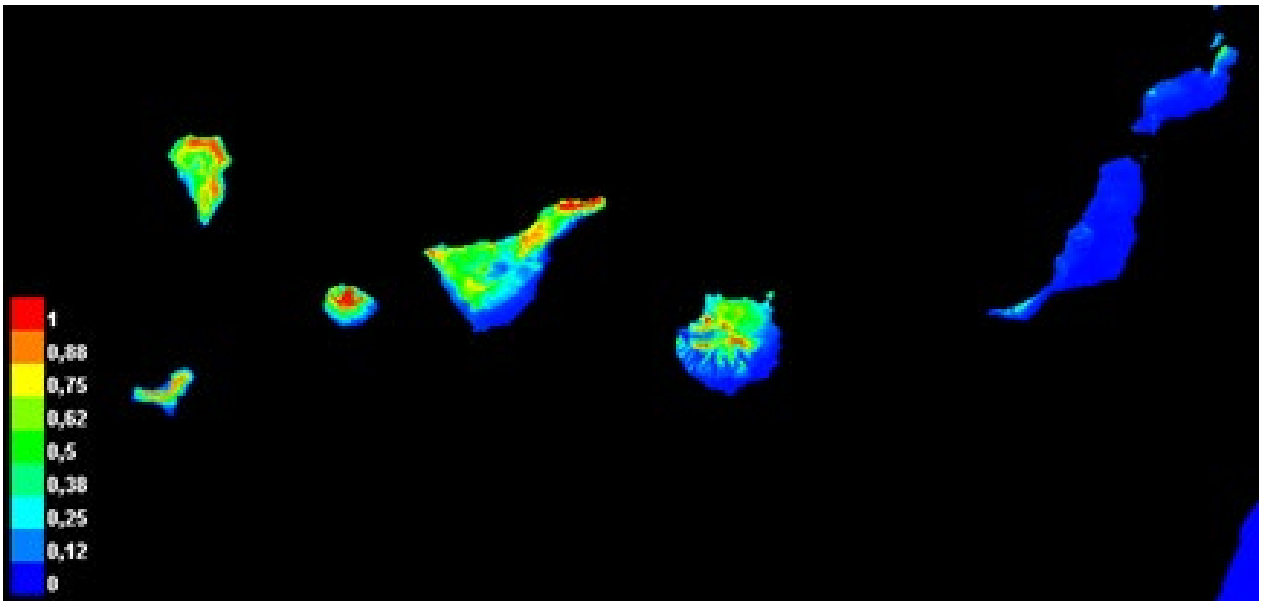


Figure 46 Potential distribution map of Lasioglossum chalcodes based upon species distribution modelling.

Current distribution and demography

Data on the distribution and population status of *Lasioglossum chalcodes* is scarce. It is listed as Least Concern on the IUCN Red List based on its suspected stable populations, its preference for a wide variety of habitats, and the lack of known threats to the species (Kemp *et al.*, 2013). Based on known distribution localities, the estimated area of occupancy (AOO) was 24 km² and the extent of occurrence (EOO) less than 12,850 km². A more accurate estimation of its potential distribution based on SDM showed a restricted distribution in the humid habitats with an AOO of 1,204 km² and an EOO of 21,759 km². Field surveys have shown that it is not common, however, the population trend remains unknown. Further research should be conducted on the population status, trends and future threats to this species. Figure 47 shows some recent records of the species.

Figure 47 Recent records (2019) of Lasioglossum chalcodes. (Data from: Carlos Ruiz Carreira)

Habitat and resource assessment

Lasioglossum chalcodes is one of the few bee species associated with laurel forests. Its distribution area overlaps with that of the laurel forest or degraded areas of the laurel forest (Hohmann *et al.,* 1993), and thus may benefit from conservation action in this habitat.

Threat analysis

The most likely threat to the species is the transformation of its habitat by agriculture or forestry. Additionally, it may be threatened by exotic wild bee species (Russell & Kaiser-Bunbury, 2019), such as *Bombus ruderatus*, whose populations have spread on the northern and eastern slopes of Tenerife and La Palma (Pérez & Hernández, 2012). Climate change is likely to affect this species as well, either indirectly via habitat shifts or directly via droughts or weather extremes. The role of pesticides on the population trend of this species is poorly understood. While the forest habitat may not be affected by pesticides, spillovers from adjacent agricultural areas may occur.

Table 4 Overview of the major threats to L. chalcodes

Threat	Timing	Knowledge	Presumed impact
Wildfires	Ongoing	Low	Low
Habitat reduction	Past	Low	Low
Climate change	Ongoing	Low	Medium
Pesticides	Ongoing	Low	Medium
Alien bee species	Ongoing	Low	Unknown

Laurisilva Hoverfly (*Heringia adpropinquans*)

Species description

Systematics / taxonomy

The species of the genus *Neocnemodon* have at various times been consigned to *Heringia*, but recent genetics work argues for separation of *Heringia* from *Neocnemodon* (Vujić *et al.*, 2013). There are then only two certain European *Heringia* species recognised as present, *Heringia heringi*, present in the continental part of Europe and the Canary Isles endemic, *Heringia adpropinquans* (Speight, 2020) (Figure 48 a-c). Both species are very similar (*Heringia heringi*, Figure 49. a-b) and differ in the structure of the male genitalia.

