

SPECIES ACTION PLAN
FOR THE MADEIRAN LARGE WHITE
Pieris wollastoni

Butterfly Conservation Europe
Madeira Fauna & Flora

SPECIES ACTION PLAN

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Preferred citation:

Wiemers, M., Ellis, S., Cosma, E., Sevilleja, C., van Swaay, C. A. M., Wynhoff, I., Gallego-Zamorano, J. and Marques Teixeira, S. B. (2022). Species Action Plan for the Madeiran Large White *Pieris wollastoni*. Butterfly Conservation Europe.

Keywords: Conservation, threats, Madeira, endemic species, endangered species.

With the financial support of:



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INTRODUCTION

This document presents a summary of all the information available for the Madeiran Large White *Pieris wollastoni* and the results of the field surveys undertaken during the field season of July to October 2021.

Species Recovery Plans (SRPs) are documents which bring together relevant information about a given threatened species, present an analysis of the threats that the species faces, and list actions needed to reverse these threats. If successful, these actions will help protect the species from extinction and greatly improve its conservation status. SRPs are vital tools for the conservation of highly threatened animal and plant species. However, in Madeira, recovery plans have never been produced for endemic butterfly species, and therefore one of the aims of this document is to fill this gap and provide for the first time guidance for the conservation of threatened endemic butterflies.

This Species Action Plan is one of the outputs of the *Conservation of Madeira's Threatened Endemic Butterflies* partnership project by Butterfly Conservation Europe and Madeira Fauna & Flora, funded by LIFE4BEST.

The production of this SRP involved three steps. First, we gathered all the information available for the species in the form of scientific papers, reports and distribution records. Second, fieldwork was planned to survey a selection of areas within the Madeira Nature Park (Parque Natural da Madeira PNM), recording the distribution and abundance of the adult butterflies using a standardised methodology. Casual observations were also made of the species' ecology (e.g., nectar sources, larval hostplants), as well as any threats to the butterfly at each survey site. Photographs of typical habitat and identified threats were also taken at each survey site regardless of whether the species was present. Finally, we met with local stakeholders and conservation experts to develop appropriate measures and discussed possible conservation actions during 2022.

The document is divided into three main sections. The first section summarizes the available information for the species and shows new data gathered during the project. A second section deals with information that is relevant for the conservation of the species, particularly an analysis of the threats that have been mentioned for the species. The final section explains in detail the specific actions that are proposed. At the end of the document there is a comprehensive list of references and an acknowledgement section.

IDENTIFICATION

Wing morphology

This is a large butterfly with a wingspan of 55-72 mm (Wakeham-Dawson & Franquinho Aguiar 2001). The wing colour is white with a black apex on the upperside and black discal spots on the underside forewing. Females also have two black discal spots on the upperside forewing. In comparison with the Large White *Pieris brassicae*, the black markings are better developed, especially in the female, but less so than in the Canary Large White *Pieris cheiranthi*. Therefore, the appearance of *Pieris wollastoni* is intermediate between those two species (Figure 1) and similar to its hybrids (Gardiner 1964).



Figure 1. Male and female of *Pieris wollastoni* (ex NHMW). Photo: Martin Wiemers

Immature stages

The egg has not been described but is probably cone-shaped and yellowish as in *Pieris brassicae* and *Pieris cheiranthi*, with an unknown number of vertical keels.

The larva is similar to that of *Pieris brassicae* but the dark yellow lines on the back and on the side are wider and the region below the yellow side line is bluish green, whereas this region is weakly yellowish in *P. brassicae* (Oehmig 1979). The head capsule is similar to the one of *P. brassicae* with a broad black mark and unlike in *P. cheiranthi* (Figure 2).



Figure 2. Caterpillar of *Pieris wollastoni* in its last instar. Photo: Steffen Oehmig, in coll. ZFMK

The pupa is similar and only slightly larger in comparison to the one of *Pieris brassicae* (Figure 3).



Figure 3. Pupae of *Pieris wollastoni*. Photo: Steffen Oehmig, in coll. ZFMK

The early stages are figured here for the first time, based on photos taken by the late Steffen Oehmig, which are kept at the Museum Alexander Koenig in Bonn.

TAXONOMY

Common name: Madeiran Large White (English) or Grande Branca da Madeira (Portuguese)

Scientific name: *Pieris wollastoni* (Butler, 1886)

Phylum: Arthropoda

Class: Insecta

Order: Lepidoptera

Family: Pieridae

Ten species of the mainly holarctic genus *Pieris* occur in Europe, four of which have been recorded in the Macaronesian Islands.

