



## Species Conservation Profiles

# Species conservation profile of moths (Insecta, Lepidoptera) from Azores, Portugal

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## Abstract

## Background

The few remnants of Azorean native forests harbour a unique set of endemic moths (Insecta, Lepidoptera), some of them under severe long term threats due to small sized habitats or climatic changes. In this contribution, we present the IUCN Red List profiles of 34 endemic moths to the Azorean archipelago, including species belonging to two diverse families: Noctuidae (11 species) and Crambidae (eight species). The objective of this paper is to assess all endemic Azorean moth species and advise on possible future research and conservation actions critical for the long-term survival of the most endangered species.

## New information

Most species have a large distribution (i.e. 58% occur in at least four islands), very large extent of occurrence (EOO) and a relatively large area of occupancy (AOO). Only nine species are single-island endemics, three of them from Flores, three from São Miguel and one from Pico, São Jorge and Faial. Most of the species also experience continuing decline in habitat quality, number of locations and subpopulations caused by the ongoing threat from pasture intensification, forestry, invasive plant species and future climatic changes. The lack of new records may indicate that one of the species previously named is extinct (*Eupithecia ogilviata*). Therefore, we suggest as future conservation actions: (1) a long-term species monitoring plan and (2) control of invasive species.

## Keywords

Azores, invasive species, islands, IUCN, Lepidoptera, moths, Portugal, species conservation profiles, rarity.

## Introduction

Knowledge on Lepidoptera from the Azorean archipelago is still scarce and skewed towards the diurnal species of Rhopalocera (Borges et al. 2010). Most of the published work on Azorean Lepidoptera are species lists containing information such as locality, capture date, collectors and brief taxonomic annotations (Carvalho et al. 1999). The first taxonomic studies on Azorean Lepidoptera in Azores consisted of the description of new species only presenting a detailed description of the wing pattern (Warren 1905, Rebel 1940). Subsequently, new explorations of the insular entomofauna revealed new taxa, whose taxonomic descriptions were expanded with information about the morphology of genitalia and how to distinguish them from related species (Pinker 1971, Meyer et al. 1997, Nuss et al. 1997). The number of endemic species of Lepidoptera in the Azores has continued to increase in the last years. Recent studies focus not only on species description, but also on the ecology and distribution of new taxa, providing crucial information towards the conservation of these taxa (Wagner 2014, Wagner 2015a).

In this contribution, we present the IUCN Red List profiles of 34 moth species endemic to the Azores, including 11 owlet moths (Noctuidae), eight grass moths (Crambidae), three geometer moths (Geometridae), three Stathmopodidae, three ermine moths (Yponomeutidae), two snout moths or pyralid moths (Pyralidae), one twirler moth or gelechiid moth (Gelechiidae), one leaf-miner moth (Gracillariidae), one plume moth (Pterophoridae) and one fungus moth or tineid moth (Tineidae), which represent the majority of families present in the Azores (Borges et al. 2010).

Several of the endemic taxa here listed are known from a single collected individual, so that one of the sexes is unknown. The lack of reference collections for species identification and

the low abundance of collected specimens for some taxa stresses the need for further studies that will allow a better understanding of the Lepidoptera fauna of the Azores.

The main objectives of this contribution are: 1) provide updated information on the distribution, abundance and ecology for the 34 Azorean endemic moths; 2) identification of the major threats involving these species; 3) the evaluation of the species conservation profiles for all known Azorean endemic moth species.

## Materials and Methods

To perform the IUCN Red List profiles, we followed the same procedure as in Borges et al. (2016), Borges et al. (2017) and Cardoso et al. (2017): i) the original species descriptions were investigated to learn about the habitats and ecology of the species; ii) recent literature was also consulted to obtain information about synonyms and critical information for the taxonomic notes; iii) for the calculation of AOO and EOO, we consulted the [Azorean Biodiversity Portal](#) and downloaded CSV files with the distribution of each species; iv) species images were obtained from specimens deposited in Coll. ZMUC (Credit: Anders Illum) and also from the repository available at the [Azorean Biodiversity Portal](#), the most important source of information on Azorean biodiversity. Species distributions in the Azores were obtained from the list of Azorean biota (Borges et al. 2010) with the addition of recently described species (Wagner 2014, Wagner 2015a, Wagner 2015b, Wagner 2017).

Prior to the calculation of area of occupancy (AOO) and extent of occurrence (EOO), the 500 m × 500 m cells obtained from [Azorean Biodiversity Portal](#) were filtered to consider only the cells with high level of precision: 1 – very precise locality, usually with known UTM data; and 2 – literature locality not exceeding 25 km<sup>2</sup>. The centroid for each cell was calculated to obtain the distribution points for each species. The calculation of AOO and EOO was performed using the [Geospatial Conservation Assessment Tool](#) (GeoCAT) and using an approximation to the standard IUCN 2 km × 2 km cells (4 km<sup>2</sup>). Final maps with species distributions were produced using the IUCN standards with Google Earth (.kmz files).

Critical information on species threats and conservation were mostly obtained from Triantis et al. (2010) and Ferreira et al. (2016).

## Species Conservation Profiles

### *Eudonia interlinealis* (Warren, 1905)

#### Species information

**Synonyms:** *Scoparia interlinealis* Warren, 1957

**Common names:** Grass Moth (English); Traça (Portuguese)

#### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Crambidae

**Taxonomic notes:** *Eudonia interlinealis* was described by Warren (1905) in the genus *Scoparia* from wing pattern characters. In a taxonomic revision of the Scopariinae from the Macaronesian Region, the species was transferred to *Eudonia* due to a detailed analysis of genitalia characters (Nuss et al. 1997). *Eudonia interlinealis* is distinguished from other species of genus *Eudonia* by the following characters: forewings long and narrow, dirty white, the antemedial and postmedial fascia triangular directed towards the medial area (Nuss et al. 1997). The species was also previously recorded for Azores as *Eudonia angustea* (Curtis, 1827) (misidentification) and *Scoparia angustea* Sph. 1905 (misidentification).

#### Region for assessment:

- Global

#### Figure(s) or Photo(s): Fig. 1

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

#### Geographic range

#### Biogeographic realm:

- Palearctic

#### Countries:

- Portugal



Figure 1. [doi](#)

*Eudonia interlinealis* (Warren, 1905) from Pico (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Map of records (Google Earth):** Suppl. material 1

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 41,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 324 km<sup>2</sup>.

**Min Elevation/Depth (m):** 0

**Max Elevation/Depth (m):** 2100

**Range description:** *Eudonia interlinealis* is an endemic species present in the islands of the Corvo, Flores, Faial, Pico, Graciosa, São Jorge, Terceira, São Miguel and Santa Maria (Azores, Portugal) (Nuss et al. 1997, Borges et al. 2010), known from 11 Natural Forest Reserves of Caldeiras Funda e Rasa (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Caveiro (Pico); Pico Pinheiro and Topo (S. Jorge); Biscoito da Ferraria, Caldeira Sta. Bárbara e Mistérios Negros and Terra Brava (Terceira); Pico da Vara (S. Miguel) and Pico Alto (Sta. Maria).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 41,000

**Trend:** Stable

**Justification for trend:** The Extent of Occurrence includes large areas of unsuitable habitats. However, the species is widely distributed, occurring in all islands of the archipelago.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 324

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in all islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Locations**

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

### **Population**

**Trend:** Stable

**Justification for trend:** *Eudonia interlinealis* is a widespread and relatively high abundant species in the native forest. The species currently presents a stable population and occurs in all islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Eudonia interlinealis* has nine subpopulations, one per island, all of them relatively highly abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs in native forests (including *Erica azorica* shrublands) of Corvo, Flores, Faial, Pico, Graciosa, S. Jorge, Terceira, S. Miguel and S. Maria islands (Azores, Portugal).

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality (Triantis et al. 2010). Currently, invasive plant species are decreasing habitat quality changing the structure of the forest.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** This is a bivoltine species. The larva is unknown, but considered to be a specialist herbivore and the adult is frequently seen as a pollinator and has nocturnal activity. Known flight period: January, March to August, October to November (Nuss et al. 1997).

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly the creation of pastures (Triantis et al. 2010). Currently invasive plants *Pittosporum undulatum* and *Hedychium gardnerianum* are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting & alteration).

**Conservation**

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 1.2. Land/water protection - Resource & habitat protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Corvo, Faial, Flores, Graciosa, Pico, S. Jorge, Terceira, S. Miguel and S. Maria islands). Degraded habitats should be restored and a strategy needs to be developed to address future threats due to climate

change. A monitoring plan is necessary for the invertebrate community in the habitat in order to contribute to the conservation of this species. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** This species is not utilised.

**Ecosystem service type:** Very important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed on its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva and find extant specimens in additional natural forest areas in all islands of the Azores and to obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of this habitat. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Eudonia luteusalis* (Hampson, 1907)

### Species information

**Common names:** Grass Moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Crambidae

**Taxonomic notes:** *Eudonia luteusalis* was described by Hampson (1907) in the genus *Scoparia* from wing pattern characters. In a taxonomic revision of the Scopariinae from

Macaronesian Region, the species was transferred to *Eudonia* due to a detailed analysis of genitalia characters (Nuss et al. 1997). *Eudonia luteosalis* is distinguished from other species of genus *Eudonia* by the following characters: wing pattern of predominantly yellow ochre. Similar to *E. interlinialis* but is distinguished by the presence of an uncus distally slightly shorter and distally broader in the male genitalia (Nuss et al. 1997).

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 2



Figure 2. [doi](#)

*Eudonia luteosalis* (Hampson, 1907) from Pico (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range**

**Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 2

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 32,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 160 km<sup>2</sup>.

**Min Elevation/Depth (m):** 100

**Max Elevation/Depth (m):** 1400

**Range description:** *Eudonia luteusalis* is an endemic species present in the islands of Flores, Faial, Pico, S. Jorge, Terceira, S. Miguel and S. Maria (Azores, Portugal) (Nuss et al. 1997, Borges et al. 2010), known from eleven Natural Forest Reserves of Morro Alto e Pico da Sé (Flores); Caldeira do Faial (Faial); Mistério da Prainha, Caveiro and Caiado (Pico); Topo (S. Jorge); Biscoito da Ferraria, Pico Galhardo, Caldeira Sta. Bárbara e Mistérios Negros and Terra Brava (Terceira); and Pico Alto (Santa Maria).

### **Extent of occurrence**

**EOO (km<sup>2</sup>):** 32,000

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 160

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below) the species keeps stable subpopulations.

**Trend:** Stable

## Population

**Trend:** Stable

**Justification for trend:** The species is common in medium and high altitude areas in several islands (Flores, Faial, Pico, S. Jorge, Terceira, S. Miguel and S. Maria islands). The species presents currently a stable population.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Eudonia luteusalis* has seven subpopulations, all of them relatively abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs in native forests of Flores, Faial, Pico, S. Jorge, Terceira, S. Miguel and Santa Maria islands (Azores, Portugal). Altitudinal range: 100-1,400 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

**Ecology**

**Size:** 0.76

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The larva is unknown, but considered to be a specialist herbivore and the adult is frequently seen as a pollinator. Known flight period: July, August, October (Nuss et al. 1997), with probably two generations per year.

**Threats**

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly the creation of pastures (Triantis et al. 2010). Currently invasive plants *Pittosporum undulatum* and *Hedychium gardnerianum* are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting & alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 1.2. Land/water protection - Resource & habitat protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Faial, Flores, Pico, S. Jorge, Terceira and Sta. Maria). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. monitoring plan for the invertebrate community is necessary in the habitat in order to contribute to the conservation of this species. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva, to find extant specimens in additional natural forest areas of most of the Azorean islands and to obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of this habitat. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011)

## ***Eudonia melanographa* (Hampson, 1907)**

### **Species information**

**Synonyms:** *Scoparia melanographa* Hampson, 1907

**Common names:** Grass Moth (English); Traça (Portuguese)

### **Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Crambidae

**Taxonomic notes:** *Eudonia melanographa* was described by Hampson (1907) in the genus *Scoparia* as from wing pattern characters. In a taxonomic revision of the Scopariinae from Macaronesian Region, the species was transferred to *Eudonia* due to a detailed analysis of genitalia characters (Nuss et al. 1997). *Eudonia melanographa* is distinguished from other species of genus *Eudonia* by the following characters: wing pattern with forewings long and narrow, predominantly black, sprinkled with white. In the male genitalia, valva ventro-distally with a pointed process (Nuss et al. 1997).

### **Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 3

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

### **Geographic range**

### **Biogeographic realm:**

- Palearctic



Figure 3. [doi](#)

*Eudonia melanographa* (Hampson, 1907) from Teceira (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

#### Countries:

- Portugal

**Map of records (Google Earth):** Suppl. material 3

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 20,100 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 104 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 800

**Range description:** *Eudonia melanographa* is an endemic species present in the islands of the Flores, Pico, S. Jorge, Terceira and S. Miguel (Azores, Portugal) (Nuss et al. 1997, Borges et al. 2010). The species was observed flying in a quarry on the western slope of the volcano Pico (Nuss et al. 1997), which belongs to the Natural Park of Pico island. It can also be found in two Natural Forest Reserves of Morro Alto e Pico da Sé (Flores) and Caldeira Sta. Bárbara e Mistérios Negros (Terceira).

#### Extent of occurrence

**EOO (km2):** 20,100

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** Yes

**Causes understood?:** Yes

**Causes reversible?:** Yes

**Extreme fluctuations?:** Unknown

### Area of occupancy

**AOO (km<sup>2</sup>):** 104

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands. Occurs also at low altitude in human modified habitats.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Locations

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below) the species keeps stable subpopulations.

**Trend:** Stable

### Population

**Trend:** Stable

**Justification for trend:** *Eudonia melanographa* is a widespread but low abundant species. All the nine known subpopulations occur in a wide range of altitudes in the Azorean islands (Flores, Pico, S. Jorge, Terceira and S. Miguel), from 10 to 800 m. The species presents currently stable populations.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Eudonia melanographa* has five subpopulations, all of them relatively highly abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs in native forest of Azorean islands, with an altitudinal range between 10-800 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The adults fly from March to October and they rest and fly around rupicolous lichens (Nuss et al. 1997), with probably two generations per year. The larva is unknown, but considered to be a specialist herbivore and the adult is frequently seen as a pollinator.

## Threats

**Threat type:** Ongoing

### Threats:

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

### Threats:

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently invasive plants *Pittosporum undulatum* and *Hedychium gardnerianum* are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting & alteration).

## Conservation

**Conservation action type:** In Place

### Conservation actions:

- 1.1. Land/water protection - Site/area protection
- 1.2. Land/water protection - Resource & habitat protection

**Conservation action type:** Needed

### Conservation actions:

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Flores, Pico, S. Jorge, Terceira and São Miguel). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. A monitoring plan for the invertebrate community is necessary in the habitat in order to contribute to the conservation of this species. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva, to find extant specimens in additional natural forest areas of most of the islands of Azores and to obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of this habitat. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Scoparia aequipennalis* Warren, 1905

### Species information

**Synonyms:** *Eudonia mercurella* (L., 1758)

**Common names:** Grass Moth (English); Traça (Portuguese)

## Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Crambidae

**Taxonomic notes:** *Scoparia aequipennalis* was described by Warren (1905) and is distinguished from other species of genus *Scoparia* by the following characters: presence of a small group of four slightly bent cornuti connected at their bases in the phallus of the male genitalia and ductus bursae beyond corpus bursae thickened and with one loop (Nuss et al. 1997).

### Region for assessment:

- Global

### Figure(s) or Photo(s): Fig. 4



Figure 4. [doi](#)

*Scoparia aequipennalis* Warren, 1905 from Pico (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 4

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 41,600 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 380 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 2200

**Range description:** *Scoparia aequipennalis* is an endemic species present in the islands of the Corvo, Flores, Faial, Pico, Graciosa, S. Jorge, Terceira, S. Miguel and Santa Maria (Azores, Portugal) (Nuss et al. 1997, Borges et al. 2010). Within these nine islands, it is known from 15 Natural Forest Reserves of Morro Alto e Pico da Sé (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Mistério da Prainha, Caveiro and Caiado (Pico); Pico Pinheiro and Topo (S. Jorge); Biscoito da Ferraria, Pico Galhardo, Caldeira Guilherme Moniz, Caldeira Sta. Bárbara e Mistérios Negros and Terra Brava (Terceira); Atalhada and Pico da Vara (S. Miguel).

**Extent of occurrence**

**EOO (km2):** 41,609

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km2):** 380

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

## Population

**Trend:** Stable

**Justification for trend:** *Scoparia aequipennalis* is a widespread and particularly abundant species in native forests. The species presents a stable population and occurs in all the islands. We assume a stable population.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Scoparia aequipennalis* has nine subpopulations, all of them relatively high abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs in native forests of mid-high altitude in all the islands (Azores). Altitudinal range: 10-2200 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** Adults and larvae are herbivores; it flies from February to October (Nuss et al. 1997), with two or more broods around the year.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species subpopulations have probably strongly declined due to changes in habitat size and quality, mostly the creation of pastures (Triantis et al. 2010). Currently, invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Corvo, Faial, Flores, Graciosa, Pico, S. Jorge, Terceira, São Miguel and Santa Maria). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. A monitoring plan is necessary for the invertebrate community in the habitat in order to contribute to the conservation of this species. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** This species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into this species ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva. Also important will be the promotion of expeditions to find extant specimens in additional natural native forests of mid-high elevation in all the islands of Azores and obtain information on population size, distribution and trends. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

***Scoparia carvalhoi* Nuss, Karsholt & Meyer, 1997****Species information**

**Common names:** Grass Moth (English); Traça (Portuguese)

**Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Crambidae

**Taxonomic notes:** *Scoparia carvalhoi* was described by Nuss et al. (1997) and is distinguished from other species of genus *Scoparia* by the following characters: male genitalia with sickle-shaped cornutus in the central part of phallus and two smaller cornuti at the base of phallus and female genitalia with ductus bursae not looped, but with a bow anterior to ductus seminalis (Nuss et al. 1997).

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 5

**Reviewers:** Nicola Mumford



Figure 5. [doi](#)

*Scoparia carvalhoi* Nuss, Karsholt & Meyer, 1997 paratype from Pico (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Editor:** Pedro Cardoso

## Geographic range

### Biogeographic realm:

- Palearctic

### Countries:

- Portugal

**Map of records (Google Earth):** Suppl. material 5

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 14,320 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 44 km<sup>2</sup>.

