# *Antipodia chaostola* subsp. *leucophaea*

## Tasmanian chaostola skipper

TASMANIAN THREATENED SPECIES LISTING STATEMENT

*Antipodia chaostola* subsp. *leucophaea*
Image © Karen Richards

| | |
|---|---|
| **Scientific name:** | ***Antipodia chaostola* subsp. *leucophaea*** (Couchman, 1946) |
| **Common names:** | Tasmanian chaostola skipper, heath-sand skipper |
| **Group:** | Invertebrate, Butterfly, Family Hesperiidae |
| **Status:** | *Threatened Species Protection Act 1995*: **endangered** |
| | *Environment Protection and Biodiversity Conservation Act 1999*: **Endangered** |
| | *IUCN Red List:* **Not listed** |
| **Distribution:** | Endemic status: **Endemic** |
| | Tasmanian NRM Region: **North, South** |
| | Tasmanian IBRA bioregion: **Furneaux, South East, Southern Ranges** |

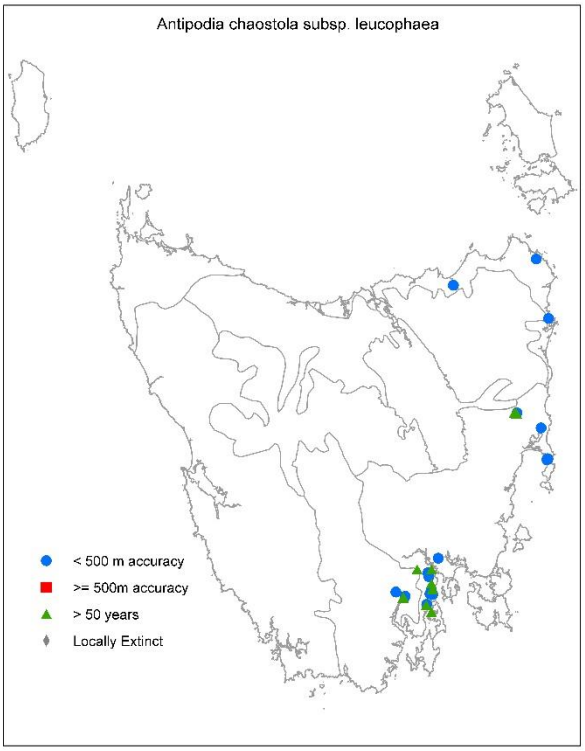


**Figure 1**. The distribution of *Antipodia chaostola* subsp. *leucophaea*, showing IBRA bioregions. Data from Natural Values Atlas (NVA 2023)

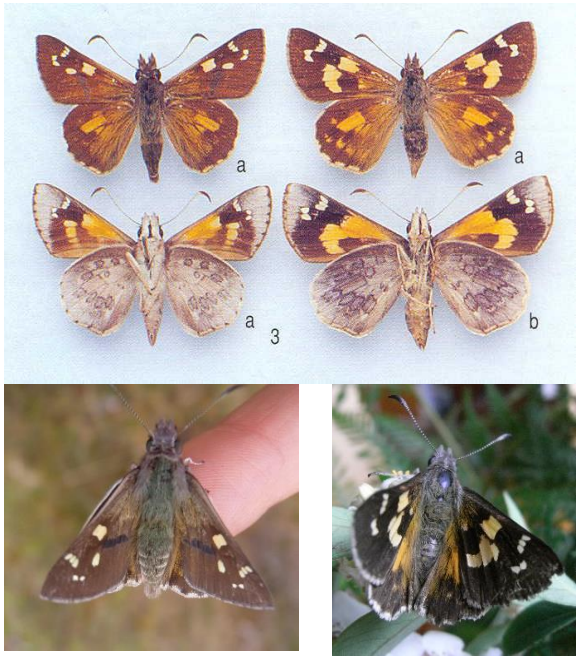


**Plate 1.** *Antipodia chaostola*
(top) a: subspecies *chares* b: subspecies *chaostola* © CSIRO
(left) male subsp. *leucophaea* © Jo Potter-Craven
(right) female subsp. *leucophaea* © Karen Richards

**SUMMARY:** The Tasmanian chaostola skipper (*Antipodia chaostola* subsp. *leucophaea*) is a medium-sized (32–35 mm), brown-coloured butterfly. It is restricted to dry forest and woodland supporting sedges of *Gahnia radula* and/or *G. microstachya*, and occurs in isolated populations in north-eastern, eastern, and south-eastern Tasmania. The adults fly for only a few weeks between October and December, but larval subpopulations can be detected by the distinctive larval shelters at any time of the year. The Tasmanian chaostola skipper, in contrast to other genera, has the entrance of the larvae shelter located at the bottom with the larva resting head downwards. The species is threatened by any activity which removes or degrades its *Gahnia* habitat including land clearing, urban development, inappropriate burning regimes, and forest harvesting. The main objective for management of this species is to protect known subpopulations.

