



Bathurst Copper Butterfly
(Paralucia spinifera)
Recovery Plan



June 2001



Natural Heritage Trust

Helping Communities Help Australia
A Commonwealth Government Initiative

**NSW
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Cover illustration: Bathurst Copper Butterfly (*Paralucia spinifera*)
Cover illustrator: Barbara Cameron-Smith © ANPWS

This plan should be cited as following
NSW National Parks and Wildlife Service (2001) Bathurst Copper Butterfly (*Paralucia spinifera*)
Recovery Plan.
ISBN 0 7313 62829

**NSW National Parks and Wildlife Service Recovery Planning
Program**

Bathurst Copper Butterfly
(Paralucia spinifera)
Recovery Plan

**Prepared in accordance with the New South Wales
Threatened Species Conservation Act 1995 and the Commonwealth
*Environment Protection and Biodiversity Conservation Act 1999***

June 2001

Acknowledgments

The recovery effort for the Bathurst Copper Butterfly has been very much a cooperative exercise. The project has involved two local government Councils, five State Government agencies, two Commonwealth Government departments, community groups, industry, and landholders all working together to conserve this endangered species. The NPWS would like to thank the following people:

Allan Goodwin (Ranger NPWS) whose enthusiasm and dedicated efforts have driven the recovery program and the production of this plan, and for just doing things when they had to be done,

Ray Mjadwesch (MESS) for his specialist survey efforts and keen eye;

Susannah Power (NPWS) for engaging the community;

The community of Lithgow, who have wholeheartedly embraced the conservation of this species, including; Jen Radloff (Bellissimo Café), Eric Mahoney (LandCare), Di Geddes and Donna Quinn (Lithgow Primary School), John Smith (Zig Zag Primary School), Brad Radloff (Baal Bone Colliery), Russ May, Ian Rufus, Ron Grocott, Helen Drew, Rob Parker, Joyce Moffitt (dec.), and the children of Grades 5&6 Lithgow Primary School.

Natasha Funke and Natalie Knipler for voluntarily producing the Education Kit;

John Fry and volunteer teams from of Conservation Volunteers Australia (formerly Australian Trust for Conservation Volunteers);

Researchers from the University of New England, for providing valuable information on the ecology of the Bathurst Copper Butterfly and commenting on the draft recovery plan. These included Professor R. Kitching (now Griffith University), E. Dexter (now Environment Australia), E. Baker and A. McIntyre;

Don Sands (CSIRO, Indooripilly) for valuable comments on drafts;

Those involved in the recovery of Victoria's' Eltham Copper Butterfly for contributing the benefits of their experience with *Paralucia spp*, including Beverly van Praagh, Tim New, and Alan Yen;

Barbara Cameron-Smith for the cover illustration;

Ann Jelinek (Australian Heritage Commission) for comment on the draft recovery plan and advice on conservation issues; and

Environment Australia Natural Heritage Trust program for the continued funding of the preparation of this recovery plan and implementation:

The Bathurst Copper Butterfly Recovery Team for guiding recovery efforts and assisting in the preparation of this plan. The Recovery Team comprises Arthur Henry (State Forests of NSW), John Guyver (Department of Land and Water Conservation), Patsy Moppett (Evans Shire Council), Ian Gordon (Lithgow City Council), Graham Larnach (Central Tablelands Rural Lands Protection Board), Joyce Moffitt (dec.) (Landholder representative), Ian Pilley (Australian Defence Industries), Ann Jelinek (Environment Australia), and NPWS staff representing Blue Mountains Region, Central West Region and Central Directorate Conservation Programs and Planning Division ; and

The owners and managers of the twenty-nine sites of the Bathurst Copper Butterfly for their cooperation and assistance with the recovery effort.

Foreword

The conservation of threatened species, populations and ecological communities is crucial for the maintenance of this State's unique biodiversity. In NSW, the *Threatened Species Conservation Act 1995* (TSC Act) provides the framework to conserve and recover threatened species, populations and ecological communities through the preparation and implementation of recovery plans.

The preparation and implementation of recovery plans is identified by both the National Strategy for the Conservation of Australia's Biological Diversity and the NSW Biodiversity Strategy as a key strategy for the conservation of threatened flora, fauna and invertebrates. The object of a recovery plan is to document the management actions required to promote the recovery of a threatened species, population or ecological community and to ensure its ongoing viability in nature.

This plan describes our current understanding of the Bathurst Copper Butterfly (*paralucia spinifera*), documents the research and management actions undertaken to date, and identifies the actions required and parties responsible to ensure the ongoing management of the taxon in nature.

The Bathurst Copper Butterfly Recovery Plan was prepared with the assistance of a recovery team comprising relevant land management and research interests, and was placed on public exhibition during September and October 2000. I thank these people for their efforts to date and I look forward to their continued involvement in the implementation of recovery actions identified in this plan.



BOB DEBUS MP

Minister for the Environment

Executive Summary

Introduction

The Bathurst Copper Butterfly, *Paralucia spinifera*, is only found between Bathurst and Hartley in the Central Tablelands of New South Wales. The Bathurst Copper Butterfly is restricted to elevations above 900 metres where it feeds on a form of Blackthorn, *Bursaria spinosa* subsp. *lasiophylla*. The Bathurst Copper Butterfly has a mutualistic relationship with a species of small black ant, *Anonychomyrma itinerans*, which protects the caterpillar from predation and host the pupae within their nest.

The Bathurst Copper Butterfly is known from a total of twenty-nine sites comprising less than thirty hectares of habitat. It is thought that native vegetation clearing has reduced the area of potential habitat to small isolated remnants. The small size of these remnants compounds the harm that the various threats to the species may have on the remaining sites. Current threats to the Bathurst Copper Butterfly include habitat loss or modification through clearing, spraying, grazing, fire, weed invasion and illegal collection. The butterfly has not been observed at six of the twenty-nine sites in recent years and may be in decline at others.

Conservation Status

The Bathurst Copper Butterfly is considered endangered in NSW and is listed on Schedule 1 of the *Threatened Species Conservation Act* 1995 (TSC Act). The Bathurst Copper Butterfly is also listed nationally as a vulnerable species under section 178 of the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

Legislative context

The TSC Act is NSW's legislative framework to protect and encourage the recovery of threatened species, populations and communities. Under the TSC Act, the Director-General of National Parks and Wildlife has certain responsibilities including the preparation of recovery plans for threatened species, populations and ecological communities. This Recovery Plan has been prepared in accordance with the provisions of the TSC Act and the objectives of the EPBC Act.

Preparation of Plan

This Recovery Plan has been prepared with the assistance of a recovery team, a non-statutory group of interested parties with relevant expertise, established to discuss and resolve issues relating to the plan. Components within the plan do not necessarily represent the views nor the official positions of all the individuals or agencies represented on the recovery team. The information in this Recovery Plan was accurate to the best of the NPWS' knowledge on the date it was approved.

The plan will be reviewed and updated five years from the date of publication.

Implementation of Plan

The TSC Act requires that a government agency must not undertake actions inconsistent with an approved recovery plan. The government agencies relevant to this plan are the NPWS, State Forests of NSW, Rural Lands Protection Board, Department of Land and Water Conservation, and Local Government areas administered by the Councils of Evans Shire and the Lithgow City. Consequently, agencies who manage lands containing habitat of the Bathurst Copper Butterfly, must, as the relevant land manager, manage the sites and habitat within those lands in accordance with this plan. Relevant land management issues include weed control, clearing, grazing, fire management and recreational use.

The TSC Act amendments to the environmental assessment provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) requires that consent and determining authorities consider relevant recovery plans when exercising a decision making function under Parts 4 and 5 of the EP&A Act. Similarly, the EPBC Act (Comm) includes provisions relating to activities that affect species listed under the EPBC Act.

Overall recovery objective

The recovery program for the Bathurst Copper Butterfly aims to stabilise the population through the prevention of threatening processes, then to increase the in situ population through habitat management, with the aim of downlisting the species to vulnerable. The recovery plan constitutes the first five-year stage of the long-term recovery program.

The overall objective of this recovery plan is to stabilise the Bathurst Copper Butterfly's status as an endangered species pursuant to the provisions of the TSC Act. Recovery relates specifically to the prevention of the decline in the number of sub-populations and individuals of Bathurst Copper Butterfly extant in the wild, by protecting sub-populations from threats.

Overall recovery performance criteria

The overall performance criteria of the recovery plan is that the number of sub-populations and individuals of Bathurst Copper Butterfly extant in the wild does not decrease and fluctuations in population parameters over five years occur in accordance with knowledge of the species' ecology.

Species Ability to Recover

The species' ability to recover is limited by the available habitat. The Bathurst Copper Butterfly's small size, and weak erratic flight, results in a low dispersal capability. Only by actively managing the identified threats can the decline in the species be controlled.

Recovery Actions

The recovery plan includes twenty recovery actions which aim to meet the overall objective.

These actions are based on the following aims:

- to identify and prevent the continuation of processes, such as habitat removal, weed incursion, alteration of fire regimes, and vehicular access to habitat, that threaten the Bathurst Copper Butterfly;
- to inform and educate the community of the significance of the species through the production of information sheets, newsletters and media releases, and involve the community in recovery actions to enable participation in the conservation effort for the Bathurst Copper Butterfly; and
- to gain a thorough understanding of the distribution, population dynamics, and ecology of the Bathurst Copper Butterfly through the encouragement of appropriate research and the assessment of potential and known sites.

Estimated Cost of Recovery

A summary of the funds required to implement this recovery plan is identified below. This recovery plan will be implemented over a five-year period. Note that many actions constitute minor amendment to existing responsibilities or actions carried out by relevant government authorities, hence have not been assigned costs in this recovery plan. Average implementation cost per year will be approximately \$45,380.

Action	Description	Funds required (\$)
10	Threat Abatement	
10.3.1	Assessment of threats ☞.	22000
10.3.2	Clearing prevention and impact assessment	5000
10.3.3	Weed management.	80500
10.3.4	Habitat corridors	3000
10.3.5	Illegal collection monitoring ☞.	0
10.3.6	Vehicular access	4600
10.3.7	Dust management / Road maintenance	0
10.3.8	Fire management	0
10.3.9	Grazing management ☞	2000
10.3.10	Feral animal management	2500
10.3.11	Dead timber removal/ Firewood collection ☞	0
11	Community education and awareness.	
11.3.1	Inform & educate the broader community ☞	5100
11.3.2	Inform and involve affected landholders ☞☑	48000
11.3.3	Inform and educate local and State government agencies ☞	700
11.3.4	Inform and involve amateur lepidopterists	0
12	Research and monitoring	
12.3.1	Record extant sites	3500
12.3.2	Monitoring ☑	31000
12.3.3	Identify and assess potential habitat	8000
12.3.4	Research	6000
13	Reservation/conservation	
13.3.1	Increase legislative protection	5000
TOTAL		226900

☞ concordant components of activities have been combined under 10.3.1

☑ funding subject to budgetary allocation or grants

Biodiversity Benefits

Butterflies are without doubt the most studied and best understood of the insects. Butterflies are the insects which also enjoy the strongest community appreciation and support.

From this understanding and community support it is only natural that butterflies have become the flagship species for the conservation of endangered insects. The Bathurst Copper Butterfly represents this change in community perception regarding the conservation of our biodiversity. It was the first invertebrate to be classified as an endangered species in NSW. It is also the only butterfly nationally listed as a vulnerable species under the Commonwealths' *Environment Protection and Biodiversity Conservation Act 1999*.

The vegetation that provides habitat for the Bathurst Copper Butterfly was previously much more widespread. In conserving this habitat, there are significant flow-on biodiversity benefits by the resultant conservation of this vegetation community.

A handwritten signature in black ink, reading "Brian Gilligan". The signature is fluid and cursive, with the first name "Brian" and last name "Gilligan" clearly distinguishable.

BRIAN GILLIGAN
Director-General

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Abbreviations

ATCV	Australian Trust for Conservation Volunteers
D/C Authorities	determining & consent authorities under the EP&A Act
DLWC	Department of Land and Water Conservation
EA	Environment Australia
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
ESC	Evans Shire Council
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
GIS	geographic information systems
km	kilometre
LCC	Lithgow City Council
LGA	Local Government Area
m	metre
mm	millimetre
NHT	Natural Heritage Trust
NPWS	National Parks and Wildlife Service
NSW	New South Wales
RFS	Rural Fire Service
RLPB	Rural Lands Protection Board
SIS	species impact statement
spp	species (plural)
subsp.	subspecies
TSC Act	<i>Threatened Species Conservation Act 1995</i>
TSP	Threatened Species Program
UMCC	Upper Macquarie County Council
UNE	University of New England

1 **Introduction**

The Bathurst Copper Butterfly, *Paralucia spinifera*, is one of Australia's rarest butterfly species (Dunn *et al.* 1994; Kitching and Baker 1990), and is only found between Bathurst and Hartley in the Central Tablelands of New South Wales. The Bathurst Copper Butterfly is restricted to elevations above 900 metres where it feeds exclusively on a form of Blackthorn, *Bursaria spinosa* subsp. *lasiophylla*. The Bathurst Copper Butterfly has a mutualistic relationship with a species of small black ant, *Anonychomyrma itinerans*, which protect the caterpillar from predation and host the pupae within their nest.

The Bathurst Copper Butterfly is known from a total of twenty-nine sites comprising less than thirty hectares of habitat, which makes it vulnerable to the operation of threatening processes. Native vegetation clearing is likely to have resulted in the reduction of the area of potential habitat to small isolated remnants. The small size of these remnants increases the risk of loss of one or more of the sites, as they are more susceptible to detrimental stochastic events. Current threats to the Bathurst Copper Butterfly include clearing and development, weed invasion, grazing, and changes in fire regimes. The butterfly has not been found at six of the twenty-nine sites in recent years and may be decline at others. This decline may however be matched by an increase in population size at sites that have had an increase in suitability.

This Recovery Plan describes the current understanding of the Bathurst Copper Butterfly, documents the research and management actions undertaken to date, and identifies the parties responsible for the actions required to ensure the ongoing viability of the taxon in the wild.

2 Legislative context

2.1 Legal status

The Bathurst Copper Butterfly is considered endangered in NSW and is listed on Schedule 1 of the *Threatened Species Conservation Act 1995*. (TSC Act)

The Bathurst Copper Butterfly is also listed nationally as a vulnerable species under section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.2 Recovery plan preparation

The TSC Act requires that the Director-General of National Parks and Wildlife prepare recovery plans for all species, populations and ecological communities listed as endangered or vulnerable on the TSC Act schedules. The TSC Act includes specific requirements for both the matters to be addressed by recovery plans and the process for preparing recovery plans. This Recovery Plan has been prepared in accordance with the provisions of the TSC Act and the objectives of the EPBC Act (Comm.)