Pieris wollastoni was first recorded from Madeira by Felder (1862) as *Pieris cheiranthi* and described as a distinct species named *Ganoris wollastoni* by Butler

(1886). Nevertheless, many subsequent authors such as Kudrna (1973) only consider it as a subspecies of *P. brassicae* due to morphological similarities. Phylogenetically, however, it appears very closely related to *Pieris cheiranthi cheiranthi* Hübner, 1808 from Tenerife, at least according to its mtDNA (Wiemers *et al.*, 2020). *Pieris cheiranthi* (Hübner, 1808) is an endemic to the Canary Islands, where it occurs on Tenerife, La Palma (ssp. *benchoavensis*) and formerly also on La Gomera, where it became extinct in the 1970s. It is closely related to *Pieris brassicae* (Linnaeus, 1758), which is widespread in the Palearctic Region and naturalized in some other regions of the world such as Chile (since 1974), South Africa (since 1994) and temporarily in New Zealand (first record in 2010) until its eradication in 2014. In the Macaronesian Islands, *Pieris brassicae* occurs only in the Azores (already reported there in 1857), but single strays have also been observed in the Canary Islands, e.g. on Lanzarote (Wiemers 1992). The population on the Azores has been described as a distinct subspecies (*azorensis* Rebel, 1917), but does not differ from populations in mainland Portugal in COI barcodes. The Small White *Pieris rapae* (Linnaeus, 1758) occurs in the Canary Islands and established on Madeira in the 1970s (Wolff 1975), but is absent from the Azores.

DISTRIBUTION

Historical distribution

P. wollastoni is a European endemic restricted to Madeira Island. It used to be widely distributed on the island with the exception of the Ponta de São Lourenço and occurred in different habitats from sea level to 1800 m altitude, but preferentially in laurel forests at medium altitudes. Wakeham-Dawson *et al.* (2002) collated the locations of specimens in museum and private collections, as well as records in published and unpublished papers for the periods 1850-1900, 1900-1950 and 1950-2000 and plotted them on a UTM grid of 1km² (Figure 4). *P. wollastoni* was recorded from 78 grid cells, 5 of them during the second and 75 during the third period, with the last ones from August 1985 (Graham 1986). Interestingly, all the records during the period 1900-1950 are situated at medium altitudes in the central parts of the island, whereas many records during the period 1950-2000 are from locations near the coast.

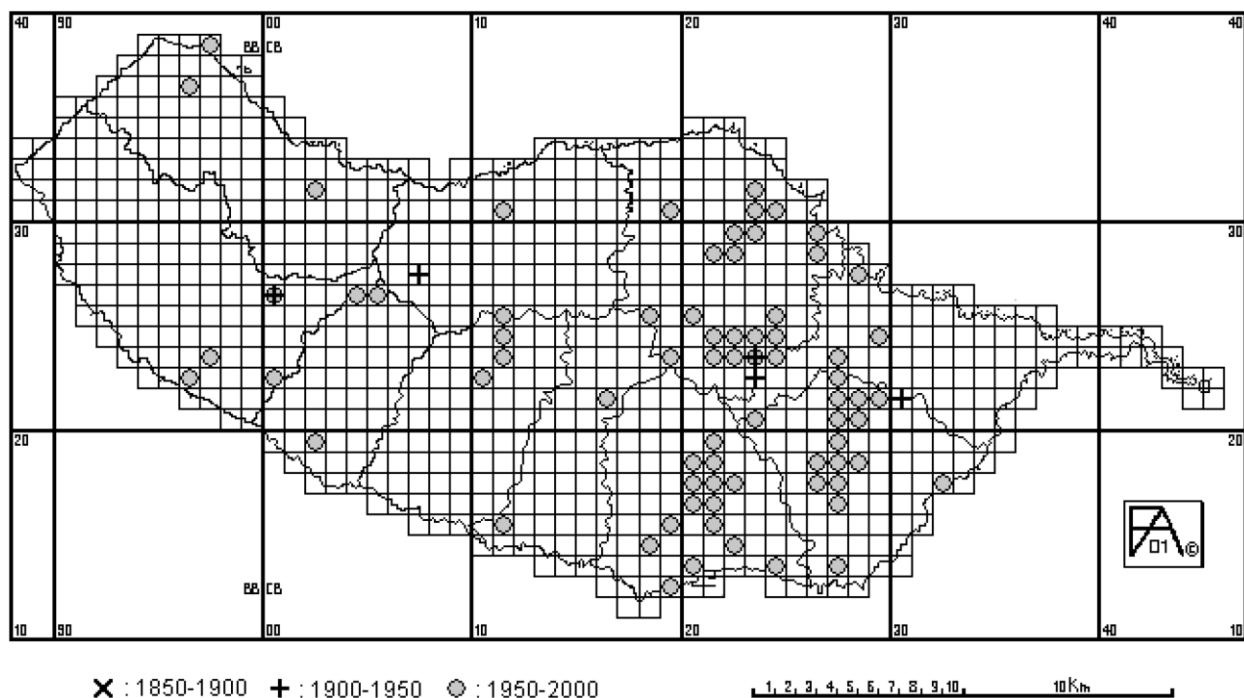


Figure 4. *Historical distribution of Pieris wollastoni*. Source: Wakeham-Dawson et al. (2002) Reproduced with the kind permission of the authors and the publisher