## IDENTIFICATION AND ECOLOGY

The Tasmanian chaostola skipper, *Antipodia chaostola* subsp. *leucophaea* (hereafter 'chaostola skipper'), belongs to the family Hesperiidae. The name 'skipper' comes from the rapid and erratic flight typical of Hesperiidae species. Skippers differ from other butterflies in having a broad head, antennae that are widely spread apart, and a dominance of brown and yellow in body colour (TSSC 2010). The Hesperiidae is a cosmopolitan family and includes some 3,500 species. The adults are small- to medium-sized and dull brown in colour, though a few species are more brightly coloured. *Antipodia* is a small genus, comprising three rare species, occurring in southern Australia and Tasmania (Braby 2000).

The appearance of the adult *Antipodia chaostola* is typical of the genus, characterised by brown wings with distinctive yellow, orange, and cream spots on the upper side, and a grey toned underside, with small variations between subspecies. Adult wingspan is 32 mm (male) and 35 mm (female). The most easily distinguished characteristic of *Antipodia chaostola* is the orientation of the larval shelter which is different to other genera.

The entrance of the larval shelter is located at the bottom, with the larva resting head downwards (Braby 2000). The larvae make chewing patterns typical of Hesperiidae species, usually at the tips of the leaves above the larval shelter, which are also relatively easy to detect. For a full description of the subspecies see Couchman (1962), Atkins (1984) and Braby (2000).

Two other subspecies of *Antipodia chaostola* occur on mainland Australia: subsp. *chaostola* is restricted to the Blue Mountains in New South Wales; and subsp. *chares* is only known from a few areas in southern Victoria (Braby 2000).

The chaostola skipper has a 2-year life cycle—unlike most butterflies which develop from egg to caterpillar to adult in one year. Adults fly for only a few weeks between October and December, at which time they lay their eggs. The larvae develop slowly over 12 to 20 months. During the second winter the final instar larva does not feed. Pupation occurs in August and adults emerge some 4 to 7 weeks later, 2 years after the egg was laid (Braby 2000; Neyland & Bell 2000; TSS 2012).

Adults mate and females lay eggs during the flight period. Eggs are laid on the sedge *Gahnia* and once hatched from the eggs the larvae feed, shelter and pupate on this food plant. *Gahnia radula* (thatch sawsedge) and *G. microstachya* (slender sawsedge) have been recorded as food plants for this species in Tasmania (TSS 2012). *Gahnia grandis* (cutting grass) has also been recorded as a food plant for the species (e.g., at Coningham), but only where *G. grandis* is found co-occurring with *G. radula* (TSS 2012). Additional species of *Gahnia* known to occur in Tasmania, including *G. sieberiana* (redfruit sawsedge), have been recorded as food plants for the mainland subspecies (Braby 2000), and so may possibly also be host species in Tasmania.

Caterpillars (Plate 2) feed at night and rest by day in a conical shelter on the food plant. Pupation occurs in the shelter which is formed by joining several *Gahnia* leaves with silk (Plate 3) (Braby 2000).

**Plate 2.** Larvae of the chaostola skipper feeding on *Gahnia microstachya*. Image © Niall Doran

**Plate 3.** Larval shelters of the chaostola skipper in *Gahnia radula*. Images © Matt Webb

Little is known of the species' local movements; however, the chaostola skipper is likely to be territorial and females able to fly large distances to lay eggs (Wainer & Yen 2009). Despite an apparent strong flying ability, it is unlikely that the species could successfully move between known subpopulations due to large expanses of unsuitable habitat separating them.

### Survey techniques

The adult chaostola skipper can be detected during its flight period (October to December), particularly on warm sunny days with little or no wind (Neyland & Bell 2000). Areas containing suitable habitat should be targeted.

The distinctive larval shelters of the chaostola skipper are present throughout the year and can remain recognisable for some time after the adults have emerged. Therefore, surveys targeting the detection of larval shelters in suitable habitat are recommended.

### Confusing species

Whilst the chaostola skipper is the only member of the genus *Antipodia* in Tasmania, distinguishing adults of the species from other skippers can be difficult unless in the hand (Braby 2000).