2.3 Recovery plan implementation

The TSC Act requires that a government agency must not undertake actions inconsistent with an approved recovery plan. The government agencies relevant to this plan are the NPWS, State Forests of NSW, Rural Lands Protection Board, Department of Land and Water Conservation, and Local Government Areas administered by the Councils of Evans Shire and Lithgow City.

Consequently, public authorities who manage lands containing habitat of the Bathurst Copper Butterfly, must as the relevant land manager, manage the sites and habitat, in accordance with this plan. Relevant land management issues include weed control, clearing, grazing, fire management and environmental assessment.

2.4 Critical habitat

The TSC Act makes provision for the identification and declaration of critical habitat for species, populations and ecological communities listed as endangered. The declaration of critical habitat allows for increased protection of threatened species habitat. A species impact statement must be prepared for all developments and activities that affect declared critical habitat.

Critical habitat has not been declared for this species. The Recovery Team for the Bathurst Copper Butterfly have determined that for the majority of sites, adequate habitat protection is afforded under existing legislation. Alternative options, including Voluntary Conservation Agreements, are considered more effective protection measures.

2.5 Environmental assessment

The TSC Act amends the environmental assessment provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) require that consent and determining authorities and the Director General of the NPWS, as a concurrence authority, consider relevant recovery plans when exercising a decision making function under Parts 4 & 5 of the EP&A Act. Decision makers must consider known and potential habitat, biological and ecological factors, and regional significance of individual sites.

Similarly, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Comm) includes provisions relating to activities by the Commonwealth or on Commonwealth land that affect species listed under the EPBC Act.

Appendix 1 - Environmental Impact Assessment Guidelines, provides guidance for consent and determining authorities in the assessment of the effect of activities and developments on the Bathurst Copper Butterfly or its habitat.

3 Conservation Status

The Bathurst Copper Butterfly was discovered in October 1964 by two CSIRO entomologists, Ian Common and Murray Upton. A single specimen of a female was collected near the village of Yetholme approximately 20 kilometres east of Bathurst. The specimen was subsequently lodged with the Australian National Insect Collection in Canberra and was noted as a previously unknown species of *Paralucia* by Don Sands.

Following a number of searches the species was rediscovered by Ted Edwards of the CSIRO on 25 October 1977. It was finally described as a new species, *Paralucia spinifera*, in November 1978 (Edwards and Common 1978).

The Bathurst Copper Butterfly, *Paralucia spinifera*, has been located at a total of twenty-nine sites since its discovery in 1964. In total these sites constitute less than thirty hectares of known habitat. Clearing of native vegetation over the past century has reduced the area of known and potential habitat to small isolated remnants. The small size of these remnants potentially allows the threats that continue to operate against the species to have a significant impact on remaining sites. Extant threats include clearing, spraying, grazing, fire and weeds. Collection of the butterfly by enthusiasts is suggested to have contributed to significant adult number declines within at least two sites (Dexter and Kitching 1991b), however, population fluctuations associated with site habitat conditions may also have significantly contributed to such declines.

A report on the conservation status of Australian butterflies (Dunn *et al.* 1994) identified the Bathurst Copper Butterfly as one of the nation's rarest. Rarity does not necessarily equate to conservation significance, unless it is combined with threatening processes, as occurs for the Bathurst Copper Butterfly.

The Scientific Committee identified that the limited distribution, habitat degradation and over-collection of specimens warranted the identification of the Bathurst Copper Butterfly as a species endangered with extinction.

Accordingly, the Bathurst Copper Butterfly is considered endangered in NSW and is currently the only butterfly listed on Schedule 1 of the *Threatened Species Conservation Act* 1995 (TSC Act). The species is also recognised nationally and is listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act* 1999.

4 Description

The Bathurst Copper Butterfly is a small species with a wingspan of approximately 20 millimetres. The male is black above with central areas of the wings shining purple and fringes checkered black and white (Figure 1). The female is black or deep brown above, with central area suffused with bronze, sometimes with basal area of the wings a deep shining purple or blue, and with fringes checkered black and white. The bronze, blue and purple suffusions are variable and most prominent when sunning. The male has more pointed wings than the female (E.D. Edwards pers. comm.). The lower surface of the wings are patterned with subtle brown, black and grey on both male and female (Figure 2). Kitching & Baker (1990) and Braby (2000) contain more complete descriptions of the species.

The genus *Paralucia* is endemic to Australia and contains three species, *P. spinifera*, *P. aurifera* and *P. pyrodiscus*. The two congeners, *P. aurifera* and *P. pyrodiscus*, have wide distributions extending from Southern Queensland through Victoria. *Paralucia aurifera* has been identified cohabiting several sites with the Bathurst Copper including sites L2 and L6. The Bathurst Copper Butterfly is distinguished from the two other species of *Paralucia* by the size, shape and colour of the wings, and also by a spine that extends over a joint in the fore legs in both sexes. The specific name of the Bathurst Copper Butterfly, *spinifera*, is derived from the presence of this spine.

The larva's head is hidden, its grey body has brown dorsal and subdorsal lines, and are approximately 14mm in length. The larvae have prominent eversible organs which are thought to secrete a liquid attractive to the attendant ant.

A full description of the Bathurst Copper Butterfly is to be found in Edwards and Common (1978). Key reference material and collections of specimens are lodged in State museums and in the Australian National Insect Collection, Canberra.



Figure 1 Bathurst Copper Butterfly dorsal surface



Figure 2 Bathurst Copper Butterfly ventral surface

5 Distribution and habitat

5.1 Current and historical distribution

Since its discovery in 1964, surveys of potential habitat have extended the Bathurst Copper Butterfly's known distribution from the village of Yetholme, on the Great Dividing Range, to that area of the Central Tablelands of NSW between Oberon, Hartley and Bathurst. All of the known sites occur within the Evans Shire and Lithgow City Local Government Areas. Figure 3 shows the distribution of the Bathurst Copper Butterfly.

The distribution of the butterfly is specifically limited by elevation. All sites where the butterfly has been located are above 900 metres elevation. Its host plant, native Blackthorn, *Bursaria spinosa* subsp. *lasiophylla*, is an altitudinal variant of the widespread and common species (Cayzer in press) and is generally only found above 900 metres. Although the attendant ant, *Anonychomyrma itinerans*, has a wider distribution than the butterfly, it too is restricted to regions above 900 metres in altitude (Dexter & Kitching 1991b). Given the reliance on elevation of both the host plant and attendant ant, the distribution of the Bathurst Copper Butterfly would always have been restricted by the distribution of these associated species. The distribution of the species may have been significantly reduced, the present distribution now representing refuges resulting from climate changes (Dexter & Kitching 1991a.). Additionally, there may be other biotic factors dictating the distribution of the species, as some potential habitat may contain both the host plant and the attendant ant, but not the Bathurst Copper Butterfly.

The distribution of the Bathurst Copper Butterfly may yet be extended through additional survey of potential habitat identified through habitat modelling. The habitat requirements and altitude constraints of the species has largely driven the survey effort to date. East of Lithgow the sandstone complex support a much higher density and diversity of understorey shrubs that largely preclude the host native Blackthorn. The most significant areas of potential habitat remain south of Oberon and assessment of these is a priority action of this plan.

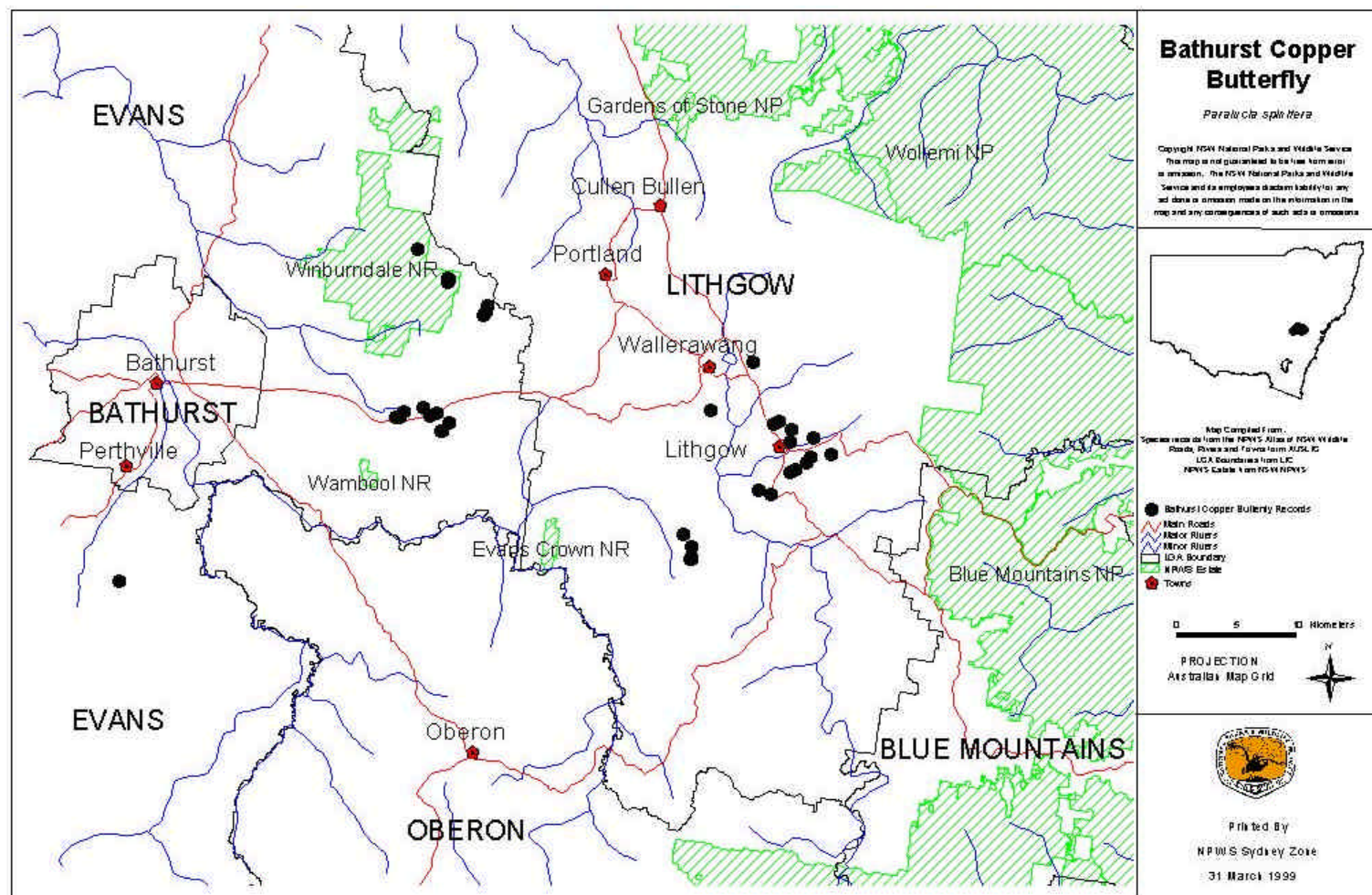


Figure 3 - Distribution of the Bathurst Copper Butterfly

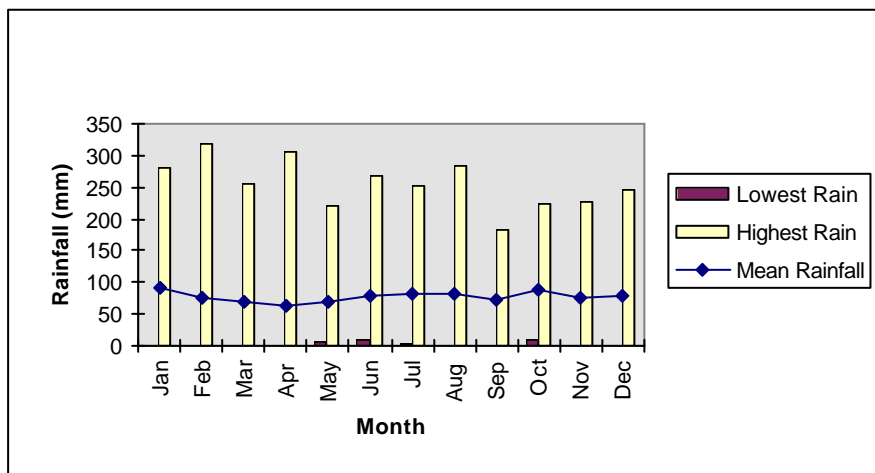
5.2 Tenure

Of the twenty-nine known Bathurst Copper Butterfly sites, fourteen are located on privately owned lands. Two sites are located on Commonwealth lands under the control of Australian Defence Industries and the remaining thirteen sites are located on land managed by local and State government agencies:

- Lithgow City Council manage lands containing three known Bathurst Copper Butterfly sites (L2, L3 ,L10);
- Evans Shire Council manage lands containing four known Bathurst Copper Butterfly sites (B3, B8, B9, B13);
- The Department of Land and Water Conservation are responsible for a Reserve for Public Recreation (the day to day management of which is vested in a local trust) containing a site of the Bathurst Copper Butterfly (site B7);
- State Forests of NSW manage two Bathurst Copper Butterfly sites (B9 and L7), one of which (B9) is subject to an Occupation Permit;
- the Rural Lands Protection Board manage a Travelling Stock Reserve with one site of the Bathurst Copper Butterfly (02); and
- the NPWS manages two sites of the Bathurst Copper Butterfly within Winburndale Nature Reserve (B10, B11).

5.3 Climate

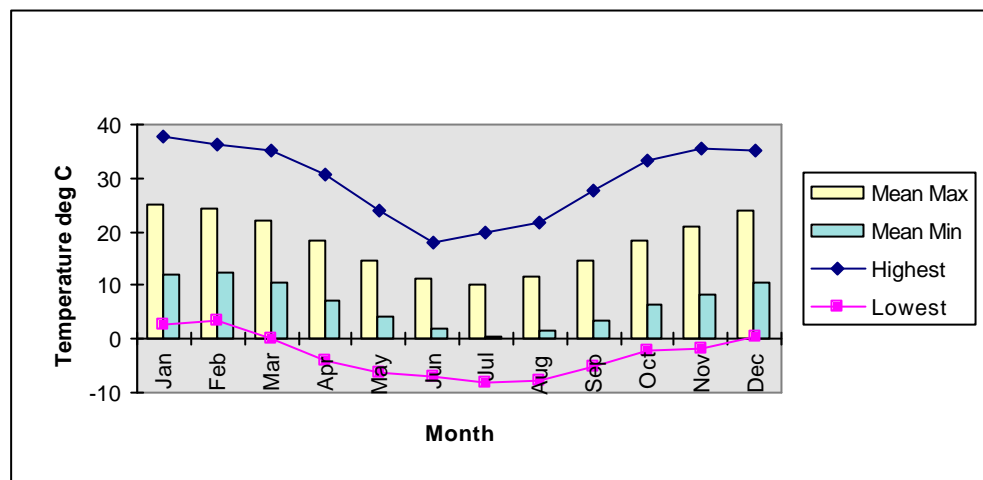
The Central Tablelands experience a temperate climate characterised by warm summers and cool winters. Rainfall is highly variable however peaks occur during spring and summer months when heavy falls can be experienced with thunderstorms. Monthly averages are illustrated in Figure 4. Average annual rainfall recorded at Sunny Corner is 927 mm.