**Min Elevation/Depth (m):** 100

**Max Elevation/Depth (m):** 700

**Range description:** *Scoparia carvalhoi* is an endemic species present in the islands of Faial, Pico, Terceira and Santa Maria (Azores, Portugal) (Nuss et al. 1997, Borges et al. 2010), known from native forest. Within these four islands, it is known from two Natural Forest Reserves of Caldeira do Faial (Faial) and Pico Alto (Santa Maria).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 14,320

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in four islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km<sup>2</sup>):** 44

**Trend:** Stable

**Justification for trend:** The species has a somewhat restricted distribution but is stable.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Locations**

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

**Population**

**Trend:** Stable

**Justification for trend:** *Scoparia carvalhoi* is restricted but relatively abundant in some of the locations with native forest. We assume a stable population, but with a tendency to

decline in the number of individuals that is inferred from the ongoing habitat degradation due to invasions of alien plants and from human activities.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Scoparia carvalhoi* has four subpopulations, all of them relatively highly abundant in the native forest. The species currently presents stable subpopulations.

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs in native forests of medium to high altitude in the Faial, Pico, Terceira and Santa Maria islands (Azores). Altitudinal range: 100-700 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** Larvae are herbivores; the moth flies in June and July (Nuss et al. 1997), with one or two broods per year.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.1. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Unspecified species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently, invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Faial, Pico, Terceira and Santa Maria). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. Further research is needed into its ecology and life history in order to find extant specimens. A monitoring plan is necessary for the invertebrate community in the habitat in order to contribute to the conservation of this species. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into this species ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva. Also important will be the promotion of expeditions to find extant specimens in additional natural native forests of mid-high elevation in all the islands of Azores and obtain information on population size, distribution and trends. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Scoparia coecimaculalis* Warren, 1905

### Species information

**Common names:** Grass Moth (English); Traça (Portuguese)

## Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Crambidae

**Taxonomic notes:** *Scoparia coecimaculalis* was described by Warren (1905) and is distinguished from other species of genus *Scoparia* by the following characters: male genitalia with a valva down-curved and phallus without cornutii and female genitalia with a base of ductus bursae thickened and with one loop before ductus seminalis (Nuss et al. 1997).

### Region for assessment:

- Global

**Figure(s) or Photo(s):** Fig. 6

### Geographic range

### Biogeographic realm:

- Palearctic

### Countries:

- Portugal



Figure 6. [doi](#)

*Scoparia coecimaculalis* Warren, 1905 from Pico (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Map of records (Google Earth):** Suppl. material 6

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 38,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 288 km<sup>2</sup>.

**Min Elevation/Depth (m):** 100

**Max Elevation/Depth (m):** 2200

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Range description:** *Scoparia coecimaculalis* is an endemic species present in the islands of Corvo, Flores, Faial, Pico, Graciosa, S. Jorge, Terceira, S. Miguel and Santa Maria (Azores, Portugal) (Nuss et al. 1997, Borges et al. 2010), known from native forest. Within these islands, it is known from sixteen Natural Forest Reserves: Caldeiras Funda e Rasa and Morro Alto e Pico da Sé (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Mistério da Prainha, Caveiro and Caiado (Pico); Pico Pinheiro and Topo (S. Jorge); Biscoito da Ferraria, Pico Galhardo, Caldeira Sta. Bárbara e Mistérios Negros and Terra Brava (Terceira); Graminhais and Pico da Vara (S. Miguel) and Pico Alto (Santa Maria).

### **Extent of occurrence**

**EOO (km2):** 38,000

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km2):** 288

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

## Population

**Trend:** Stable

**Justification for trend:** *Scoparia coecimaculalis* is a widespread and particularly abundant species in native forests. The species has probably a stable population.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Scoparia coecimaculalis* has seven subpopulations, all of them relatively highly abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Scoparia coecimaculalis* occurs in native forests in the Azorean archipelago. Altitudinal range: 100-2200 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

**Ecology**

**Size:** 0.57

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** Larvae are herbivores and adults are pollinators; the adult flies from January to October, but there are no records from June (Nuss et al. 1997), with one or two broods per year.

**Threats**

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010).

Currently, invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Corvo, Faial, Flores, Graciosa, Pico, S. Jorge, Terceira, São Miguel and Santa Maria). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate in native forests. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva, to find extant specimens in additional natural native forests of mid-high altitude in all the islands of Azores and to obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of this habitat. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

***Scoparia semiampalis* Warren, 1905****Species information**

**Common names:** Grass Moth (English); Traça (Portuguese)

**Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Crambidae

**Taxonomic notes:** *Scoparia semiampalis* was described by Warren (1905) and is distinguished from other species of genus *Scoparia* by the following characters: wing pattern with the forewings shining black and yellow, male genitalia without cornutii in the phallus and female genitalia without ductus bursae without loops (Nuss et al. 1997).

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 7

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso



Figure 7. [doi](#)

*Scoparia semiampalis* Warren, 1905 from Pico (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

## Geographic range

### Biogeographic realm:

- Palearctic

### Countries:

- Portugal

**Map of records (Google Earth):** Suppl. material 7

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 35,500 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 220 km<sup>2</sup>.

**Min Elevation/Depth (m):** 50

**Max Elevation/Depth (m):** 900

**Range description:** *Scoparia semiampalis* is an endemic species present in Flores, Faial, S. Jorge, Terceira, S. Miguel and Santa Maria islands (Azores, Portugal) (Nuss et al. 1997, Borges et al. 2010). Within these islands, it is known from ten Natural Forest Reserves: Caldeiras Funda e Rasa and Morro Alto e Pico da Sé (Flores); Caldeira do Faial (Faial), Topo (S. Jorge), Biscoito da Ferraria and Caldeira Sta. Bárbara e Mistérios Negros (Terceira); Atalhada, Graminhais and Pico da Vara (S. Miguel) and Pico Alto (Santa Maria).

**Extent of occurrence**

EOO (km<sup>2</sup>): 35,500

Trend: Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

AOO (km<sup>2</sup>): 220

Trend: Stable

**Justification for trend:** The species is widely distributed occurring in many islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Locations**

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

Trend: Stable

**Population**

Trend: Stable

**Justification for trend:** *Scoparia semiampalis* is a widespread and abundant species in native forest areas. The species presents stable populations.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Scoparia semiimplalis* has six subpopulations, all of them relatively highly abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Scoparia semiimplalis* is known in native forests of Flores, Faial, Pico, S. Jorge, Terceira, S. Miguel and Santa Maria islands (Azores). Altitudinal range: 50-900 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Size:** 0.55

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):**

We assume that the larvae are specialist herbivores and adults pollinators. The adult flies from April to October (Nuss et al. 1997), having possibly two or more generations per year.

## Threats

**Threat type:** Ongoing

### Threats:

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

### Threats:

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently, invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

### Conservation actions:

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

### Conservation actions:

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Faial, Flores, Pico, S. Jorge, Terceira, São Miguel and Santa Maria). Degraded habitats should be restored and a strategy needs to be developed to address the future threats by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrates in native forests. A habitat management plan is needed and anticipated to be developed over the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Very important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva, to find extant specimens in additional natural native forests of mid-high altitude in all the islands of Azores and to obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrates in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## ***Udea azorensis* Meyer, Nuss & Speidel, 1997**

### Species information

**Common names:** Grass Moth (English); Traça (Portuguese)

## Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Crambidae

**Taxonomic notes:** *Udea azorensis* was described by Meyer et al. (1997) and is distinguished from other species of the genus *Udea*, especially of *Udea ferrugalis* (Hübner, 1796) by the following characters: appearance of wing pattern similar to *U. ferrugalis* but is distinguished by the larger wingspan and the more contrasting drawing of the hindwings; valva distally narrow with a mediobasal process small and thorny, juxta distinctly U-shaped, phallus with cresciform cornutus in the male genitalia; antrum sclerotised, ductus bursae and ductus seminalis thickened and sclerotised. Corpus bursae large, oval with signum almond-shaped (Meyer et al. 1997). The species was also recorded for Azores as: *Udea delineatalis* (Walker, 1875) (misidentification); *Udea numeralis* (Hübner, 1796) (misidentification)

### Region for assessment:

- Global

### Figure(s) or Photo(s): Fig. 8



Figure 8. [doi](#)

*Udea azorensis* Meyer, Nuss & Speidel, 1997 from Pico (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 8

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 20,300 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 136 km<sup>2</sup>.

**Min Elevation/Depth (m):** 50

**Max Elevation/Depth (m):** 800

**Range description:** *Udea azorensis* is an endemic species present in Flores, Pico, S. Jorge, Terceira and S. Miguel islands (Azores, Portugal) (Borges et al. 2010), known from native herbaceous vegetation. Within these five islands, it is known from four Natural Forest Reserves of Biscoito da Ferraria, Pico Galhardo, Caldeira Guilherme Moniz and Terra Brava (Terceira).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 20,300

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in several islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km<sup>2</sup>):** 136

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in several islands and some of the host plants are widely distributed.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

## Population

**Trend:** Stable

**Justification for trend:** *Udea azorensis* is a widespread and relatively abundant species in native herbaceous vegetation of several habitats of the islands Flores, Pico, S. Jorge, Terceira and S. Miguel (Azores). The species presents currently stable populations.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Udea azorensis* has five subpopulations, all of them relatively abundant in the canopy of endemic trees. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Udea azorensis* occurs in several habitats with native herbaceous vegetation in the Flores, Pico, S. Jorge, Terceira and S. Miguel islands (Azores). Altitudinal range: 50-800 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat. In addition, some of the semi-natural grasslands were replaced by intensive pastures.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** It is assumed that the larvae are specialist herbivores and this moth may occur at almost any time of year (March to October), but most often in summer and autumn, with probably three generations per year.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Management of semi-natural pastures is critical for the conservation of this species. In some islands, the input of fertilisers is increasing. The spread of some invasive plants can also be a problem (e.g. *Hedychium gardnerianum*). These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation**

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Flores, Pico, S. Jorge, Terceira and São Miguel). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate in native forests. A habitat management plan is needed and anticipated to be developed during the coming years.

**Other**

**Use type:** International

**Justification for use and trade:** This species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.3. Monitoring - Trade trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva, to find extant specimens in additional habitats with native herbaceous vegetation areas of most islands of Azores and to obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrates community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## ***Brachmia infuscatella* Rebel, 1940**

### **Species information**

**Common names:** Twirler Moth; Gelechiid Moth (English); Traça (Portuguese)

### **Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Gelechiidae

**Taxonomic notes:** *Brachmia infuscatella* was described by Rebel (1940) and is distinguished from other species of genus *Brachmia* by the wing pattern description. It is necessary to re-analyse the taxon from the description of male, female genitalia and DNA barcode to compare with other species of its genus.

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 9

Figure 9. [doi](#)

*Brachmia infuscatella* Rebel, 1940 from Santa Maria (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range**

**Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 9

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 13,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 68 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 800

**Range description:** *Brachmia infuscatella* is an endemic species present in Faial, Pico, S. Jorge, Terceira and Santa Maria islands (Azores, Portugal) (Borges et al. 2010), known from native habitats (see Rebel 1940). It is known from the Natural Forest Reserve of Pico Alto (Santa Maria).

### Extent of occurrence

**EOO (km<sup>2</sup>):** 13,000

**Trend:** Decline (inferred)

**Justification for trend:** The species is widely distributed occurring in five islands. However, there are ongoing severe threats on most sites.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Area of occupancy

**AOO (km<sup>2</sup>):** 68

**Trend:** Decline (inferred)

**Justification for trend:** A decline in the AOO is inferred as a consequence of degradation of habitat caused by human activities and invasions of alien plants.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Locations

**Number of locations:** 7

**Justification for number of locations:** This species is rare through native vegetation of five islands, but is frequent in low altitude modified habitats and occurs in at least 7 locations under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations were made in the territory with impacts in native habitats. In the last ten years, the spread of invasive plants namely *Pittosporum undulatum* and *Hedychium gardnerianum* are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** The species is rare (low number of specimens known) and is known from populations in several elevation areas of the Faial, Pico, S. Jorge, Terceira and Santa Maria islands. A decline in the number of individuals is probably due to the degradation of habitat caused by human activities and invasions of alien plants.

**Basis for decline:**

- (a) direct observation

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Yes

**Extreme fluctuations?:** Unknown

**Population Information (Narrative):** The species is rare and a decline is probable due to the degradation of habitat caused by human activities and invasions of alien plants.

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Brachmia infuscatella* has five subpopulations, all of them relatively highly abundant in the native forest. The species currently presents decline in subpopulations due to the degradation of habitat caused by human activities and presence of invasive plants.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Brachmia infuscatella* occurs in several habitats and in several islands of the Azorean archipelago (Faial, Pico, S. Jorge, Terceira and Santa Maria). Altitudinal range: 10-800 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

**Ecology**

**Size:** 0.54

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** We assume that the larvae are specialist feeding on plant material and this moth flies in June and July (see data in Rebel 1940; O. Karsholt unpubl.), with probably one or two generations per year.

**Threats**

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently, invasive plants (*Pittosporum undulatum* and *Hedychium gardnerianum*) are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on research by Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 1.2. Land/water protection - Resource & habitat protection
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Pico and Santa Maria). Further research is needed to monitor the species and conservation measures to control the invasive *Hedychium gardnerianum* and *Pittosporum undulatum* should be implemented to improve habitat quality for this species. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed over the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Very important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva, to find extant specimens in additional natural areas of most islands of Azores and obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

***Cyclophora azorensis* (Prout, 1920)****Species information**

**Synonyms:** *Cyclophora maderensis azorensis* Prout, 1920

**Common names:** Geometer Moth (English); Traça (Portuguese)

**Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Geometridae

**Taxonomic notes:** *Cyclophora azorensis* was described by Prout (1920) as a subspecies *azorensis* of *Cyclophora maderensis* (Bethune-Baker, 1891) and its range was erected from a detailed comparative analysis of genitalia (Meyer 1991). *Cyclophora azorensis* is extremely variable in colouration of the wing pattern, but can distinguished from other species of genus *Cyclophora* by the configuration of the male genitalia (Fischer and Ivinskis 2008).

**Region for assessment:**

- Global

Figure(s) or Photo(s): Fig. 10



Figure 10. [doi](#)

*Cyclophora azorensis* (Prout, 1920) from Mistérios Negros at Terceira (Azores, Portugal)  
(Credit: José V. Pérez Santa-Rita).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

### Geographic range

**Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 10

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 44,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 532 km<sup>2</sup>.

**Min Elevation/Depth (m):** 0

**Max Elevation/Depth (m):** 1800

**Range description:** *Cyclophora azorensis* is an endemic species present in the islands of the Corvo, Flores, Faial, Pico, Graciosa, S. Jorge, Terceira, S. Miguel and Santa Maria (Azores, Portugal) (Borges et al. 2010), known from all habitats in which the host plant *Erica azorica* grows, but it is especially common in medium/higher altitudes where there are remnants of Laurisilva forest, being known from all Azorean Natural Forest Reserves: Caldeiras Funda e Rasa and Morro Alto e Pico da Sé (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Mistério da Prainha, Caveiro and Caiado (Pico); Pico Pinheiro and Topo (S. Jorge); Biscoito da Ferraria, Pico Galhardo, Caldeira Guilherme Moniz, Caldeira Sta. Bárbara e Mistérios Negros and Terra Brava (Terceira); Atalhada, Graminhais and Pico da Vara (S. Miguel) and Pico Alto (Santa Maria).

### **Extent of occurrence**

**EOO (km<sup>2</sup>):** 44,000

**Trend:** Stable

**Justification for trend:** The species is widely distributed, occurring in all nine islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 532

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands and the host plant (*Erica azorica*) is widely distributed.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Locations**

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

## Population

**Trend:** Stable

**Justification for trend:** The species is very common and well known from several subpopulations. The maintained number of mature individuals is inferred from monitoring schemes (sampled since 1999 by BALA project).

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Cyclophora azorensis* has eight subpopulations, all of them relatively highly abundant in the canopy of endemic trees. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Cyclophora azorensis* occurs in native forest (dominated by *Laurus azorica*, *Juniperus brevifolia* and *Erica azorica*) of all islands and also in all habitats in which the host plant (*Erica azorica*) grows, being especially common in higher altitudes (above 500 m a.s.l.) where there are remnants of laurel forest. Altitudinal range: 10-1800 m.

**Trend in extent, area or quality?:** Stable

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently, the host plant *Erica azorica* is expanding and has stable population

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Size:** 1.3

**Generation length (yr):** 0

**Dependency of single sp?:** Yes

**Dependent on species:** *Erica azorica*

**Dependent on IUCN Status:** Near Threatened (NT)

**Ecology and traits (narrative):** The larvae are a specialist on *Erica azorica*. The moth has a continuous development with several generations per year (multivoltine species).

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). The species is considered common in the native vegetation. The most important ongoing threat to this species is the spread of invasive plants (e.g. *Hedychium gardnerianum* and *Clethra arborea* in S. Miguel) that are changing the habitat structure. These changes are

decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on research by Ferreira et al. (2016), the habitat will decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Corvo, Faial, Flores, Graciosa, Pico, S. Jorge, Terceira, S. Miguel and Santa Maria). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed over the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to find extant specimens in additional natural forest areas dominated by *Laurus azorica*, *Juniperus brevifolia* and *Erica azorica* (host plant) of Azores islands and obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of this habitat. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

***Eupithecia ogilviata* (Warren, 1905)****Species information**

**Synonyms:** *Tephroclystia ogilviata* Warren, 1905

**Common names:** Geometer Moth (English); Traça (Portuguese)

**Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Geometridae

**Taxonomic notes:** *Eupithecia ogilviata* was described by Warren (1905) in the genus *Tephroclystia* from wing pattern characters and was transferred to *Eupithecia*. A single male has been collected from Faial. It is necessary to collect more individuals and have more information about morphological characters to clarify the identity of the taxon.

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 11

**Basis of EOO and AOO:** Observed

**Basis (narrative):** It is known just from one single male captured in Faial in May 1903 (Warren 1905).

**Min Elevation/Depth (m):** 700

**Max Elevation/Depth (m):** 750

**Range description:** *Eupithecia ogilviata* is a single-island endemic species from Faial (Azores, Portugal) (Warren 1905, Borges et al. 2010). We assume that this species is probably extinct in Azores.