Current distribution

Surveys were undertaken in August and September 2021 by walking 49 pre-defined transect routes of approximately 5km length, focussing primarily on laurisilva forest but also including other forest types, some open habitats and close to urban areas. Recording was usually undertaken on both outward and return walks, so approximately 10 km was surveyed per transect route. Both butterfly distribution and abundance of all species were recorded using the 15-minute Count function in the ButterflyCount app (see <https://butterfly-monitoring.net/bms-methods> for method details). A total of 648 timed counts were made.

During these counts no individuals of *Pieris wollastoni* were seen, confirming the extinction of the species (see **POPULATION**).

HABITAT

Habitat description

P. wollastoni seems to have been restricted to forests at middle altitudes (500-1,000m a.s.l.) until 1950, but afterwards was also recorded in cultivated land. In the study by Lace & Jones (1984), however, it was exclusively associated with Laurel and Tree Heather habitats.

BIOLOGY

Phenology and behaviour

P. wollastoni has been recorded from March to the November, probably in about 3-4 generations with a short pupal diapause in winter. Larvae have been reported in August (Wolff 1975). Little else is known about its behaviour.

Larval foodplants

Cabbage (*Brassica oleracea*) and Nasturtium (*Tropaeolum majus*) constitute the only published larval hostplants for *Pieris wollastoni* (Fonteneau 1971; Aguiar & Karsholt 2006) and Oehmig (1979) successfully bred the larvae on the former. However, both were introduced into Madeira only after human colonization during the 15th century, which raises the question of suitable native hostplants.

Pieris caterpillars only feed on plants with glucosinolates which are found in the plant families Brassicaceae and Tropaeolaceae. Due to their gregarious life style, only plants with sufficient size and/or large leaves are capable of supporting a colony of larvae until pupation. In the Canary Islands, *Pieris cheiranthi* larvae use species of the genus *Crambe*, which are endemic to the Macaronesian Islands. *Brassica oleracea* is only rarely used as a hostplant there, but the introduced *Tropaeolum majus* is a favourite hostplant in parts of Tenerife. The only *Crambe* species on Madeira is *C. fruticosa*, which is a rather small plant and almost only grows on coastal cliffs. However, the endemic genus *Sinapidendron* contains more suitable hostplant species, in particular *S. gymnocalyx*, a glabrous shrub which is not uncommon on the cliffs of the north coast from sea level to 500 m and sporadically at altitudes up to 1000 m. This species is currently listed as Near Threatened in the IUCN Red List. According to Isamberto Silva (pers. comm. to Sérgio Teixeira) caterpillars of *Pieris wollastoni* were actually observed on this plant during the 1970s (e.g. in 1972). All the other *Sinapidendron* species are now very rare and listed either as Endangered or even Critically Endangered on the IUCN Red List, but some of them (such as *S. frutescens* or *S. ruprestre*) might have been important foodplants in former times.

Eggs

No details on the eggs and their positioning on hostplants have been published. According to Oehmig (1979), egg development takes 9 days.

Larva

Larvae feed gregariously and take 26-27 days until pupation (Oehmig 1979).

Pupation

Under laboratory conditions, the pupal stage lasted 13-16 days and the complete development cycle took 49-54 days (Oehmig 1979).

Nectar sources

Oehmig (1977) observed adult feeding on *Agapanthus praecox orientalis* (syn. *umbellatus*) along roadsides, on the yellow flowers of *Sonchus fruticosus* (syn. *squarrosus*) near Rabaçal and on the white flowers of *Origanum virens*.

Natural enemies

Pieris species are thought to be distasteful to predators due to uptake of glucosinolates, but parasitism by the wasp *Cotesia glomerata* (Braconidae) is common in *Pieris brassicae* and has also been reported for *Pieris cheiranthi* (Lozan *et al.*, 2007). No information on parasitism is available for *Pieris wollastoni*.

POPULATION

According to Wakeham-Dawson *et al.* (2002), *Pieris wollastoni* was rather uncommon and mostly restricted to laurel forests of middle altitudes until 1950, but became more widespread and numerous during the 1960s to 1970s, when it also appeared in cultivated areas at lower altitudes. After the establishment and subsequent population explosion of *Pieris rapae* in the 1970s (Wolff 1975), the species declined quickly and no reliable observations are known after 1986, when the last known specimen (a female) was captured near Seixal on 21 October by Antonio Bivar de Sousa (pers. comm.). After 1981, *P. wollastoni* seemed to have retreated again to laurel forests on the north side of the island, where only few individuals were seen.