(Bureau of Meteorology and Department of Primary Industries Queensland, 1994)

Figure 4 - Rainfall Summary

The automatic weather station at Lithgow most accurately represents climate across the range of the Bathurst Copper Butterfly. Summer mean daily temperatures for Lithgow range from 10° to 25° and winter temperatures from 1° to 12° (see Fig. 6). The hottest month is January and the coldest month is July. Frosts usually occur from mid-April to mid-October and can be heavy at times. Light to heavy snow falls may also occur during winter, although they seldom remain on the ground longer than a few days.



(Data supplied by the Bureau of Meteorology, 1998)

Figure 5 - Temperature Summary

Strong north westerly winds are mostly experienced during late spring to mid summer (October, November, December). Temperatures and winds tend to moderate with the onset of autumn.

5.4 Landscape and topography

All the Bathurst Copper Butterfly sites are located above 900 metres elevation. The topographic position and orientation varies considerably between the butterfly sites. Some sites occur on the crest of the tablelands where they are exposed to regular winter snow events. Other sites occur on foothills and valley floors where cold air drainage patterns result in regular severe frosts. A commonality between sites is that they are subjected to extremes of cold.

Another common factor between habitat at sites is the exposure of *Bursaria spinosa* ssp *lasiophylla* to direct sunlight for a large portion of the day, due to orientation and / or canopy openness. The majority of sites have a westerly to northerly aspect. Sites located on south facing slopes are generally high enough and flat enough to ensure that they also receive full sun.

There does not appear to be any consistency in the geology of the various sites. Sites are located on sandy soils with granite outcropping, basalt derived soils, and east of Lithgow on coal measures and some sandstone soils.

5.5 Vegetation

The vegetation across the range of Bathurst Copper Butterfly sites varies according to the geology and derived soils. In particular the dominant canopy species vary considerably. The vegetation structure is typically an open woodland although open forests occur at butterfly sites on the basaltic soils around Yetholme.

A detailed vegetation survey of Bathurst Copper Butterfly habitats was carried out in March 1999 (Porteners 1999). A total of 181 plant taxa were recorded during the survey from the 10 sample sites. A high proportion of the recorded species (32 species or 18%) were exotic. The most common families represented were Asteraceae (26 species, 35% exotic), Poaceae (18 species, 28% exotic), Fabaceae-Faboideae (15 species, 20% exotic) and Myrtaceae (14 species, none exotic).

The Native Blackthorn species common to all sites was identified as *Bursaria lasiophylla* var. *atriplicina*. This identification is based on currently accepted taxonomy and not that proposed by Cayzer (In Press). Several other native species are also predominant in all sites including *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-Rush), *Poa sieberiana* var. *sieberiana* (Snowgrass) and *Joycea pallida* (Silvertop Wallaby Grass). The sites generally show a high proportion of weed species, the most common being *Crepis capillaris* (Smooth Hawksbeard), *Hypochaeris glabra* (Smooth Catsear), *Taraxacum officinale* (Dandelion) and *Rubus fruticosus* (Blackberry species-aggregate).

Structurally the vegetation generally has a sparse to moderately dense tree canopy component, with a grassy and sparsely shrubby understorey. The two-layered understorey comprises tall shrubs (including the Native Blackthorn) in the higher stratum and tussock grasses and scattered low shrubs in the lower stratum. There is usually a groundcover of mixed low grasses and herbaceous species, occasionally including Native Blackthorn seedlings.

Bathurst Copper Butterfly require a vegetation structure that is exposed to all-day sun. A commonality between all known sites is an aspect and open vegetation that allows a high level of solar radiation. Almost all sites are associated with significant levels of disturbance such as mining, roadways or frequent fire that have resulted in an open vegetation structure and an understorey dominated, or well represented, by Blackthorn. Fire is likely to have contributed to maintaining this open habitat at many sites.

6 Ecology

6.1 Life History

The butterfly emerge from pupation at different times of the year at different sites, appearing earlier at low elevation sites and persisting later at higher elevation sites. The butterfly begin to emerge at some sites from early August and are on the wing until at least early November. Even at sites in the same general area there appears to be early or late activity probably influenced by site variables such as the aspect of the site. For most sites there appears to be a peak of activity for a couple of weeks during September.

Adult males fly rapidly at about one metre from the ground and rest with wings parted in sites exposed to full sun. Females fly less rapidly and tend to stay closer to the host plant (Edwards & Common 1978). The butterfly generally remain in the vicinity of the host Blackthorn, and are rarely observed beyond 10 metres of the habitat.

After mating, the female oviposits (lays eggs) on Blackthorn bushes that are associated with the ant *Anonychomyrma itinerans*. Eggs are laid either singly, or in groups up to five, on leaves towards the base of the host plant or on adjacent debris (Dexter & Kitching 1991a.). The eggs take approximately 14 to 17 days to hatch. It has been observed that the attendant ants constantly patrol the Blackthorn during this phase, presumably searching out newly hatched larvae (Dunn *et al.* 1994).

Butterfly larvae moult their cuticle as they grow with the stages between each moult termed instars. For the Bathurst Copper Butterfly there can be as many as eight instars within the six to eight week larval period (Dunn *et al.* 1994). On hatching, first instar larvae are attended by a single ant of *A. itinerans*. The larvae are diurnal until the fourth instar at which stage both the larvae and attendant ant become nocturnal (Dexter & Kitching 1991a). The larvae graze on the host plant *Bursaria spinosa* subsp. *lasiophylla*. As the larvae will not traverse open ground to reach the host plant, closely spaced *B. spinosa* subsp. *lasiophylla* with intertwining branchlets offer the best habitat for grazing larvae.

Pupation occurs from December through to late February and is known to take place in the ant's nest at the base of the host plant (Dunn *et al.* 1994). The pupae remain in the ant's nest until the following spring.

6.2 Population Structure

For most of the year the population consists of immature stages of the Bathurst Copper Butterfly. For a few short weeks between September and October, adult butterfly are also present. All stages are subject to natural mortality and for immature stages this is probably in the order of 70 % or higher (Dr D. Sands pers. comm.).

The concept of metapopulations has been applied to the Bathurst Copper Butterfly in the Lithgow Valley area (Dexter & Kitching 1991a). This concept describes a species existing as a 'population of populations' where numerous small areas of habitat are occupied, and where a natural pattern of extinctions and colonisation of habitat occur (Levins 1970; Harrison *et al* 1988 in: New 1997). If metapopulations apply to the Bathurst Copper Butterfly then the recent lack of adult butterfly that has been recorded at six of the twenty-nine sites may be a stage of a natural cycle. As the species exists as immature stages for most of the year, natural mortality (eg. from parasitoids) during these stages may exceed 70%, hence local extinctions and recolonisations are expected (D Sands pers. comm.). It is likely, however, that declines in populations and resultant local extinctions are reinforced by the continued fragmentation of habitat. Recolonisation becomes increasingly difficult as areas of habitat become smaller and more disjunct.

For many sites the fragmentation of habitat has occurred to such an extent that each sub-population may be considered closed, however, genetic analysis is required to establish the degree of separation.

There has been no systematic monitoring of Bathurst Copper Butterfly sites. Assessments at sites L1 and L2 indicated adult counts of 2,800 and 4,500 over one particular flight season (Dexter & Kitching 1991a). In recent seasons only a handful of butterfly have been observed at L1. For Bathurst Copper Butterflies massive swings occur in local adult numbers, for some years they may not be detected then they re-appear, sometimes with large adult densities (Dr D. Sands pers. comm.). The lack of systematic population monitoring coupled with these population dynamics make it very difficult to determine true trends.

6.3 Attendant Ant

The butterfly has a mutualistic relationship with the ant *Anonychomyrma itinerans*. Larvae of the Bathurst Copper Butterfly are tended by the ants and protected from predators. In return the ants receive nutritional secretions from the larvae (Dexter & Kitching 1991a). The significance of this relationship appears to be critical to the persistence of the Bathurst Copper Butterfly in the wild although this has not been conclusively demonstrated. Ant surveys of known butterfly sites, have shown that the Bathurst Copper Butterfly does not utilise host plants within or adjacent to the colony, where the ant is absent. A significant decline in adult numbers at one butterfly site, over seasons 1989 to 1991, has also been linked to the absence or disappearance of *A. itinerans* (Dexter & Kitching 1991a).

Ant surveys identified a number of other species that may be important to the life cycle of the Bathurst Copper Butterfly. These included *Iridomyrex* sp.1,2,3, *I. purpureus*, *I. rufoniger* group 1 and 2, and *Ochetellus* sp (Dexter & Kitching 1991b). The taxonomy of *A. itinerans* is also in need of review (Dr S. Shattock CSIRO Division of Entomology pers. comm. 21/8/97) due to variety in the profile of the thorax possibly indicating a number of distinct species.

The known Bathurst Copper Butterfly sites have not been surveyed to determine the presence or absence or the extent of ant species present. *A. itinerans* has not been recorded at one significant site (B10) which continues to support healthy adult numbers of the butterfly (J. Moffitt pers. comm). *A. itinerans* is rarely obvious at the majority of sites even when the butterfly is active. However, the absence of records of ant species is most likely a result of lack of survey rather than the absence of ants from these sites.

Similarly, the presence of other ant species that may be involved in the ecology of the Bathurst Copper has not been established or assessed.

6.4 Host Plant

The larval food plant of the Bathurst Copper Butterfly is native Blackthorn, *Bursaria spinosa* subsp. *lasiophylla*. Spindly, spinescent and generally multi-stemmed, the shrub grows to five metres tall but rarely exceeds two metres within the range of the butterfly (Figure 6).

The taxonomy of this endemic Australian genus has recently been reviewed (Cayzer in press) with this taxon being described as an altitudinal variant of the more common and widespread *B. spinosa* subsp. *spinosa*. *B. spinosa* subsp. *lasiophylla* is quite distinct in the lower surface of the leaves being hoary, with minute matted hairs, rather than glabrous.

Despite the occurrence of intergrading stands of *B. spinosa* subsp. *spinosa* adjacent to *B. spinosa* subsp. *lasiophylla* the Bathurst Copper Butterfly has not been recorded to graze on *B. spinosa* subsp. *spinosa*.

All taxa in *Bursaria* are vigorously rhizomatous (Cayzer in press) and stands of shoots within a five metre radius are commonly a single genetic individual. The rhizome allows the shrub to respond favourably to disturbance including clearing, herbicide application, and fire. The general resilience of the species has led to it being considered a weed, particularly on agricultural lands. It is an aggressive coloniser of marginal and disturbed sites (Cayzer in press) and is routinely found in road verges, mining areas and within the ecocline where agricultural clearing meets the base of steep escarpment lands.

Within the known habitat of the Bathurst Copper Butterfly the Blackthorn is often found in a suppressed or juvenile form. The larvae of the Bathurst Copper Butterfly commonly graze the Blackthorn to a stage where the shoots die and the shrub resprouts from the base or main stems. It is unclear whether the grazing results in the bush being maintained in a dwarf habit, with younger, and presumably more palatable foliage, or whether the habit is the result of other factors. The density and spatial arrangement of the Blackthorn appears to largely determine the number of adults (Common & Waterhouse 1981; Dexter & Kitching 1991a), with closely spaced individuals with intertwining branchlets thought to provide the most accessible grazing for larvae.



Figure 6 - Blackthorn flowering

7 Previous management actions

7.1 Bathurst Copper Butterfly Recovery Team

A recovery team was formed in 1997 to coordinate recovery efforts and guide the preparation of a recovery plan. The team comprises stakeholder representatives including NPWS, State Forests of NSW, Rural Lands Protection Board, Department of Land and Water Conservation, Local Government, industry, and land holders. Expertise in the ecology of lycaenid butterflies is provided by involvement of Environment Australia representatives and CSIRO entomologists in Canberra and Queensland.

7.2 Survey of Potential Habitat

Between 1989 and 1992, researchers from the University of New England (UNE), along with a private landholder, actively surveyed potential habitat of the Bathurst Copper Butterfly. Several new sites were subsequently located away from the type locality at Yetholme, taking the total number of sites recorded at that time to twelve.

During 1997 and 1998, further survey of potential habitat was undertaken by the NPWS and volunteers under Threatened Species Program (TSP) funding. A total of seventeen new sites were located, significantly extending the range of the species as well as the number of known sites.

Potential habitat was identified using aerial photo and map interpretation. Sites were predicted on the basis of remnant vegetation, elevation and aspect. The proximity of Bathurst Copper Butterfly sites was also considered. Potential habitat was then surveyed remotely from road or air to confirm the occurrence of the host plant.

Where reasonable areas of Blackthorn were observed, a ground survey of the area was organised. Information on the Bathurst Copper Butterfly, and the associated recovery efforts, were supplied to the landowners. The majority of owners and land managers have been happy to assist in the survey effort and local knowledge on occurrence of Blackthorn has led to the location of several significant sites.

NPWS staff from the Spatial Systems Unit in the GIS Division are establishing a database to cover the Bathurst, Katoomba, Oberon and Lithgow 1:100,000 map sheets. This database includes remnant vegetation, solar radiation, topographic position, elevation and moisture data, and has the potential to be used to model Blackthorn distribution and hopefully predict butterfly habitat. Such modelling can provide the basis for identifying areas for future surveying.

7.3 Weed Control

Weed control was carried out at two butterfly sites (B9, B10) in May 1997 by the Australian Trust for Conservation Volunteers (ATCV) and spray contractors funded jointly by the NPWS and the Department of Agriculture. The project involved bush regeneration techniques within and adjacent (10 metre buffer) to butterfly sites as well as control of weeds by conventional spraying away from the habitat. This program targeted blackberry, *Rubus fruticosus*, within Winburndale Nature Reserve and broome, *Cytisus scoparius*, and pine wildings, *Pinus radiata*, within Sunny Corner State Forest.