The egg of the chaostola skipper is hemispherical and ellipsoidal, 1.4 mm wide, pale green to white with a reddish-brown apex and 36 longitudinal ribs. The egg of *Hesperilla chrysotricha* (chrysotricha skipper) is similar but has fewer ribs (Atkins 1989; Braby 2000). The larvae (Plates 2 & 3) are 29 mm long, have a yellow body with a grey middorsal line, a brown-black head, as well as a bright red prothorax and white setae which distinguishes it from the similar *Hesperilla donnysa* (donnysa skipper) (Neyland & Bell 2000, Braby 2000). The pupae are 23 mm long, black, partly covered by a white waxy powder, and can be distinguished from that of *Hesperilla donnysa* by less developed projections of the pupal cap (Atkins 1984, Braby 2000).

## DISTRIBUTION AND HABITAT

The chaostola skipper is endemic to Tasmania and was thought to only occur at five discrete and well defined "colonies" (subpopulations) in the east and southeast in mainly near-coastal lowlands (Neyland and Bell 2000). In 2016 the species' known range was extended significantly with its discovery near Bridport. This prompted further surveys across its potential range, which increased the known range and number of known subpopulations (Bell 2018).

The distribution of the species is fragmented as most known subpopulations are small, isolated, and geographically separated by distances presumed greater than the dispersal/flying capability of the species. They are also usually separated by large expanses of unsuitable habitat such as residential areas, intensively managed agricultural land and/or unsuitable native vegetation.

Chaostola skipper has been found in dry lowland vegetation communities supporting the food plants *Gahnia radula* and/or *G. microstachya* (cutting sedges in the Cyperaceae family).

**Plate 4.** Chaostola skipper habitat at Knocklofty: heathy *Eucalyptus amygdalina* woodland on sandstone, *Gahnia radula* as the food plant. Image © Phil Bell

**Plate 5.** Chaostola skipper habitat in the Peter Murrell Reserve: heathy *Eucalyptus amygdalina* woodland on sandstone, with *Gahnia radula* as the food plant. Image © Phil Bell

**Plate 6.** Chaostola skipper habitat on Freycinet Peninsula: open woodland on granite, with *Gahnia microstachya* and *G. radula* as the food plant. Image © Phil Bell

These communities occur on relatively infertile substrates derived from sandstones, mudstones, siltstones, granites or windblown sands (Neyland and Bell 2000).

Chaostola skipper has been found in several vegetation types. At Knocklofty (Plate 4) and the Peter Murrell Reserves (Plate 5), the habitat is a mosaic of heathland, heathy woodland, and dry *Eucalyptus amygdalina* and *E. tenuiramis* forests on a sandstone substrate supporting *Gahnia radula*. At Little Swanport the habitat is dry sedgy/grassy woodland and forest dominated by *Acacia mearnsii*, and *Eucalyptus globulus* forest on sandstone supporting *Gahnia radula*.

Sites at The Hazards in Freycinet National Park include heathland and *Eucalyptus tenuiramis* forest/woodland, both vegetation types occurring on granite and supporting both *Gahnia radula* and *G. microstachya* (Plate 6). At Hop Pole Bottom, near Royal George the vegetation is different to other known sites, primarily heathy/sedgy *Eucalyptus amygdalina – E. pulchella* forest on dolerite with an abundant understorey of *Xanthorrhoea australis* with occasional small clumps of *Gahnia microstachya*. This broadened range of known habitat suggests the chaostola skipper is potentially more persistent at known sites and more common across its potential range than previously thought (Bell 2018). Considerable surveys have since been undertaken on Flinders Island, but efforts so far have not found evidence of chaostola skipper there (Bell, pers. comms.).

**POPULATION PARAMETERS**

*Number of subpopulations:* 14
*Number of locations:* 8
*Extent of occurrence:* 15,842 km$^2$ (possibly extinct sites fall within this extent of occurrence)
*Linear extent:* 256 km
*Area of occupancy (as per IUCN criteria)* = 104 km$^2$ (92 km$^2$ excluding possibly extinct sites)
*Number of mature individuals:* Unknown
*Largest subpopulation:* Unknown

The extent of occurrence is 15,842 km$^2$, which has increased due to increased survey effort.

There is insufficient quantitative data to indicate past or future changes in extent of occurrence, except by reference to loss of habitat through land clearing subject to the Permanent Native Forest Estate Policy.