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 0-4

**Trend:** Stable

**Justification for trend:** The species is considered extinct in the historical locality possibly due to habitat destruction. Not sampled during the last century despite some intensive field work.

**Causes ceased?:** No

**Causes understood?:** No

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km<sup>2</sup>):** 0-4

**Trend:** Stable

**Justification for trend:** The species is likely extinct in the historical locality possibly due to habitat destruction. Not sampled recently despite some intensive field work.

**Causes ceased?:** No

**Causes understood?:** No

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 0-1

**Justification for number of locations:** The species is potentially extinct due to destruction of the habitat in all its range.

**Trend:** Stable

**Justification for trend:** Possibly extinct.

## Population

**Trend:** Stable

**Justification for trend:** The species is only known from a single subpopulation that occurred in the Laurel forest of Central Faial. We assume that this species is probably extinct due to the removal of native forest in the historical locality.

**Causes ceased?:** Yes

**Causes understood?:** Yes

**Causes reversible?:** Yes

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** The species is only known from a single subpopulation that occurred in the Laurel forest of Central Faial. We assume that this species is probably extinct due to the removal of native forest in the historical locality.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Eupithecia ogilviata* is only known from Central part of Faial island. It has been sampled in a laurel forest, that was later destroyed and therefore this species is considered probably extinct. Altitudinal range: 700-750 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** There is no information about the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** Unknown

**Ecology and traits (narrative):** This is a phytophagous species.

## Threats

**Threat type:** Ongoing

**Threats:**

- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species
- 12. Other options - Other threat

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality. The major land-use changes in the island in the last 100 years resulted in the deforestation of the original patch of native forest between 700 and 750 m. If the species is still surviving in any small patch of modified forest, the current and future threats are the invasive plant *Hedychium gardnerianum*.

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in a regionally protected area (Natural Park of Faial). Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva and find extant specimens. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by invasive species and climate change. A monitoring plan is necessary for the invertebrate community in the habitat in order to contribute to the conservation of this species.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends

- 3.4. Monitoring - Habitat trends
- 4. Other

**Justification for research needed:** Further research is needed into the species ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva, to find extant specimens in additional natural forest areas of the Faial (unique locality since now) and to obtain information on population size, distribution and trends. It is also necessary to establish an area-based management plan and a monitoring plan for the invertebrate community in the habitat in order to contribute towards a species potential recovery plan. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011). Due to the fact that several larger, endemic moths have been found in the Azores in recent years, it is not impossible that this rather small, inconspicuous species can still be found.

## *Xanthorhoe inaequata* Warren, 1905

### Species information

**Common names:** Geometer Moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Geometridae



Figure 11. [doi](#)

*Xanthorhoe inaequata* Warren, 1905, from Mistérios Negros at Terceira (Azores, Portugal) (Credit: José V. Pérez Santa-Rita).

**Taxonomic notes:** *Xanthorhoe inaequata* was described by Warren (1905) and can be distinguished from other species of the genus *Xanthorhoe* by the configuration of the male genitalia (Fischer and Ivinskis 2008).

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 11

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range**

**Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 12

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 42,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 280 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 1400

**Range description:** *Xanthorhoe inaequata* is an endemic species present in the islands of Corvo, Flores, Faial, Pico, Graciosa, S. Jorge, Terceira, S. Miguel and Santa Maria (Azores, Portugal) (Borges et al. 2010). The species can be found in native forest fragments, but also in the habitats which are dominated by forest plantations and patches of semi-natural and exotic vegetation, being known from all eighteen Natural Forest Reserves: Caldeiras Funda e Rasa and Morro Alto e Pico da Sé (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Mistério da Prainha, Caveiro and Caiado (Pico); Pico Pinheiro and Topo (S. Jorge); Biscoito da Ferraria, Pico Galhardo, Caldeira Guilherme Moniz, Caldeira Sta. Bárbara e Mistérios Negros and Terra Brava (Terceira); Atalhada, Graminhais and Pico da Vara (S. Miguel) and Pico Alto (Santa Maria).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 42,000

**Trend:** Stable

**Justification for trend:** The species is widely distributed, occurring in all nine islands

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km<sup>2</sup>):** 280

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands and some of the host plants are widely distributed.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Locations**

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

**Population**

**Trend:** Stable

**Justification for trend:** The species is a widespread and highly abundant species in native and naturalised vegetation of several habitats of all Azorean islands. The species

apparently has currently a stable population, but it greatly depends of the conservation of both native forest fragments and the semi-natural vegetation.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Xanthorhoe inaequata* has six subpopulations, all of them relatively high abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Xanthorhoe inaequata* occurs in several habitats with native and naturalised herbaceous vegetation in the all Azorean islands. Altitudinal range: 10-1,400 m.

**Trend in extent, area or quality?:** Stable

**Justification for trend:** The species occurs in native forest and herbaceous vegetation, but has also adapted to naturalised plants.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Size:** 1.35

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** We assume that the larvae are specialist herbivores (e.g. Rubiaceae family such as *Rubia agostinhoi* and *Galium* spp.); the adult flies from May to August, having probably two generations per year.

## Threats

**Threat type:** Ongoing

### Threats:

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.1. Agriculture & aquaculture - Livestock farming & ranching - Nomadic grazing
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

### Threats:

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently invasive plants, *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on reaserch by Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

### Conservation actions:

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

### Conservation actions:

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration

- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Corvo, Faial, Flores, Graciosa, Pico, S. Jorge, Terceira, S. Miguel and Santa Maria). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed over the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to find extant specimens in additional natural forest areas of all the islands of Azores and obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## ***Micrurapteryx bistrigella* (Rebel, 1940)**

### Species information

**Synonyms:** *Gracilaria bistrigella* Rebel, 1940

**Common names:** Leaf-Miner Moth (English); Lagarta mineira (Portuguese)

## Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Gracillariidae

**Taxonomic notes:** *Micrurapteryx bistrigella* was described in the genus *Gracilaria* by Rebel (1940) from the description of the wing pattern but subsequently was reassigned to the genus *Micrurapteryx* by conducting a deeper analysis of the taxon (Karsholt and Vieira 2005). It is necessary to re-analyse the taxon from the description of male and female genitalia to compare with other species of its genus.

### Region for assessment:

- Global

### Figure(s) or Photo(s): Fig. 12



Figure 12. [doi](#)

*Micrurapteryx bistrigella* (Rebel, 1940) from Pico\_ (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

### Geographic range

### Biogeographic realm:

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 13

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 6,200 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 32 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 800

**Range description:** *Microrapteryx bistrigella* is an endemic species from Flores, Pico, S. Jorge and Terceira islands (Azores, Portugal) (Borges et al. 2010). It is especially known in higher elevations where there are remnants of native forest, being known from the Natural Forest Reserves of Caldeiras Funda e Rasa (Flores) and Biscoito da Ferraria (Terceira).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 6,200

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in four islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km<sup>2</sup>):** 32

**Trend:** Decline (inferred)

**Justification for trend:** A decline in the AOO is inferred as a consequence of degradation of habitat caused by human activities and invasions of alien plants.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 5

**Justification for number of locations:** This species is not abundant but it is widespread through the native vegetation of four islands and occurs in at least 5 locations under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations were made in the territory with impacts in native habitats. In the last ten years, the spread of invasive plants namely *Pittosporum undulatum* and *Hedychium gardnerianum* are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** The species is a widespread and relatively abundant species in native plants from medium and high altitudes (e.g. *Hypericum foliosum*, *Morella faya*) of several habitats in four islands (Azores). We assume that the species presents decreasing populations, due to the spread of invasive plants namely *Pittosporum undulatum* and *Hedychium gardnerianum* which are changing the structure of the forest and the cover of bryophytes and ferns in the soil and which will impact the species habitat quality.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Micrurapteryx bistrigiella* has four subpopulations, all of them relatively highly abundant in the canopy of endemic trees. We assume that the species presents decreasing subpopulations, due to the spread of invasive plants namely *Pittosporum undulatum* and *Hedychium gardnerianum* which are changing the structure of

the forest and the cover of bryophytes and ferns in the soil and which will impact the species habitat quality.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Micrurapteryx bistrigella* occurs in several habitats with native vegetation in the four Azorean islands. Altitudinal range: 10-800 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland

## Ecology

**Size:** 0.25

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** This leafminer is a specialist herbivore and was found associated with *Hypericum foliosum* and *Morella faya* plants; it flies from June to August and has probably two generations per year.

## Threats

**Threat type:** Ongoing

### Threats:

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations

- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently *Cryptomeria japonica* plantations management and invasive plants *Hedychium gardnerianum* are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Flores, Pico, S. Jorge and Terceira). Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and confirm data on the feeding substrate of the larva and find extant specimens. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first

step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of this habitat. A habitat management plan is needed and anticipated to be developed over the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at mid elevations. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Apamea ramonae* Wagner, 2015

### Species information

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuida

**Taxonomic notes:** *Apamea ramonae* was described by Wagner (2015a) and is distinguished from other species of genus *Apamea* by the following characters: the wing

pattern with a base colour much darker, more uniform with less white elements, male genitalia with a tip of uncus broader rounded and the presence of two cornuti in the vesica of the phallus and female genitalia with a ductus bursae shorter than other species of the genus.

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 14

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 12 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 12 km<sup>2</sup>.

**Min Elevation/Depth (m):** 400

**Max Elevation/Depth (m):** 900

**Range description:** *Apamea ramonae* is single-island endemic species from Flores island, but it is possible that a small population exists in Corvo island (Azores, Portugal) (Wagner 2015a), known from native vegetation dominated by a mix of mosses as *Sphagnum* and grass tussocks as *Festuca*, but also at their surroundings (between 400 and 900 m). This species occurs in the Natural Forest Reserve of Morro Alto e Pico da Sé (Flores).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 12

**Trend:** Decline (observed)

**Justification for trend:** This species occurs in the native vegetation at high elevations from Flores island and also in mid-elevation areas. Several sections of the habitat are

currently being invaded by invasive plants (*Hedychium gardnerianum*, *Hydrangea macrophylla*). The surrounding area is already heavily invaded by the same invasive plants and parts are occupied by *Cryptomeria japonica* plantations. Consequently the EOO is in continuing decline.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Area of occupancy

**AOO (km<sup>2</sup>):** 12

**Trend:** Decline (observed)

**Justification for trend:** A decline in the AOO is inferred as a consequence of degradation of habitat caused by human activities (human activities at mid elevations) and invasions of alien plants at high elevation.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Locations

**Number of locations:** 2

**Justification for number of locations:** This species occurs only in two locations of native forest and naturalised vegetation of Flores, which have several ongoing threats (see below).

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations were made in the territory with impacts in native habitats. In the last ten years, the spread of invasive plants namely *Hedychium gardnerianum* and *Hydrangea macrophylla* are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality. Midland habitat is under severe impact of agriculture activities.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** This species is rare in Flores island, occurring mostly in highland *Juniperus brevifolia* woodland wet habitats with *Festuca* spp. grass and *Sphagnum* spp. moss (Wagner 2015a). A decline is inferred due to the degradation of habitat caused by human activities at mid elevations and invasions of alien plants (*Hedychium gardnerianum*, *Hydrangea macrophylla*) at mid to high elevations that are changing the structure of soil moss occupation (*Sphagnum* spp.) with impacts on the species.

**Basis for decline:**

- (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** The species has one subpopulation in Flores. Currently, invasive plants, namely *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat in both islands. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns). In addition, Wagner (2015a) observed that, in Flores island, cattle are destroying lower embankments of *Sphagnum* through their weight ("cattle erosion") which impacts the species.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs mostly in highland *Juniperus brevifolia* woodland wet habitats with *Festuca* spp. grass and *Sphagnum* spp. moss (Wagner 2015a). The species occurs in very wet embankments, slopes or more rarely also plain areas in open heathland between 400 and 900 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** A decline is inferred due to the degradation of habitat caused by human activities at mid elevations and invasions of alien plants (*Hedychium gardnerianum*, *Hydrangea macrophylla*) at mid to high elevations that are changing the structure of soil moss occupation (*Sphagnum* spp.) with impacts on the species.

**Habitat importance:** Major Importance

**Habitats:**

- 1. Forest
- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4.4. Grassland - Temperate

## Ecology

**Size:** 0.33-0.38

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** Primarily, the larvae feed on various mosses (especially *Sphagnum* spp.) and grass tussocks (mainly *Festuca francoi*) (Wagner 2015a). Possibly, the larvae are a specialised herbivore and the adults have probably only one generation per year. Wagner (2015a) observed that adults emerged after a pupal phase of 21 to 25 days (18–19°C) in the second half of April and early May 2014. Adults are active between late April and June.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration

- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly the creation of pastures (Triantis et al. 2010). Currently, invasive plants, *Hedychium gardnerianum* and *Hydrangea macrophylla*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. In addition, intensive agriculture and *Cryptomeria japonica* plantations are decreasing the available habitat. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 1.2. Land/water protection - Resource & habitat protection

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in a regionally protected area (Natural Park of Flores). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed over the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed to obtain information on population size, distribution and trends. A survey in Corvo Island is needed to inform about the possibility of occurrence in this island. An important first step in creating a potential specific species recovery plan is performing an area-based management plan. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

***Apamea sphagnicola* Wagner, 2014****Species information**

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

**Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Apamea sphagnicola* was described by Wagner (2014) and is distinguished from other species of genus *Apamea* by the following characters: base colour reddish-brown, male genitalia with tip of uncus shortly pointed, not forked, short and very wide costal process cornuti and female genitalia with a wide ductus bursae and bulge-pattern of bursa copulatrix (Wagner 2014). There are two subspecies: *A. sphagnicola sphagnicola* that occupy localities from S. Miguel and *A. sphagnicola centralazorensis* that occupy localities from Pico (Wagner 2014, Wagner 2015a)

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

## **Geographic range**

### **Biogeographic realm:**

- Palearctic

### **Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 15

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 1,958 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 16 km<sup>2</sup>.

**Min Elevation/Depth (m):** 650

**Max Elevation/Depth (m):** 860

**Range description:** *Apamea sphagnicola* is an endemic species present in Pico and S. Miguel islands (Azores, Portugal) with two subspecies: *A. sphagnicola sphagnicola* from S. Miguel and *A. sphagnicola centralazorensis* from Pico (Wagner 2014, Wagner 2015a), occurring mostly in native forest and surrounding areas (Wagner 2015a). This species occurs in Natural Forest Reserves of Caveiro (Pico) and Pico da Vara (S. Miguel).

## **Extent of occurrence**

**EOO (km2):** 1,958

**Trend:** Decline (observed)

**Justification for trend:** The species continues in decline due to native forest destruction and habitat fragmentation. Several sections of the habitat are currently being invaded by invasive plants (*Hedychium gardnerianum*). The surrounding area is already heavily invaded by the same invasive plants and parts are occupied by *Cryptomeria japonica* plantations. Consequently the EOO is in continuing decline.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Area of occupancy

**AOO (km<sup>2</sup>):** 16

**Trend:** Decline (observed)

**Justification for trend:** A decline in the AOO is inferred as a consequence of degradation of habitat caused by human activities (at Serra Devassa and Serra deÁgua de Pau), invasions of alien plants and cattle trampling in the habitat.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 4

**Justification for number of locations:** The species inhabits four native vegetation patches in two islands (Pico, S. Miguel) under ongoing severe impacts of invasive plants and cattle trampling in the habitat.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations have been made within this species' territory. In the last ten years, the spread of invasive plants, namely *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality. Cattle trampling in the habitat is also a major problem, with impacts on larvae.

## Population

**Trend:** Decline (observed)

**Justification for trend:** This species is relatively abundant and occurs mostly in highland *Juniperus brevifolia* woodland wet habitats with *Festuca francoi* grass and *Sphagnum* spp. moss (Wagner 2014, Wagner 2015a). A decline is inferred due to the degradation of habitat caused by human activities (agriculture, tourism) and invasions by alien plants.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (observed)

**Justification for trend:** The species has two subpopulations, one in Pico and another in S. Miguel corresponding to two subspecies. Currently invasive plants, namely *Hedychium gardnerianum* are changing some of the areas and decreasing the quality of the habitat in both islands. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns). In addition, Wagner (2015a) observed that in Pico Island cattle are destroying lower embankments of *Sphagnum* through their weight (“cattle erosion”) which impacts the species. In S. Miguel, Wagner (2014) observed the impact of cattle in some of the sites, tourism activity (hiking in accessible parts) and large-scale collecting of *Sphagnum* mosses. Consequently, we assume a decline in number of subpopulations due to major threats.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *A. sphagnicola* occurs in wet embankments or steep slopes in open heathland or more rarely in open woodland mostly between elevations of 700-900 m (supposedly up to 1,100 m) at S. Miguel (Wagner 2014) and in steep, mainly shady places with *Sphagnum* mosses at Pico.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species population has probably strongly declined due to changes in habitat size and quality. Currently, invasive plant species are decreasing the quality of the habitat. In addition, in Pico Island cattle are destroying lower embankments with *Sphagnum* through their weight (“cattle erosion”) with impacts on the species. In S. Miguel, the impact of cattle in some of the sites, tourism activity (hiking in accessible parts) and large-scale collecting of *Sphagnum* mosses, are all decreasing the quality of the habitat (Wagner 2014, Wagner 2015a).