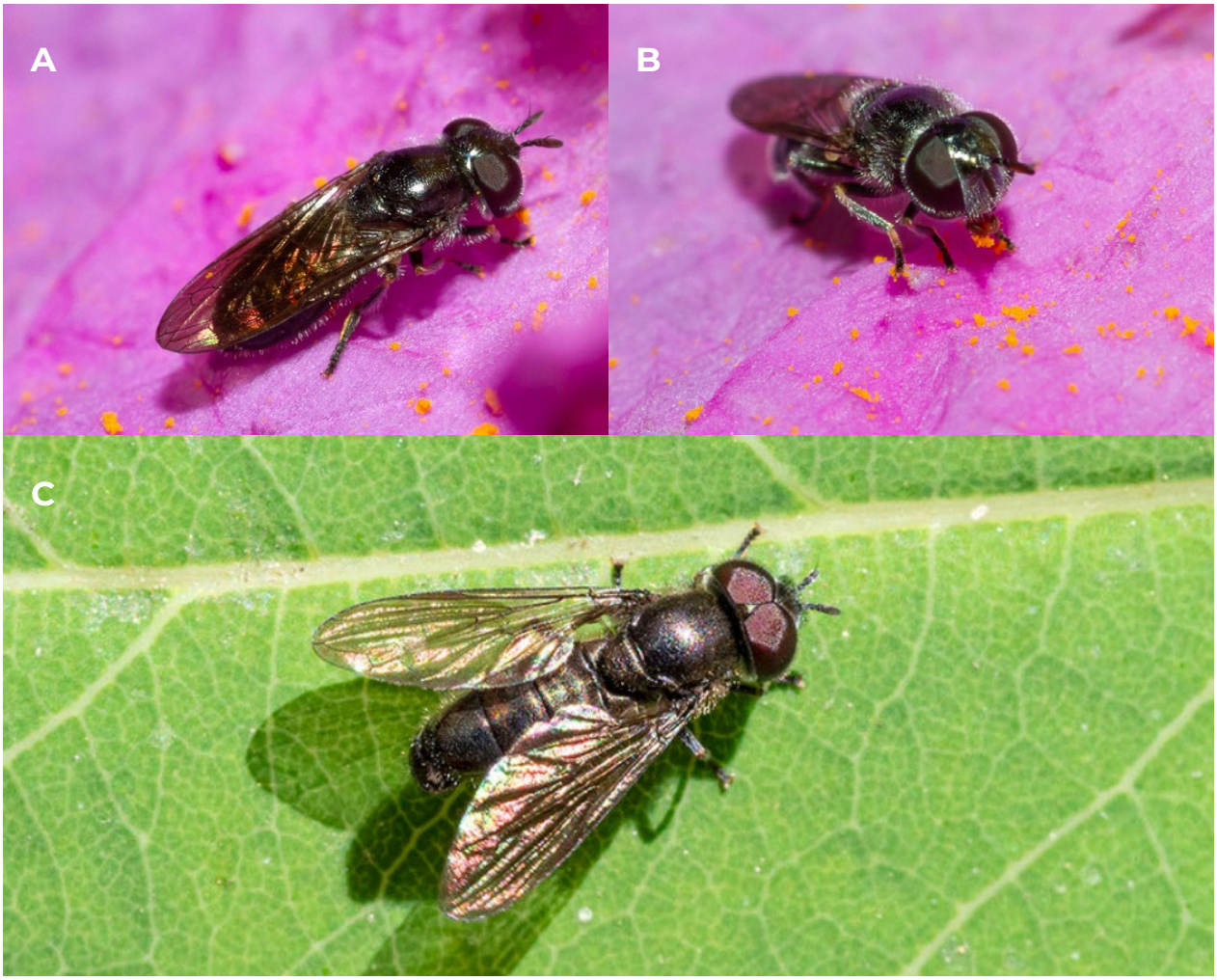


Figure 48A-C Heringia adpropinquans, Santa Cruz de Tenerife (a-b: © Gustavo Peña – some rights reserved (CC BY-NC), c: © djbich, some rights reserved (CC-BY-NC)

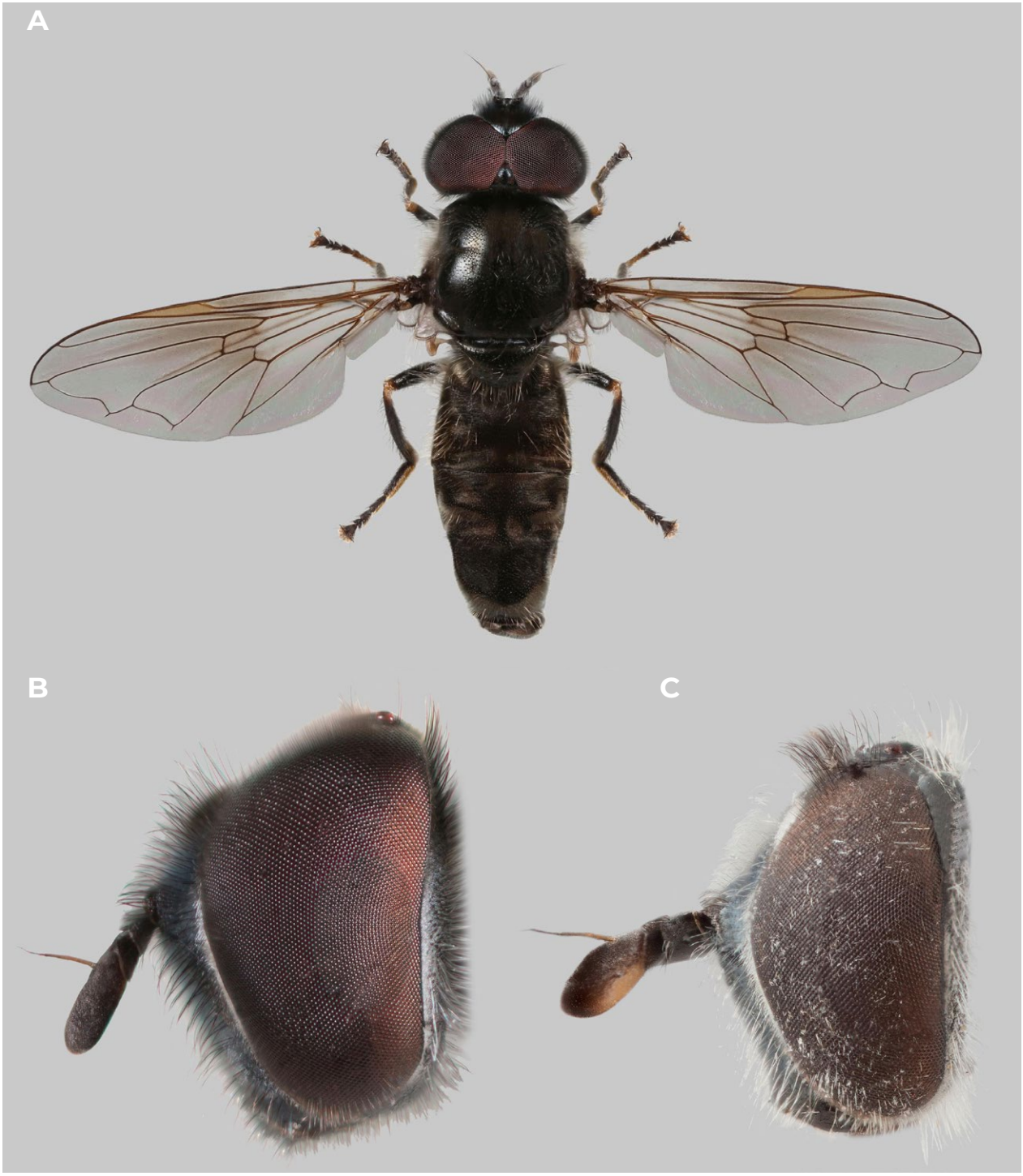


Figure 49A-C Heringia heringi: A. habitus, male, dorsal view; B. head, male, lateral view; C. head female, lateral view. (Photos: Sander Bot)

Biology and ecology

The preferred environment of this species is Laurisilva forest (Báez, 1977). Based on Speight (2020), there is no data about adult habits and flower visitation. The flight period for adults is May and July/August. Developmental stages have not been described, but larvae of the genus *Heringia* and related genera are aphidophagous.