The chaostola skipper has a linear range of 256 km from Snug to near Musselroe Bay (based on data in Table 1). Based on known subpopulations (see Table 1), the area of occupancy is estimated to be around 100 km$^2$, with the greatest area of potential habitat (and therefore, largest potential subpopulations) being *Gahnia microstachya* habitat within Freycinet National Park (Bell, pers. comms.). It is possible that the chaostola skipper is distributed more widely across potential habitat of dry forest and woodland supporting *G. radula* and/or *G. microstachya* (Usually *Eucalyptus amygdalina* or *E. tenuiramis* dominated forest/woodland on sandstone, mudstone, aeolian sands or granite substrates) (Bell 2018).

There are no estimates of the size of individual subpopulations or of the entire population in Tasmania (TSSC 2010), especially in relation to mature individuals. Historically, the chaostola skipper was considered to be very localised and uncommon (McQuillan 1994). It is possible to estimate the abundance of larvae (e.g., larvae per square metre—see Table 1 for some estimates) but extrapolation of data collected in an unsystematic manner to the broader range of the species has not been attempted. It is not known whether the species undergoes extreme natural fluctuations in population numbers.

It is likely the abundance of the chaostola skipper has declined significantly since described in 1946 by Couchman, due to the clearing of potential habitat especially in near-coastal areas, mainly for agricultural and residential development.

Both the decrease in suitable habitat and the increase in threats to the species (e.g., inappropriate fire regimes and stock grazing) have likely resulted in a reduction in the number and size of subpopulations and hence overall population size.

Habitat clearing has also reduced the effectiveness of dispersal between subpopulations due to the fragmentation of sites (TSS 2012; Bell 2018).

The chaostola skipper was ranked as 13th out of 26 Australian butterfly species considered most at risk of extinction in the next 20 years (by 2040) by a panel of Australian butterfly and conservation experts. It was determined to have a low/medium extinction risk of 11% if no remedial actions are undertaken to protect the species (Geyle *et al.* 2021).

**RESERVATION STATUS**

Chaostola skipper is reserved in Freycinet National Park, Mt William National Park, Bay of Fires Conservation Area, Coningham Nature Recreation Area, Peter Murrell State Reserve/Conservation Area, Knocklofty Reserve (Hobart City Council Bushland Reserve), and a private land conservation covenant under the Tasmanian *Nature Conservation Act 2002* at Little Swanport.

**CONSERVATION STATUS**

*Antipodia chaostola* subsp. *leucophaea* was listed as endangered on the schedules of the Tasmanian *Threatened Species Protection Act 1995* in 1995, meeting the following criteria based on the knowledge available on the species at that time: B (extent of occurrence estimated to be less than 5000 km$^2$), specifically B1 (severely fragmented) and B2c (continuing decline in area, extent and/or quality of habitat).

Justification for listing was its very restricted geographic distribution which is precarious for its survival given the nature of ongoing threats (TSSC 2010).

Please note that the initial assessment was conducted under the previous version of the *Guidelines for Listing under the Threatened Species Protection Act 1995*, which has since been superseded by a newer version endorsed by the Scientific Advisory Committee (Threatened Species) in March 2023.

*Antipodia chaostola* subsp. *leucophaea* was listed as Endangered under the Commonwealth, *Environment Protection and Biodiversity Conservation Act 1999* in 2010.

**Table 1.** Population summary for the Tasmanian chaostola skipper

| | Location | Tenure | NRM region* | 1:25 000 mapsheet | Years seen | Abundance |
|---|---|---|---|---|---|---|
| 1 | The Hazards, Freycinet Peninsula | Freycinet National Park | South | Coles Bay | 2003<br>2012<br>2016–2017 | Unknown.<br>2 larval shelters found per 10 m² |
| 2 | South of Apsley River, Freycinet | Freycinet National Park | South | Lodi | 2017 | Unknown. Larval shelters were found in *Gahnia microstachya* |
| 3 | Little Swanport | Conservation Covenant | South | Royalty | 2002 | 1 larval shelter found per 10 m²<br>Possibly extinct |
| 4 | Sheppards Hill (Coningham) | Nature Recreation Area/Private Property | South | Blackmans Bay<br>Barnes Bay | 1992<br>2005<br>2012 | One adult observed during intensive search of potential habitat (1992) |
| 5 | Kingston (Hawthorn Drive, Peter Murrell State Reserve, Private land) | Private Land and Peter Murrell State Reserve and Conservation Area | South | Blackmans Bay<br>Taroona | 1950s<br>1980–1982<br>2004, 2006<br>2008<br>2012<br>2017 | Unknown. 10–15 shelters found in an area of ~2 ha (2012) |
| 6 | Knocklofty (Hobart) | Local Government | South | Taroona | 1950s<br>2006<br>2017 | Unknown |
| 7 | Huonville | Private Land | South | Huonville | 1899<br>1902<br>1942<br>2017 | Unknown. Larval shelters were found in a small clump of *Gahnia radula* |
| 8 | Lenah Valley | Road reserve | South | Hobart | 2017 | Unknown. Larval shelters were found in *Gahnia radula*. Likely to occur more widely in the area |
| 9 | Hop Pole Bottom | Future Potential Production Forest / Swan River Forest Reserve | North | Henry | 1992<br>2017 | 1992 - Incidental record of adult<br>2017 – Larval shelters were found in *Gahnia microstachya* |
| 10 | Bay of Fires | Bay of Fires Conservation Area | North | Binalong | 2017 | Unknown. Larval shelters were found *Gahnia radula* |