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

- 4. Grassland
- 16. Introduced vegetation

## Ecology

**Size:** 0.35-0.41

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** Primarily the larvae feed on various mosses (especially *Sphagnum* spp.) and grass tussocks (mainly *Festuca francoi*) (Wagner 2014). Possibly, the larvae are a specialised herbivore and the adults have probably only one generation per year. Wagner (2014) observed larvae in November-December. Adults are active between March and June.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.1. Agriculture & aquaculture - Livestock farming & ranching - Nomadic grazing
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly the creation of pastures (Triantis et al. 2010). Currently invasive plants, namely *Hedychium gardnerianum* are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns). In addition, Wagner (2015a) observed that, in Pico Island, cattle are destroying lower embankments of *Sphagnum* through their weight ("cattle erosion") which impacts the species. In S. Miguel, Wagner (2014) observed the impact of cattle in some of the sites, tourism activity (hiking in accessible parts) and large-scale collecting of *Sphagnum* mosses. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 1.2. Land/water protection - Resource & habitat protection

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in a regionally protected area (Natural Parks of Pico and S. Miguel). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of this habitat. A habitat management plan is needed and anticipated to be developed over the coming years. Education and awareness are needed to avoid large-scale collecting of *Sphagnum* mosses.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Very important

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed to find extant specimens in additional natural forest areas in all Azorean islands and obtain information on population size, distribution and trends. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of this

habitat. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## ***Hadena azorica* Meyer & Fibiger, 2002**

### **Species information**

**Synonyms:** *Hadena bicruris* (Hufnagel, 1766)

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

### **Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Hadena azorica* was described as genus *Hadena* by Meyer & Fibiger 2002. This species is only known from a single specimen from São Jorge. To clarify the identity of the taxon, it is necessary to collect more individuals and obtain more information about morphological characters and molecular data. In the original description, *H. azorica* differs from other species of the same genus by a ground colour of forewing dark grey, uncus narrower and smaller, valva subapically broader and phallus with a subbasal cornutus, basally broader and double-peaked and other smaller narrower, basally membranous and the presence of a subapical spinoluse field larger than other species of the genus.

### **Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

### **Geographic range**

### **Biogeographic realm:**

- Palearctic

### **Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 16

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 4 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 4 km<sup>2</sup>.

**Min Elevation/Depth (m):** 500

**Max Elevation/Depth (m):** 500

**Range description:** *Hadena azorica* is a single-island endemic species from São Jorge island (Azores, Portugal) (Borges et al. 2010), known from a remnant laurel forest patch at Pico das Morgadas 500 m a.s.l.

### **Extent of occurrence**

**EOO (km<sup>2</sup>):** 4

**Trend:** Decline (inferred)

**Justification for trend:** If extant, the species occurs only in a patch of native forest in São Jorge.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 4

**Trend:** Decline (inferred)

**Justification for trend:** The species continues in decline due to native forest destruction, invasive plants habitat modification and habitat fragmentation.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 1

**Justification for number of locations:** This species occurs in one single native forest patch in São Jorge island under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations were made in the territory with impacts in native habitats. The historical location suffered major changes during the last 20 years and invasive plants are occupying vast areas, destroying the original habitat.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** Probably the species is rare and only known from a single population in high elevation areas in São Jorge island (at Pico das Morgadas).

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Yes

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** The species is only known from a single population inhabiting in São Jorge. We assume that this population is declining or, in the worst case, the species is probably extinct.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** Probably, the species is rare and only known from a single population in high elevation areas in São Jorge island (at Pico das Morgadas, 500 m a.s.l.) but can also occur in other places with native and naturalised plants like Caryophyllaceae.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species (namely *Pittosporum undulatum*) are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 16. Introduced vegetation

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** We assume that one or two broods are produced per year and adults can be seen flying in to light from June to August.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly the creation of pastures (Triantis et al. 2010). Currently, invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:**

In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations in São Jorge Island (only known at Pico das Morgadas, 500 m a.s.l.) or in other places with native and naturalised plants like Caryophyllaceae. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests and performing an area-based management plan. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## ***Melanchra granti* Warren, 1905**

### **Species information**

**Synonyms:** *Graphania granti granti* Warren, 1905; *Polia granti* (Rebel, 1940); *Mamestra granti* (Warren, 1905)

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

### **Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Melanchra granti* was described in the genus *Melanchra* by Warren 1905 but subsequently was reassigned to the genus *Graphania* by Meyer, 1995. *Melanchra granti* is distinguished from other species of genus *Melanchra* by the following characters: wing pattern show differences at level of species in the hindwing, male genitalia with differences in the morphology of the valva and phallo in relation to other close genera.

### **Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

### **Geographic range**

### **Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 17

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 7,800 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 40 km<sup>2</sup>.

**Min Elevation/Depth (m):** 200

**Max Elevation/Depth (m):** 600

**Range description:** *Melanchra granti* is an endemic species occurring in Pico, Terceira and S. Miguel islands (Azores, Portugal) (Borges et al. 2010), known from the remnant laurel forest.

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 7,800

**Trend:** Decline (inferred)

**Justification for trend:** The species continues in decline due to native forest destruction and habitat fragmentation.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km<sup>2</sup>):** 40

**Trend:** Decline (inferred)

**Justification for trend:** A decline in the AOO is inferred as a consequence of degradation of habitat caused by human activities and invasions of alien plants.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 4

**Justification for number of locations:** This species is not particularly abundant and widespread through the native vegetation of three islands and occurs in at least four locations under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations were made in the territory with impacts in native habitats. In the last ten years, the spread of invasive plants, namely *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** The species is scattered and rare in Pico, Terceira and São Miguel islands (Azores), occurring mostly in uplands wet biotopes with native vegetation (larvae associated with grasses and mosses). There is a continuing decline in the number of mature individuals, based on the ongoing threats.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Melanchra granti* has three subpopulations. All of them are in continuing decline due to human activity and the spread of invasive plants.

**Extreme fluctuations?:** Unknown

**Severe fragmentation?:** Yes

**Justification for fragmentation:**

The species is rare and is scattered through a restricted number of suitable patches in three islands. At least 50% of its population can be found in subpopulations that are 1) smaller than would be required to support a viable population and 2) separated from other habitat patches by a large distance. In fact, the species occurs in fragments that are isolated in a matrix of pastures.

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs preferably in the native forests of the Pico, Terceira and São Miguel islands (Azores), surrounded by plantations of exotic trees and pastures. Altitudinal range: 200-600 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently human activities in historical localities and invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 16. Introduced vegetation

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** This species is probably a univoltine species, but the life cycle is unknown. Some adults were captured in light traps from January to July (Carvalho et al. 1999). The host plant of the larva is unknown.

## Threats

**Threat type:** Ongoing

### Threats:

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations

- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Human activities in at least two of the historical localities (Furnas, S. Miguel; area of Gruta dos Balcões, Terceira) promoted major changes in the habitat in the last 50 years with major reductions of native vegetation. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation**

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in only one regionally protected area (Natural Park of Terceira). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva and to find extant specimens in additional natural forest areas of the Pico, Terceira and São Miguel islands (Azores), surrounded by plantations of exotic trees and pastures. Obtaining information on population size, distribution and trends is important too. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011)

## *Mesapamea storai* (Rebel, 1940)

### Species information

**Synonyms:** *Hadena storai* Rebel, 1940; *Mesapamea acorina* strigata Pinker, 1969; *Mesapamea acorina* Pinker, 1969

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Mesapamea storai* was described in the genus *Hadena* by Rebel (1940) but subsequently was reassigned to the genus *Mesapamea* by Meyer 1991.

*Mesapamea storai* is distinguished from other species of genus *Mesapamea* by the following characters: male genitalia with differences in the valva, clavi bent down hook, the neck of the cucullus very long, thin and directed upwards and vesica is equipped with a spike-braided crown (Pinker 1971).

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range**

**Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 18

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 28,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 248 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 1000

**Range description:** *Mesapamea storai* is an endemic species occurring in Corvo, Flores, Faial, Pico, Graciosa, S. Jorge, Terceira and S. Miguel islands (Azores, Portugal) (Borges et al. 2010), known from native forest but also in habitats located in and around exotic coniferous forests (e.g. in Terceira island above 350 m a.s.l.) (Vieira et al. 1998), being known from twelve Natural Forest Reserves: Caldeiras Funda e Rasa and Morro Alto e Pico da Sé (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Pico Pinheiro and Topo (S. Jorge); Biscoito da Ferraria, Caldeira Guilherme Moniz, Caldeira Sta. Bárbara e Mistérios Negros and Terra Brava (Terceira); Graminhais and Pico da Vara (S. Miguel).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 28,000

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in eight islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Area of occupancy

**AOO (km<sup>2</sup>):** 248

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in eight islands in native forest and introduced coniferous forests.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Locations

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

### Population

**Trend:** Stable

**Justification for trend:** This species is common in most Azorean islands except Santa Maria, being rare in terms of abundance at lower elevations (e.g. in Terceira island) (Vieira et al. 1998) and abundant at medium and high elevations, where it occurs mostly in native vegetation (*Juniperus brevifolia* and *Laurus azorica* forests), although it can also occur in exotic coniferous forests. This species presents a stable population.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Mesapamea storai* has seven subpopulations, all of them relatively highly abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Mesapamea storai* occurs at medium and high elevations in the Azorean islands except Santa Maria (above 350 m a.s.l.), preferably associated with native grasses (e.g. *Holcus azoricus*; Poaceae) of *Juniperus brevifolia* woodland forests as well as habitats located in and around exotic coniferous forests. Altitudinal range: 10-1000 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to reduction in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat. Nevertheless, the species has also adapted to naturalised vegetation.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 14.3. Artificial/Terrestrial - Plantations
- 16. Introduced vegetation

## Ecology

**Size:** 1.18

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):**

The larvae develop from autumn to spring and the moths fly readily to light from March to November (Vieira et al. 1998). Possibly it is a specialist herbivore and has about three generations per year.

## Threats

**Threat type:** Ongoing

### Threats:

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

### Threats:

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to reduction in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently invasive plants *Pittosporum undulatum* and *Hedychium gardnerianum* are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

### Conservation actions:

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

### Conservation actions:

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration

- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

### Justification for conservation actions

The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Corvo, Faial, Flores, Graciosa, Pico, S. Jorge, Terceira and S. Miguel). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Since this species occurs in relict native Azorean forests, some awareness measures were put recently into practice using, for instance, images from extreme macro (see Fig. 13 and Arroz et al. 2016, Amorim et al. 2016).



Figure 13. [doi](#)

Extreme macro image of *Mesapamea storai* (Rebel, 1940) from Terra Brava (Terceira, Azores) (Credit: Javier Torrent).

### Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations associated with native grasses (e.g. *Holcus azoricus*; Poaceae) of *Juniperus brevifolia* woodland forests as well as habitats located in and around exotic coniferous forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

***Noctua atlantica* (Warren, 1905)****Species information**

**Synonyms:** *Agrotis atlantica* Warren, 1905

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

**Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Noctua atlantica* was described in the genus *Agrotis* by Warren 1905 but subsequently was reassigned to the genus *Noctua* by Pinker 1971. *Noctua atlantica* is distinguished from other species of genus *Noctua* by the following characters: wing pattern with a hindwing ochre-brown, male genitalia with differences in the morphology of the valva and phallo, emphasising the reduction of the projection of the cucullus.

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 14

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso



Figure 14. [doi](#)

*Noctua atlantica* (Warren, 1905) from São Miguel (Azores, Portugal) (Credit: Virgílio Vieira).

## Geographic range

### Biogeographic realm:

- Palearctic

### Countries:

- Portugal

**Map of records (Google Earth):** Suppl. material 19

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 28,800 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 312 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 1000

**Range description:** *Noctua atlantica* is an endemic species present in Corvo, Flores, Faial, Pico, Graciosa, S. Jorge, Terceira and S. Miguel islands (Azores, Portugal) (Borges et al. 2010), known from native vegetation dominated by *Juniperus brevifolia* but also at their surroundings (above 600 m a.s.l.). The species occurs in at least six Natural Forest Reserves: Caldeiras Funda e Rasa and Morro Alto e Pico da Sé (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Pico Pinheiro (S. Jorge); Caldeira Guilherme Moniz (Terceira).

**Extent of occurrence**

EOO (km<sup>2</sup>): 28,800

Trend: Stable

**Justification for trend:** The species is widely distributed occurring in eight islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

AOO (km<sup>2</sup>): 312

Trend: Stable

**Justification for trend:** The species is widely distributed occurring in eight islands in native forest and introduced coniferous forests.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Locations**

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

Trend: Stable

**Population**

Trend: Stable

**Justification for trend:** This species is very abundant on most Azorean islands and occurs mainly in native vegetation. This species presents a stable population.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Noctua atlantica* has eight subpopulations, all of them relatively highly abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** This species inhabits the uplands on Azorean islands except Santa Maria (above 600 m a.s.l.), preferably into native forest and also at their surroundings with grassy clearings as well as along sunny forest roads of exotic coniferous forests. Altitudinal range: 10-1000 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to reduction in habitat size and quality. Currently, invasive plant species are decreasing the quality of the habitat. Nevertheless, the species has also adapted to naturalised vegetation.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland
- 14.3. Artificial/Terrestrial - Plantations
- 16. Introduced vegetation

## Ecology

**Generation length (yr):** 0

**Dependency of single sp?: No**

**Ecology and traits (narrative):** The larvae are polyphagous feeding on grasses and the adults are nearly present throughout the year, with individuals flying readily to light from April to November (Vieira et al. 1998); it has two generations per year at high elevations (Oliveira et al. 2004).

**Threats**

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to reduction in habitat size and quality, mostly the creation of pastures (Triantis et al. 2010). Currently, invasive plants, *Pitosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation**

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Corvo, Faial, Flores, Graciosa, Pico, S. Jorge, Terceira and S. Miguel). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests.

**Other**

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations associated with surroundings with grassy clearings as well as along sunny forest roads of exotic coniferous forests. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## ***Noctua carvalhoi* (Pinker, 1983)**

### **Species information**

**Synonyms:** *Sineugraphe carvalhoi* Pinker, 1983

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

### **Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Noctua carvalhoi* was described in the genus *Sineugraphe* by Pinker 1983 but subsequently was reassigned to the genus *Noctua* by Fibiger 1993. *Noctua carvalhoi* is distinguished from other species of genus *Noctua* by the following characters: dark wing pattern in relation to the rest of species, male genitalia with a long uncus, pointed valva, powerful ampulla and the phallo short and thick, a tiny curnutus present (Pinker 1983).

### **Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

### **Geographic range**

#### **Biogeographic realm:**

- Palearctic

#### **Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 20

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 10,900 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 100 km<sup>2</sup>.

**Min Elevation/Depth (m):** 50

**Max Elevation/Depth (m):** 1000

**Range description:** *Noctua carvalhoi* is an endemic species occurring in Flores, Faial, Pico, S. Jorge and Terceira islands (Azores, Portugal) (Borges et al. 2010), known from laurel forest (with ferns, *Calluna vulgaris* and mosses) but also in other areas of exotic and naturalised plants (Wagner 2015b). Within these five islands, it is known from three Natural Forest Reserves of Caldeira do Faial and Cabeço do Fogo (Faial) and Biscoito da Ferraria (Terceira).

### **Extent of occurrence**

**EOO (km<sup>2</sup>):** 10,900

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in five islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 100

**Trend:** Decline (inferred)

**Justification for trend:** A decline in the AOO is inferred as a consequence of degradation of habitat caused by human activities and invasions of alien plants.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Locations**

**Number of locations:** 11

**Justification for number of locations:** The species is widespread but has low abundance in native and exotic vegetation of five islands and occurs in at least 11 locations under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations were made in the territory with impacts in native habitats. In the last ten years, the spread of invasive plants, namely *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** This species has low populations in Flores, Faial, Pico, S. Jorge and Terceira islands (Azores), occurring mostly in the native vegetation at medium and high elevations of these islands, but also in exotic vegetation. This species presents declined populations.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Noctua carvalhoi* has five subpopulations, all of them with relatively low abundance in the native forest. The species currently presents declining subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):**

This species occurs mostly in areas of native forest, but also at their surroundings and in other modified biotopes. Altitudinal range: 50-1,000 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to reduction in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland
- 16. Introduced vegetation

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The larvae are polyphagous on herbs and small shrubs like *Rubus* spp., being recorded on *Scrophularia* spp. and *Rubus* spp. in Flores Island; they feed at night and immature stages occur from autumn to spring and larvae mature between early March and early May; the adult flies in summer and seem to aestivate (Wagner 2017).

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to reduction in habitat size and quality, mostly from the creation of pastures (Triantis et al. 2010). Currently invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Faial, Flores, Pico, S. Jorge). Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva and to find extant specimens. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations. A monitoring plan is also necessary for the invertebrate community in the habitat in order to contribute to forming a species potential recovery plan. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

***Phlogophora cabrali* Pinker, 1971****Species information**

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

**Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Phlogophora cabrali* was recorded originally as *Eumichtis whitei* Rebel 1940 but subsequently was reassigned to the genus *Phlogophora* by Pinker (1971). *Phlogophora cabrali* is distinguished from other species of genus *Phlogophora* by the following characters: wing pattern show differences at level of species in the hindwing, male genitalia with costal margin of the ampulla larger, straight and bears 7 setae, female genitalia with ductus bursae narrower at the base and has two loops at the apex, one proceeds into the corpus bursae and the other into the ductus seminalis (Saldaitis and Ivinskis 2006). The species was also recorded as *Eumichtis whitei* sensu Rbl. 1940 (misidentification).

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 21

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 6,200 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 92 km<sup>2</sup>.

**Min Elevation/Depth (m):** 100

**Max Elevation/Depth (m):** 800

**Range description:** *Phlogophora cabrali* is an endemic species present in Faial, Pico, S. Jorge and S. Miguel islands (Azores, Portugal) (Borges et al. 2010), known from native forest as well as habitats with *Rubus* spp. species located in and around allochthonous coniferous forests (Wagner 2015b).

**Extent of occurrence**

**EOO (km2):** 6,200

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in four islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km2):** 92

**Trend:** Stable

**Justification for trend:** The species is widely distributed occurring in many islands and some of the host plants are widely distributed.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

## Population

**Trend:** Stable

**Justification for trend:** This species is relatively abundant in Faial, Pico, S. Jorge and S. Miguel islands, occurring mostly in the native vegetation and naturalised plants at medium and high elevations (between 400 and 800 m a.s.l.), in particular, in areas with *Rubus* species located in and around exotic coniferous forests as well as laurel woodlands (Wagner 2015b). This species presents a stable population.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Phlogophora cabrali* has four subpopulations, all of them relatively abundant in the canopy of endemic trees. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Phlogophora cabrali* occurs in humid, wind-protected places most often between 400 and 1,000 m a.s.l. in Faial, Pico, S. Jorge and S. Miguel islands (Borges et al. 2010). Altitudinal range: 100-800 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently, invasive plant species are decreasing the quality of the habitat. Nevertheless, the species has also adapted to naturalised vegetation.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 14.3. Artificial/Terrestrial - Plantations
- 16. Introduced vegetation

## Ecology

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The larvae feeds preferably on *Rubus* species that are located in and around allochthonous coniferous forests as well as native woodlands (Wagner 2015b). This species is possibly a specialist herbivore and has several generations per year.