In April 1998 the NPWS engaged the ATCV for follow up work on the Nature Reserve and State Forest sites as well as initial control work within a third site (L5) on private land where blackberry was treated. In October 1998 initial control works were undertaken at two new sites (02, 03) on a Travelling Stock Reserve and private property.

During April 1999 bush regeneration continued at sites B9, B10 and was initiated at sites B3, B7 and B13.

In 2000, weed control works were commenced on lands in the Hermitage Flat and Pottery Estate areas of Lithgow. Much of this work was bush regeneration undertaken by Conservation Volunteers Australia, Department of Land and Water Conservation, Baal Bone Colliery. Australian Defence Industries at Lithgow also continued weed control works on their lands.

7.4 Research

A number of research programs on the microhabitat, behaviour and requirements of the Bathurst Copper Butterfly has been undertaken to date. These include:

- Preliminary laboratory studies have shown that larvae without ants remain on the bush permanently while larvae with ants return to the base of the plant during daylight hours. Larvae reared without ants were also considerably smaller than larvae reared with ants (Dexter & Kitching unpub.)
- A genetic study was conducted on the various Bathurst Copper Butterfly sites in 1992. The study sampled butterflies at various sites at the extent of the known range and found that the heterogeneity within sites was high but that the individual sites were closely related (Dexter & Kitching unpub.). This indicated either some movement of butterfly between sites, or that the time since separation and isolation of the various colonies is relatively recent (E. Dexter pers. comm.).
- Microhabitat requirements and population dynamics of the Bathurst Copper Butterfly were the subject of research by the Department of Ecosystem Management, University of New England, (UNE) between 1988 and 1992. The

research was conducted over the majority of sites known at that time and included mark - recapture data (Dexter & Kitching unpub.).

- Habitat prediction using Bioclim modeling was applied to the Bathurst Copper Butterfly in 1992. Sites of similar climate and topography were identified as the Barrington Tops and areas of the Southern Highlands (E. Dexter pers. comm.)

7.5 Information Brochure

An information brochure on the Bathurst Copper Butterfly has been produced by the NPWS. The brochure provides a description of the Bathurst Copper Butterfly as well details on the ecology, habitat and threats facing the species. The brochure has been used to inform the owners and managers of Bathurst Copper Butterfly habitat of the significance of the butterfly.

7.6 Newsletter

The first issue of the annual Bathurst Copper Butterfly Newsletter was produced by the NPWS in 1998. The newsletter has been produced for owners and managers of Bathurst Copper Butterfly habitat and others involved in the recovery effort. The aim of the newsletter is to keep individuals informed and involved with the various recovery efforts.

7.7 Site Descriptions

Each confirmed site of the Bathurst Copper Butterfly has been described and documented in the format described in Appendix 2. Aerial photographs of each site have been produced at 1:2,500 scale. The aerial photographs are marked with the areas of potential habitat and location of butterfly activity, to provide a record of each site. The sites have also been marked on the relevant 1:25,000 scale topographic maps.

Site information including location, elevation, aspect, slope and area have been recorded. Contact details for owners or managers are listed and an assessment of immediate management requirements has been made in relation to threatening processes such as grazing, fire, and weeds.

The site descriptions are used to identify threats, develop conservation strategies to manage habitat and to monitor changes over time.

7.8 Vegetation Survey

Ten sites of known Bathurst Copper Butterfly habitat were sampled in late March 1999 (Porteners 1999). The sites were selected as representative of the range of habitats from which the butterfly has been positively recorded. Sampling procedures followed the standards set by the NSW National Parks and Wildlife Service as well as the National Herbarium of NSW. All vascular plant species were

recorded within 20 × 20 metre quadrats, and assigned a cover abundance rating. Vegetation structure was described by measuring the height and canopy cover of the dominant species in each stratum. Plant specimens collected during the survey are held at the National Parks and Wildlife Service (Bathurst Sub District office).

7.9 Captive Breeding

Bathurst Copper Butterfly have been successfully reared through eight successive generations in a captive situation. A lepidopterist from the Australian Capital Territory (ACT), Bill Graham, conducted the trial between 1981 and 1990. The program was achieved without ants and utilised the Native Blackthorn variety naturally occurring in the ACT.

Approximately four adult males and females were introduced to a small enclosure containing Blackthorn and placed in sunlight. Within half a day each of the females had successfully mated and subsequently produced between fifty and sixty eggs over a two to three day interval. Pupae were observed to be particularly delicate and were held in ice cream containers containing 75 to 100 millimetres of moist potting mix. The pupae were half buried in this mix and then covered with the leaf of a passionfruit to prevent desiccation. The leaf was replaced as required and approximately seven months later almost one hundred per cent of the butterfly successfully emerged (W. Graham pers. comm.).

8 Management Issues

The management of a threatened species requires the development of a “recovery program” which considers (i) the biological and ecological aspects of the species; (ii) the social, political and organisational parameters that may affect the success or otherwise of the program; and (iii) the economic factors which may influence the operation of the program’s implementation.

As such, this section identifies the management issues affecting the Bathurst Copper Butterfly including:

- limits of our current understanding of the taxon’s biology and ecology;
- threats and reasons for decline; and
- social and economic factors which may influence the success of the recovery program.

As the sites primarily occur outside of conservation reserves, and, as there are a number of threats acting at known sites, further effects are likely if current management practices continue unmanaged. An increase in the level of reservation status, or through other legislative provisions relating to land use or encumbrances on titles can be used to maximise the protection and security of sites. Threat abatement actions should occur for all sites, prioritised on the basis of their function in metapopulation dynamics.

8.1 Level of Understanding

As the Bathurst Copper Butterfly was only described recently (1978), there is limited knowledge of its ecology and ecology. Significant information gaps lie in the areas of population dynamics, habitat requirements, nature of relationship with and ecology of the attendant ant (*Anonychomyrma itinerans*), and fire ecology.

Continued monitoring of population parameters is required to assess the effectiveness of the recovery actions and to provide a data source for the review of the Recovery Plan and recovery actions.

8.2 Threatening Processes

8.2.1 Habitat loss

Over the last one hundred and fifty years the native vegetation of the Central Tablelands has been extensively cleared for sheep and cattle grazing and more recently for the cultivation of Radiata Pine (*Pinus radiata*). Remnant native vegetation is generally restricted to road verges, Crown lands, and small areas under private ownership. The remnant habitat available to the Bathurst Copper Butterfly exists as a series of disjunct and often quite small sites (<0.5ha). The continued clearing and disturbance of remnant vegetation are the most serious threats to the Bathurst Copper Butterfly.

Legislative protection of Bathurst Copper Butterfly habitat is available under both the *National Parks and Wildlife Act* 1974 (NPW Act) and the *Native Vegetation Conservation Act* 1997 (NVC Act). While this legislation is effective, the key to the recovery effort is an informed and supportive community.

Community awareness and involvement in the recovery effort is a priority of this recovery plan. A range of media have been produced, or are proposed in this plan, to increase awareness of Blackthorn as an endangered species habitat. This awareness in landholders, managers and the general community will help ensure that clearing of Blackthorn does not continue.

8.2.2 Habitat modification and disturbance

In addition to the loss of habitat through clearing operations, a range of threatening processes continue to degrade remnant areas making them unsuitable for the Bathurst Copper Butterfly. These factors are discussed below.

8.2.2.1 Weeds

Weed invasion has been identified as a threat to the Bathurst Copper Butterfly at ten of the twenty-nine sites. Weeds including Broome (*Cytisus scoparius*) and Blackberry (*Rubus fruticosus*) compete with the host Blackthorn and at some sites threaten to exclude the butterfly. Radiata Pine (*Pinus radiata*) windings are also a problem at some sites where they threaten to shade out the habitat. Other lesser weeds include Hawthorn (*Crataegus spp*), Sweet Briar (*Rosa rubiginosa*) and Cotoneaster (*Cotoneaster spp*). The weeds species not only compete with the host Blackthorn but also the range of shrubs that the butterfly utilises while on the wing.

Conversely, some weeds may be beneficial, providing a source of nectar. The Bathurst Copper Butterfly has been observed flying approximately thirty metres across a sealed roadway to utilise flowers of white clover (*Trifolium repens*), and feeding on Broome flowers.

8.2.2.2 Vehicular access and recreational vehicle use

Recreational use by trail bikes, mountain bikes and four wheel drives is impacting on a number of sites including sites B9, L2, and L6. Significant erosion of unformed trails within butterfly habitat is causing damage to host plants as well as associated ant colonies.

8.2.2.3 Dust

At two butterfly sites (B3 and B9), dust from road traffic is believed to be affecting the butterfly. Host plants adjacent to the roadway are coated with a thick film of dust during the drier spring and summer months that the larvae are active. Despite butterflies being observed on the road verge Blackthorn, no grazing is evident, and it is believed that the plants are not being utilised. The dust film is likely to affect the edibility or at least palatability of the Blackthorn. The distribution of the sites

along the road verge and the amount of Blackthorn involved make the dust factor at these particular sites a significant management issue.

8.2.2.4 Fire

There is evidence to suggest that the Bathurst Copper Butterfly habitat is adapted to the occurrence of fire events, and that it may play an important role in habitat maintenance. Sixteen of the twenty-nine sites have been exposed to a history of reasonably frequent fire events, both prescribed and wildfire. The Lithgow Valley has a history of repeated hazard reduction burning, arson and other wildfire events extending over the past one hundred years. The fire history of this area is reflected in the highest concentration of Bathurst Copper Butterfly sites within the range of the species.

Despite being a spindly shrub, Blackthorn foliage is quite flammable and readily ignited and burnt in even a low intensity fire event. While fire will kill the above ground component, the shrub readily resprouts from the base, suckered from well developed underground rhizomes. The rhizome allows the Blackthorn to actively colonise new areas following disturbance such as fire at the expense of fire sensitive species. This view is supported by the density of other fire promoted species, including Kangaroo Grass (*Themeda australis*), Bracken Fern (*Pteridium esculentum*) and Blady Grass (*Imperata cylindrica*), at many Bathurst Copper Butterfly sites. Not only does fire support the spread of the host Blackthorn the fresh growth following a fire event is favoured by the butterfly larvae.

At six recently burnt sites, the butterfly is thriving two seasons on, although the adult numbers were reputedly down at one site the season immediately following a fire (J. Moffitt pers. comm.). Ants are also very obvious at two of these sites although it is unclear whether this reflects a response to fire, response to good numbers of adult butterflies, or other factors.

Fire also has the capacity to exclude butterflies at many sites. Burning during the period of July to February could remove the host plant and kill any larvae or eggs on the bush at that time. During summer the intensity of any fire event is likely to be higher and more destructive. If a destructive fire does occur, repopulation from adjacent unburnt sites may be necessary. This can be difficult for the Bathurst Copper Butterfly which occurs in restricted colonies, has a fragmented distribution and low vagility (E. Edwards pers. comm.).

During pupation (February to August) the butterfly are more likely to survive a fire event as they are in the ground in the ant's nest. It may be possible to undertake prescribed burning operations between March and June in order to allow sufficient time for the Blackthorn to resprout before the next flying season. It is possible that in areas where the attendant ant is not available, the butterflies pupate in leaf litter rather than under the ground. In this situation the pupae would obviously be more vulnerable in a fire event.

The exclusion of fire from Bathurst Copper Butterfly habitat is considered a threat to the species in the absence of other disturbance regimes that encourage the regeneration of Blackthorn. Although the use of fire as a management tool may assist in the management of Bathurst Copper Butterfly habitat, the timing of the activity is critical to managing rather than damaging habitat.

Accordingly, the prescription of a managed fire regime may be an effective tool in the maintenance of Bathurst Copper Butterfly habitat.

The listing of the Bathurst Copper Butterfly as an endangered species under the TSC Act has had practical implications for those undertaking hazard reduction burning. If an environmental impact assessment (EIA) is required for the activity, the potential impact of the burning on the Bathurst Copper Butterfly or its habitat must be considered. As a result of the EIA, there may be a need to implement modified burn management practices, exclude some areas, or burn at a time that minimises risk to the Bathurst Copper Butterfly.

Trial burning of an Eltham Copper Butterfly habitat was undertaken in late summer 1998. The following season a larval count in the burnt colony indicated that numbers were down significantly (ECBCG 1998). The Eltham Copper Butterfly will be monitored closely through larval and adult butterfly counts over the next few seasons. The outcome of this prescribed burning trial will be used to refine fire management guidelines for the Bathurst Copper Butterfly.

8.2.2.5 Grazing

Grazing, like fire, can operate both as an important tool for reducing the effect of threats at a site or as a significant direct threat to the maintenance of Bathurst Copper Butterfly habitat.

Low level grazing can maintain an open sunny site by removing shrubs and reducing regeneration of canopy species. When stocking is at a low level, vegetation is selectively grazed and Blackthorn is largely passed over for less spiny and more palatable species. Conversely, grazing at high stocking rates can damage butterfly habitat by removing Blackthorn, preventing recruitment of new Blackthorn, and changing the spatial pattern of the plant (Dexter & Kitching 1991a).

Excluding grazing may however be harmful to Bathurst Copper Butterfly habitat particularly in the absence of other mechanisms to control weeds and vegetation that are reducing the availability of habitat. One of the best habitats of the endangered British butterfly, The Large Blue, *Maculinea arion*, was declared a nature reserve in the 1920's and later fenced. The protective fencing, which excluded grazing, led to the habitat becoming overgrown and the butterfly to disappear (New 1997).

Grazing by cattle, at low stocking rates, has been undertaken for over twenty years at two particular butterfly sites with healthy numbers of adults present. Two other

butterfly sites have survived in paddocks largely cleared of native vegetation but where the Blackthorn has persisted. While grazing certainly may harm Bathurst Copper Butterfly habitat it can also prevent the operation of more significant threats, providing it is at a level that allows recruitment of Blackthorn.

The continuation of grazing at some site may be advantageous until alternative methods are introduced to manage other threats. However, the continuation of grazing is not considered an effective long term strategy for managing Bathurst Copper Butterfly habitat.

Grazing can impact on the attendant ants in a number of ways (Dexter & Kitching 1991a). Stock trample the Blackthorn plants disturbing or destroying the ant colonies. The action of hooves cause soil compaction and erosion which may also impact on the ant. The application of superphosphate to improve pasture species, cause changes to soil properties that may exclude the ant as well as native plants that the butterfly utilise. Stock manure can spread weed species and may also cause nutrient changes in the soil inimical to the ant population

8.2.2.6 Feral Animals

Feral pigs have been identified as a significant threat to one of only two butterfly sites located within a conservation reserve (B10). A research project conducted by University of New England in 1990 (McIntyre unpub) found that 30% of Blackthorn within the Site B10 had been impacted by pig activity and 10% had been killed. In addition to the damage and loss of host plants, the action of the feral pigs may also have affected the associated ant colonies.