Functions and values

Syrphids are among the most important pollinators on our planet, but less well studied than butterflies or wild bees. Syrphids are also known as bioindicators of habitat modification. While the pollination service of *Heringia adpropinquans* has not been studied in detail, this species is likely to contribute to pollination of wild flowers.

Historical account

There have been no targeted studies to find more individuals, but unlike *Eumerus purpureus* and other species endemic to the Canary Islands, recent research on the islands has not provided any new specimen based on a couple of surveys done in the Canary Islands. The known records of the species are shown in Figure 50 (Vujić & Šebić, 2021).

Figure 50 Records of Heringia adpropinquans on the Canary Islands.

Current distribution and demography

This species is endemic to the Canary Islands. There is no data about the population trend of this species, and there are no recent records. There are <100 specimens found, but most of them date from the beginning of the 1990s.

Habitat and resource assessment

The species is found within the boundaries of some protected areas which are part of the Natura 2000 network and very close to national parks. However, the habitat of this species has been and still is subject to various influences. The laurel forest has been extensively exploited since the 15th century and nowadays only 11% of the original forest remains. Approximately 85% of the laurel forest is included in the Canarian Network of Protected Areas and up to 92% within the Natura 2000 Network. Additionally, the first long-term monitoring (12 years) of the laurel forest seedlings bank in the Canary Islands revealed the high regeneration potential of the forest in well-preserved stands, indicating that probably no management interventions are required to ensure the regeneration of the forest.

Threat analysis

The species is undergoing a continuing decline in the quality of its habitat due to human-made pressure. Based on IUCN assessment, the species is assessed as Endangered due to its very small area of occupancy (16 km^2) and extent of occurrence (155 km^2), a severely fragmented population with no possibility of dispersal between populations situated on two different islands, a low number of locations (2) and a continuing loss of habitat quality due to fire as the main threat (Vujić & Šebić, 2021). The conservation of the species should be based on habitat protection, and protection of the original forest, prohibition of illegal house construction within the protected areas and regulation of other human activities. As this species inhabits laurel forests, it may be affected by direct or indirect effects of climate change. Increasing droughts and weather extremes may affect survival or development of eggs and larvae or alter the forest habitat. The role of pesticides for this species is unknown. While forest habitats may be less affected by pesticides than agricultural land, spill-over of pesticides into the habitat of *H. adpropinquans* may occur.

Table 5 Overview of the major threats to Heringia adpropinquans

Threat	Timing	Knowledge	Presumed impact
Wildfires	Ongoing	Medium	High
Forestry (habitat destruction)	Ongoing	Medium	High
Climate change	Ongoing	Medium	Medium
Pesticides	Ongoing	Low	Medium

Conservation planning

To develop a conservation strategy for the four target pollinator species, the approach of the IUCN Species Survival Commission was adopted according to the IUCN Guidelines for Species Conservation Planning (IUCN SSC Species Conservation Planning Sub-Committee, 2017) and the Species Conservation Planning Principles and Steps (CPSG, 2020). A draft strategy was prepared by a core group of stakeholders and discussed and amended during a participatory workshop, involving species specialists and planners, state government agencies, managers, researchers, NGOs and other stakeholders.

The workshop was held on 22 and 23 November 2021 with one 4-hour long session each day. The first day started with introductions to IUCN and the project, and to the strategic conservation planning methodology. During the first day, the biology and conservation of the four key species were introduced as well as their historical and current distribution trends. Finally, the participants discussed and modified the draft vision, goals and objectives of the action plan developed by the core group together with the first major objective, research.

The second day was fully dedicated to discussing the remaining major objectives, such as conservation management, monitoring, legal protection, outreach and funding. The workshop agenda is given in Annex I.

Conservation Action Plan

Vision

The Canary Islands maintain large, well connected areas of native laurel forest vegetation, providing adequate, sustainable habitat for endemic pollinators, including the Canary Islands Large White, the Canary Brimstone, the Canarian Laurisilva Bee and the Laurisilva Hoverfly. These pollinators are flagship species for Canarian insect conservation and have self-sustaining, healthy populations, so that future generations can enjoy them and benefit from the services they provide. Local communities are aware of their importance and the threats to their populations and engage in conservation action.

The vision was carefully worded to reflect the following points:

(i) "large, well connected areas of native laurel forest": Laurel forests occupy only 12.5% of their original range on the Canary Islands; species affiliated with these ecosystems are threatened by habitat loss and fragmentation; increasing habitat connection requires restoration of habitat, particularly in areas with larger gaps in forest vegetation.

(ii) "providing adequate, sustainable habitat": Habitat management is key to ensure the provision of adequate habitat and the survival of threatened species, this includes management of wildfires, water extraction, invasive species, tourism, forestry, agriculture and development.

(iii) "endemic pollinators": The Canary Islands are known for their high number of endemic species, including endemic pollinators, for which an enhanced responsibility exists to ensure their survival.

(iv) "flagship species for Canarian insect conservation": Insects are often unknown to the public, so awareness needs to be enhanced.

(v) "self-sustaining, healthy populations": This highlights the aim to secure existing populations and improve the status of threatened pollinator species; a population is considered self-sustaining if its survival is ensured with high probability over the long term.

(vi) "future generations can enjoy them and benefit from the services they provide": Insects, and particularly butterflies, provide multiple ecosystem services, including pollination, but they are also of high aesthetic and educational value.

(vii) "Local communities are aware of their importance and the threats to their populations and engage in conservation action": This highlights the local responsibility and need for increased awareness, not only of the values of pollinators, but also their main threats and the opportunity to engage in their conservation by planting host plants.

Goals, objectives and actions

Goal 1: Governance and protection

Governance and protection established and secured for the four selected Canarian pollinators (*Pieris cheiranthi, Gonepteryx cleobule, Lasioglossum chalcodes, Heringia adpropinquans)*, facilitating the implementation of the Conservation Action Plan.

Objective 1.1 Governance

To establish a steering group by 2021 in order to guide and facilitate implementation of the plan and review progress regularly.

Actions

1.1.1 Creation of a steering group

Purpose: To guarantee the implementation of all actions
Note: Regular meetings each year to review progress (more often during the first year). The steering group was established during the workshop. The members are listed below.
Who? IUCN SSC Mid Atlantic Island Invertebrate Specialist Group (MAIISG) / University of La Laguna (ULL) / ZERYNTHIA / Loro Parque Fundación (LPF) / Gobierno de Canarias (GC) / Ministry for the Ecological Transition and Demographic Challenge (MITECO) / Butterfly Conservation Europe (BCE) / IUCN SSC Invertebrate Conservation Committee (ICC) / IUCN SSC Hoverfly SG (HSG)
By when? 2021
Indicator? Regular meetings
Resources required? Volunteer time

Objective 1.2 Inclusion of pollinators in key legal documents

To add the target pollinator species (*Pieris cheiranthi, Gonepteryx cleobule, Lasioglossum chalcodes, Heringia adpropinquans)* to existing key legal documents of the Canary Islands and Spain, in order to set the basis for implementation of conservation action.