## Threats

**Threat type:** Ongoing

### Threats:

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality, mostly from the creation of pastures (Triantis et al. 2010). Currently invasive plants *Pittosporum undulatum* and *Hedychium gardnerianum* are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation**

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Faial, Pico, S. Jorge and S. Miguel). Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva and to find extant specimens. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change.

**Other**

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations. A monitoring plan is also necessary for the invertebrate community in the habitat in order to contribute to undertaking a species potential recovery plan. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## ***Phlogophora furnasi* Pinker, 1971**

### **Species information**

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

### **Taxonomy**

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Phlogophora furnasi* was described by Pinker (1971) and is distinguished from other species of genus *Phlogophora* by the following characters: wing pattern show differences at level of species in the hindwing, male genitalia with differences in the morphology of the valva and the phallus (Pinker 1971).

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 22

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 10,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 72 km<sup>2</sup>.

**Min Elevation/Depth (m):** 200

**Max Elevation/Depth (m):** 1000

**Range description:** *Phlogophora furnasi* is an endemic species present in Pico, S. Jorge, Terceira and S. Miguel islands (Azores, Portugal) (Borges et al. 2010), known originally from localities with native vegetation (e.g. Caldeira Guilherme Moniz -Terceira; Pico Maria Pires - S. Jorge; Ribeiras - Pico; Serra Água de Pau - São Miguel), but currently some of those localities have highly modified vegetation.

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 10,0000

**Trend:** Stable

**Justification for trend:** This species occurs in the native vegetation from characteristic highland biotopes of Pico, S. Jorge, Terceira and S. Miguel. The EOO includes a relative large area of unsuitable areas and possibly its value is slightly overestimated.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km<sup>2</sup>):** 72

**Trend:** Decline (inferred)

**Justification for trend:** The species occurs in the native and naturalised vegetation of four islands of the Azorean archipelago, that are under threat due to invasive plants expansion.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 6

**Justification for number of locations:** This species is moderately widespread, occurring in the native medium and high altitude vegetation of four islands, occurring in at least 6 locations under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations were made in the territory with impacts in native habitats. In the last ten years, the spread of invasive plants, namely *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** This species was particularly abundant in Pico, S. Jorge, Terceira and S. Miguel islands, occurring mostly in the native and naturalised vegetation at medium and high elevations of these islands. However, changes in the vegetation in the last 30 years are threatening this species. Therefore, we suspect that the population is decreasing.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Phlogophora furnasi* has four subpopulations, all of them relatively abundant in the canopy of endemic trees. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Phlogophora furnasi* occurs particularly in native vegetation (*Calluna vulgaris*, *Erica azorica*, mosses and *Festuca francoi*) of open native woodlands. Altitudinal range: 200-1,000 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat. Nevertheless, the species has also adapted to naturalised vegetation.

**Habitat importance:** Major Importance

**Habitats:**

- 3.4. Shrubland - Temperate
- 4. Grassland
- 16. Introduced vegetation

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The larvae are mostly abundant in humid, shady, wind-protected places in northern exposition with only small *Calluna vulgaris* bushes between ca. 500 and 1000 m a.s.l. and in low numbers also in embankments and edges of streets through allochthonous coniferous forests and other places (Wagner 2015b).

## Threats

**Threat type:** Ongoing

### Threats:

- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

### Threats:

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to reduction in habitat size and quality, mostly from the creation of pastures (Triantis et al. 2010). Currently, *P. furnasi* is under threat due to degradation of the habitat by cattle (Wagner 2015b), but also due to invasive plants *Pittosporum undulatum* and *Hedychium gardnerianum* that are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

### Conservation actions:

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

### Conservation actions:

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Terceira). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Phlogophora interrupta* (Warren, 1905)

### Species information

**Synonyms:** *Brotolomia periculosa* ab. *interrupta* Warren, 1905; *Chutapha wollastoni interrupta* Warren; *Phlogophora jarmilae* (Saldaitis & Ivinskis, 2006).

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

## Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Phlogophora interrupta* was described as *Brotolomia periculosa* ab. *interrupta* by Warren (1905) but subsequently was reassigned to the genus *Phlogophora* by Pinker 1971. *Phlogophora interrupta* is distinguished from other species of genus *Phlogophora* by the following characters: wing pattern show differences at level of species in the hindwing, male genitalia with costal margin of the ampula curved and sickle-shaped, it only gradually widens, and has 4 setae and female genitalia with ductus bursae sclerotised and wide from the base to the centre. The ductus bursae and the ductus seminalis branch from the common stem at the apex. The corpus bursae has sac-shaped with an elongate plate-shaped signum (Saldaitis and Ivinskis 2006). The species was also recorded as *Phlogophora wollastoni* Bethune-Baker, 1891 (misidentification).

### Region for assessment:

- Global

### Figure(s) or Photo(s): Fig. 15



Figure 15. [doi](#)

*Phlogophora interrupta* (Warren, 1905) from São Miguel (Azores, Portugal) (Credit: Virgílio Vieira).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 23

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 38,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 312 km<sup>2</sup>.

**Min Elevation/Depth (m):** 100

**Max Elevation/Depth (m):** 1000

**Range description:** *Phlogophora interrupta* is an endemic species present in Flores, Faial, Pico, Graciosa, S. Jorge, Terceira, S. Miguel and Santa Maria islands (Azores, Portugal) (Borges et al. 2010), occurring mostly in native forest (Vieira et al. 1998), specially of the central group of the Azorean archipelago (e.g. Meyer 1991), being known from nine Natural Forest Reserves: Caldeiras Funda e Rasa and Morro Alto e Pico da Sé (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Pico Pinheiro (S. Jorge); Caldeira Guilherme Moniz and Caldeira Sta. Bárbara e Mistérios Negros (Terceira), Graminhais (S. Miguel), Pico Alto (Santa Maria).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 38,000

**Trend:** Stable

**Justification for trend:** This species occurs in the native vegetation from medium and high altitudes in eight of the nine Azorean islands. The EOO includes a relative large area of unsuitable habitats and possibly the value is slightly overestimated.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Area of occupancy

**AOO (km<sup>2</sup>):** 312

**Trend:** Stable

**Justification for trend:** The species occurs in the native forests of eight islands of the Azorean archipelago, as well as in naturalised vegetation.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** NA

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

## Population

**Trend:** Stable

**Justification for trend:** The species is a widespread and abundant species in native and naturalised vegetation at medium and high elevations of the Azorean islands (with the exception of Corvo island). The adults are rare at lower elevations (Vieira et al. 1998). The species has currently a stable population.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:**

*Phlogophora interrupta* has eight subpopulations, all of them relatively abundant in the canopy of endemic trees. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** This species occurs particularly in typical medium to highland biotopes with native grass and moss on Azorean islands (despite some registered records at lower altitudes). Altitudinal range: 100-1,000 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to reduction in habitat size and quality. Currently, invasive plant species are decreasing the quality of the habitat. Nevertheless, the species has also adapted to naturalised vegetation.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland
- 16. Introduced vegetation

## Ecology

**Size:** 4

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The adults of *P. interrupta* are captured in light traps from April to November, with a maximum of individuals in summer (e.g. Santa Bárbara, Terceira, at the end of July; Vieira et al. 1998). Primarily, the larvae feed on various ferns (e.g. *Dryopteris* spp., *Osmunda regalis*) and also on *Rubus* spp. (Wagner 2015b). The larvae are possibly a specialised herbivore and have three generations per year.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality, mostly from the creation of pastures (Triantis et al. 2010). Currently invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation****Conservation action type:** In Place**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Faial, Flores, Graciosa, Pico, S.

Jorge, Terceira, S. Miguel and Santa Maria). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations, mostly with a high dominance of mosses. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Phlogophora kruegeri* Saldaitis & Ivinskis, 2006

### Species information

**Common names:** Owlet Moth; Underwing Moth (English); Traça; Borboleta noturna (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Noctuidae

**Taxonomic notes:** *Phlogophora kruegeri* was described by Saldaitis and Ivinskis (2006) and is distinguished from other species of genus *Phlogophora* by the following characters:

pattern of forewing more prominent than in related species, male genitalia with ampulla curved in the ventral margin, which contain 6 setae and female genitalia with a ductus bursae that it is almost of the same width throughout (Wagner 2015b).

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 24

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 8 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 8 km<sup>2</sup>.

**Min Elevation/Depth (m):** 600

**Max Elevation/Depth (m):** 750

**Range description:** *Phlogophora kruegeri* is a single-island endemic species from Flores island (Azores, Portugal) (Borges et al. 2010), occurring in highland biotopes of *Juniperus brevifolia* woodland forest (e.g. Caldeira Rasa, Marcela) (Saldaitis and Ivinskis 2006). The species occurs in a single Natural Forest Reserve: Caldeiras Funda e Rasa (Flores).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 8

**Trend:** Decline (inferred)

**Justification for trend:** This species is restricted to remnant native vegetation of Flores island, the Natural Forest Reserve of Caldeiras Funda e Rasa that has a very low index of habitat quality due to the rapid expansion of invasive plants (Gaspar et al. 2011).

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Area of occupancy

**AOO (km<sup>2</sup>):** 8

**Trend:** Decline (inferred)

**Justification for trend:** Due to native forest destruction and habitat fragmentation. The species is restricted to a single native forest patch in Flores island, the Natural Forest Reserve of Caldeiras Funda e Rasa that has a very low index of habitat quality due to the rapid expansion of invasive plants (Gaspar et al. 2011).

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Locations

**Number of locations:** 1

**Justification for number of locations:** This species occurs in one single native forest patch in Flores island, with a very low index of habitat quality due to the rapid expansion of invasive plants (Gaspar et al. 2011).

**Trend:** Stable

**Justification for trend:** In the last ten years, the rapid spread of invasive plants, namely *Hedychium gardnerianum* and *Hydrangea macrophylla*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality. Habitat destruction and invasive plants can drive this species to extinction very fast.

### Population

**Trend:** Decline (inferred)

**Justification for trend:** This species is still relatively abundant on Flores island, occurring mostly in highland *Juniperus brevifolia* woodland wet habitats with grass and *Sphagnum* spp. moss (Saldaitis and Ivinskis 2006). A decline is probably due to the degradation of

habitat caused by human activities and invasions of alien plants. Habitat destruction and invasive plants can drive this species to extinction very fast.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Phlogophora kruegeri* has one subpopulation which is in continuing decline due to the degradation of habitat caused by human activities and invasions of alien plants. Habitat destruction and invasive plants can drive this species to extinction very fast.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** This species occurs mostly in typical highland wet *Juniperus brevifolia* woodland habitats with native grasses and mosses on Flores island (Saldaitis and Ivinskis 2006).

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** This species is a polyphagous herbivore. Adults are present except for winter months with surveys suggesting highest abundance from July to August.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to reductions in habitat size and quality, mostly from the creation of pastures (Triantis et al. 2010). Currently invasive plants, (mostly *Hydrangea macrophylla* and *Hedychium gardnerianum*), are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1.1. Land/water protection - Site/area protection

- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in a regionally protected area (Natural Park of Flores). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed during the coming years.

**Other**

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations with *Juniperus brevifolia* and areas of native grasses and mosses on Flores island. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Stenoptilia meyeri* Gielis, 1997

### Species information

**Common names:** Plume Moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Pterophoridae

**Taxonomic notes:** *Stenoptilia meyeri* was described by Gielis (1997) and is distinguished from other species of genus *Stenoptilia* by the following characters: distinct line in the first lobe of the forewing, the small extension of the margin of the valva in male genitalia and the small process at the distal end of the ostium in the female genitalia (Gielis 1997).

### Region for assessment:

- Global

### Figure(s) or Photo(s): Fig. 16



Figure 16. [doi](#)

*Stenoptilia meyeri* Gielis, 1997 from São Miguel (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 25

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 8 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 8 km<sup>2</sup>.

**Min Elevation/Depth (m):** 700

**Max Elevation/Depth (m):** 1000

**Range description:** *Stenoptilia meyeri* is a single-island endemic species from S. Miguel islands (Azores, Portugal). This species occurs in Natural Forest Reserve of Pico da Vara (S. Miguel).

**Extent of occurrence**

**EOO (km2):** 8

**Trend:** Decline (observed)

**Justification for trend:** The species continues in decline due to native forest destruction and habitat fragmentation. Several sections of the habitat are currently being invaded by invasive plants (*Hedychium gardnerianum*, *Clethra arborea*). The surrounding area is already heavily invaded by the same invasive plants and parts are occupied by *Cryptomeria japonica* plantations. Consequently, the EOO is in continuing decline.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km2):** 8

**Trend:** Decline (observed)

**Justification for trend:** Several sections of the habitat are currently being invaded by invasive plants (*Hedychium gardnerianum*, *Clethra arborea*). The surrounding area is already heavily invaded by the same invasive plants and parts are occupied by *Cryptomeria japonica* plantations. Consequently the AOO is in continuing decline.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 1

**Justification for number of locations:** The species occurs only at Tronqueira native forest area at Northeast part of S. Miguel. The complete forest is threatened by invasive plants.

**Trend:** Stable

**Justification for trend:** Only one location left.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** The species is possibly rare and only known from a single population. A continuing decline in the number of mature individuals is inferred from the ongoing habitat degradation due to invasions by alien plants (*Hedychium gardnerianum*, *Clethra arborea*).

**Basis for decline:**

- (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** The species is possibly rare and only known from a single population. A continuing decline habitat due to degradation and the presence of invasions by alien plants (*Hedychium gardnerianum*, *Clethra arborea*) possibly has caused a decline of the only population.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** This is possibly a closed forest species that occurs in the hyper-humid Azorean native forests, surrounded by plantations of exotic trees (*Cryptomeria japonica*), with an altitudinal range between 700 and 1000 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** Unknown

**Ecology and traits (narrative):** We assume that this species is a specialist herbivore, but with unknown current details on its ecology.

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** The most important ongoing threat to this species is the spread of invasive plants (*Hedychium gardnerianum* and *Clethra arborea*) that are changing the habitat structure, namely decreasing the cover of bryophytes and ferns in the soil and promoting the spread of other plants. Research performed by Ferreira et al. (2016) indicates that the habitat will decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration), which may drive this species to extinction, because it is dependent on humid forests.

**Conservation**

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 1.2. Land/water protection - Resource & habitat protection

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in a regionally protected area (S. Miguel Natural Park). The São Miguel Natural Park administration is currently starting control measures of the invasive plants. LIFE PRIOLO project started with a restoration of degraded habitats to increase the area of pristine forest. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** Further research is needed into its ecology and life history in order to learn about the ecological requirements of the species and the feeding substrate of the larva. Further surveys and monitoring is required to clarify its population size, trends and distribution into other forest areas of S. Miguel island. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests and performing an area-based management plan. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Homoesoma miguelensis* Meyer, Nuss & Speidel, 1997

### Species information

**Common names:** Snout Moth; Pyralid Moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Pyralidae

**Taxonomic notes:** *Homoesoma miguelensis* and *Homoesoma picoensis* were described by Meyer et al. (1997) and are distinguished from other species of genus *Homoesoma* by the following characters: labial palpus extended, male genitalia with gnathos distally thickened and with the presence of a small curved hook in the apical part and phallus with

a vesica that has a sclerotised tubular zone in the form of a screw. Females are unknown. The Azorean species are allopatric, the main difference between them being the presence of a larger phallus in *H. picoensis* (Meyer et al. 1997). Holotype of *H. miguelensis* is the only known specimen and it was collected from São Miguel.

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 26

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 20 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 20 km<sup>2</sup>.

**Min Elevation/Depth (m):** 200

**Max Elevation/Depth (m):** 600

**Range description:** *Homoeosoma miguelensis* is a single-island endemic species restricted to S. Miguel island (Azores, Portugal) (Borges et al. 2010). It possibly lives in native vegetation in the Natural Forest Reserve of Pico da Vara and surrounding fragmented areas (e.g. Povoação at 300m a.s.l.; Meyer et al. 1997).

**Extent of occurrence**

**EOO (km2):** 20

**Trend:** Decline (inferred)

**Justification for trend:** This species possibly occurs in the native vegetation from medium and high altitudes of the Povoação and Nordeste localities (S. Miguel island).

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Area of occupancy

**AOO (km<sup>2</sup>):** 20

**Trend:** Decline (inferred)

**Justification for trend:** A decline is inferred due to native forest destruction and habitat fragmentation.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Locations

**Number of locations:** 1

**Justification for number of locations:** This species occurs in one single native forest patch in São Miguel island under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last ten years, the spread of invasive plants namely, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

### Population

**Trend:** Decline (inferred)

**Justification for trend:** *Homoeosoma miguelensis* is possibly scattered and low abundant in S. Miguel island, occurring mostly in native vegetation but also in naturalised plants.

**Causes ceased?:** No

**Causes understood?:** No

**Causes reversible?:** Yes

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** The species has one subpopulation in S. Miguel. Currently invasive plants, namely *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat in both islands. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns). Consequently, we assume a decline in number of subpopulations due to major threats.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** Preferably, the species occurs in areas of native forest and fragmented areas of the surroundings. Altitudinal range: 200-600 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality. Currently invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The larvae are supposed to feed on the Asteraceae plants. We assume that this species is a specialist herbivore and flies in July at medium altitudes of the Povoação (Meyer et al. 1997).

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size and quality, mostly by the creation of pastures and *Cryptomeria japonica* plantations (Triantis et al. 2010). Currently, invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Park of S. Miguel). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations with *Juniperus brevifolia* and areas of native grasses and mosses on S. Miguel island. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011)

## *Homoeosoma picoensis* Meyer, Nuss & Speidel, 1997

### Species information

**Common names:** Snout Moth; Pyralid Moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Pyralidae

**Taxonomic notes:** *Homoesoma picoensis* and *Homoesoma miguelensis* were described by Meyer et al. (1997) and are distinguished from other species of genus *Homoesoma* by the following characters: labial palpus extended, male genitalia with gnathos distally thickened and with the presence of a small curved hook in the apical part and phallus with a vesica that has a sclerotised tubular zone in the form of a screw. Females are unknown. The Azorean species are allopatric, the main difference between them being the presence of a larger phallus in *H. picoensis* (Meyer et al. 1997).

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range**

**Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 27

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 4 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 4 km<sup>2</sup>.