Feral pig activity has not been obvious at any site since 1996. Control of blackberry at site B10 in 1996 and 1997 has significantly modified the habitat making it less attractive to feral pigs. There is potential for the pig to again impact on this site and regular site monitoring is required. It is unlikely that any butterfly sites, outside the two NPWS sites (B10, B11), would be affected by feral pigs or goats. The large area of habitat and remote location of the NPWS sites means that monitoring and ongoing control of feral animals is a significant issue to be addressed.

Feral goats have also been identified as threats to habitat (Kitching & Baker 1990) by grazing the host plant, however no grazing by goats has been recorded in the last four years.

8.2.2.7 Habitat Fragmentation

The widespread clearing of native vegetation has not only reduced the amount of Blackthorn available for the butterfly, but also fragmented the habitat into isolated remnants. The isolation of the remaining sites is a significant threat to the Bathurst Copper Butterfly. The smaller a population the more vulnerable it is to the various threats that operate against it. The viability of isolated sites relies on population

size, and habitat quality and extent, to allow the species to recover from extreme seasons or the operation of threatening factors.

The dispersal ability of the Bathurst Copper Butterfly is limited by its small size, its recorded flight behaviour and the proximity of potential habitat. For the majority of known habitat, movement between sites or colonisation of potential habitat by natural dispersal is limited by the large distances involved. Several sites are located close enough for inter-site movement to be feasible. This movement is likely to be assisted by the creation of habitat corridors that link sites.

At site B9, the habitat is present in discrete patches that could be linked by the creation of habitat corridors. If the creation of connecting habitat at site B9 allows the movement of the Bathurst Copper Butterfly between areas of habitat, it is likely to contribute to the protection of the genetic variability of the species and allow recovery of the butterfly at the site following impacts such as fires. The effectiveness of establishing habitat links in allowing intra or inter-site migration is not known. Trial establishments of habitat at site B9 may provide useful data on the value of establishing such links.

Additionally, under a metapopulation structure all potential habitat within the range of the species is important (New 1997). Accordingly, it is important to recognise that contiguous areas of habitat, such as that within the Lithgow Valley, are likely to play a significant role in the ecology of the Bathurst Copper Butterfly.

8.2.2.8 Loss of Attendant Ant

The relationship between the Bathurst Copper Butterfly and its attendant ant is little known or understood. Healthy numbers of adults are generally associated with healthy numbers of ant, and butterflies will rarely utilise Blackthorn where the ant is not present. Changes to soil characteristics such as compaction, erosion or nutrient status can exclude the ant (Dexter & Kitching 1991a, Dexter & Kitching 1991b).

The decline of butterfly numbers has also been correlated to disappearance of the attendant ant. It is not known how to create or maintain an environment suitable for the ant so that potential habitat adjacent to known sites becomes utilised. The effects of weed spraying, fire and grazing, on the attendant ant also need to be understood.

8.2.2.9 Firewood Collection

The habitat requirements of the Bathurst Copper Butterfly attendant ant, *A. itinerans*, are not well understood. It may be that dead and fallen timber is an important component. Dead and fallen timber has been documented as a significant habitat component for the Coconut Ant (*Papyrius nitidus*) which has a mutualistic relationship with the rare Small Ant-blue butterfly (*Acrodipsus myrmecophila*) (Britton & Jelinek 1995). The provision of artificial “trap nests”, constructed from

old fence posts, has led to the establishment of colonies of the Coconut ant along with the butterfly larvae and pupae.

8.2.3 Collection

From its initial description as a new species, Edwards and Common (1978) raised concerns that over-collection of the Bathurst Copper Butterfly at its type locality may place the species in jeopardy. Prior to its protection under the TSC Act the Bathurst Copper Butterfly was open to uncontrolled collection by enthusiasts. Collection at one particular site, the so-called "collectors" site, was later linked with a severe reduction in the number of adults (Dexter & Kitching 1991b). The Bathurst Copper Butterfly has not been recently recorded at six sites including the type locality and "collectors" site. While collection alone is unlikely to have caused these declines, the small size of these sites may make them unable to sustain harvesting.

The legislative protection of butterflies has been opposed by many lepidopterists who argue that amateur collectors play an important role in surveying and locating new sites of rare species such as the Bathurst Copper Butterfly. The efforts of these enthusiasts is hampered by legislation that requires licenses to collect specimens. The result of this is that amateur lepidopterists become reluctant to search out potential habitat and report new sites. The opposing view is that only by actively surveying potential habitat and reporting new sites can enthusiasts work toward the eventual delisting of rare species.

The TSC Act includes provisions that allow the issuing of licences that permit the taking of the Bathurst Copper Butterfly. This mechanism allows collection activities that are in the interests of the conservation of the Bathurst Copper Butterfly. It also ensures that ecological information obtained during collection activities is captured, hence can be utilised for recovery planning.

The NPWS is responsible for the enforcement of NSW legislation relating to the collection of threatened species such as the Bathurst Copper Butterfly. The monitoring of prominent sites to detect and deter illegal collection is a key component of understanding the effect of this activity. Communication with the entomological community through relevant journals is also a high priority. The support of enthusiasts should be sought so that the valuable habitat, distribution and ecology information is shared. These forums would allow the NPWS to discuss concerns associated with collection and also outline opportunities for genuine research. The NPWS understands that collection activities for this species may be very low.

The extent, origin, and location of specimens held in private collections are not known. Accordingly, trade in specimens collected legally prior to the promulgation of the TSC Act cannot be easily monitored or controlled if necessary. It appears that trade in the species is negligible (Dons Sands, pers. comm.).

Despite references to the historical collection of the species, and anecdotal evidence that illegal collection is occurring, it is difficult to determine the extent of current

illegal collection activities. Similarly, the demand for national and international trade in specimens of the Bathurst Copper Butterfly is not known, though it is expected to be low.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) establishes an international regulatory framework to restrict the illegal trade of endangered species between party countries.

The *Wildlife Protection (Regulation of Exports and Imports) Act 1982* (Comm.) (WP(REI) Act) offers CITES-equivalent levels of protection regarding the export of native species, and specifically includes EPBC Act listed species such as the Bathurst Copper Butterfly. However, the WP(REI) Act does not control the trade of the Bathurst Copper Butterfly between countries other than Australia.

The listing of the Bathurst Copper Butterfly under CITES does not confer additional controls over the export and import of the species from and to Australia beyond those provided by the WP(REI) Act. Listing under CITES would provide additional controls relating to the export and import of the species from and to countries that are party to the Convention (145 countries are party to the Convention).

Provided that the Commonwealth legislation is effective in the management of the export of specimens of the species from Australia, the trade of specimens between other countries will not affect the conservation of the species. In the absence of demonstrated international trade in the Bathurst Copper Butterfly, CITES listing is not warranted.

8.3 Community awareness and involvement

Community awareness and involvement in the Bathurst Copper Butterfly recovery effort is a high priority of this plan. Four target audiences have been identified and a range of interpretive media has been produced to meet each groups specific needs.

The owners and managers of Bathurst Copper Butterfly habitat are the first and most important audience. The informed support of habitat owners is the best protection most sites will achieve. Through annual joint on-site inspections and an annual newsletter the owners and managers will be kept up to date on recovery initiatives and involved where possible in the recovery actions.

The second key audience are public authorities in local, State and Commonwealth Government. Authorities with approval responsibilities under the *Environmental Planning and Assessment Act 1979*, *Native Vegetation Conservation Act 1997*, or other legislation, assess proposals that may impact on Bathurst Copper Butterfly habitat. This sector of the community requires an understanding of the significance of the Bathurst Copper Butterfly, its specific ecological requirements, and its sensitivity to impacts.

Many public authorities are also operational and may directly impact on sites through their day to day responsibilities. Local government, County Council, Roads and Traffic Authority, Rural Fire Service and the range of power, telecommunications and other utilities suppliers all need to be aware of the Bathurst Copper Butterfly. In particular the employees and contractors of these authorities need to identify Blackthorn as potential endangered species habitat.

The entomological community are an important target audience. Amateur and professional lepidopterists need to be informed and involved in the recovery effort. Interpretive efforts will be developed to encourage cooperation with entomologists in habitat survey, population monitoring and research into the Bathurst Copper Butterfly.

The final target audience are the general community. It is community support and awareness that highlights the plight of species such as the Bathurst Copper Butterfly. Increased community awareness is evident in increased involvement in bush regeneration, habitat survey and site monitoring programs.

8.4 Translocation

Translocation is defined as the deliberate reintroduction of species into an area where it once occurred or introduction to an area where it never occurred. Translocation may also involve the supplementation of a declining population with new individuals. Captive breeding may be a component of a translocation program and is used as a source of stock for the above. Translocation programs are usually devised to assist in the conservation of a threatened species, within the context of a broader recovery strategy. Translocation programs can provide a measure of security for critically endangered populations in the event of catastrophes such as the impacts of fire or disease.

Translocation of an Eltham Copper Butterfly population to Melbourne Zoo is currently being initiated (Eltham Copper Butterfly Coordinating Group 1999a; Eltham Copper Butterfly Coordinating Group 1999b). The proposal first involves the establishment of Native Blackthorn plants and two species of attendant ants *Notoncus spp.* Pending the establishment of host plant and attendant ants, either mated female Eltham Copper Butterfly or larvae will then be translocated to the Zoo site. The outcome of this project should provide useful parallels on the viability of translocation for Bathurst Copper Butterfly.

The translocation of Bathurst Copper Butterfly is not considered to be an appropriate conservation mechanism at this stage of the recovery effort. The conservation and appropriate management of remaining habitat areas is considered a more effective option. The captive breeding efforts outlined in sub-section 7.9 do however indicate that translocation is feasible. The option of translocation will be considered in the review of this plan and on the basis of a greater understanding of the ecology of the Bathurst Copper Butterfly and threatening processes. For this reason, potential habitat within the range of the Bathurst Copper Butterfly should

continue to be managed and conserved even if active adults have not been recently recorded.

8.5 Consideration of Social and economic consequences

8.5.1 Social considerations

The implementation of this recovery plan will have a social impact on the local communities and in particular the owners and managers of Bathurst Copper Butterfly habitat. In general this impact will be very positive. Local communities have been quick to support the conservation efforts of a species of such local and thus identifiable range. This is particularly true for the type locality of Yetholme where it still enjoys strong community support. As an endangered butterfly species and a butterfly of subtle but spectacular beauty the Bathurst Copper Butterfly is also ensured strong community support. Landholders have in general been enthusiastic in their management of a threatened species on their properties.

Minor negative social impacts may also occur. Some landholders are reluctant to conserve habitat and view the recovery effort as either a waste of money or as an intrusion on their rights to manage their land. While these opinions are in the minority they certainly constitute a challenge for the recovery effort. Personal and regular contact with landholders is a key strategy in encouraging awareness and involvement in the recovery effort.

Another impact may be consideration of the Bathurst Copper Butterfly in any environmental impact assessment for proposed development. As a taxon listed pursuant to the provisions of the TSC Act, the Bathurst Copper Butterfly must be considered in any development proposals. Due to the taxon's occurrence at twenty-nine discrete sites, it is possible that a number of development proposals will need to consider their likely effects on the Bathurst Copper Butterfly or its habitat.

The continued liaison with the local community, affected landholders, and relevant government agencies will address and minimise social impacts arising from the conservation of the Bathurst Copper Butterfly.

8.5.2 Economic considerations

The economic consequences of this recovery plan on private landholders relate to implementation costs and possible development restrictions. Implementation costs relate to weed control and possible loss in income from restricted grazing. The relatively small size of habitat areas make these considerations inconsequential. Noxious weed control is an existing responsibility to landholders and under this plan may be shared with the NPWS. The potential impact on development approvals should also be minimal since most of the actions expand the existing provisions of the *Environmental Planning and Assessment Act 1979*.

Management costs related to NPWS land should be reflected in the plan of management for Winburndale Nature Reserve. Management costs on other public lands are either minor, such as fencing and signposting, or recurrent activities required for the normal management of the land, such as fire management and weed control.

Many of the proposed recovery actions are subject to available funding. These funding opportunities will provide a financial incentive to landholders to co-operate in the recovery effort.

8.6 Biodiversity benefits

The Bathurst Copper Butterfly represents a change in philosophy regarding the conservation of our biodiversity. It is the only butterfly currently listed as an endangered species under the *Threatened Species Conservation Act* 1995 in NSW. It is also the only butterfly currently listed as a vulnerable species under the Commonwealths' *Environment Protection and Biodiversity Conservation Act* 1999.

Butterflies have been described as the insect equivalents of the Blue Whale, Giant Panda, Rhinoceros and Californian Condor (New, 1997). Given the aesthetic appeal of butterflies, and the Bathurst Copper Butterfly specifically, it is only natural that they be the flagship for invertebrate conservation efforts.

8.7 Ability to recover

The Bathurst Copper Butterfly ability to recover is limited by the available habitat. However, as discussed above it is not feasible at this stage to create additional areas of habitat. The Bathurst Copper Butterfly's small size and weak erratic flight results in an extremely low dispersal capability.

No data currently exists that clearly demonstrate the past or present status of the Bathurst Copper Butterfly. It is not conclusively known whether the Bathurst Copper Butterfly population is stable and fluctuating within normal ranges due to annual and seasonal variation in breeding success, or whether the Bathurst Copper Butterfly population is in decline from factors such as habitat loss, habitat modification, weed incursion, altered fire regimes, and illegal collection. However, the combination of the apparent lack of flying adults of the Bathurst Copper Butterfly at some sites and the continued loss of potential habitat potentially indicates that the species is in decline. Conversely, changes in population may represent a natural fluctuation in population cycles.

At this stage the likelihood of recovery for the Bathurst Copper Butterfly is not known. Ongoing monitoring of the Bathurst Copper Butterfly is being undertaken to provide an assessment of the Bathurst Copper Butterfly's response to recovery actions, and to provide information to assist in the review of recovery actions and to identify alternative management practices.

9 Overall objectives and criteria

9.1 Overall objective

The recovery program for the Bathurst Copper Butterfly aims to stabilise the population through the prevention of threatening processes, then to increase the in situ population through habitat management, with the aim of downlisting the species to vulnerable. The recovery plan constitutes the first five-year stage of the long-term recovery program.