Actions

1.2.1 Motion for inclusion of laurel forest pollinators in the Biodiversity Strategy of Tenerife.

Who? ZERYNTHIA / ULL / BCE / LPF / ICC / MAIISG / HSG
By when? December 2021
Indicator? Motion submitted
Resources required? Volunteer time
Note: The motion was submitted during the consultation period of the new Biodiversity Strategy (2020–2030) of Tenerife, asking for the inclusion of laurel forest pollinators in the Tenerife Biodiversity Strategy. This action was finalised in December 2021. The Local Government of Tenerife has accepted the motion and included the pollinators in the 2020–2030 Biodiversity Strategy (accessible here: https://www.tenerife.es/documentos/medioambiente/2022EstrategiaBiodiversidadTenerife.pdf)

1.2.2 Inclusion of all four target pollinator species in the Canarian Regional Catalogue of Threatened Species

Purpose: Increasing legal protection of species (either of special interest or endangered) in the Canary Islands and/or Spain, which is the necessary basis for any species conservation action
Note: Including also *P. cheiranthi benchoavensis* on La Palma
Who? ZERYNTHIA / ULL / BCE / LPF / ICC / MAIISG / HSG
By when? Proposal submission 2023
Indicator? Species are listed in the Regional Catalogue of the Canary Islands
Resources required? Volunteer time

1.2.3 Inclusion of Pieris cheiranthi in the Spanish National Catalogue of Threatened Species

Purpose: Increasing legal protection (currently only protected on Tenerife)
Note: Provided it fulfils the necessary criteria
Who? ZERYNTHIA / BCE / LPF / ICC / MAIISG
By when? 2026
Indicator? Species is listed
Resources required? Volunteer time

Goal 2: Research

Research on the Canarian pollinator population status (focusing on the four selected species), to better understand the dynamics and associated drivers, to identify and understand better the present and likely future threats, and to clarify their genetic uniqueness and ecological roles.

Objective 2.1 Distribution and ecology

To clarify the number of existing populations of the four Canarian pollinator species, their spatial extent and key ecological requirements (including diet, nesting requirements) in order to implement the most suitable conservation action.

Actions

2.1.1 Systematic survey on distribution and abundance of the four selected species on the Canary Islands (including search for P. cheiranthi on La Gomera)

Purpose: High quality spatial data on the current population status. This is an important basis for several other actions below!
Note: To be coordinated with any other existing monitoring activities for pollinators, including the EU Pollinator Monitoring Scheme
Who? MAIISG / BCE / ZERYNTHIA / ULL / HSG
By when? 2023
Indicator? High quality map of key areas for conservation / population status
Resources required? Funding for personnel and travel costs

2.1.2 Study on suitability of different Crambe species as host plants for Pieris cheiranthi on the Canary Islands

Purpose: Clarifying suitable food plants (for management or potential reintroduction on La Gomera)
Note: Field study (also check *Brassica*) on the relevant sites where the species are present
Who? BCE / ZERYNTHIA / ULL (botanists)
By when? 2024
Indicator? Assessment of suitable *Crambe* species
Resources required? Funding for personnel and travel costs

2.1.3 Study on suitability of different Rhamnus species as host plant for G. cleobule on the Canary Islands

Purpose: Clarifying suitable food plant species for improving management of habitats of *G. cleobule*
Who? BCE / ZERYNTHIA / ULL (botanists)
By when? 2024
Indicator? Assessment of suitable *Rhamnus* species
Resources required? Funding for personnel and travel costs

2.1.4 Study on host plant distribution for the four selected Canarian pollinator species

Purpose: Obtaining better knowledge of suitable areas for enhanced management
How: Could be studied with survey (2.1.1) / Citizen Science / species distribution modelling
Who? ZERYNTHIA / beekeepers
By when? 2024
Indicator? Map of host plant distribution (using the existing information and closing knowledge gaps) (incl. data on phenology)
Resources required? Funding for personnel and travel costs

2.1.5 Research on nesting requirements of Lasioglossum chalcodes on the central and western Canary Islands

Purpose: Identification of critical resources for *L. chalcodes*
Who? ULL / Trier University (TU)
By when? 2024
Indicator? Knowledge of nesting requirements
Resources required? Student (thesis)

2.1.6 Research on larval and adult habitat requirements of Heringia adpropinquans on the Canary Islands

Purpose: Better knowledge of critical resources for the conservation of *H. adpropinquans*
Who? HSG
By when? 2024
Indicator? Knowledge of habitat requirements (larvae and adults)
Resources required? Travel costs

2.1.7 Study of the nectariferous sources of the four Canarian pollinator target species using environmental DNA techniques (pollen)

Purpose: Better knowledge of important food plants
Who? ULL (in collaboration with labs, such as IBE CSIC, TU or IPNA CSIC)
By when? *L. chalcodes*: 2027 (for butterflies not as important)
Indicator? Analysis of food plants of the four pollinators
Resources required? Personnel and consumables

Objective 2.2 Improving knowledge to mitigate threats

To obtain better knowledge of the major threats to Canarian pollinator species, specifically to the four selected species, and clarify the impact of lesser known threats, such as climate change, parasitoids and pesticides.

Actions

2.2.1 Research on the major threats to Lasioglossum chalcodes

Purpose: Better knowledge of the key factors for its conservation
How: Analysing anthropogenic impact in the main areas of occurrence (based upon 2.1.1)
Who? ULL
By when? 2025
Indicator? Analysis of the threats to *L. chalcodes*
Resources required? Personnel

2.2.2 Research on the major threats to Heringia adpropinquans

Purpose: Better knowledge of the key factors for its conservation
How: Analysing anthropogenic impact in the main areas of occurrence (based upon 2.1.1)
Who? HSG
By when? 2025
Indicator? Analysis of the threats to *H. adpropinquans*
Resources required? Travel costs / Personnel

2.2.3 Research on potential future habitats of all four species (and host plants) under climate change

Purpose: Identification of important future habitats
How: Species Distribution Modelling
Who? ULL / TU
By when? 2023
Indicator? Species Distribution Models available
Resources required? Student

2.2.4 Research on the role of parasitoids on population dynamics of P. cheiranthi

Purpose: Better knowledge of the impact of parasitoids (*Cotesia glomerata*)
How: Breeding caterpillars from different habitats (during captive breeding project)
Who? Loro Parque Fundación (LPF) / ZERYNTHIA / BCE
By when? 2026
Indicator? Data on parasitoid load
Resources required? Personnel