CONSERVATION

Conservation status

P. wollastoni was assessed as Critically Endangered and a Species of Global Conservation Concern by van Swaay and Warren (1999). It was listed as Critically Endangered (Possibly Extinct) for both pan-Europe and the EU 27 in the European Red List of Butterflies (van Swaay *et al.*, 2010).

According to the International Union for Conservation of the Nature, the global conservation status of *P. wollastoni* is Critically Endangered (Possibly Extinct) B1 ab(v); *The IUCN Red List of Threatened Species* 2010 (downloaded on 17th September 2022). We propose to change its status to Extinct for the next version of the IUCN Red List.

THREATS

The reasons for the sudden decline are unknown, but some relationship with the introduction and sudden mass occurrence of *Pieris rapae* appears probable. According to Gardiner (2003), the reason might not have been direct competition, but the associated import of another strain of granulosis virus, to which *P. wollastoni* was not adapted. Another possible cause could have been the associated introduction of an alien parasitoid such as *Cotesia glomerata* (Lozan *et al.* 2007). Interestingly, *Pieris rapae* is now much less common than it must have been in the late 1970s, probably due to biotic interactions with parasites and/or viruses. Other possible reasons for the demise of *P. wollastoni* include pesticide use in cabbage fields and the decline of its native hostplant.

SPECIES ACTION PLAN

Survey and monitoring

Despite extensive surveys, *Pieris wollastoni* has not been observed for 36 years. Because it is a rather large and conspicuous butterfly, it is reasonable to assume that the species is now extinct.

Review

We suggest to produce a historical account of all known specimens in collections including photographs of specimens and labels. This would improve our knowledge on distribution and phenology and provide important information on the range of individual variation.

In order to verify whether the introduction of *Cotesia glomerata* could be a possible reason for the extinction of this species, all available records of this parasitoid from Madeira should be collated and evaluated.

Research

Although the species appears to be extinct, dried specimens still exist in museum collections, which allow further research with the help of modern genetic methods. Genome analysis could help to shed more light on the origin and age of *Pieris wollastoni* and the relationship to its congeners. Current data from morphology, biology and mitochondrial DNA are contradictory in this regard. Therefore, funding should be made available to carry out such studies.

Public awareness

Pieris wollastoni is currently the only known European butterfly species which appears to have become extinct in historical times. Although this means that efforts to save this species are now too late, raising public awareness about its fate can serve as an emblematic warning in order to prevent the extinction of other endangered endemic island invertebrates. The case of *Pieris wollastoni* shows that extinction on oceanic islands can happen very fast and therefore stresses the importance of regular surveys and monitoring, more detailed studies on the biology and ecology of island species and measures to prevent the introduction of invasive species.

Species Action Plan summary

ACTION	PRIORITY (High, Medium. Low)	PARTNERS (Lead partner in bold)	TIMESCALE
Review			
Documentation of all known specimens in collections with photos and collecting data	Medium	University of Madeira, Senckenberg	2023-2025
Collation of records of <i>Cotesia</i> parasitoids from Madeira	Medium	University of Madeira, Senckenberg	2023-2025
Research			
Study the genomics of <i>Pieris wollastoni</i> in order to better understand its origin and relationship with <i>P. cheiranthi</i> and <i>P. brassicae</i>	High	Senckenberg, University of Madeira	2023-2027
Public awareness			
Publicise the demise of <i>Pieris wollastoni</i> to a wider audience and raise awareness of the extinction risk to oceanic island endemics and its irreversibility	Medium	MF&F, BCE	2023-2027

ACKNOWLEDGEMENTS AND LITERATURE

Acknowledgments

The Species Action Plan for *Pieris wollastoni* is an output of the LIFE4BEST 2020-M-37 *Conservation of Madeira's Threatened Endemic Butterflies* partnership project by Butterfly Conservation Europe and Madeira Fauna & Flora.

Support was also provided by Butterfly Conservation (UK), De Vlinderstichting (Dutch Butterfly Conservation) and Senckenberg Deutsches Entomologisches Institut.

Together with the authors the following persons helped to deliver the project and their contribution is gratefully acknowledged:

Fieldwork: Constanti Stefanescu, Mike Prentice, Rudi Verovnik (BCE Board members), Gordana Glavan, Maria Fungomeli, Marta Miralles (BCE volunteers), Edgar Barros, Eva Gouveia, Marta Ramirez, Eva Nobrega, Joao Perestrelo, Manuel Contreras, Pedro Gouveia, Renato Ornelas, Rodrigo Silva (MF&F volunteers).

Development of species actions and revision of the manuscript: Constanti Stefanescu, Rudi Verovnik (BCE Board members), Duarte Barreto, José Jesus, Hugo Silva (IFCN), Dora Aguin-Pombo (University of Madeira).

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