| | Location | Tenure | NRM region* | 1:25 000 mapsheet | Years seen | Abundance |
|---|---|---|---|---|---|---|
| 11 | Mt William | Mt William National Park, and Private Freehold | North | Musselroe | 2017 | Unknown. Larval shelters were found *Gahnia radula* |
| 12 | Ranelagh | Conservation Area | South | Huonville | 2017 | Single larval shelter was found in *Gahnia radula* |
| 13 | Grasstree Hill | Private Land | South | Richmond | 2013 | Unknown |
| 14 | Bridport | Private Land | North | Bridport | 2016 | Unknown |
| **Miscellaneous sightings** | | | | | | |
| 1 | Mt Nelson (Hobart) | Probably Private Land | South | Taroona | 1992 | Incidental record of adult |
| 2 | Bicheno | Probably Private Land | South | Bicheno | 1945 | Unknown |
| 3 | Snug River | Probably Private Land | South | Blackmans Bay | Undated record | Unknown |

*NRM region = Natural Resource Management region

**THREATS, LIMITING FACTORS & MANAGEMENT ISSUES**

**Habitat loss (land clearing and other habitat modification):** Habitat loss due to urbanisation, agricultural and other development such as building on bush blocks has likely been the major cause of declines and local extinctions of the chaostola skipper. Roadside and fenceline stands of *Gahnia radula* indicate that the plant was once extensively distributed throughout the South Arm, Kingborough, Huon and Derwent Valley areas in south-eastern Tasmania. Many of these areas are now largely subdivided into small residential blocks (Neyland & Bell 2000). Understorey modification involving the loss of *Gahnia* alone is sufficient to render sites unsuitable for the species.

Agricultural development has also contributed to a decline in the extent and quality of habitat of the chaostola skipper. The clearance of lowland coastal vegetation supporting *Gahnia radula* and *G. microstachya* continues along the east coast of Tasmania (Bell, pers. comm).

**Fire regimes that cause declines in biodiversity:** An increase in fire frequency, intensity and season can cause direct and indirect declines in ecological communities (DAWE 2022).

Research suggests that the chaostola skipper is a 'fire succession species', although its relationship with fire is considered a gap in the ecological knowledge required for the conservation management of the species (Sands & New 2002). Observations on the Australian mainland suggest that chaostola skipper is most abundant for a few years following fire. Regrowth of *Gahnia* species is encouraged by fire, but too frequent fires will remove both the butterfly and food plant (Wainer & Yen 2009).

Ecological and fuel reduction burns may need to be mosaic or compartmentalised to maintain a variety of vegetation age classes to allow for the recolonisation of the chaostola skipper from neighbouring areas (TSS 2012; Bell 2018; Wainer & Yen 2009). Furthermore, in the absence of fire, scrub vegetation can displace the open vegetation which supports *Gahnia microstachya* and *G. radula*. This is notable in Freycinet National Park and in Peter Murrell Reserve.

**Forestry activities:** Parts of the predicted range of the species occur in areas suitable for forestry activities. Historically substantial areas of potential habitat have been subject to forestry practices. This risk has been reduced by the requirement for pre-operational surveys for chaostola skipper habitat and the subsequent application of management prescriptions for protection of the species under the Forest Practices System.

**Climate change:** The trend towards a warmer climate may increase the frequency effect of wildfire on chaostola skipper habitat, potentially leading to declines in habitat quality and the abundance of butterflies. Climate change may also influence the butterfly's life history such as emergence times and duration of the flying season.

**Stochastic risk:** The small size of many subpopulations may expose the species to a stochastic risk of extinction. In addition, the highly fragmented nature of the species' distribution may have implications for genetic exchange, and hence genetic diversity, within and between subpopulations.