2.2.5 Research on the use of agrochemicals (pesticides and herbicides) in high altitudes and their potential impacts on pollinators in the Canary Islands, focusing mostly on the four species (Pieris cheiranthi, Gonepteryx cleobule, Lasioglossum chalcodes, Heringia adpropinquans)

Purpose: Better knowledge on the potential impact of pesticides and herbicides on the target species
Note: It appears that pesticides are mainly used in agriculture, not in forestry. They are banned in road maintenance by some Canarian local governments. A study would start with an initial inquiry to obtain data on pesticide types and typical applications to assess potential effects in relevant areas
Who? ULL / TU
By when? 2023
Indicator? Information on pesticide/ herbicide use
Resources required? Student or personnel

2.2.6 Research on potential effects of honey bee keeping on native pollinators on the Canary Islands

Note: Honey bees have been shown to outcompete native wild bees in several places globally, including Teide National Park (Valido *et al.,* 2014, 2019)
Who? ULL / beekeepers
By when? 2025
Indicator? Report available
Resources required? Personnel

Objective 2.3 Taxonomy, systematics and population genetics

To clarify the taxonomic status and genetic differentiation of the four target species in order to identify management units and avoid inbreeding and outbreeding depression.

Actions

2.3.1 Taxonomic study to improve identification of L. chalcodes (distinguishing from L. viride)

Purpose: Increasing the potential of monitoring and Citizen Science engagement
Who? ULL / Université Libe de Bruxelles (ULB)
By when? 2023

Indicator? Availability of a field identification method
Resources required? Personnel

2.3.2 Genetic study to clarify the management units of P. cheiranthi

Purpose: Clarification of the subspecies status to identify management units (particularly on La Gomera)
Note: Subspecies from Tenerife and La Palma strongly differentiated (clear management units)
Who? Senckenberg Deutsches Entomologisches Institut (SDEI) / ZERYNTHIA / IBE-CSIC
By when? 2026
Indicator? Assessment of subspecies status
Resources required? Personnel and consumables

2.3.3 Genetic study to clarify the taxonomic status of the different populations of G. cleobule

Purpose: Clarification of the subspecies status to identify management units
Who? SDEI / ZERYNTHIA / IBE-CSIC
By when? 2026
Indicator? Assessment of subspecies status
Resources required? Personnel and consumables

2.3.4 Research on systematic and population genetics of different subspecies of Lasioglossum chalcodes

Purpose: Clarification of the subspecies status to identify management units
Who? ULL
By when? 2025
Indicator? Assessment of management units
Resources required? Personnel and consumables

2.3.5 Population genetics of H. adpropinquans

Purpose: Clarifying genetic isolation of different populations
Who? HSG / ULL
By when? 2028
Indicator? Population genetic analysis
Resources required? Personnel and consumables

Objective 2.4 Population monitoring

To set up a monitoring programme for the four Canarian pollinators in order to estimate their population trends and the effectiveness of conservation action.

Actions

2.4.1 Improve the population monitoring programme for butterflies by adding five transects on Tenerife and five on La Gomera

Purpose: Comprehensive coverage of all Canarian populations (10 transects exist on La Palma and 10 on Tenerife)
Note: The monitoring should be linked to the EU Pollinator Monitoring Scheme.
Who? ZERYNTHIA in collaboration with regional competent authorities (GC / Cabildos)
By when? 2025
Indicator? 5 new transects on La Gomera / Tenerife
Resources required? Volunteer time / material / personnel

2.4.2 Establishment of monitoring protocols for L. chalcodes and H. adpropinquans on the Canary Islands

Purpose: Data on population trends (training rangers? bee-keepers!)
Who? ULL / HSG in collaboration with regional competent authorities (GC / Cabildos)
By when? 2025
Indicator? Monitoring scheme in place
Resources required? Personnel

2.4.3 Monitoring the effectiveness of conservation management actions for the four selected Canarian pollinator species and feeding back into management practices

Purpose: Assessment of effectiveness of actions
How: Obtaining detailed population data in areas where actions took place
Who? ZERYNTHIA / ULL / HSG in collaboration with regional competent authorities (GC / Cabildos)
By when? 2023–2030
Indicator? Monitoring data available
Resources required? Personnel, volunteer time, travel costs

2.4.4 Monitoring the conservation status trends of pollinators of the Laurel Forest zone on the Canary Islands

Note: Green-listing
Who? ZERYNTHIA / ULL / HSG / BCE / MAIISG / ICC
By when? 2028
Indicator? Monitoring data available
Resources required? Personnel and volunteer time

Goal 3: Species Support for *Pieris cheiranthi*

Pieris cheiranthi with an improved conservation status through an ex-situ captive population and reintroduction on La Gomera.

Objective 3.1 Species Recovery Plan

To compile a species recovery plan approved by the Canarian regional government by 2023 in order to set the legal basis for captive breeding and reintroduction of the Canary Large White.

Actions

3.1.1 Species Recovery Plan for the Canary Large White

Who? ZERYNTHIA / ULL / LPF / BCE to revise the draft in collaboration with GC
Note: The plan should also include an assessment, whether a captive breeding programme is justified (see objective 3.2); consider existing legislation:
https://www.miteco.gob.es/es/biodiversidad/temas/conservacion-de-especies/conservacion-ex-situ/ce-exsitu-reintroduccion.aspx
https://www.miteco.gob.es/es/biodiversidad/temas/conservacion-de-especies/doc_directrices_reintroduccion_tcm30-198128.pdf
By when? 2023
indicator: Recovery plan approved
Resources required? Personnel

Objective 3.2 Captive breeding programme for Pieris cheiranthi

To establish a captive back-up population of the Canary Large White on Tenerife by 2025 in order to reduce extinction risk and create a source population for further reintroduction.

Actions

3.2.1 Identification of suitable source populations for the captive breeding programme for P. cheiranthi

Purpose: Minimising risk of threatening existing populations by determining how many can be collected at what times?
Note: Data available from Action 2.1.1 (survey)
Who? ZERYNTHIA / BCE / LPF
By when? 2023
Indicator? Analysis of suitable source populations
Resources required? Personnel

3.2.2 Development of a captive breeding protocol for P. cheiranthi

Purpose: Optimising the captive breeding programme
Note: Building on experience of the butterfly house in Icod
Test suitability of food plants
Who? LPF (with EAZA) / ZERYNTHIA / BCE
By when? 2024
Indicator? Captive breeding protocol
Resources required? Personnel

3.2.3 Collection of eggs, caterpillars and/or adult females of P. cheiranthi

Purpose: Foundation of the captive population (including parasitoid monitoring – see above)
Note: Permits need to be applied for early enough / early collection for avoidance of parasitation
Who? ZERYNTHIA / BCE / LPF
By when? 2025
Indicator? Individuals collected
Resources required? Personnel / travel costs / material

3.2.4 Captive breeding of P. cheiranthi on Tenerife

Purpose: Back-up population in at least one zoo
Note: Only breed the individuals from the same island where breeding takes place; extension to other zoos is possible later
Who? LPF (with EAZA) / ZERYNTHIA / BCE
By when? 2026
Indicator? Captive population in place
Resources required? Personnel / cages

Objective 3.3 Reintroduction of Pieris cheiranthi on La Gomera

To prepare the reintroduction of the Canary Large White (*Pieris cheiranthi*) on La Gomera in order to re-establish a wild back-up population and fill a distribution gap.