The overall objective of this recovery plan is to stabilise the Bathurst Copper Butterfly's status as an endangered species pursuant to the provisions of the TSC Act. Recovery relates specifically to the prevention of the decline in the number of sub-populations and individuals of Bathurst Copper Butterfly extant in the wild, by protecting known sub-populations from threats.

9.2 Performance Criteria

The overall performance criteria of the recovery plan is that the number of sub-populations and individuals of Bathurst Copper Butterfly extant in the wild does not decrease and fluctuations in population parameters over five years occur in accordance with knowledge of the species' ecology.

10 Threat abatement

10.1 Objectives

The objectives of the threat abatement program are;

- to prevent the continuation of factors that are detrimentally affecting the Bathurst Copper Butterfly or its habitat, and
- to prevent the occurrence of activities that may affect the Bathurst Copper Butterfly or its habitat.

10.2 Criteria

- Factors detrimentally affecting the Bathurst Copper Butterfly or its habitat are known for each of the sites within two years.
- Factors detrimentally affecting the Bathurst Copper Butterfly or its habitat are reduced to a level where their level of effect is not significant within five years. These factors include; loss of habitat, illegal collection, weed incursion, access road maintenance, grazing, firewood collection, feral animal activity, and fire management practices. This reduction is expected to result in stabilisation of sub-populations of the Bathurst Copper Butterfly.

10.3 Recovery actions

10.3.1 Complete assessment of threats operating on freehold land

- The NPWS will complete assessment of the threats operating at Bathurst Copper Butterfly sites on freehold land. The NPWS will liaise with landholders to provide advice about species ecology, threatening processes, ameliorative actions, and potential sources of incentives.

10.3.2 Clearing prevention and impact assessment

- For Bathurst Copper Butterfly sites or habitat potentially affected by a development or activity proposal, determination and consent authorities under the *Environmental Planning and Assessment Act 1979* and the *Native Vegetation Conservation Act 1997* shall have due regard to this recovery plan (including the environmental impact assessment guidelines included as Appendix 1).
- The NPWS, State Forests of NSW, RLPB, DLWC, ESC, ADI and LCC, and any other relevant land managers will ensure that the contents of this recovery plan are considered during the preparation and implementation of strategic land-use planning documents such as NPWS Reserve Plans of Management, Local Environmental Plans, and Regional Environmental Plans.

- For Bathurst Copper Butterfly sites under its management the State Forests of NSW will manage adjacent forestry operations to prevent impacts on known and potential habitat in accordance with the guidelines described in Appendix 6.
- The ESC will ensure that the management and future operation of its waste management facility does not impact on the adjacent Bathurst Copper Butterfly habitat. The ESC will erect an exclusion fence around site B9 to prevent rubbish being tipped or spread outside the facility. The ESC will arrange for the regular removal of rubbish from site B9.

10.3.3 Manage weeds to prevent impacts on habitat

- For Bathurst Copper Butterfly sites under their management the NPWS, RLPB, DLWC, LCC, ESC, ADI, and State Forests of NSW will ensure that weed control is carried out in accordance with the guidelines outlined in Appendix 3.
- State Forests of NSW will undertake weed control on large infestations of Broome, *Cytisus scoparius*, adjacent to site B9.

10.3.4 Create habitat corridors to reduce isolation of sites

- State Forests of NSW will rehabilitate the area adjacent to site B9 that is cleared of Broome under action 10.3.3. The rehabilitation will involve the establishment of Blackthorn, *Bursaria spinosa* subsp. *lasiophylla* and will be designed in a manner that maximises habitat links between extant Bathurst Copper Butterfly habitat. NSW State Forests will consult with the NPWS in the rehabilitation of this area.
- Where ESC proposes to cease landfill operations at site B9, the ESC will consult with the NPWS in the formulation of the rehabilitation specifications to assist in the enhancement of Bathurst Copper Butterfly habitat.
- NPWS will facilitate the creation of habitat links between proximal sites.

10.3.5 Monitor the illegal collection of Bathurst Copper Butterfly

- The NPWS will undertake surveillance of known Bathurst Copper Butterfly habitat in order to detect and deter the illegal collection of Bathurst Copper Butterfly specimens. The NPWS will contact Bathurst Copper Butterfly site landholders and adjoining landholders in order to seek their assistance in the detection of illegal collection activities.

10.3.6 Manage vehicular access and recreational vehicle use to prevent impacts on habitat

- For Bathurst Copper Butterfly sites under their management, the RLPB and State Forests of NSW will prevent unauthorised vehicle access to site O2 and B9 (respectively) through the installation of gates/barriers and other appropriate access management structures
- The ESC will prevent unauthorised vehicle access to site B9. This will include the closure of the vehicular track traversing site B9. In consultation with the

NPWS, the ESC will construct drains to ensure that runoff from this track does not impact on Bathurst Copper Butterfly habitat.

10.3.7 Management of road surfaces and maintenance activities to prevent impacts on habitat

- For Bathurst Copper Butterfly sites under their management the ESC and LCC will ensure that road maintenance activities are assessed and conditions of operation are included to ensure that such activities do not affect Bathurst Copper Butterfly habitat.
- The ESC will consider the need to prevent the continuation of impacts on Bathurst Copper Butterfly habitat at sites B3 and B9 associated with the generation of dust from adjacent unsealed roads under the ESC's management. This consideration will include the recognition of this need when establishing priorities for the sealing of gravel roads within the Shire.

10.3.8 Management of fire prevention activities and planning to prevent impacts on habitat

- For Bathurst Copper Butterfly sites under their management the NPWS, RLPB, DLWC, LCC, ESC, ADI, and State Forests of NSW will ensure that fire management of the sites is planned in cognisance of the ecological requirements of the Bathurst Copper Butterfly and effected in accordance with the guidelines for fire management outlined in Appendix 4.

10.3.9 Management of grazing activities to prevent impacts on habitat

- For Bathurst Copper Butterfly sites under their management ADI, NSW State Forests, and DLWC will generally exclude grazing by domestic stock.
- For the Bathurst Copper Butterfly site under its management the RLPB will restrict grazing to a level not exceeding historical levels and to a level that ensures that harm to Bathurst Copper Butterfly habitat is avoided. The RLPB will liaise with the NPWS regarding any proposal to authorise the grazing domestic stock on the site.
- The NPWS will prepare guidelines for the management of grazing at Bathurst Copper Butterfly sites.
- The NPWS will liaise with affected freehold landholders to encourage them to manage grazing activities in accordance with the guidelines for grazing described above.

10.3.10 Management of impacts associated with feral animals

- The NPWS will monitor sites B10 and B11 each year for any evidence of goat or pig activity. Where sign of feral pig or goat activity is detected the NPWS will initiate control programs including aerial culling, trapping or baiting.

10.3.11 Management of dead timber removal / firewood collection to prevent impacts on habitat

- For Bathurst Copper Butterfly sites under their management the NPWS, RLPB, DLWC, LCC, ESC, ADI, and State Forests of NSW will ensure that firewood harvesting and the removal of dead timber does not occur.
- The NPWS will encourage the owners of freehold Bathurst Copper Butterfly sites to retain dead timber and firewood within or adjacent to Bathurst Copper Butterfly habitat.

11 Community awareness and involvement

11.1 Objectives

The objectives of the community awareness and involvement program are;

- to increase community awareness of the Bathurst Copper Butterfly and Blackthorn as an endangered species habitat;
- to encourage involvement of the entomological community in recovery efforts;
- to guide and assist the owners and managers of Bathurst Copper Butterfly habitat in the recovery efforts on their lands;
- to ensure that local, State government and Commonwealth agencies make informed decisions on matters that affect the conservation of the Bathurst Copper Butterfly.

11.2 Criteria

- There is an increase in the reporting of Bathurst Copper Butterfly sites, potential habitat, or suspected illegal collection activities by the community within five years.
- Land management practices that are sensitive to the recovery of the Bathurst Copper Butterfly habitat are implemented by land managers and owners within five years.
- Decision reports on proposals affecting the Bathurst Copper Butterfly or its habitat include specific consideration of the Bathurst Copper Butterfly within one year.
- Lepidopterists actively participate in recovery actions or research within four years.

11.3 Recovery actions

11.3.1 Inform and involve the broader community of issues associated with the conservation of the Bathurst Copper Butterfly

- The NPWS will produce and disseminate an information brochure on the Bathurst Copper Butterfly. The information brochure will be disseminated to affected landholders, and will be available from NPWS offices at Oberon, Bathurst, Blackheath, and Hurstville and the offices of Lithgow City, Oberon Shire, and Evans Shire Councils.
- The NPWS will produce an information brochure on the identification and significance of the native Blackthorn, *Bursaria spinosa* subsp. *lasiophylla*. The information brochure will be made available to NPWS offices at Oberon, Bathurst, Blackheath, and Hurstville and the offices of Lithgow City, and Evans Shire Councils.
- The NPWS will encourage and coordinate the involvement of community-based groups in the implementation of recovery actions.

- The NPWS will prepare and disseminate regular media releases on the Bathurst Copper Butterfly and associated recovery efforts.
- State Forests of NSW, ESC, and LCC, in consultation with the NPWS, will install signs identifying significant habitat at sites on road reserves under their management.

11.3.2 Inform and involve affected landholders of issues associated with the conservation of the Bathurst Copper Butterfly

- The NPWS will produce and disseminate to affected landholders an annual newsletter of Bathurst Copper Butterfly recovery actions and issues.
- The NPWS will liaise with affected landholders personally through annual site assessments as described in Appendix 5.
- For all known Bathurst Copper Butterfly sites within its local government area, the ESC will include a notation regarding the Bathurst Copper Butterfly on any s.149 Certificates issued under the *Environmental Planning and Assessment Act* 1979 in respect of affected lands. The notation will include reference to the Bathurst Copper Butterfly, its habitat, and its status under the TSC Act.
- For all known Bathurst Copper Butterfly sites within its local government area, the LCC will include a notation regarding the Bathurst Copper Butterfly on any planning certificate issued in response to an application for advice under s.149(5) of the *Environmental Planning and Assessment Act* 1979 in respect of affected lands. The notation will include reference to the Bathurst Copper Butterfly, its habitat, and its status under the TSC Act.
- The NPWS will target landholders within the range of the butterfly with the Native Blackthorn and Bathurst Copper Butterfly leaflets. The leaflets will be displayed on community notice boards, through field days and distributed to key groups such as Rural Fire Service and LandCare.

11.3.3 Inform and educate local and State government agencies of issues associated with the conservation of the Bathurst Copper Butterfly

- The NPWS will produce and disseminate to affected local and State government agencies an annual newsletter of Bathurst Copper Butterfly recovery actions and issues.
- The NPWS will produce and disseminate to local and State government agencies a species information sheet and an environmental impact assessment guideline (Appendix 1) on the Bathurst Copper Butterfly.
- The NPWS will disseminate to affected local government and county councils and State government agencies a description of the known sites of the Bathurst Copper Butterfly within the relevant local government area, or area of management responsibility respectively.
- Evans and Lithgow Shire Councils will ensure that all relevant sections of their organisations are informed of Council's role in the recovery of the Bathurst Copper Butterfly.

- The NPWS will produce a Native Blackthorn leaflet. NPWS will distribute the leaflet to relevant authorities including LCC, ESC, UMCC, RTA, Telstra, Delta Electricity, Advance Energy for the advice of their field operators.

11.3.4 Inform and involve lepidopterists of issues associated with the conservation of the Bathurst Copper Butterfly

- The NPWS will encourage involvement of lepidopterists in the Bathurst Copper Butterfly recovery effort particularly in habitat survey, population monitoring and research. NPWS will prepare an annual article for The Australian Entomologist, other relevant journals and newsletters.

12 Research and monitoring

12.1 Objectives

The objectives of the research and monitoring program are to;

- create and disseminate records of known sites to relevant persons,
- monitor population dynamics at each of the sites
- identify and assess potential Bathurst Copper Butterfly habitat, and
- undertake or encourage research into aspects of the ecology of the Bathurst Copper Butterfly that is likely to provide information valuable to the recovery of the taxon.
- To understand essential aspects of the ecology of the Bathurst Copper Butterfly, host Blackthorn and attendant ant.

12.2 Criteria

- Site record forms are completed for each site and disseminated to relevant persons within one year.
- A program to monitor Bathurst Copper Butterfly population parameters is established within one year.
- A model of potential Bathurst Copper Butterfly habitat is produced within three years.
- Potential habitat is assessed within five years.
- A research project on an aspect of Bathurst Copper Butterfly ecology is completed within five years

12.3 Recovery actions

12.3.1 Recording of extant sites

- The NPWS will record extant Bathurst Copper Butterfly sites in accordance with the style identified in Appendix 2.
- For Bathurst Copper Butterfly sites under their management the NPWS, RLPB, LCC, ESC, DLWC, ADI and State Forests of NSW will maintain records of these sites.

12.3.2 Annual monitoring of population and site parameters

- The NPWS will undertake an annual assessment of Bathurst Copper Butterfly sites in accordance with the guidelines specified in Appendix 5.
- The NPWS will examine the appropriateness of establishing and implementing a method of assessing Bathurst Copper Butterfly population size.

12.3.3 Identification and assessment of potential habitat

- The NPWS will develop and apply a GIS model to assist in the prediction of potential habitat for the Bathurst Copper Butterfly.
- The NPWS will liaise with entomological societies in order to seek their assistance in the identification of otherwise unrecorded habitat and sites.
- The NPWS will investigate funding options for the continuation of the Bathurst Copper Butterfly potential habitat survey and assessment program.

12.3.4 Research into the ecological requirements of the Bathurst Copper Butterfly, host Blackthorn and attendant ant

- The NPWS will monitor the effect of creating habitat corridors between areas of discrete habitat at site B9. The monitoring will include the collection of data on the occupation of the rehabilitated areas, and the movement of individuals between formerly discrete patches of habitat.
- The NPWS will investigate funding sources for effecting an ant survey at Bathurst Copper Butterfly sites to determine the range of ant species present, and the distribution and abundance of the attendant ant, *Anonychomyrma itinerans*.
- The NPWS will encourage research on the morphology and microhabitat requirements of the attendant ant, *Anonychomyrma itinerans*.
- The NPWS will encourage research into the role of *Iridomyrex* sp.1,2,3, *I. purpureus*, *I. rufoniger* group 1 and 2, and *Ochetellus* sp in the ecology of the Bathurst Copper Butterfly.
- The NPWS will encourage research on the population dynamics, ecology, and habitat requirements of the Bathurst Copper Butterfly, in order to address specific information gaps in the understanding of the taxon's ecology. Particular emphasis will be placed on the need to determine the extent of gene flow between sub-populations, the biotic factors influencing distribution, causes of immature stage mortality (including parasitoids), the use of *B. subsp. lasiophylla* by *Paralucia aurifer*.
- The NPWS will encourage research on the response of the attendant ant, butterfly, and host plant to fire.