**Min Elevation/Depth (m):** 700

**Max Elevation/Depth (m):** 900

**Range description:** *Homoeosoma picoensis* is a single-island endemic species restricted to Pico island (Azores, Portugal) (Borges et al. 2010), known from semi-natural grassland and endemic plants at Furna Frei Matias Mistério (900 m a.s.l.; Meyer et al. 1997).

**Extent of occurrence**

**EOO (km2):** 4

**Trend:** Decline (inferred)

**Justification for trend:** The species occurs in one site with few remnants of native forest. Native forest destruction and habitat fragmentation can greatly influence a decline in EOO.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 4

**Trend:** Decline (inferred)

**Justification for trend:** Possible, due to native forest destruction and habitat fragmentation. The species is restricted to a single patch in Pico with a dominance of semi-natural pasture and few isolated endemic trees.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Yes

**Extreme fluctuations?:** Unknown

### **Locations**

**Number of locations:** 1

**Justification for number of locations:** This species occurs in one single location with semi-natural grassland and few patches with endemic plants in Pico island under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations have been made in the territory, mostly for the creation of pastures, with impacts in native habitats. In the last ten years, the spread of invasive plants, namely *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

### **Population**

**Trend:** Decline (inferred)

**Justification for trend:** *Homoeosoma picoensis* is scattered and scarce in Pico island. As the species is restricted to a single patch in Pico with a dominance of semi-natural pasture and few isolated endemic trees, we assume a decreasing trend in abundance.

**Causes ceased?:** No

**Causes understood?:** No

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** The species has one population in Pico. As the species is restricted to a single patch in Pico with a dominance of semi-natural pasture and few isolated endemic trees, we assume a decreasing trend in abundance.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** This species occurs mostly in areas of native vegetation at medium and high elevations of the Pico island. Altitudinal range: 700-900 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently human activities (cattle production) and invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The species is known to preferably feed on Asteraceae plants. We assume that this species is a specialist herbivore and flies in July (Meyer et al. 1997).

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently, cattle production and invasive plants (*Pitosporum undulatum* and *Hedychium gardnerianum*) are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on research by Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection

- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Park of Pico). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. A habitat management plan is needed and anticipated to be developed during the coming years.

**Other**

**Use type:** International

**Justification for use and trade:** The species is not utilized.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations on Pico island. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

## *Neomariania incertella* (Rebel, 1940)

### Species information

**Synonyms:** *Megaceraea incertella* Rebel, 1940

**Common names:** Moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Stathmopodidae

**Taxonomic notes:** *Neomariania incertella* was described in the genus *Megaceraea* by Rebel (1940) based on the wing pattern description, but subsequently was reassigned to the genus *Neomariania*. Males are unknown. It is necessary to collect more individuals and have more information about morphological characters (e.g. genitalia structures) to clarify the identity of the taxon.

### Region for assessment:

- Global

### Figure(s) or Photo(s): Fig. 17



Figure 17. [doi](#)

*Neomariania incertella* (Rebel, 1940) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

## **Geographic range**

### **Biogeographic realm:**

- Palearctic

### **Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 28

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 4 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 4 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 100

**Range description:** *Neomariania incertella* is a single-island endemic species restricted to Flores island (Azores, Portugal) (Borges et al. 2010), known from native forest and in open landscapes with isolated tree groups.

## **Extent of occurrence**

**EOO (km2):** 4

**Trend:** Decline (inferred)

**Justification for trend:** Based on the area of the single historical locality. There is an inferred continuing decline in EOO due to the spread of invasive plants and observed loss of habitat area in the last 10 years.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## **Area of occupancy**

**AOO (km2):** 4

**Trend:** Decline (inferred)

**Justification for trend:** Based on the area of a unique cell of the historical locality. There is an inferred continuing decline in AOO due to the spread of invasive plants and observed loss of habitat area in the last 10 years.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

## Locations

**Number of locations:** 1

**Justification for number of locations:** The original historical single native forest patch in Flores island, which has a severe and ongoing threat from invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations were made in the territory with impacts in native habitats. In the last ten years, the spread of invasive plants, namely *Hydrangea macrophylla* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** This species is rare in Flores island, occurring mostly in native vegetation but also in naturalised plants in a small patch of native vegetation in the North part of the island. A continuing decline in the number of mature individuals is inferred from the degradation of its habitat due to human activities (pastures for dairy cattle) and invasions of alien plants.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** The species is only known from a single population inhabiting in Flores, occurring in disturbed native forest. It is assumed, due to ongoing threats, that this species population is in decline. Worst case inferences show it could possibly even be extinct.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs in native forest areas but also in open landscapes with isolated tree groups. Altitudinal range: 10-100 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently human activities (cattle production) and invasive plant species are decreasing the quality of the habitat. The species has also adapted to naturalised plants.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The feeding substrate of the larvae of *Neomariania* species is unknown; the adult flies in June (Rebel 1940).

## Threats

**Threat type:** Ongoing

**Threats:**

- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). Currently, invasive plants, *Hydrangea macrophylla* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation****Conservation action type:** In Place**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Park of Flores). The control of the invasive plant species, *Hydrangea macrophylla* and *Pittosporum undulatum*, should be implemented

to improve the habitat quality for this species. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests. A habitat management plan is needed and anticipated to be developed during the coming years.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.1. Research - Taxonomy
- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at mid and high elevations associated with native forests of *Juniperus brevifolia* woodland forests in Flores island. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community at low elevations. The genus *Neomariania* is in need of a detailed taxonomic revision.

## ***Neomariania oecophorella* (Rebel, 1940)**

### Species information

**Synonyms:** *Megaceraea oecophorella* Rebel, 1940

**Common names:** Moth (English); Traça (Portuguese)

## Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Stathmopodidae

**Taxonomic notes:** *Neomariania oecophorella* was described in the genus *Megaceraea* by Rebel (1940) based on the wing pattern description, but subsequently was re-assigned to the genus *Neomariania*. It is necessary to re-analyse the taxon based on the description of male and female genitalia and perform a full comparative study with other species of its genus.

### Region for assessment:

- Global

### Figure(s) or Photo(s): Fig. 18



Figure 18. [doi](#)

*Neomariania oecophorella* (Rebel, 1940) from São Miguel (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

### Geographic range

### Biogeographic realm:

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 29

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 17,000 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 32 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 200

**Range description:** *Neomariania oecophorella* is an endemic species present in Flores, Faial, Pico, Terceira and S. Miguel islands (Azores, Portugal) (Borges et al. 2010), known originally from native forest and in open landscapes with isolated tree groups.

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 17,000

**Trend:** Stable

**Justification for trend:** The EOO includes several islands and, within these islands, a relatively large area of unsuitable habitats exist and possibly the value of EOO is slightly overestimated.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

**Area of occupancy**

**AOO (km<sup>2</sup>):** 32

**Trend:** Decline (inferred)

**Justification for trend:** The species occurs in a restricted number of native vegetation patches (currently modified) in Faial, Flores, Pico, Terceira and S. Miguel islands, in the Azorean archipelago.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 6

**Justification for number of locations:** This species is somewhat restricted through the native low altitude vegetation of five islands, occurring in at least 6 locations under ongoing severe impacts of land-use changes and invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major land-use alterations were made in the territory with impacts in native habitats, particularly at low elevations. In the last ten years, the spread of invasive plants, namely *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** This species is scarce in the Azorean islands (Flores, Faial, Pico, Terceira and S. Miguel), occurring mostly in native vegetation but also in naturalised plants at low elevations.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Neomariania oecophorella* has four subpopulations, occurring mostly in native vegetation but also in naturalised plants at low elevations. We need more information about the taxon to clarify the real status of the subpopulations, but it is possible that they are declining due to human activities promoting major land-use changes and invasions of alien plants.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species occurs in native forest areas but also in open landscapes with isolated tree groups. Altitudinal range: 10-200 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality. Currently, human activities (cattle production) and invasive plant species are decreasing the quality of the habitat. The species has also adapted to naturalised plants.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland
- 16. Introduced vegetation

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The feeding substrate of the larvae of *Neomariania* species is unknown; the adult flies in May and June (Rebel 1940).

## Threats

**Threat type:** Ongoing

### Threats:

- 1.1. Residential & commercial development - Housing & urban areas
- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). In some of the historical localities, major changes also occurred for urban development in the last 50 years. Currently invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation****Conservation action type:** In Place**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Conservation measures are needed to control the invasive plants, *Hedychium gardnerianum* and *Pittosporum undulatum*. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance
- 10. Pollination

**Research needed:**

- 1.1. Research - Taxonomy
- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at low and mid elevations. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community at low elevations. The genus *Neomariania* is in need of a detailed taxonomic revision.

## *Neomariania scriptella* (Rebel, 1940)

### Species information

**Synonyms:** *Megaceraea scriptella* Rebel, 1940

**Common names:** Moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Stathmopodidae

**Taxonomic notes:** *Neomariania scriptella* was described in the genus *Megaceraea* by Rebel (1940) based on the wing pattern description, but subsequently was re-assigned to the genus *Neomariania*. It is necessary to re-analyse the taxon based on the description of

male and female genitalia and to perform a full comparative study with other species of its genus.

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 19



Figure 19. [doi](#)

*Neomariania scriptella* (Rebel, 1940) from Azores (Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range**

**Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 30

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 3,400 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 48 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 500

**Range description:** *Neomariania scriptella* is an endemic species present in Pico, Graciosa and Terceira islands (Azores, Portugal) (Borges et al. 2010), known from native forest and in open landscapes with isolated tree groups.

### **Extent of occurrence**

**EOO (km<sup>2</sup>):** 3,400

**Trend:** Decline (inferred)

**Justification for trend:** The species occurs in a restricted number of localities in highly modified sites on three islands. Native forest destruction and habitat fragmentation can influence a decline in EOO.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 48

**Trend:** Decline (inferred)

**Justification for trend:** The species occurs in a restricted number of highly modified native vegetation patches in Graciosa, Pico and Terceira islands, in the Azorean archipelago. Native forest destruction and habitat fragmentation can influence a decline in AOO.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 3

**Justification for number of locations:** This species is somewhat restricted to low elevations, occurring in at least 3 locations under ongoing severe impacts of land-use changes and invasive plants.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations have been made in the territory with impacts to native habitats. In the last ten years, the spread of invasive plants, namely *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** *Neomariania scriptella* has small population abundances in three Central Azorean islands (Pico, Graciosa and Terceira), occurring mostly in highly modified native vegetation but also in naturalised plants.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (observed)

**Justification for trend:** *Neomariania scriptella* has three subpopulations, occurring mostly in native vegetation but also in naturalised plants at low elevations. We need more information about the taxon to clarify the real status of the subpopulations, but it is possible that they are declining due to human agriculture and urban activities at low elevations, as well as the spread of invasive plants.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** The species was originally associated with native forest areas but also in open landscapes with isolated tree groups. The vegetation in those sites is currently highly modified. Altitudinal range: 10-500 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently human activities (cattle production; urban development) and invasive plant species are decreasing the quality of the habitat. The species has also adapted to naturalised plants.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate
- 4. Grassland
- 16. Introduced vegetation

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The feeding substrate of the larvae of *Neomariania* species is unknown; the adult flies in June (Rebel 1940).

## Threats

**Threat type:** Ongoing

**Threats:**

- 1.1. Residential & commercial development - Housing & urban areas
- 2.1.2. Agriculture & aquaculture - Annual & perennial non-timber crops - Small-holder farming
- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming

- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to a reduction in habitat size and quality, mostly from the creation of pastures (Triantis et al. 2010). Currently, several threats are operating at low elevations: urban development; agriculture (maize rotation with pastures; invasive plants *Pittosporum undulatum* and *Hedychium gardnerianum* that are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on research by Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation**

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Park of Graciosa). Conservation measures are needed to control the invasive plants *Hedychium gardnerianum* and *Pittosporum undulatum*. Restoration of low elevation native habitats are also needed.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Justification for ecosystem services :** Unknown.

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at low and mid elevations. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community at low elevations. The genus *Neomariania* is in need of a detailed taxonomic revision.

## *Eudarcia atlantica* Henderickx, 1995

### Species information

**Common names:** Tineid Moth, Fungus Moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Tineidae

**Taxonomic notes:** *Eudarcia atlantica* was described by Henderickx (1995) and is distinguished from other species of genus *Eudarcia* by the following characters: forewing small, unsuitable for flying, female genitalia with two sclerotised bands in the VIIIth segment and the proximal ends are slightly connected to the anterior apophyses (Henderickx 1995). Henderickx had only females and predicted that the species could be parthenogenetic. However, from larvae collected in April from S. Miguel, both males and females emerged (O. Karsholt, unpubl.).

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 20

Figure 20. [doi](#)

*Eudarcia atlantica* Henderickx, 1995 from São Miguel (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 31

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 7,600 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 36 km<sup>2</sup>.

**Min Elevation/Depth (m):** 10

**Max Elevation/Depth (m):** 200

**Range description:** *Eudarcia atlantica* is an endemic species present in Faial, Terceira and S. Miguel islands (Azores, Portugal) (Borges et al. 2010), known from coastal rocks. Only known from one Natural Forest Reserve at Caldeira do Faial (Faial).

### **Extent of occurrence**

**EOO (km<sup>2</sup>):** 7,600

**Trend:** Decline (inferred)

**Justification for trend:** This species occurs in coastal habitats at Faial, Terceira and S. Miguel islands. Possibly, the EOO value is slightly overestimated. Possible decline due to human impact in coastal habitats, namely invasive plants *Carpobrotus edulis* and *Hedychium gardnerianum* that are changing some of the areas and decreasing the quality of the habitat.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 36

**Trend:** Decline (inferred)

**Justification for trend:** The species occurs in natural rocky habitats and man-made stone structures in three islands. Nevertheless, several impacts on the coastal areas can induce a decline in the AOO, namely invasive plants, *Carpobrotus edulis* and *Hedychium gardnerianum*, that are changing some of the areas and decreasing the quality of the habitat.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 3

**Justification for number of locations:** The species is widespread through the coastal and rocky areas. These habitats are currently under threat, mostly due to invasive plants *Carpobrotus edulis* and *Hedychium gardnerianum* that are changing some of the areas and decreasing the quality of the habitat.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations have been made in the territory with impacts in coastal areas. In the last ten years, the spread of invasive plants, namely *Carpobrotus edulis* and *Hedychium gardnerianum*, are changing the structure of the coastal habitats which will impact the species habitat quality.

## Population

**Trend:** Decline (inferred)

**Justification for trend:** The species is widespread and often found on walls and rocks in the coastal habitats with green algae, which grow along with lichens on shaded rocks (Henderickx 1995). It presents a declining population due to the spread of the invasive coastal plant *Carpobrotus edulis*.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Eudarcia atlantica* has three subpopulations, found on walls and rocks in the coastal habitats with green algae, which grow along with lichens on shaded rocks. The subpopulation are declining due to the spread of the invasive coastal plant *Carpobrotus edulis*.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Eudarcia atlantica* occurs in three Azorean islands (Faial, Terceira and S. Miguel). Altitudinal range: 10-200 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** The species occurs in rocky areas with algae and lichens as well as in man-made stone structures (e.g. stone walls).

**Habitat importance:** Major Importance

### Habitats:

- 6. Rocky areas (e.g. inland cliffs, mountain peaks)
- 13.1. Marine Coastal/Supratidal - Sea Cliffs and Rocky Offshore Islands

## Ecology

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** The larvae live in a portable case that is covered with sand and soil particles and feed on green algae which grow along with lichens on black lava rocks; larval cases are often found on walls and rocks in the coastal area (Henderickx 1995). Since only females were found, the possibility of parthenogenesis was considered by Henderickx (1995). According to this author, larvae and pupae were collected in July, imagos were obtained in August-September. From larvae collected in April in S. Miguel, adults emerged in May and June (O. Karsholt, unpubl.).

## Threats

**Threat type:** Ongoing

### Threats:

- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably declined due to changes in habitat size and quality, mostly the by creation of pastures (Triantis et al. 2010). Currently, invasive plants, *Carpobrotus edulis* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of algae and lichens) with the expansion of other plants and potential threats to the species. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting & alteration).

**Conservation**

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Conservation measures are needed to control the invasive plants *Hedychium gardnerianum* and *Carpobrotus edulis*. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change.

**Other**

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology

- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional rocky coastal areas with pristine habitat. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community of rocky coastal areas.

## *Argyresthia atlanticella* Rebel, 1940

### Species information

**Common names:** Small ermine moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Yponomeutidae

**Taxonomic notes:** *Argyresthia atlanticella* was described by Rebel (1940) from the wing pattern description. It is necessary to re-analyse the taxon from the description of male and female genitalia and DNA barcode to compare with other species of its genus.



Figure 21. [doi](#)

*Argyresthia atlanticella* Rebel 1940 from São Miguel (Azores, Portugal) deposited in Coll. ZMUC (Credit: Anders Illum).

**Region for assessment:**

- Global

**Figure(s) or Photo(s):** Fig. 21

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range****Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 32

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 44,400 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is ca. 580 km<sup>2</sup>.

**Min Elevation/Depth (m):** 0

**Max Elevation/Depth (m):** 1800

**Range description:** *Argyresthia atlanticella* is an endemic species present in the islands of Corvo, Flores, Faial, Pico, Graciosa, S. Jorge, Terceira, S. Miguel and Santa Maria (Azores, Portugal) (Borges et al. 2010), known from several native plants of native forest. Within these islands, it is known from all eighteen Natural Forest Reserves: Caldeiras Funda e Rasa and Morro Alto e Pico da Sé (Flores); Caldeira do Faial and Cabeço do Fogo (Faial); Mistério da Prainha, Caveiro and Caiado (Pico); Pico Pinheiro and Topo (S. Jorge); Biscoito da Ferraria, Pico Galhardo, Caldeira Guilherme Moniz, Caldeira Sta. Bárbara e Mistérios Negros and Terra Brava (Terceira); Atalhada, Graminhais and Pico da Vara (S. Miguel) and Pico Alto (Santa Maria).