**Illegal collection:** Illegal collection for the purposes of selling or personal insect collections is a potential threat. However, it is considered a minor threat, given the intensity of survey required to find adults and there are no documented cases of illegal trade in the species. Pupae are more easily targeted and can be distributed via the postal network (Bell, pers. comms.).

## MANAGEMENT STRATEGY

### Management objectives

The main objectives for the recovery of the chaostola skipper are to prevent further habitat loss, improve the species reservation status, improve understanding of the ecological requirements of the species, improve knowledge on known subpopulations and identify new subpopulations of the species.

### What has been done?

**Targeted surveys & monitoring:** The species has been intermittently monitored. In 1992 a survey was conducted that only targeted known sites (Neyland & Bell 2000). In the early 2000s, survey effort around Little Swanport, Freycinet Peninsula and St Helens found two new sites located at Little Swanport and within the Freycinet National Park near Coles Bay (Bell, pers. comms.). The Threatened Species Section (2012) undertook a detailed survey of the Kingborough Municipality to ensure population maintenance and provide management recommendations for council. The discovery of the chaostola skipper 100 km outside of its known range near Bridport in 2016 prompted a wider reaching survey across its potential range. Surveys in 2017 significantly increased the known range and number of known subpopulations, including the northeast of the state with discovery of subpopulations at the Bay of Fires and Mt William (Bell 2018). Prior to Bell (2018) surveys generally targeted patches of potential habitat associated with development proposals (e.g., forest practices plans, residential subdivisions, farm dams). Several other surveys have focused with the historically known range such as within the greater Hobart area.

**Existing management plans:** The Kingborough Municipality prepared a strategic plan for the management of the chaostola skipper in 2012 (TSS 2012). Fire Management Plans have been prepared for the Peter Murrell State Reserve/Conservation Area and the City of Hobart (PWS 2006; COH 2021), which do not specifically mention chaostola skippers but do detail fire management practices to minimise the threat of fire to ecological diversity and natural values. In the City of Hobart Biodiversity Action Plan for bushland and reserves, chaostola skipper is identified as a key threatened species for management prioritisation (COH 2019).

**Forestry management:** Under the Tasmanian Forest Practices System there are requirements to survey for potential habitat within areas proposed for Forest Practices activities and apply conservation management prescriptions where required (FPA 2020; FPA 2021).

In some cases, the FPA Biodiversity Program undertakes surveys of potential habitat where new populations of chaostola skipper are likely to occur. This management approach has resulted in the discovery of several new subpopulations of the species (e.g., Bell 2005; 2018).

**Education:** The Forest Practices Authority in conjunction with the Threatened Species Section occasionally run training courses and field days on identification and management of chaostola skipper habitat for forest planners, government regulators, environmental consultants, environmental care groups and interested members of the general public.

**What is needed?**

- Develop guidelines and management prescriptions to retain significant habitat in the chaostola skippers core range; and reduce the impact of urban and other development on potential habitat of the chaostola skipper and disseminate to local councils;
- Provide guidance on appropriate conservation management of chaostola skippers across their potential habitat (dry forest and woodland supporting *Gahnia radula* (usually on sandstone and other sedimentary rock types)) or *Gahnia microstachya* (usually on granite-based substrates) to the public, local government, and private land managers;
- Undertake extension surveys in potential habitat to improve understanding of the distribution of the species, which will inform its threatened status;
- Perform monitoring at known subpopulations to determine distribution, abundance, ecology and potential threats;
- Determine the species response to disturbance types to determine an appropriate regime (e.g. slashing, stock grazing, fire) to improve understanding of the species ecological requirements;
- Support the Private Land Conservation Program (NRE Tas) to establish conservation covenants on private land supporting chaostola skipper. Ensure that current priorities for the species are incorporated into the program's reservation strategies;
- Promote awareness of the species and its supporting habitat (species of the *Gahnia* genus) by providing informative resources and support to relevant Natural Resource Management committees, local councils, government agencies and local community;
- Determine the species' response to potential climate change impacts, such as habitat changes, emergence times and duration of flying season.

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*declines in biodiversity as a key threatening process*, Department of Agriculture, Water and the Environment, Canberra, April. CC BY 4.0.