13 Reservation / conservation status

13.1 Objectives

The objectives of the reservation / conservation status program are to;

- increase the legislative protection of publicly-owned land Bathurst Copper Butterfly sites, and
- increase the security of freehold Bathurst Copper Butterfly sites.

13.2 Criteria

- Four publicly owned Bathurst Copper Butterfly sites are afforded a higher level of legislative protection concordant with the conservation significance of these sites within five years
- Negotiations for Voluntary Conservation Agreements over three freehold Bathurst Copper Butterfly sites are commenced or completed within five years.

13.3 Recovery actions

13.3.1 Seek increase in legislative protection of freehold and publicly owned Bathurst Copper Butterfly sites

- The NPWS will discuss options for the increase in level of legislative protection of Bathurst Copper Butterfly sites with site owners. Protection mechanisms that could be negotiated include land rezoning, joint management agreements, property management plans, voluntary conservation agreements and plans of management for sites.
- For Bathurst Copper Butterfly sites on Crown land administered by DLWC, DLWC may investigate a review of the status of these Crown lands. Where Crown land status does not reflect the extant of conservation values, DLWC may amend the status to reflect the need to manage these sites for conservation purposes.
- Evans Shire Council and Lithgow City Council will, when reviewing relevant planning instruments, identify Bathurst Copper Butterfly sites as sites of conservation significance, and include objectives and provisions that specify the need to conserve that Bathurst Copper Butterfly at the sites.
- State Forests of NSW will identify Bathurst Copper Butterfly sites in Forest Management Zoning as sites of conservation significance, and include objectives and provisions that specify the need to conserve that Bathurst Copper Butterfly at the sites.

14 Implementation

14.1 Implementation responsibility

Table 1 allocates responsibility for the implementation of recovery actions specified in this plan to relevant government agencies for the period 2000 to 2004.

14.2 Implementation Costs

Appendix 7 provides detailed implementation costs and the source of funding.

Table 1: Implementation schedule

Action	Description	Responsibility for implementation	Timeframe	Priority
10	Threat Abatement			
10.3.1	Assessment of threats.	NPWS	2000	Essential
10.3.2	Clearing prevention and impact assessment	D/C Authorities NPWS, SF, ESC, LCC, ADI, DLWC	As required 2000	Essential Essential
10.3.3	Weed management.	NPWS, SF, ESC, LCC, ADI, DLWC	Ongoing	Essential
10.3.4	Habitat corridors	SF, ESC, NPWS		
10.3.5	Illegal collection monitoring.	NPWS	Ongoing	High
10.3.6	Vehicular access	RLPB, SF, LCC, ESC	Subject to funding	Moderate
10.3.7	Dust management / Road maintenance	ESC, LCC	Subject to funding	High
10.3.8	Fire management	SF, NPWS, RLPB, LCC, ESC, ADI, DLWC	Ongoing	High
10.3.9	Grazing management	RLPB, NPWS, ADI, DLWC	Ongoing	Essential
10.3.10	Feral animal management	NPWS		
10.3.11	Dead timber removal / Firewood collection	NPWS, SF, ESC, LCC, RLPB, ADI, DLWC	Ongoing	High
11	Community education and awareness.			
11.3.1	Inform and educate the broader community	NPWS, ESC, LCC	Ongoing	Essential
11.3.2	Inform and involve affected landholders	NPWS, ESC, LCC	Ongoing	Essential
11.3.3	Inform and educate local and State government agencies	NPWS	Ongoing	High
11.3.4	Inform and involve lepidopterists	NPWS	Ongoing	High
12	Research and monitoring			
12.3.1	Record extant sites	NPWS, SF, ESC, LCC, RLPB, ADI, DLWC	Ongoing	High
12.3.2	Monitoring	NPWS	Ongoing	High
12.3.3	Identify and assess potential habitat	NPWS	Subject to funding	High
12.3.4	Research	NPWS	Subject to funding	High
13	Reservation/conservation			
13.3.1	Increase legislative protection	NPWS, DLWC, LCC, ESC	Ongoing	Moderate

D/C Authorities	determining & consent authorities under the EP&A Act
All	All agencies listed below
NPWS	National Parks and Wildlife Service
State Forests	State Forests of NSW
DLWC	Department of Land and Water Conservation
RLPB	Rural Lands Protection Board
RFS	Rural Fire Service
LG	Local Government
ESC	Evans Shire Council
LCC	Lithgow City Council
UMCC	Upper Macquarie County Council

15 Preparation details

This Recovery Plan was prepared by Allan Goodwin, Ranger, Tweed Area (formerly Central West District) NPWS, and Simon Nally, Senior Threatened Species Officer, Central Directorate NPWS.

15.1 Date of last amendment

This document is the first recovery plan for the Bathurst Copper Butterfly. No amendments to the plan have been made.

15.2 Review date

This recovery plan will be reviewed five years from the date of publication.

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Appendix 1
EIA Guidelines and Information Sheet

On following pages

Bathurst Copper Butterfly

Paralucia spinifera

(Edwards and Common, 1978)

Other common name(s): Yetholme Copper Butterfly

The following information is provided to assist authors of Species Impact Statements, development and activity proponents, and determining and consent authorities, who are required to prepare or review assessments of likely impacts on threatened species pursuant to the provisions of the *Environmental Planning and Assessment Act 1979*. These guidelines should be read in conjunction with the NPWS *Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The '8 Part Test' of Significance* (November 1996).

Identification of habitat

Current knowledge suggests that *P. spinifera* occurs only at altitudes in excess of 900 metres and requires the presence of the larval food plant *Bursaria spinosa* subsp. *lasiophylla*. Aspect, geology, vegetation overstorey species are sufficiently variable at known locations of *P. spinifera* to preclude their use as factors in identifying potential *P. spinifera* habitat. Similarly, the cryptic nature of the attendant ant, *Anonychomyra itinerans*, and its apparent absence from at least one *P. spinifera* location precludes its use as an indicator of the presence or absence of *P. spinifera*.

It is recommended that potential habitat for *P. spinifera* be identified by the presence of *Bursaria spinosa* subsp. *lasiophylla* at locations above approximately 900 metres in altitude. *Bursaria spinosa* subsp. *lasiophylla* is described in Cayser et al (in press).

Survey

The adult phase of a *P. spinifera* may only last two weeks, however, adults may be expected to be active at a site for a number of weeks as emergence of adults is affected by intra-site microclimate variation.

Survey of potential habitat for *P. spinifera* should be designed in cognisance of; records of adult emergence occurring between August and November, the factors affecting activity (eg. weather), the emergence of adults at nearest known sites, the sensitivity of the species to disturbance and handling, the need to ensure that the habitat is adequately sampled.

Life cycle of the species

The ecology of *P. spinifera* is described in the referenced literature and the Recovery Plan.

P. spinifera's lifecycle includes egg, larval, pupal, and adult stages. These stages encompass a number of key elements; oviposition, larvae emergence and survival, acquisition of nutrition through grazing of host plant by larvae, diurnal and nocturnal migration between host plant and *A. itinerans* nest, pupation in *A. itinerans* nest, emergence of adults, courtship and mating, dispersal, and so on. The continuity of *P. spinifera*'s lifecycle may be interrupted if any one of these elements is directly or indirectly affected.

As the lifecycle of *P. spinifera* relies on a mutualistic relationship with the ant species, *A. itinerans*, and on the presence of the larval food plant *B. spinosa* subsp. *lasiophylla* the lifecycles of these species

must be considered in assessing potential impact on *P. spinifera*.

For example, the spacial distribution of *B. spinosa* subsp. *lasiophylla* affects its availability to larvae, which are not known to cross open ground to graze - only reaching additional plants by traversing intertwining branchlets. Accordingly, changes to the actual or effective density of *B. spinosa* subsp. *lasiophylla* through wildfire fuel reduction or by the invasion of weeds may cause early pupation due to starvation, reduced adult size and reduced fecundity. Reduced fecundity may lead to population decline and local extinction.

Threatening processes

The Threatened Species Conservation Act 1995 (TSC Act) does not list a key threatening process that affects *P. spinifera*.

The Recovery Plan identifies clearing of habitat (associated with grazing by stock or feral animals, development or land use activities), isolation of habitat, weed invasion, inappropriate fire regimes, disturbance to soils and vegetation by feral animals, loss of attendant ant, and dust generated by traffic as threats.

Viable local population of the species

Although the population of *P. spinifera* is small and occurs as discrete sub-populations within a restricted range, activities which result in the destruction of individuals have the potential to significantly affect the viability of a population of *P. spinifera*. The potential for *P. spinifera* sub-populations to operate as metapopulations should also be considered. Sub-population sizes may vary greatly from year to year according to variations in climate and other site factors. Accordingly, adults may be apparently absent.

A significant area of habitat

The restricted distribution of *P. spinifera* may be partially explained through the

apparent reliance on a combination of restrictive habitat requirements, mainly its mutualistic association with *A. itinerans* and requirement for the larval food plant *B. spinosa* subsp. *lasiophylla*. However, both these species are more widespread than *P. spinifera*.

It is assumed that there has been a reduction in the natural extent or distribution of this species or its habitat. Recent genetic studies allow for a recent reduction in the extent of habitat. Dexter and Kitching (unpub.) consider the population sites as refugia from past climate changes.

An assessment of the effect of a proposal on habitat should consider all direct and indirect effects on the habitat of *P. spinifera* and on the habitat of *A. itinerans* and *B. spinosa* subsp. *lasiophylla*.

Isolation/fragmentation

P. spinifera has a low dispersal capability, which may present an increased risk of extinction due to the potential for the sub-populations to have inadequate levels of genetic exchange. Accordingly, isolated habitat fragments are less likely to be recolonised if local extinction does occur. In addition to habitat removal, structures or other developments may restrict movement of *P. spinifera*.

Effect on apparently unoccupied potential habitat may reduce *P. spinifera* ability to respond to opportunities to occupy habitat.

Regional distribution of the habitat

The TSC Act defines region as the regions defined in the Interim Biogeographic Regionalisation of Australia. The known distribution of *P. spinifera* is confined to the South Eastern Highlands region.

Limit of known distribution

P. spinifera is restricted to an area between Oberon, Hartley and Bathurst on the Central Tablelands of NSW.

Further survey of potential habitat may identify additional populations and range extensions.

Adequacy of representation in conservation reserves or other similar protected areas

Two of the 29 known populations of *P. spinifera* are located within land managed for conservation purposes by the NPWS. Although a genetic study found that the heterogeneity within populations was high and that the sub-populations were closely related (Dexter and Kitching

unpub.), it is not known whether *P. spinifera*'s genetic variation is adequately reserved. Similarly, in the absence of adequate population dynamic studies, it is not known whether a significant proportion of the population is reserved. The reserved sites do not represent the full range of vegetative variability, altitudinal range or geographic range.

Critical habitat

There is currently no critical habitat declared for *P. spinifera*.

For further information contact:

Threatened Species Unit, Central Directorate, NSW NPWS, PO Box 1967, Hurstville NSW 2220. Phone: 9585 6678. www.npws.nsw.gov.au

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THREATENED SPECIES INFORMATION

Bathurst Copper Butterfly

Paralucia spinifera

(Edwards and Common, 1978)

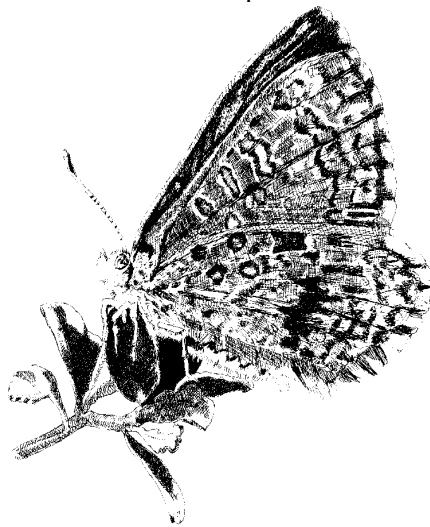
Other common name(s): Yetholme Copper Butterfly

Conservation Status

Paralucia spinifera is listed as an endangered species on Schedule 1 of the *Threatened Species Conservation Act 1995*. *P. spinifera* is also listed as a vulnerable species on Schedule 1 Part 2 of the *Endangered Species Protection Act 1992* (Cwlth).

Description

P. spinifera is a small butterfly with a thick body and a wingspan of 20–30 mm. The upper sides of *P. spinifera*'s wings are copper colored and display a purple, blue, and green iridescence when sunning. The undersides of the wings are patterned with subtle brown, black, and grey. Its black antennae are dotted with white spots, and terminate with a black tip.



P. spinifera is distinguished from *P. aurifera* and *P. pyrodiscus* by the size, shape and colour of the wings, and also by a spine that extends over a joint in the forelegs.

Distribution

P. spinifera occurs on the Central Tablelands of NSW in an area generally bounded by Oberon, Hartley and Bathurst. *P. spinifera* is found at 29 locations, all within the local government areas of Greater Lithgow and Evans. It is possible that additional locations will be identified, and these may lie outside the currently known distribution.

Occurrences in conservation reserves

Of the twenty-nine known locations, four occur within areas managed for conservation purposes by the NPWS. The remainder occur on freehold land, and land managed by other State and local government agencies.

Habitat

P. spinifera locations occur above 900m in altitude, are generally associated with exposure to full day sun (often with a west to north aspect), and with extremes of cold such as regular winter snowfalls or heavy frosts.

Geology, soils and dominant vegetation canopy species vary between locations of *P. spinifera*. Conversely, vegetation structure is consistent, commonly open woodland or open forest with a sparse understorey that is dominated by the shrub, Blackthorn (*Bursaria spinosa* subsp. *lasiophylla*).

Ecology

The lifecycle of *P. spinifera* relies on a mutualistic relationship with the ant, *Anonychomyra itinerans*, and on the presence of the larval food plant *B. spinosa* subsp. *lasiophylla*.

The butterflies emerge between August (later at higher altitude sites) and

November, with a two-week peak of activity in September. After mating, the female oviposits eggs on or in the immediate vicinity of *B. spinosa* subsp. *lasiophylla*. After hatching, the larva is attended by *A. itinerans*, which is thought to offer the larva predator protection and receive nutritional secretions from the larva (Dexter and Kitching unpub). Initially diurnal, the larva becomes nocturnal in the latter part of its six-to-eight week larval period. Pupation occurs in the underground nest of *A. itinerans* at the base of the host plant between December and February (Dunn et al. 1994).