Actions

3.3.1 Feasibility study to determine suitable reintroduction habitats for P. cheiranthi on La Gomera and appropriateness of suitable source populations

Note: Considering Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. Artículo 55. Reintroducción de especies silvestres autóctonas extinguidas.
Basis: Climate maps, micro-distribution of food plant
Purpose: Maximising reintroduction success probability
Who? BCE / ZERYNTHIA / ULL (botanists)
By when? 2025
Indicator? Map with priority sites for reintroduction
Resources required? Personnel

3.3.2 Compiling a reintroduction strategy for P. cheiranthi on La Gomera

Purpose: Maximising reintroduction success probability
Note: Consider IUCN reintroduction guidelines, consider research on the genetic structure under 2.3.2 and potential threats in the reintroduction area
How: Introduction of caterpillars or adults from captive breeding
Who? BCE / ICC / ZERYNTHIA
By when? 2026
Indicator? Reintroduction strategy exists
Resources required? Personnel

3.3.3 Preparation of recipient sites for new P. cheiranthi populations

Purpose: Maximising reintroduction success probability
Note: potentially sowing or promoting *Crambe* spp. etc. Introduction only with *Crambe* spp. that are native on the island
Who? Cabildos / Municipalities / Regional government / ZERYNTHIA / LPF / ULL (botanists)
By when? 2028
Indicator? Recipient sites have been optimised for reintroduction
Resources required? Personnel / travel costs

Goal 4: Assessment of existing plans and conservation management

An increase in large, well connected, sustainable areas of native laurel forest vegetation within the Canarian pollinators' ranges and a reduction in key threats across the Canary Islands.

Objective 4.1 Assessment of water management in laurel forest

To assess existing water management plans for each island by 2024 and instigate amendments in order to improve habitat suitability of high-altitude habitats.

Actions

4.1.1 Assessment of the suitability of water management plans for preserving the selected Canarian pollinator species on each island

Note: Each island has a different plan, a public consultation was in place for La Gomera; early participation in the ongoing public information procedures needed. The consultation period was closed in May 2022. This page provides links to the documentation of the third cycle hydrological plans, which are with the Ministry to examine and implement the received comments: https://www.miteco.gob.es/es/agua/temas/planificacion-hidrologica/planificacion-hidrologica/PPHH_tercer_ciclo.aspx.
Who? ULL / ZERYNTHIA / Insular Water Councils (Cabildos) (e.g. Consejo Insular de Aguas de La Gomera)
Collaboration with other experts (hydrologists) needed
By when? 2024
Indicator? Assessment report
Resources required? Personnel

4.1.2 Instigate amendments to water management plans on the Canary Islands where this is needed for the protection of the four Canarian pollinator species

Purpose: Increasing habitat availability and quality (might be necessary for reintroduction)
Who? ULL / ZERYNTHIA
Collaboration with other experts (hydrologists) needed
By when? 2025
Indicator? Water extraction reduced at least in one key habitat
Resources required? Personnel

Objective 4.2 Reduce the risk of importing potentially harmful alien species

To review the existing list of potentially invasive species for the Canary Islands and instruct inspection services for health of vegetable products in order to minimise potential future threats of introducing potentially harmful alien species, such as *Pieris brassicae*.

Actions

4.2.1 Review the existing lists of potentially invasive alien species on the Canary Islands for potential gaps

Some more information is found here: https://www.miteco.gob.es/es/biodiversidad/temas/conservacion-de-especies/especies-exoticas-invasoras/default.aspx
Who? ULL / ZERYNTHIA / BCE
By when? 2024
Indicator? Import of potentially invasive alien species reduced
Resources required? Personnel

4.2.2 Instruct inspection services for health of vegetable products regarding the risk of introducing P. brassicae eggs or caterpillars

Note: A special sanitary regulation (decree) exists for Canary Islands (including Cabbage)
Who? ZERYNTHIA / LPF / GC / Agricultural Ministry
By when? 2023
Indicator? Inspection services have included steps to reduce risk of *P. brassicae* introduction
Resources required? Personnel / travel costs

Objective 4.3 Pesticide reduction

To work with farmers on the reduction of pesticide use in order to mitigate risk to the four selected pollinators.

Actions

4.3.1 Reduction of pesticide use in farmland adjacent to habitats of the four selected Canarian pollinators

How? Beekeepers make contracts with farmers for pollination of their fields, including the requirement to ban pesticides.
Who? Beekeepers / ZERYNTHIA / ULL
By when? 2022
Indicator? Number of contracts between beekeepers and farmers
Resources required? Volunteer time

Objective 4.4 Improving pollinator conservation in protected areas

To facilitate collaboration of park managers and entomologists, review existing habitat management plans, create management principles for lesser known pollinators and create micro-reserves in order to improve consideration of pollinators in protected areas.

Actions

4.4.1 Better consideration of threatened pollinator species in existing protected areas on the Canary Islands by facilitating collaboration between PA management and entomologists

Purpose: Avoiding neglect of threatened pollinators
Who? ULL / Cabildos / Canarian Government / ZERYNTHIA / IPNA CSIC
By when? 2024
Indicator? Regular meetings
Resources required? Personnel

4.4.2 Analyse existing habitat management plans for Natura 2000 areas on the Canary Islands for potential gaps regarding the conservation of the four selected Canarian pollinator species

Links: https://www.gobiernodecanarias.org/planificacionterritorial/temas/informacion-territorial/enp/
https://www.gobiernodecanarias.org/medioambiente/temas/biodiversidad/espacios_protegidos/red-natura-2000/red_natura_2000_en_canarias/planes-gestion-zec/
Purpose: Analyse plans for potential gaps for consideration of pollinators along ecotones
Who? ULL / ZERYNTHIA / Cabildos / Gobierno de Canarias
By when? 2025
Indicator? Pollinators considered in plans for protected areas
Resources required? Personnel

4.4.3 Creating habitat management principles for L. chalcodes and H. adpropinquans based upon the best knowledge and revise based on new knowledge