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**View:** www.naturalvaluesatlas.tas.gov.au
https://nre.tas.gov.au/conservation/threatened-species-and-communities/lists-of-threatened-species/full-list-of-threatened-species
www.threatenedspecieslink.tas.gov.au

**Contact details:** Threatened Species Section, Department of Natural Resources and Environment Tasmania, GPO Box 44, Hobart, Tasmania, Australia 7001. Ph: 1300 368 550.

threatenedspecies.enquiries@nre.tas.gov.au

## Attachment A – Listing Assessment for *Antipodia chaostola subsp. leucophaea*

**ASSESSMENT PARAMETERS**

| Metric | Estimate used in the assessment | Minimum plausible value | Maximum plausible value | Justification |
|---|---|---|---|---|
| **Number of mature individuals** | Unknown | Unknown | Unknown | There are no estimates of the size of individual subpopulations or of the entire population in Tasmania (TSSC 2010), especially in relation to mature individuals. |
| **Trend** | Unknown, but suspected to be declining. | | | It is likely the abundance of chaostola skipper has declined significantly since European settlement, due to the clearing of potential habitat especially in near-coastal areas, mainly for agricultural and residential development (DSEWPaC 2012, TSS 2012). |
| **Generation length (years)** | 2 | 2 | 2 | Chaostola skipper has a 2-year life cycle (Braby 2000, Neyland & Bell 2000, TSS 2012) |
| **Extent of occurrence (EOO)** | 15,842 km$^2$ | 15,842 km$^2$ | Unknown | The EOO was calculated using a minimum convex polygon around all validated records from the Natural Values Atlas (2023) |
| **Trend** | There is insufficient quantitative data to indicate past or future changes in extent of occurrence, except by inferred decrease due to loss of habitat through land clearing. | | | Both the decrease in suitable habitat and the increase in threats to the species (e.g., inappropriate fire regimes and stock grazing) have likely resulted in a reduction in the number and size of subpopulations and hence overall population size. Habitat clearing has also reduced the effectiveness of dispersal between colonies due to the fragmentation of sites (TSS 2012; Bell 2018). |
| **Area of Occupancy (AOO)** | 104 km$^2$ | 104 km$^2$ | Unknown | AOO calculated using 2 x 2 km grid square overlayed on verified records used to calculate EOO. |
| **Trend** | There is insufficient quantitative data to indicate past or future changes in area of occupancy, except by inferred decrease due to loss of habitat through land clearing. | | | |
| **Number of subpopulations** | 14 | 12 | Unknown | |
| **Trend** | Declining | | | |
| **Basis of assessment of subpopulation number** | Subpopulation numbers are based on both historic and more recent surveys undertaken as outlined in Table 1. Locations surveyed greater than 10 years ago are removed for the minimum plausible value. Maximum plausible value based on suitable habitat has not been calculated. | | | |

| Metric | Estimate used in the assessment | Minimum plausible value | Maximum plausible value | Justification |
|---|---|---|---|---|
| **No. locations** | 14 | 12 | 14 | Threats used to define locations with subpopulations (as outlined in Table 1) affected:<br>Habitat loss: High probability due to ongoing agricultural development and urbanisation on unreserved land (3, 4, 5, 7, 8, 9, 11, 13, 14).<br>Fire regimes that cause a decline in biodiversity: Higher probability of inappropriate fire regimes rapidly affecting most individuals in a subpopulation (1, 2, 6, 10, 12).<br>Climate change: Primary threat is an increased risk of fire frequency, intensity and season – and has therefore been grouped with the fire regimes threat for the purposes of this assessment. |
| **Trend** | Declining. | | | Habitat loss due to agricultural development and urbanisation has likely been the major cause of declines and local extinctions of the chaostola skipper. Roadside and fence line stands of *Gahnia radula* indicate that the plant was once extensively distributed throughout the South Arm, Kingborough, Huon and Derwent Valley areas in south-eastern Tasmania. Many of these areas are now largely subdivided into small residential blocks (Neyland & Bell 2000). Understorey modification involving the loss of *Gahnia* alone is sufficient to render sites unsuitable for the species. Agricultural development has also contributed to a decline in the extent and quality of habitat of the chaostola skipper. The clearance of lowland coastal vegetation supporting *Gahnia radula* and *G. microstachya* continues along the east coast of Tasmania (Bell, pers. comms.). |
| **Basis of assessment of location number** | Habitat loss (due to development) was counted as the most plausible threat to subpopulations located on unreserved land (which may be subject to future agricultural or urban development). They were counted as separate locations as they are unlikely to be impacted by the same development event. For subpopulations located on reserved land, the threat of fire regimes that cause a decline in biodiversity / climate change (increased risk of wildfire) was counted as the most plausible treat. A circular buffer of 20km radius was used to define the extent of a location to account for the potential extent of impact from a single Wildfire event. This did not group any subpopulations identified as most at risk of this threat into one location. | | | |