The relationship between *P. spinifera*, *A. itinerans*, and *B. spinosa* subsp. *lasiophylla* is not completely understood, but it is thought to be highly significant. Even though it is sometimes difficult to detect, *A. itinerans* has been recorded at almost all of the *P. spinifera* locations. Similarly *B. spinosa* subsp. *lasiophylla* is present at all locations of *P. spinifera*.

Adult male *P. spinifera* fly rapidly at about one metre from the ground and rest with wings parted in sites exposed to full sun. Female *P. spinifera* fly less rapidly and tend to remain nearer to the host plant (Edwards and Common 1978). *P. spinifera*

generally remain in the vicinity of *B. spinosa* subsp. *lasiophylla*, and are rarely observed more than 10 metres distant from the habitat.

Threats

The 29 known locations are generally small and isolated and are vulnerable to impacts from weed invasion, and control, inappropriate fire management, clearing, and overgrazing. *P. spinifera*'s sedentary nature indicates it has a low dispersal capability, hence is unlikely to colonise new areas after its habitat has been destroyed. *P. spinifera*'s reliance on *A. itinerans*, and *B. spinosa* subsp. *lasiophylla* means that factors affecting those species also affect *P. spinifera*. The rarity of *P. spinifera* makes it attractive to collectors, and collection is thought to have contributed to severe population decline at one site (Dexter and Kitching 1991).

Management

Management varies from site to site depending on the threats operating.

Recovery Plans

The recovery plan was approved in June 2001.

For Further Information contact

Threatened Species Unit Central Directorate NSW NPWS PO Box 1967, Hurstville NSW 2220
Phone 02 9585 6678 www.npws.nsw.gov.au

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- Dexter E. M. and Kitching R. L. *Nomination for the Register of the National Estate*. Australian Heritage Commission (unpublished report).
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Appendix 2

Site Description Records

Site descriptions have been prepared for each confirmed site of Bathurst Copper Butterfly. The descriptions comprise geographic details including location, access, and size of the site as well as information on the land use, threats and general site condition. A sample site description is outlined on the following page.

Each confirmed Bathurst Copper Butterfly site has also been marked on the relevant 1:25,000 scale topographic map sheet, and has been recorded on the NPWS Atlas of NSW Wildlife.

Finally an aerial photo of each known site has been produced by the Land Information Centre at 1:2,500 scale. The air photo allows the total area of habitat to be clearly identified. Points within the habitat where butterflies or attendant ants are observed can also be located accurately.

Colour copies of the air photo are used during the annual site assessments described in Appendix 5. They allow the accurate location and recording of habitat and butterfly activity from year to year allowing changes in population dynamics to be monitored.

A sample completed Site Description Record is shown on the following page.

A complete set of site description records is not included due to confidentiality reasons

B8. Macabees Rd - road verge 500m from Yetholme crossroads.

Location: **Map Sheet:** Meadow Flat 1:25 000. 8831-2-S **Zone:** 55

AMG: 761650 Lat: 149°48'53"
6295850 Long: 33°26'40"

Region: Central West

Owner/Access: Evans Shire Council. (02) 6331 4200.

Land Use: Road verge.

Status: Probably extinct. AG 6/10/99. Site has been cleared of all vegetation recently.

Slope: 10° **Aspect:** S **Elevation:** 1100m **Area:**
0.1ha

Attendant ant: None seen.

Weeds: No.

Fire History: Long unburnt.

Actions Required: Check for presence of butterfly.
Check for presence of ant.

Site Inspections: Multiple inspections 97, 98 by AG/RM. No butterflies or grazing evident.
6/10/99. AG. None seen.

Appendix 3

Weed Control Guidelines

Weed invasion is a significant issue at ten of the twenty-nine known Bathurst Copper Butterfly habitats. The control of weeds is determined by their proximity to the habitat used by the Bathurst Copper Butterfly and mapped as part of the Site Descriptions. For weeds outside of the Bathurst Copper Butterfly habitat, control should be by conventional means and is the responsibility of the relevant land owner or manager. For weed control within the actual area of mapped habitat the guidelines outlined below should be applied.

- **Mapping**

The NPWS will produce a map of the weed problem with the extent of weeds marked on the site aerial photo. The scale of this photo is 1:2,500 and allows for the accurate location of the habitat area and associated weeds.

- **Control**

The control programs will utilise bush regeneration techniques such as cut and paint method where the shrub is cut off close to the ground and herbicide, generally Roundup ©, applied to the cut stem. Hand removal of the weed could also be considered where it would not cause too much disturbance to adjacent Blackthorn or to ant colonies. Generally the optimum period for control works are when the weeds are actively growing, November to March, depending on the seasonal conditions. For pine wildings, mature trees can simply be felled or where the site is sensitive, stem injection or ring-barking applied, and the tree left in situ.

Bush regeneration is labour intensive and may involve contract of such groups as the Australian Trust for Conservation Volunteers (ATCV) or local community volunteers. Alternatively, specialist bush regenerators can be contracted.

- **Priority**

Priority for weed control will be given to the largest habitat areas with largest Bathurst Copper Butterfly sites regardless of tenure.

- **Funding**

The NPWS are prepared to coordinate weed control programs within the limited areas of known Bathurst Copper Butterfly habitat. Application will be made for Threatened Species funding or other grant schemes. The NPWS and other departments will be expected contribute to the cost of control works on their lands.

Appendix 4

Fire Management Guidelines

Appendix 5 details the Site Assessment Guidelines that will be undertaken by NPWS each year. The site assessment will indicate whether prescribed burning is appropriate or in fact desirable for any particular habitat.

Prescribed burning may be appropriate when site assessment indicates.

- dense regeneration of overstorey components are shading habitat;
- Blackthorn is being excluded or suppressed by shrub competition;
- Blackthorn within sites is represented by predominantly mature individuals with mature foliage which indicates the plants are senescing;
- fuels within the site have been identified as a risk to adjacent property.

Where prescribed burning is being proposed the following guidelines will apply:

- The site assessments must be carried out by the NPWS in the seasons immediately prior and post fire to assess the response;
- The site descriptions must have been completed by NPWS so that the extent of habitat actually utilised by butterfly within sites is known and mapped;
- Only a proportion (<50 %) of any single site should be treated in any one year.
- An interval of at least five years should be left before treating the remaining unburnt habitat and; Site assessment must record recovery in burnt habitat before adjacent areas are also treated;
- Prescribed burning should only be undertaken between March and June;
- Proponents need to apply the Eight-part test when assessing the possible impact of the activity.

Where prescribed burning is being proposed primarily to reduce fuels, consideration should be given to excluding butterfly habitat from the operation. The small areas of habitat that exist should not constitute undue hazard to adjacent lands.

During a wildfire event, known habitat areas of the Bathurst Copper Butterfly should be excluded from backburning operations, or fireline construction where possible. Where backburning operations cannot be avoided then the amount of habitat treated should be minimised. The use of retardants within known sites of Bathurst Copper Butterfly should be avoided.

Appendix 5

Site Assessment Guidelines

Site assessment is critical to the successful recovery of the Bathurst Copper Butterfly. The site assessment will be undertaken by NPWS on an annual basis during the flying season of the butterfly between late August and late October. The site assessment has a number of components designed to monitor changes in the vegetation structure, distribution and density of butterflies within the habitat, condition of Blackthorn and presence of attendant ant. The data sheet attached will be amended to provide for the range of relevant observations. The site assessment also has a regulatory function in the detection or deterrence of illegal butterfly collection.

Site assessments should be undertaken with the property owner or manager. Joint assessment allows the landholder to be informed and involved in the recovery efforts.

- **Timing**

The site assessment should be undertaken on calm sunny days during the flight season of the Bathurst Copper Butterfly between late August and late October. While the emergence of butterflies varies considerably between sites there is generally a peak of activity during September.

- **Habitat Monitoring**

A fixed reference point consisting of a steel post and metal tag has been located within or adjacent to each Bathurst Copper Butterfly site. Photos of the core or typical habitat will be taken from these reference points every two years. The photos will be used to monitor changes in the structure of the vegetation that may be linked to changes in the number of adults.

The key to habitat monitoring is the understanding that the Bathurst Copper Butterfly requires sunny exposed sites. Photo monitoring will detect shrub competition with the host Blackthorn that may indicate that a low intensity prescribed burn is required. Alternatively a severe fire event may result in recruitment of *Acacia sp.* or *Eucalyptus sp.* occurring as dense stands that within a small Bathurst Copper Butterfly site may exclude the butterfly by shading out a site.. In this situation hand thinning of the vegetation may be required.

Where the habitat is identified as a fire risk to adjacent property the fuels will be assessed as part of the site assessment using the Overall Fuel Hazard Guide (McCarthy *et al* 1998).

- **Population Monitoring**

Site assessment requires an estimate of the distribution and relative abundance of Bathurst Copper Butterflies at each site each year. This information is critical to understanding the natural population dynamics and response to events such as fire.

It is also critical for detecting the loss or decline of adult numbers so that threats or causes can be determined and remedial actions taken. Within the metapopulation structure potential habitat may be colonised or abandoned. Monitoring should attempt to detect and map these changes.

The actual area of habitat for each Bathurst Copper Butterfly site is described on an air photo provided under the Site Description in Appendix 1. The distribution and occurrence of butterflies is described by walking the site and marking the air photo where butterflies are observed and making notes on the number, condition and behaviour, particularly if the butterfly are mating or feeding. Where the butterfly are feeding notes should be made on the species involved.

This method relies on a subjective description where the adult number estimate is categorised between common and none observed. It represents the minimum action required to monitor the number of Bathurst Copper Butterfly at each site. A much better method for estimating the population is described by van Praagh (1996) and has been applied to the Eltham Copper Butterfly *Paralucia pyrodiscus lucida* in Victoria.

The NPWS will seek funding for a quantitative survey of the Bathurst Copper Butterfly at each site using the protocols established for the Eltham Copper. If funding is not successful then basic monitoring by NPWS will be carried out.

- **Attendant Ant**

Blackthorn plants should be randomly checked for presence of the attendant ant and any observations marked on the air photo and recorded on the data sheet.

- **Blackthorn**

Comment should be made on the growth form of the Blackthorn particularly whether juvenile plants are present, resprouting is occurring or whether plants are represented primarily by mature plants with mature foliage. The extent of grazing of the Blackthorn foliage should also be noted although it may not necessarily reflect Bathurst Copper Butterfly activity.

- **Actions Required**

As part of the annual site assessment a record will be made of issues or threats to the butterfly or its habitat. The assessment will recommend the appropriate remedial action consistent with the recovery plan.

- **Law Enforcement**

As part of the annual site assessment process, surveillance of Bathurst Copper Butterfly sites will be undertaken. The NPWS will liaise with site owners, neighbours and the entomological community regarding the illegal collection of butterfly specimens and encourage the reporting of suspicious activity. The presence of NPWS officers should deter illegal collection and enhance the possibility of collectors being detected.

Bathurst Copper Butterfly Site Assessment

Site:

Date:

Time: (period)

Owner/Manager:

Weather: (Sunny/overcast/wind/temperature etc)

Butterfly: (Number observed/breeding/larvae/location/behaviour)

Blackthorn: (Condition/extent/grazed/habit)

Ants: (Observed)

Vegetation: (Species flowering/utilised)

Insects: (Other insects on *Bursaria*, presence of *P. aurifera* etc)

Weeds:

Actions Required:

Appendix 6

Forestry Operation Guidelines

This guideline has been formulated in consultation with State Forests of NSW and includes recommendations for the management of forestry operations on land containing known or potential Bathurst Copper Butterfly habitat.

- **Clearing of Bathurst Copper Butterfly habitat**

Potential or known Bathurst Copper Butterfly habitat will not be cleared as a result of forestry operations. Known sites are those identified in this recovery plan, and those that the NPWS has provided notification of to State Forests of NSW. Potential habitat refers to sites that generally meet the parameters of habitat described within this recovery plan. Factors to be considered in assessing whether a site offers potential habitat include; presence of host plant, proximity to other Bathurst Copper Butterfly sites, altitude, and aspect.

- **Buffers**

Prior to the commencement of forestry operations (such as native forest harvesting or pine plantation establishment), a buffer zone surrounding Bathurst Copper Butterfly habitat will be maintained. The buffer will consist of locally indigenous vegetation, and will be of sufficient width to prevent impacts on Bathurst Copper Butterfly habitat. Potential impacts to be considered in the design of the buffers include; changes to soil and water properties, and the maintenance of solar radiation levels through the prevention of shading of habitat throughout the life of the forest or plantation. The width of the buffer will depend upon the slope and aspect of the lands, drainage patterns and the location of plantation in relation to the Bathurst Copper Butterfly habitat.

Appendix 7 -- Implementation Costs

Action No.	Action Title	Estimated Cost/yr					Total	Source of funding							
		Year 1	Year 2	Year 3	Year 4	Year 5		NPWS	ESC	LCC	SF	RLPB	DLWC	ADI	Unfunded
10.3.1	Assessment of threats operating on freehold land	6000	4000	4000	4000	4000	22000	22000							0
10.3.2	Clearing prevention and impact assessment	5000					5000		5000						0
10.3.3	Weed management	23500	23500	23500	5000	5000	80500	19000	1000	1000	8000	2000	5000	1000	43500
10.3.4	Habitat corridor creation	1000	1000	1000			3000				3000				0
10.3.5	Monitor illegal collection														
10.3.6	Manage vehicular access	4600					4600		1000		3500	100			0
10.3.7	Dust management/Road maintenance														0
10.3.8	Fire management														0
10.3.9	Manage grazing	2000	0	0	0	0	2000	2000							0
10.3.10	Feral Animals	500	500	500	500	500	2500	2500							0
10.3.11	Dead timber/firewood retention						0								0
11.3.1	Inform and educate community	2500	1100	500	500	500	5100	4500	200	200	200	0	0		0
11.3.2	Inform and involve affected landholders	12000	18000	18000	0	0	48000	0							48000
11.3.3	Inform and educate local and State government agencies	500	200	0	0	0	700	700							0
11.3.4	Inform and educate lepidopterists						0								0
12.3.1	Record extant populations	1500	1000	1000	0	0	3500	500							3000
12.3.2	Monitoring	13000	7000	7000	2000	2000	31000	0							31000
12.3.3	Identify and assess potential habitat	6000	2000	0	0	0	8000	2000							6000
12.3.4	Undertake research	4000	1000	1000	0	0	6000	0							6000
13.3.1	Increase status of lands		2500	2500	0	0	5000	0							5000
	OVERALL TOTAL / YEAR & per AGENCY	82100	61800	59000	12000	12000	226900	53200	7200	1200	14700	2100	5000	1000	142500