Note: As the habitat requirements of *L. chalcodes* and *H. adpropinquans* are not sufficiently well known, this action needs to consider the results of research conducted under 2.1.5 and 2.1.6
Who? ULL / HSG
By when? 2027
Indicator? Habitat management measures conducted
Resources required? Personnel

4.4.4 Delimitation of critical areas for the four selected species and creation of micro-reserves (special zones/ exclusion zones within larger protected areas, e.g. site of specific interest) across the Canary Islands

Note: One should be at the southernmost population in Tenerife (Barranco del Infierno).
Purpose: Better legal protection of the last remaining habitats
Who? ZERYNTHIA / Government / Municipalities
By when? 2030
Indicator? Microreserves exist
Resources required? Personnel

Objective 4.5 Laurel forest restoration and conservation

To increase potential habitat of Canarian pollinators by facilitating laurel forest restoration and improving preservation of laurel forest ecotones

Actions

4.5.1 Review and update existing plans for laurel forest restoration on the Canary Islands with a focus on key areas for the four threatened pollinators

Purpose: Increasing availability of habitat
Note: A laurel forest restoration plan exists (from 1999) and needs to be updated. Laurel Forest restoration will also help to mitigate mesoclimatic effects and as a measure to mitigate global warming by enhancing carbon storage. Laurel forest restoration is particularly needed on Gran Canaria!
Who? ULL / Cabildos / ZERYNTHIA / HSG / BCE
By when? 2026
Indicator? Updated plans for laurel forest restoration
Resources required? Personnel

4.5.2 Avoiding degradation of laurel forest ecotones on the Canary Islands

Purpose: Reduction of pressures to the populations of pollinators
Note: As the threats to *L. chalcodes* and *H. adpropinquans* are not sufficiently well known, this action needs to consider the results of research conducted under 1.2.1 and 1.2.2; Laurel forests have a high priority (and management plans); in line with management plans of Natura 2000 (these have actions to address threats)
Potential threats: invasive alien species; recreational activities; bee-keeping
Who? ULL / Cabildos
By when? 2027
Indicator? Threat mitigation measures conducted
Resources required? Personnel

Goal 5: Public awareness

An increase in awareness of the importance of native pollinators and their habitats and threats on the Canary Islands, as well as more citizens actively engaged in their conservation.

Objective 5.1 Public awareness of endemic pollinator species

To increase public awareness of endemic pollinator species on the Canary Islands, their importance and genetic uniqueness of populations and their food plants and habitats, such as ecotones.

Actions

5.1.1 Creating a website to share information on the Canarian pollinator conservation project, with pages dedicated to the four selected pollinators

Who? LPF / ZERYNTHIA / ULL
By when? 2023–2028
Indicator? Website in place and updated
Resources required? Personnel / designer / website fee

5.1.2 Organise a campaign to raise awareness among the general public for the threatened Canarian pollinators (press, educational centres, schools, farmers, municipalities, foresters)

Purpose: Increasing public awareness of the importance of endemic pollinators
Note: Cabildo on Tenerife has pollinator campaign (others may need support)
Who? LPF / ZERYNTHIA / beekeepers / ULL
By when? 2023
Indicator? Awareness campaign started
Resources required? Personnel / material

5.1.3 Creating material for schools on the Canary Islands to inform about the threatened Canarian pollinators

Who? ZERYNTHIA / ULL / LPF
By when? 2023
Indicator? Material for schools completed
Resources required? Personnel / material

5.1.4 Butterfly/Pollinator Oasis Campaigns (schools, municipalities, etc.) on the Canary Islands

Note: Any action in education centres needs approval
Who? ZERYNTHIA / ULL / LPF
By when? Starting 2022
Indicator? Campaigns conducted
Resources required? Personnel / material

5.1.5 Create information signs along hiking trails (also visitor centres) where the four selected Canarian pollinator species occur

Who? ZERYNTHIA / ULL / Cabildos
By when? 2024
Indicator? Signs completed
Resources required? Personnel / material

5.1.6 Raise awareness of the importance of the four selected pollinators, and pollinators in general with specific local communities, by identifying those living closest to the last remains of laurel forest.

Purpose: Improving connection of local communities to their neighbouring fauna
Who? LPF / ZERYNTHIA / Cabildos
By when? 2024
Indicator? Information events conducted
Resources required? Personnel / material

Objective 5.2 Behaviour change

To raise awareness of and reduce threats posed by importing potentially invasive alien species or causing wildfires on the Canary Islands.

Actions

5.2.1 Increasing outreach of existing awareness campaigns on the Canary Islands regarding the risk of wildfires and the negative effects on threatened pollinators

Purpose: Reducing wildfire risk
Note: Cabildos have ongoing campaigns, NGOs and other stakeholders can help to increase outreach
Who? LPF / ZERYNTHIA / Cabildos
By when? 2023
Indicator? Social media posts on risks of causing wildfires
Resources required? Volunteer time

5.2.2 Raising awareness of the risk of inter-island transfer of endemic organisms on the Canary Islands as a possible threat to their genetic diversity

Purpose: Education on the threat of gene pool swamping and value of unique genetic (evolutionary) heritage on each island
Who? LPF / ZERYNTHIA / ULL / TU
By when? 2024
Indicator? Education material available
Resources required? Personnel

Objective 5.3 Citizen engagement

To provide means for citizens and institutions to engage in pollinator conservation by planting food plants for Canarian pollinators and removing human litter from habitats.

Actions

5.3.1 Promote growth of Crambe spp. in habitats of P. cheiranthi on the Canary Islands

Note: Needs to be informed by research (action 2.1.2); ensure correct *Crambe* species are promoted
How: seed collection, cultivation, e.g. with Botanical Garden?
Who? ZERYNTHIA / BCE ideally with other partners, such as ULL (Botany), Vivero insular de flora autóctona de Tenerife, Jardín de aclimatación da la Orotava, Vivero Caldera de Taburiente
By when? 2024
Indicator? Increased population of *Crambe* spp.
Resources required? Personnel, plant nursery, volunteers

5.3.2 Promote planting of Rhamnus spp. as shrubs in the green spaces of towns and cities, as well as private gardens and schools on the Canary Islands

Who? ZERYNTHIA / BCE ideally with other partners, such as ULL (Botany), Vivero insular de flora autóctona de Tenerife, Jardín de aclimatación da la Orotava, Vivero Caldera de Taburiente
By when? 2024
Indicator? More localities with *Rhamnus* spp. plants
Resources required? Personnel, plant nursery, volunteers

5.3.3 Improve the habitats of selected Canarian pollinators by removing litter of human origin and invasive plants

Purpose: Improving habitat quality, which is also useful to raise public awareness
How? Citizen campaign
Who? Cabildos / ZERYNTHIA / Oficina del voluntariado de Tenerife
By when? 2025
Indicator? Reduction of litter in key habitats
Resources required? Personnel, material, volunteers