**Extent of occurrence**

**EOO (km<sup>2</sup>):** 44,400

**Trend:** Stable

**Justification for trend:** The species keeps its large distribution in nine islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Area of occupancy**

**AOO (km<sup>2</sup>):** 580

**Trend:** Stable

**Justification for trend:** The species occurs in the native forests and vegetation of all nine islands of the Azorean archipelago.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### **Locations**

**Number of locations:** N

**Justification for number of locations:** Despite some threats (see below), the species keeps stable subpopulations.

**Trend:** Stable

### **Population**

**Trend:** Stable

**Justification for trend:** The species is a widespread and highly abundant species in native plants (e.g. Ericaceae, Cupressaceae and Polygonaceae) of several habitats in all Azorean islands. It is probably the most common Lepidoptera species in the Azores. This species has probably a stable population.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Stable

**Justification for trend:** *Argyresthia atlanticella* has nine subpopulations, all of them relatively abundant in the native forest. The species currently presents stable subpopulations.

**Extreme fluctuations?:** Unknown

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** *Argyresthia atlanticella* occurs mostly in native forest. Altitudinal range: 0-1,800 m.

**Trend in extent, area or quality?:** Stable

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently, invasive plant species are decreasing the quality of the habitat, but without impacting the distribution of this native forest specialist, at least in protected areas.

**Habitat importance:** Major Importance

### Habitats:

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

## Ecology

**Size:** 0.34

**Generation length (yr):** 0

**Dependency of single sp?:** No

**Ecology and traits (narrative):** According to Silva et al. (1995) and Silva and Tavares (1995), larvae are generalist polyphagous herbivores and develop on *Morella faya* male flowers and green fruits from April until August; they were also associated with *Erica azorica* and *Vaccinium cylindraceum*, being particularly abundant in *E. azorica* (Ericaceae)

where larvae also develop. Adults and larvae were found associated with *E. azorica* throughout the year. This species has a continuous development with several generations per year (multivoltine species).

## Threats

**Threat type:** Ongoing

### Threats:

- 2.3.2. Agriculture & aquaculture - Livestock farming & ranching - Small-holder grazing, ranching or farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

### Threats:

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably declined due to a reduction in habitat size and quality, mostly by the creation of pastures (Triantis et al. 2010). The main host plant *Erica azorica* is an early successional plant that tends to invade semi-natural pastures creating conflicts with farming. Currently, invasive plants, *Pitosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. Based on Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

## Conservation

**Conservation action type:** In Place

### Conservation actions:

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed

### Conservation actions:

- 1.2. Land/water protection - Resource & habitat protection
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Corvo, Faial, Flores, Graciosa, Pico, S. Jorge, Terceira, S. Miguel and Santa Maria). Degraded habitats outside protected areas should be restored and a strategy needs to be developed to address the future threat by climate change.

## Other

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.1. Research - Taxonomy
- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011). A taxonomic revision of Azorean *Argyresthia*, which should also include a comparison of the DNA barcodes, is needed to show how many species are present in the Azores islands.

## *Argyresthia minusculella* Rebel, 1940

### Species information

**Common names:** Small ermine moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Yponomeutidae

**Taxonomic notes:** *Argyresthia minusculella* was described by Rebel (1940) from the wing pattern description. It is necessary to re-analyse the taxon from the description of male and female genitalia and DNA barcode to compare with other species of its genus. It is not clear if *A. minusculella* is a distinct species or a synonym of *A. atlanticella*.

**Region for assessment:**

- Global

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

**Geographic range**

**Biogeographic realm:**

- Palearctic

**Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 33

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is ca. 8,900 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 28 km<sup>2</sup>.

**Min Elevation/Depth (m):** 50

**Max Elevation/Depth (m):** 800

**Range description:** *Argyresthia minusculella* is an endemic species present in Flores, Pico and Terceira islands (Azores, Portugal) (Borges et al. 2010), known from the Natural Forest Reserve of Mistério da Prainha (Pico).

**Extent of occurrence**

**EOO (km2):** 8,900

**Trend:** Decline (inferred)

**Justification for trend:** This species occurs in remnant native forests of Flores, Pico and Terceira islands. The EOO includes a relatively large area of unsuitable habitats and possibly this value is slightly overestimated. The species is rare and occurs in a restricted

number of localities. Native forest destruction and habitat fragmentation can greatly influence a decline in EOO.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Area of occupancy

**AOO (km<sup>2</sup>):** 28

**Trend:** Decline (inferred)

**Justification for trend:** The species occurs in a restricted number of native vegetation patches in Flores, Pico and Terceira islands, in the Azorean archipelago. Native forest destruction and habitat fragmentation can greatly influence a decline in AOO.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

### Locations

**Number of locations:** 3

**Justification for number of locations:** This species is recorded from just one site in each of the three islands where it occurs (Flores, Pico and Terceira) and all are under ongoing severe impacts of invasive plants.

**Trend:** Stable

**Justification for trend:** In the last ten years, the spread of invasive plants, namely *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

### Population

**Trend:** Decline (inferred)

**Justification for trend:** The species occurs in native forest from three islands, but in two of the islands, the historical localities were highly modified in the last decades. The species is particularly rare in terms of abundance in all these islands.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Yes

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Decline (inferred)

**Justification for trend:** *Argyresthia minusculella* has three subpopulations, all of them are in continuing decline due to human activity and introduction of invasive plants.

**Extreme fluctuations?:** Unknown

**Severe fragmentation?:** Yes

**Justification for fragmentation:** The species occurs in three isolated patches, one in each island (Flores, Pico and Terceira). At least 50% of its population can be found in subpopulations/in habitat patches that are smaller than would be required to support a viable population and separated from other habitat patches by a large distance. In fact, the species occurs in three natural forest fragments that are isolated in a sea of pastures and *Cryptomeria japonica* plantations. At least two of the locations will be under severe threat in the next 10 years due to the aggressive spread of the invasive plant *Hedychium gardnerianum*.

## Habitat

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** This species occurs mainly in the Azorean native forest. Altitudinal range: 50-800 m.

**Trend in extent, area or quality?:** Decline (inferred)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently, invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

**Habitats:**

- 1.4. Forest - Temperate
- 3.4. Shrubland - Temperate

**Ecology**

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** Possibly it is a specialist phytophagous that feeds preferentially on Ericaceae plants. The moth flies in June and July (Rebel 1940).

**Threats**

**Threat type:** Ongoing

**Threats:**

- 1.1. Residential & commercial development - Housing & urban areas
- 2.1.2. Agriculture & aquaculture - Annual & perennial non-timber crops - Small-holder farming
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** Two of the historical localities were recently highly modified by degradation of the habitat by urban development and agriculture. Currently, the invasive plants, *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing some of the areas and decreasing the quality of the habitat. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on research performed by Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation**

**Conservation action type:** In Place

**Conservation actions:**

- 1.1. Land/water protection - Site/area protection
- 2.1. Land/water management - Site/area management

**Conservation action type:** Needed**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Its habitat is in regionally protected areas (Natural Parks of Flores and Pico). Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change and ongoing impact of invasive species. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests.

**Other**

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Research needed:**

- 1.1. Research - Taxonomy
- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at mid and high elevations. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011). A taxonomic revision of Azorean *Argyresthia*, which should also include a

comparison of the DNA barcodes, is needed to show how many species are present in the Azores islands.

## *Argyresthia poecilella* (Rebel, 1940)

### Species information

**Common names:** Small ermine moth (English); Traça (Portuguese)

### Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Lepidoptera	Yponomeutidae

**Taxonomic notes:** *Argyresthia poecilella* was described in the genus *Tinea* by Rebel (1940) from the wing pattern description. It is necessary to re-analyse the taxon from the description of male and female genitalia to compare with other species of its genus. Only one individual has been collected from São Miguel. A study of the holotype shows that it belongs to the genus *Argyresthia* (O. Karsholt, unpubl.).

### Region for assessment:

- Global

### Figure(s) or Photo(s): Fig. 22



Figure 22. [doi](#)

*Argyresthia poecilella* (Rebel 1940) type from São Miguel (Azores, Portugal) deposited in Coll. MZH (Credit: Anders Illum).

**Reviewers:** Nicola Mumford

**Editor:** Pedro Cardoso

## **Geographic range**

### **Biogeographic realm:**

- Palearctic

### **Countries:**

- Portugal

**Map of records (Google Earth):** Suppl. material 34

**Basis of EOO and AOO:** Observed

**Basis (narrative):** The extent of occurrence (EOO) is 8 km<sup>2</sup> and the maximum estimated area of occupancy (AOO) is 8 km<sup>2</sup>.

**Min Elevation/Depth (m):** 200

**Max Elevation/Depth (m):** 400

**Range description:** *Tinea poecilella* is a single-island endemic species from S. Miguel island (Azores, Portugal) (Rebel 1940, Borges et al. 2010), known only from Furnas.

## **Extent of occurrence**

**EOO (km<sup>2</sup>):** 8

**Trend:** Decline (inferred)

**Justification for trend:** Based on the area of the historical locality.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## **Area of occupancy**

**AOO (km<sup>2</sup>):** 8

**Trend:** Decline (inferred)

**Justification for trend:** The species possibly occurs in its historical locality of Furnas, São Miguel island, in the Azores. If extant, the species AOO is declining due to high human impact in the historical locality.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Locations

**Number of locations:** 1

**Justification for number of locations:** The original historical locality.

**Trend:** Stable

**Justification for trend:** In the last 100 years, major alterations have been made in the territory with impacts in native habitats. In the last ten years, urban development and the spread of invasive plants, namely *Pittosporum undulatum* and *Hedychium gardnerianum*, are changing the structure of the forest and the cover of bryophytes and ferns in the soil which will impact the species habitat quality.

## Population

**Trend:** Unknown

**Justification for trend:** Only known from one specimen. The species was not registered by local taxonomists in recent years.

**Causes ceased?:** No

**Causes understood?:** Yes

**Causes reversible?:** Unknown

**Extreme fluctuations?:** Unknown

## Subpopulations

**Trend:** Unknown

**Justification for trend:** The species has one subpopulation in S. Miguel island.

**Extreme fluctuations?:** Unknown

## **Habitat**

**System:** Terrestrial

**Habitat specialist:** Yes

**Habitat (narrative):** Only known from one historical specimen from Furnas, São Miguel island. Altitudinal range: 200-400 m.

**Trend in extent, area or quality?:** Decline (observed)

**Justification for trend:** In the past, the species has probably strongly declined due to changes in habitat size and quality. Currently urban development and invasive plant species are decreasing the quality of the habitat.

**Habitat importance:** Major Importance

### **Habitats:**

- 1.4. Forest - Temperate
- 14.5. Artificial/Terrestrial - Urban Areas

## **Ecology**

**Generation length (yr):** 1

**Dependency of single sp?:** No

**Ecology and traits (narrative):** Unknown. The unique female was recorded in May (Rebel 1940).

## **Threats**

**Threat type:** Ongoing

### **Threats:**

- 1.3. Residential & commercial development - Tourism & recreation areas
- 2.2.1. Agriculture & aquaculture - Wood & pulp plantations - Small-holder plantations
- 8.1.2. Invasive and other problematic species, genes & diseases - Invasive non-native/ alien species/diseases - Named species

**Threat type:** Future

**Threats:**

- 11.1. Climate change & severe weather - Habitat shifting & alteration
- 11.2. Climate change & severe weather - Droughts

**Justification for threats:** In the past, the species has probably strongly declined due to changes in habitat size (Triantis et al. 2010). In the last 50 years, additional major land-use changes occurred in the historical locality and the spread of invasive species is a major threat namely *Hedychium gardnerianum*. Residential development can also be a problem for this species. These changes are decreasing the relative cover of endemic plants and changing the soil cover (decreasing the cover of bryophytes and ferns) with the expansion of other plants and potential threats to the species. Based on research by Ferreira et al. (2016), the habitat will further decline as a consequence of climate change (increasing number of droughts and habitat shifting and alteration).

**Conservation**

**Conservation action type:** Needed

**Conservation actions:**

- 2.1. Land/water management - Site/area management
- 2.2. Land/water management - Invasive/problematic species control
- 2.3. Land/water management - Habitat & natural process restoration
- 4. Education & awareness
- 5.4.3. Law & policy - Compliance and enforcement - Sub-national level

**Justification for conservation actions:** The species is not protected by regional law. Further research is needed into its ecology and life history in order to find extant specimens. Degraded habitats should be restored and a strategy needs to be developed to address the future threat by climate change. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests.

**Other**

**Use type:** International

**Justification for use and trade:** The species is not utilised.

**Ecosystem service type:** Less important

**Ecosystem services:**

- 8. Habitat Maintenance

**Justification for ecosystem services :** Insufficient information about the species.

**Research needed:**

- 1.1. Research - Taxonomy
- 1.2. Research - Population size, distribution & trends
- 1.3. Research - Life history & ecology
- 2.2. Conservation Planning - Area-based Management Plan
- 3.1. Monitoring - Population trends
- 3.4. Monitoring - Habitat trends

**Justification for research needed:** In order to learn about the species' population size, distribution and ecological requirements, for example the feeding substrate of the larvae, further research is needed into its ecology and life history. It will be also important to find extant specimens in additional natural forest areas at high elevations in Nodeste at S. Miguel. An important first step in creating a potential specific species recovery plan is monitoring the entire invertebrate community in native forests and perform an area-based management plan. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011). A taxonomic revision of Azorean *Argyresthia*, which should also include a comparison of the DNA barcodes, is needed to show how many species are present in the Azores islands.

## Discussion

In this study we have analysed 34 species of moth described as endemic to the Azores, grouping the historical data and giving new information about their distribution, habitat, threats and proposals for their conservation. Twenty out of the 34 studied species are known from at least four islands and many of them are widely distributed within each island. These common species include all eight Crambidae, which are important pollinators of the Azorean native forest (Picanço et al. 2017).

We evaluated that 15 endemic species have an extent of occurrence (EOO) and area of occupancy (AOO) that is stable with a range of between 6,200-62,00 km<sup>2</sup> for EOO and 44-584 km<sup>2</sup> for AOO. Five species have a stable EOO but a decline in AOO decline, of which we must emphasise *Micrurapteryx bistrigella* (Rebel, 1940) and *Neomariania oecophorella* (Rebel, 1940) for presenting a low value of AOO. Five more species have an AOO and EOO decline, which present a low range between 1,950-8,900 km<sup>2</sup> for EOO and 16-48 km<sup>2</sup> for AOO. In addition to this, nine of these species have a very restricted distribution, occupying a unique island (three of them from Flores, another three from São Miguel, one from Faial, one from Pico and one from S. Jorge) and, therefore, they have a very small EOO and AOO. Amongst the analysed taxa, it should be noted that, for five species, only one individual is known (historical data), leaving one of the two sexes totally unknown. These species have low areas of occupation and are frequently restricted to a single patch of native forest. The lack of new records may indicate that one of the species previously named is extinct (*Eupithecia ogilviata*). In addition, many other species are in a

critical conservation situation and actions should be taken with some urgency, namely the implementation of area-based management plans for those species distribution historical sites.

The recent description of four new endemic Noctuid moth species for the Azores (*Hadena azorica* Meyer & Fibiger, 2002; *Phlogophora kruegeri* Saldaitis & Ivinskis, 2006; *Apamea sphagnicola* Wagner, 2014; *Apamea ramonae* Wagner, 2015) challenges the notion that Lepidoptera are one of the most well studied taxonomic groups of insects in the Azores (cf. Borges et al. 2010, Borges et al. 2016b). Consequently, additional surveys are needed as well as taxonomic work on the earlier described species by Warren (1905) and Rebel (1940). There is also some urgency to perform standardised sampling of moths in the most important habitats of the Azores to investigate whether the negative impact of land-use changes observed for beetles and other Azorean arthropods (Cardoso et al. 2009) may also apply to this group.

Climate change is one of the prevailing threats across the world affecting numerous species and studies on some Azorean taxa show its negative effects, such as on Macaronesian bryophytes (Patiño et al. 2016) and Azorean spiders (Ferreira et al. 2016). Therefore and although the precise climate change impacts on Azorean moths are yet to be investigated, in a first approximation, we must assume a similar negative impact upon Lepidoptera. Further, most endemic moth species are now mostly restricted to the Azorean network of protected areas (RAA 2002) and their populations are decreasing due to pasture intensification, forestry (*Cryptomeria japonica* pulp plantations management) and invasive species (e.g. *Pittosporum undulatum*, *Hedychium gardnerianum*). Consequently, formal education and awareness is needed to allow future investments in habitat restoration of areas invaded by invasive plants or impacted by forestry and dairy-cow management, located mostly at mid elevations. The use of greatly magnified images (extreme macro photography) of Lepidoptera may be a successful strategy to inform the public about the ecological and aesthetical value of Azorean endemic moths (e.g. see Vieira 2006, Amorim et al. 2016, Arroz et al. 2016) (Fig. 13).

Concerning the most threatened Azorean moth species, a community monitoring plan is also crucial to generate data for the development of species recovery plans. Monitoring every ten years using the BALA protocol will inform about habitat quality (e.g. see Gaspar et al. 2011).

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profiles of Azorean endemic arthropods. Open access was funded by FCT – Fundação para a Ciência e a Tecnologia, within the project UID/BIA/00329/2013.