| Metric | Estimate used in the assessment | Minimum plausible value | Maximum plausible value | Justification |
|---|---|---|---|---|
| **Fragmentation** | The distribution of the species is fragmented as most known subpopulations are small, isolated, and geographically separated by distances presumed greater than the dispersal / flying capability of the species. They are also usually separated by large expanses of unsuitable habitat such as residential areas, intensively managed agricultural land and/ or unsuitable native vegetation. | | | |
| **Fluctuations** | No extreme fluctuations in EOO, AOO or number of subpopulations, although these have increased due to increased survey effort outside of known range (Bell 2018). No data is available on number of mature individuals to assess fluctuations in population numbers, outside of assumptions on reduced abundance since European settlement, primarily due to habitat clearing. | | | |

**IUCN ASSESSMENT**

**Overall assessment result:**

Endangered under Criterion B2ab(iii)

**CRITERION 1:**

**Population size reduction (reduction in total numbers)**
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

| | Critically Endangered Very severe reduction | Endangered Severe reduction | Vulnerable Substantial reduction |
|---|---|---|---|
| **A1** | **≥ 90%** | **≥ 70%** | **≥ 50%** |
| **A2, A3, A4** | **≥ 80%** | **≥ 50%** | **≥ 30%** |

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be reversible.

*based on any of the following*

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

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

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

**Assessment result**

Data deficient.

**Justification**

There is insufficient evidence to demonstrate a substantial population size reduction.

**CRITERION 2:**

| Geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy | | | |
|---|---|---|---|
| | **Critically Endangered Very restricted** | **Endangered Restricted** | **Vulnerable Limited** |
| B1. Extent of occurrence (EOO) | **< 100 km²** | **< 5,000 km²** | **< 20,000 km²** |
| B2. Area of occupancy (AOO) | **< 10 km²** | **< 500 km²** | **< 2,000 km²** |
| AND at least 2 of the following 3 conditions: | | | |
| (a) Severely fragmented OR Number of locations | **= 1** | **≤ 5** | **≤ 10** |
| (b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals | | | |
| (c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (number of mature individuals | | | |

**Assessment result**
Qualifies as Endangered under Criterion B2ab(iii)
**Justification**
AOO is <500 km² AND a) it is considered to be severely fragmented; b) inferred continuing decline (iii) in area extent and quality of habitat. The basis for inferred continuing decline in extent /quality of habitat is based on a high probability that habitat degradation will occur over the next 100 years via land clearing / land use changes, as well as risk from fire regimes or increased frequency of wildfire due to climate change.
EOO is less then <20,000 km², meeting the criteria for Vulnerable, but not Endangered (> 5,000 km²).

**CRITERION 3:**

| Small population size and decline | | | |
|---|---|---|---|
| | **Critically Endangered Very low** | **Endangered Low** | **Vulnerable Limited** |
| Estimated number of mature individuals | **< 250** | **< 2,500** | **< 10,000** |
| AND either (C1) or (C2) is true | | | |
| C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future | **Very high rate 25% in 3 years or 1 generation (whichever is longer)** | **High rate 20% in 5 years or 2 generation (whichever is longer)** | **Substantial rate 10% in 10 years or 3 generations (whichever is longer)** |
| C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions: | | | |
| (a) (i) Number of mature individuals in each subpopulation | **≤ 50** | **≤ 250** | **≤ 1,000** |
| (a) (ii) % of mature individuals in one subpopulation = | **90 – 100%** | **95 – 100%** | **100%** |
| (b) Extreme fluctuations in the number of mature individuals | | | |

**Assessment result**
Data deficient.
**Justification**
There are no estimates which have been quantified in relation to the number of mature individuals and future decline.

**CRITERION 4:**

| Very small population | | | |
|---|---|---|---|
| | **Critically Endangered Extremely low** | **Endangered Very Low** | **Vulnerable Low** |
| Number of mature individuals | **< 50** | **< 250** | **< 1,000** |

**Assessment result**
Data deficient.
**Justification**
There are no estimates of the size of individual subpopulations or of the entire population in Tasmania, especially in relation to mature individuals.

**CRITERION 5:**

| Quantitative Analysis | | | |
|---|---|---|---|
| | **Critically Endangered Immediate future** | **Endangered Near future** | **Vulnerable Medium-term future** |
| Indicating the probability of extinction in the wild to be: | **≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)** | **≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)** | **≥ 10% in 100 years** |

**Assessment result**
Data deficient.
**Justification**
No quantitative analysis of extinction risk has been undertaken.