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Annex I: Agenda

"Canary Islands multi-species Action Plan for Pollinators" Online Workshop

22 and 23 November 2021

The link to join the workshop will be provided to registered participants by email

Monday 22 November 2021

13:00	Welcome and introduction
13:20	What is the IUCN and the ICC? What is Strategic Conservation Planning?
13:30	Background of the project, outlining the workshop
13:40	Biology and Conservation of *Pieris cheiranthi, Gonepteryx cleobule, Eucera hohmanni,* and *Heringia adropinguans*
14:00	Historic and current species distribution, status assessment and threats
14:45	Coffee Break
15:00	Vision, Goals and Objectives
16:10	Discussion on major objectives: I Research
17:00	End of day 1

Time zone: Canary Islands, Spain (GMT+1)

Tuesday 23 November 2021

13:00	Discussion on major objectives: II Conservation management
14:00	Discussion on major objectives: III Monitoring
15:00	Coffee break
15:10	Discussion on major objectives: IV Legal protection
15:50	Discussion on major objectives: V Outreach
16:45	Discussion on major objectives: VI Funding
17:00	Conclusions
17:30	End of day 2

Annex II: Action Plan

Annex II: Action Plan

The plan is organised in two phases (2023–2026 and 2027–2030). Grey cells show general times of activity, while dark grey cells show the milestones as defined in the Action Plan.

Goal	Objective	Action	Text		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	1.1	1.1.1	Creation of a steering group		x	x	x	x	x	x	x	x	x	x
1	1.2	1.2.1	Motion for Biodiversity Strategy Tenerife		x									
1	1.2	1.2.2	Canarian Catalogue of Threatened Species			x	x							
1	1.2	1.2.3	Spanish Catalogue of Threatened Species				x	x	x	x				
2	2.1	2.1.1	Survey on distribution and abundance				x							
2	2.1	2.1.2	Study on suitability of *Crambe* species for *P. cheiranthi*				x	x						
2	2.1	2.1.3	Study on suitability of *Rhamnus* species for *G. cleobule*				x	x						
2	2.1	2.1.4	Study on host plant distribution				x	x						
2	2.1	2.1.5	Research on nesting requirements of *L. chalcodes*				x	x						
2	2.1	2.1.6	Research on habitat requirements of *H. adpropinquans*				x	x						
2	2.1	2.1.7	Study on nectar plants				x	x	x	x	x			
2	2.2	2.2.1	Research on threats to *L. chalcodes*				x	x	x					
2	2.2	2.2.2	Research on threats to *H. adpropinquans*				x	x	x					
2	2.2	2.2.3	Research on future habitats under climate change				x							
2	2.2	2.2.4	Research on role of parasitoids					x	x	x				
2	2.2	2.2.5	Research on agrochemicals			x	x							
2	2.2	2.2.6	Research on effects of bee-keeping				x	x	x					
2	2.3	2.3.1	Taxonomic study on *L. chalcodes*				x							
2	2.3	2.3.2	Genetic study on *P. cheiranthi*				x	x	x	x				
2	2.3	2.3.3	Genetic study on *G. cleobule*				x	x	x	x				
2	2.3	2.3.4	Population genetics of *L. chalcodes*				x	x	x					
2	2.3	2.3.5	Population genetics of *H. adpropinquans*							x	x	x		
2	2.4	2.4.1	Ten new butterfly monitoring transects				x	x	x					
2	2.4	2.4.2	Monitoring protocols *for L. chalcodes* & *H. adpropinquans*				x	x	x					
2	2.4	2.4.3	Monitoring effectiveness of conservation action				x	x	x	x	x	x	x	x
2	2.4	2.4.4	Monitoring conservation status trend (Green-listing)								x	x		

Canarian Islands endemic pollinators of the Laurel Forest zone
Conservation plan 2023–2028

Annex II: Action Plan

Goal	Objective	Action	Text		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
3	3.1	3.1.1	Species Recovery Plan *P. cheiranthi*			x	x							
3	3.2	3.2.1	Identification of source populations			x	x							
3	3.2	3.2.2	Development of captive breeding protocol			x	x	x						
3	3.2	3.2.3	Collection of eggs, caterpillars or adult females					x	x					
3	3.2	3.2.4	Captive breeding on Tenerife						x	x				
3	3.3	3.3.1	Reintroduction feasibility study					x	x					
3	3.3	3.3.2	Reintroduction strategy						x	x				
3	3.3	3.3.3	Preparation of recipient sites							x	x	x		
4	4.1	4.1.1	Assessment of water management plans				x	x						
4	4.1	4.1.2	Amendments to water management plans					x	x					
4	4.2	4.2.1	Review list of invasive species				x	x						
4	4.2	4.2.2	Instruct inspection services				x							
4	4.3	4.3.1	Reduce pesticide use in farmland			x	x	x	x	x				
4	4.4	4.4.1	Consideration of pollinators in PAs				x	x						
4	4.4	4.4.2	Analyse habitat management plans for Natura 2000				x	x	x					
4	4.4	4.4.3	Management principles for *L. chalcodes*/*H. adpropinquans*				x	x	x	x	x			
4	4.4	4.4.4	Create micro-reserves				x	x	x	x	x	x	x	x
4	4.5	4.5.1	Review laurel forest restoration plans				x	x	x	x				
4	4.5	4.5.2	Avoid degradation of laurel forest ecotones				x	x	x	x	x			
5	5.1	5.1.1	Website to share information on Canarian pollinator project				x	x	x	x	x	x	x	x
5	5.1	5.1.2	Awareness campaign				x	x	x	x	x	x	x	x
5	5.1	5.1.3	Material for schools				x	x	x	x	x	x	x	x
5	5.1	5.1.4	Butterfly/Pollinator Oasis Campaign			x	x	x	x	x	x	x	x	x
5	5.1	5.1.5	Signs along hiking trails					x	x	x	x	x	x	x
5	5.1	5.1.6	Awareness raising with local communities				x	x	x	x	x	x	x	x
5	5.2	5.2.1	Increase outreach of existing campaigns on wildfires				x	x	x	x	x	x	x	x
5	5.2	5.2.2	Raise awareness for risk of inter-island transfer					x	x	x	x	x	x	x
5	5.3	5.3.1	Promote growth of Crambe				x	x	x	x	x	x	x	x
5	5.3	5.3.2	Promote planting of Rhamnus				x	x	x	x	x	x	x	x
5	5.3	5.3.3	Improve habitats by removing litter						x	x	x	x	x	x

Canarian Islands endemic pollinators of the Laurel Forest zone
Conservation plan 2023–2028