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## References

- Amorim IR, Arroz AM, São Marcos R, Borges PAV, Gabriel R (2016) Bugs and society II: testing two communication strategies for public engagement in the Azores. In: Castro P, Azeiteiro UM, Bacelar-Nicolau P, Leal-Filho W, Azul AM (Eds) Biodiversity and Education for Sustainable Development. Springer, World Sustainability Series, Dordrecht, 125-153 pp. [https://doi.org/10.1007/978-3-319-32318-3\\_9](https://doi.org/10.1007/978-3-319-32318-3_9)
- Arroz AM, Gabriel R, Amorim IR, São Marcos R, Borges PAV (2016) Bugs and society I: Raising awareness about endemic biodiversity. In: Castro P, Azeiteiro UM, Bacelar Nicolau P, Leal Filho W, Azul AM (Eds) Biodiversity and Education for Sustainable Development. Springer, World Sustainability Series, Dordrecht, 125-153 pp. [https://doi.org/10.1007/978-3-319-32318-3\\_9](https://doi.org/10.1007/978-3-319-32318-3_9)
- Borges PAV, Costa A, Cunha R, Gabriel R, Gonçalves V, Martins AF, Melo I, Parente M, Raposeiro P, Rodrigues P, Santos RS, Silva L, Vieira P, Vieira V (Eds) (2010) A list of the terrestrial and marine biota from the Azores. 1st. Princípiã, Lisbon. URL: [http://www.azoresbioportal.angra.uac.pt/files/publicacoes\\_Listagem\\_ml.pdf](http://www.azoresbioportal.angra.uac.pt/files/publicacoes_Listagem_ml.pdf) [ISBN 978-989-8131-75-1]
- Borges PAV, Crespo L, Cardoso P (2016a) Species conservation profile of the cave spider *Turinyphia cavernicola* (Araneae, Linyphiidae) from Terceira Island, Azores, Portugal. Biodiversity Data Journal 4: e10274. <https://doi.org/10.3897/BDJ.4.e10274>
- Borges PAV, Cardoso P, Gabriel R, Ah-Peng C, Emerson BC (2016b) Challenges, advances and perspectives in Island Biogeography. Frontiers of Biogeography 8 (e29136): 1-10. URL: <http://escholarship.org/uc/item/1zj0s95c>
- Borges PAV, Lamelas-López L, Amorim I, Danielczak A, Nunes R, Serrano ARM, Boieiro M, Rego C, Hochkirch A, Virgilio V (2017) Conservation status of forest beetles (Insecta, Coleoptera) from Azores, Portugal. Biodiversity Data Journal 5: e14557. <https://doi.org/10.3897/BDJ.5.e14557>
- Cardoso P, Aranda SC, Lobo JM, Dinis F, Gaspar C, Borges PAV (2009) A spatial scale assessment of habitat effects on arthropod communities of an oceanic island. Acta Oecologica 35 (5): 590-597. <https://doi.org/10.1016/j.actao.2009.05.005>
- Cardoso P, Crespo LC, Silva I, Borges PAV, Boleiro M (2017) Species conservation profiles of endemic spiders (Araneae) from Madeira and Selvagens archipelagos, Portugal. Biodiversity Data Journal 5: e20810. <https://doi.org/10.3897/BDJ.5.e20810>

- Carvalho J, Vieira V, Carvalho MUP (1999) Borboletas nocturnas dos Açores. [Moths of Azores]. 1. Amigos dos Açores, Ponta Delgada, 115 pp.
- Ferreira MT, Cardoso P, Borges PAV, Gabriel R, de Azevedo EB, Reis F, Araújo MB, Elias RB (2016) Effects of climate change on the distribution of indigenous species in oceanic islands (Azores). *Climatic Change* 138: 603-615. <https://doi.org/10.1007/s10584-016-1754-6>
- Fibiger M (1993) Noctuidae II. Noctuidae Europaeae II. Entomological Press, Sorø, 230 pp.
- Fischer H, Ivinskis P (2008) Die Geometridenfauna der Azoren (Lepidoptera, Geometridae). *Atalanta* 39 (1-4): 315-319. URL: [https://www.zobodat.at/pdf/Atalanta\\_39\\_0315-0319.pdf](https://www.zobodat.at/pdf/Atalanta_39_0315-0319.pdf)
- Gaspar C, Gaston KJ, Borges PAV, Cardoso P (2011) Selection of priority areas for arthropod conservation in the Azores archipelago. *Journal of Insect Conservation* 15 (5): 671-684. <https://doi.org/10.1007/s10841-010-9365-4>
- Gielis C (1997) *Stenoptilia meyeri* spec. nov., a new endemic species of the Azores (Lepidoptera: Pterophoridae). *Entomologische Berichten* 57 (5): 79-81.
- Hampson GF (1907) Descriptions of new Pyralidae of the subfamilies Hydrocampinae and Scopariinae. *Annals and Magazine of Natural History, including Zoology, Botany and Geology* 13 (7): 1-24. <https://doi.org/10.1080/00222930709487226>
- Henderickx H (1995) A new *Eudarcia*-species from Terceira (Azores): *Eudarcia atlantica* n. sp. (Lepidoptera: Tineidae). *Phegea* 23 (2): 105-112. URL: [http://www.phegea.org/Phegea/1995/Phegea23-2\\_105-111.pdf](http://www.phegea.org/Phegea/1995/Phegea23-2_105-111.pdf)
- Karsholt O, Vieira V (2005) Lepidoptera. In: Borges PAV, Cunha R, Gabriel R, Martins AF, Silva L, Vieira V (Eds) A list of the terrestrial fauna (Mollusca and Arthropoda) and flora (Bryophyta, Pteridophyta and Spermatophyta) from the Azores. Direção Regional do Ambiente and Universidade dos Açores. Angra do Heroísmo and Ponta Delgada, 318 pp. URL: [https://www.azores.gov.pt/NR/ronlyres/3E255F0D-6AFD-4EF8-974D-CF920B5F933E/126771/Indice\\_Index1.pdf](https://www.azores.gov.pt/NR/ronlyres/3E255F0D-6AFD-4EF8-974D-CF920B5F933E/126771/Indice_Index1.pdf)
- Meyer M (1991) Les Lépidoptères de la région macaronésienne, II. Liste des Macro-Hétérocères observés en juillet/août 1990 aux Açores. *Linneana Belgica* 13: 117-134. URL: [http://www.azoresbioportal.angra.uac.pt/files/publicacoes\\_MEYER91\\_LesLepidopteresdelaregionMacaronesienneListedesMacroHeteroceres1990a](http://www.azoresbioportal.angra.uac.pt/files/publicacoes_MEYER91_LesLepidopteresdelaregionMacaronesienneListedesMacroHeteroceres1990a)
- Meyer M, Nuss M, Speidel W (1997) Kommentierte Checkliste der Pyraloidea von den Azoren, mit der Beschreibung von drei neuen Arten (Lepidoptera: Pyraloidea). *Beiträge zur Entomologie* 47 (1): 13-34. <https://doi.org/10.21248/contrib.entomol.47.1.13-34>
- Nuss M, Karsholt O, Meyer M (1997) A taxonomic revision of the Scopariinae from the Macaronesian Region (Lepidoptera: Pyraloidea: Crambidae). *Entomologica Scandinavica* 28 (4): 509-551. <https://doi.org/10.1163/187631297X00312>
- Oliveira MLM, Vieira V, Garcia PV (2004) Effect of temperature on the biology of *Noctua atlantica* (Lepidoptera: Noctuidae), a species endemic to the Azores. *European Journal of Entomology* 101 (3): 423-426. <https://doi.org/10.14411/eje.2004.059>
- Patiño J, Mateo RG, Zanatta F, Marquet A, Aranda SC, Borges PAV, Dirkse G, Gabriel R, Gonzalez-Mancebo JM, Guisan A, Muñoz J, Sim-Sim M, Vanderpoorten A (2016) Climate threat on the Macaronesian endemic bryophyte flora. *Scientific Reports* 6: 1-12. <https://doi.org/10.1038/srep29156>
- Picanço A, Gil A, Rigal F, Borges PAV (2017) Pollination services mapping and economic valuation from insect communities: a case study in the Azores (Terceira

- Island). *Nature Conservation* 18: 1-25. <https://doi.org/10.3897/natureconservation.18.11523>
- Pinker R (1971) Neue und interessante Lepidopteren aus Madeira und den Azoren mit faunistischen Hinweisen auf die Kanaren. *Zeitschrift der Wiener entomologischen Gesellschaft* 54: 101-131.
  - Pinker R (1983) *Sineugraphe* BRSN. *carvalhoi* n. sp. (Lep., Noctuidae). *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen* 35 (1-2): 13.
  - Prout LB (1920) New Goemetridae. *Novitates Zoologicae* 27: 265-312. <https://doi.org/10.5962/bhl.part.7304>
  - RAA (2002) Regime jurídico da conservação da natureza e proteção da biodiversidade - Decreto Legislativo Regional n.º 15/2012/A, de 2 de Abril. Região Autónoma dos Açores. URL: <http://dre.tretas.org/dre/290449/decreto-legislativo-regional-15-2012-A-de-2-de-abril>
  - Rebel H (1940) Die Lepidopteroфаuna des Azorischen Archipels. Im Anhang: Eine Lepidopteren-Ausbeute von Madeira. *Societas Scientiarum Fennica, Communicationes Biologicae* 8 (1): 1-59.
  - Saldaitis A, Ivinskis P (2006) Three new Noctuidae taxa from the Macaronesian archipelago (Lepidoptera). *Atalanta* 37 (1-2): 291-300.
  - Silva L, Tavares J (1995) Phytophagous insects associated with endemic, macaronesian and exotic plants in the Azores. In: Comité-editorial (Ed.) *Avances en Entomología Ibérica*. Museo Nacional de Ciencias Naturales (CSIC) y Universidad Autónoma de Madrid, 179-188 pp. URL: <http://hdl.handle.net/10400.3/789>
  - Silva L, Markin G, Tavares J (1995) *Argyresthia atlanticella* Rebel (Insecta: Lepidoptera) an excluded agent for *Myrica faya* Aiton (Myricaceae) biocontrol. *Arquipelago. Life and Marine Sciences* 13 (A): 105-113. URL: [http://www.horta.uac.pt/intradop/images/stories/arquipelago/13a/Cap11\\_SilvaLuisGeorgeMarkin.pdf](http://www.horta.uac.pt/intradop/images/stories/arquipelago/13a/Cap11_SilvaLuisGeorgeMarkin.pdf)
  - Triantis KA, Borges PAV, Ladle RJ, Hortal J, Cardoso P, Gaspar C, Dinis F, Mendonça E, Silveira LMA, Gabriel R, Melo C, Santos AMC, Amorim IR, Ribeiro SP, Serrano ARM, Quartau JA, Whittaker RJ (2010) Extinction debt on oceanic islands. *Ecography* 33: 285-294. <https://doi.org/10.1111/j.1600-0587.2010.06203.x>
  - Vieira V, Gomes de Araújo G, Tavares G (1998) Seasonal distribution and sex ratio of eleven noctuid species (Insecta, Lepidoptera) captured in blacklight traps on Terceira Island (Azores). *Boletim do Museu Municipal do Funchal* 5: 495-509. URL: <http://repositorio.uac.pt/handle/10400.3/819>
  - Vieira V (2006) Borboletas dos Açores (Papilionoidea e Sphingoidea). Universidade dos Açores - Departamento de Biologia e CIRN, Ponta Delgada, 104 pp.
  - Wagner W (2014) *Apamea shagnicola* sp. n. - a surprising new species from the Azores in westernmost Europe (Lepidoptera, Noctuidae, Xyleninae, Apameini). *Nachrichten des Entomologischen Vereins Apollo* 35 (4): 177-184.
  - Wagner W (2015a) *Apamea ramonea* n. sp. and *Apamea sphagnicola centralazorensis* n. ssp. two new noctuid taxa (Lepidoptera, Noctuidae, Xyleninae, Apameini) from the Azores (Portugal) in westernmost Europe. *Nachrichten des Entomologischen Vereins Apollo* 36 (1): 21-29.
  - Wagner W (2015b) A contribution to the knowledge of the larval ecology of the Azorean *Phlogophora* (Lepidoptera: Noctuidae) with taxonomic notes on the complex of *P. interrupta* (*P. interrupta jarmilae* Saldaitis & Ivinskis, 2006, stat. rev.). *Nachrichten des Entomologischen Vereins Apollo, Neue Folge* 36 (2-3): 80-92.

- Wagner W (2017) Lepidoptera and their ecology: *Noctua carvalhoi* (Pinker, 1983). [http://www.pyrgus.de/Noctua\\_carvalhoi\\_en.html](http://www.pyrgus.de/Noctua_carvalhoi_en.html). Accessed on: 2017-9-05.
- Warren W (1905) Lepidoptera collected by W. R. Ogilvie-Grant on the Azores and Madeira in 1903. *Novitates Zoologicae* 12: 439-447.

## Supplementary materials

### Suppl. material 1: *Eudonia interlinealis* map [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Eudonia interlinealis* in the Azores islands.

**Filename:** Eudonia\_interlinealis.kmz - [Download file](#) (167.72 kb)

### Suppl. material 2: *Eudonia luteusalis* map [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Eudonia luteusalis* in the Azores islands.

**Filename:** Eudonia\_luteusalis.kmz - [Download file](#) (73.85 kb)

### Suppl. material 3: *Eudonia melanographa* map [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Eudonia melanographa* in the Azores islands.

**Filename:** Eudonia\_melanographa.kmz - [Download file](#) (57.29 kb)

### Suppl. material 4: *Scoparia aequipennalis* map [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Scoparia aequipennalis* in Azores islands.

**Filename:** Scoparia\_aequipennalis.kmz - [Download file](#) (206.90 kb)

### Suppl. material 5: *Scoparia carvalhoi* map [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Scoparia carvalhoi* in Azores islands.

**Filename:** Scoparia\_carvalhoi.kmz - [Download file](#) (20.99 kb)

### Suppl. material 6: *Scoparia coecimaculalis* map [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Scoparia coecimaculalis* in Azores islands.

**Filename:** Scoparia\_coecimaculalis.kmz - [Download file](#) (165.10 kb)

**Suppl. material 7: *Scoparia semiampalis* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Scoparia semiampalis* in Azores islands.

**Filename:** Scoparia\_semiampalis.kmz - [Download file](#) (101.46 kb)

**Suppl. material 8: *Udea azorensis* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Udea azorensis* in the Azores islands.

**Filename:** Udea\_azorensis.kmz - [Download file](#) (58.82 kb)

**Suppl. material 9: *Brachmia infuscatella* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution *Brachmia infuscatella* in Azores islands.

**Filename:** Brachmia\_infuscatella.kmz - [Download file](#) (17.51 kb)

**Suppl. material 10: *Cyclophora azorensis* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Cyclophora azorensis* in the Azores islands.

**Filename:** Cyclophora\_azorensis.kmz - [Download file](#) (262.04 kb)

**Suppl. material 11: *Eupithecia ogilviata* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Eupithecia ogilviata* in Faial island.

**Filename:** Eupithecia\_ogilviata.kmz - [Download file](#) (6.44 kb)

**Suppl. material 12: *Xanthorhoe inaequata* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Xanthorhoe inaequata* in the Azores islands.

**Filename:** Xanthorhoe\_inaequata.kmz - [Download file](#) (153.03 kb)

**Suppl. material 13: *Micrurapteryx bistrigella* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Micrurapteryx bistrigella* in Azores islands.

**Filename:** Micrurapteryx\_bistrigella.kmz - [Download file](#) (10.36 kb)

**Suppl. material 14: *Apamea ramonae* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Apamea ramonae* in Flores island.

**Filename:** Apamea\_ramone.kmz - [Download file](#) (12.28 kb)

**Suppl. material 15: *Apamea sphagnicola* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Apamea sphagnicola* in Azores islands.

**Filename:** Apamea\_sphagnicola.kmz - [Download file](#) (31.86 kb)

**Suppl. material 16: *Hadena azorica* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Hadena azorica* in São Jorge island.

**Filename:** Hadena\_azorica.kmz - [Download file](#) (5.73 kb)

**Suppl. material 17: *Melanchra granti* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Melanchra granti* in Azores islands.

**Filename:** Melanchra\_granti.kmz - [Download file](#) (20.85 kb)

**Suppl. material 18: *Mesapamea storai* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Mesapamea storai* in Azores islands.

**Filename:** Mesapamea\_storai.kmz - [Download file](#) (139.05 kb)

**Suppl. material 19: *Noctua atlantica* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Noctua atlantica* in Azores islands.

**Filename:** Noctua\_atlantica.kmz - [Download file](#) (176.38 kb)

**Suppl. material 20: *Noctua carvalhoi* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Noctua carvalhoi* in Azores islands.

**Filename:** Noctua\_carvalhoi.kmz - [Download file](#) (60.70 kb)

**Suppl. material 21: *Phlogophora cabrali* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Phlogophora cabrali* in Azores islands.

**Filename:** Phlogophora\_cabrali.kmz - [Download file](#) (64.78 kb)

**Suppl. material 22: *Phlogophora furnasi* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Phlogophora furnasi* in Azores islands.

**Filename:** Phlogophora\_furnasi.kmz - [Download file](#) (30.68 kb)

**Suppl. material 23: *Phlogophora interrupta* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Phlogophora interrupta* in Azores islands.

**Filename:** Phlogophora\_interrupta.kmz - [Download file](#) (167.88 kb)

**Suppl. material 24: *Phlogophora kruegeri* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Phlogophora kruegeri* in Flores island.

**Filename:** Phlogophora\_kruegeri.kmz - [Download file](#) (6.31 kb)

**Suppl. material 25: *Stenoptilia meyeri* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Stenoptilia meyeri* in São Miguel island.

**Filename:** Stenoptilia\_meyeri.kmz - [Download file](#) (8.06 kb)

**Suppl. material 26: *Homoeosoma miguelensis* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Homoeosoma miguelensis* in São Miguel island.

**Filename:** Homoeosoma\_miguelensis.kmz - [Download file](#) (11.40 kb)

**Suppl. material 27: *Homoeosoma picoensis* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Homoeosoma picoensis* in Pico island.

**Filename:** Homoeosoma\_picoensis.kmz - [Download file](#) (3.37 kb)

**Suppl. material 28: *Neomariania incertella* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Neomariania incertella* in Flores island.

**Filename:** Neomariania\_incertella.kmz - [Download file](#) (4.14 kb)

**Suppl. material 29: *Neomariania oecophorella* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Neomariania oecophorella* in Azores islands.

**Filename:** Neomariania\_oecophorella.kmz - [Download file](#) (21.00 kb)

**Suppl. material 30: *Neomariania scriptella* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Neomariania scriptella* in Azores islands.

**Filename:** Neomariania\_scriptella.kmz - [Download file](#) (14.32 kb)

**Suppl. material 31: *Eudarcia atlantica* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Eudarcia atlantica* in Azores islands.

**Filename:** Eudarcia\_atlantica.kmz - [Download file](#) (16.70 kb)

**Suppl. material 32: *Argyresthia atlanticella* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Argyresthia atlanticella* in Azores islands.

**Filename:** Argyresthia\_atlanticella.kmz - [Download file](#) (297.79 kb)

**Suppl. material 33: *Argyresthia minusculella* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Argyresthia minusculella* in Azores islands.

**Filename:** Argyresthia\_minusculella.kmz - [Download file](#) (3.73 kb)

**Suppl. material 34: *Argyresthia poecilella* map** [doi](#)

**Authors:** Anja Danielczak

**Data type:** Map Google Earth

**Brief description:** Distribution of *Argyresthia poecilella* in São Miguel island.

**Filename:** Argyresthia\_poecilella.kmz - [Download file](#) (8.98 kb)