

## Recovery plan for the bull oak jewel butterfly (*Hypochrysops piceatus*) 1999–2003

Prepared by Geoff Lundie-Jenkins and Alison Payne for the Bull oak  
Jewel Butterfly Recovery Team



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This is the first edition of the bull oak jewel butterfly plan. Information in the plan is accurate at November 2000.

This plan has included significant public input through the representatives on the recovery team.

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## Summary

### Current species status

Endangered (*Nature Conservation Act 1992 - Nature Conservation (Wildlife) Regulation 1994, Schedule 2*). Surveys in 1994 recorded the species from only a single site in south-east Queensland. Listed by IUCN as a species whose "survival is now considered to be threatened".

### Habitat requirements and limiting factors

The habitat requirements of *Hypochrysops piceatus* are complex involving a mutualistic relation with the bull oak *Allocasuarina luehmannii* and ant species of the *Anonychomyrma* genus which attend the *H. piceatus* larvae and a number of dependent factors. It has also been suggested that *H. piceatus* may depend on eriococcid scale insects which are attended by the ant and hence may concentrate ant activity. This relationship is however yet to be proven conclusively.

### Recovery plan objectives

To secure and expand populations of the bull oak jewel butterfly during the life of this plan.

### Progress criteria

1. Secure and rehabilitate the two known colonies within two years.
2. Carry out systematic vegetation and butterfly surveys within 50km of the known populations within two years.
3. Locate at least three additional colonies of the butterfly or establish at least three sustainable translocated populations within the next five years.
4. Identify and implement management of the key threats within five years and develop effective management prescriptions for the species.
5. Research and describe the lifecycle of the butterfly and plant/ant association within five years.
6. Develop interpretative material within one year and involve community groups and amateurs in the identification of habitat and monitoring of populations within two years.

### Estimated cost of recovery

(1999 Prices(+4% p.a.) in \$000s/year.)

Action	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Total
1999	20	0	9	0	0	0	3	32
2000	28	16	9	1	5	0	3	62
2001	29	20	15	2	5	0	4	75
2002	0	16	10	1	6	60	3	96
2003	0	17	12	1	6	0	3	39
<b>Total</b>	<b>77</b>	<b>69</b>	<b>54</b>	<b>6</b>	<b>22</b>	<b>60</b>	<b>16</b>	<b>304</b>

### Actions needed

1. Locate additional colonies and clarify and map the present distribution and habitat variables.
2. Devise and implement management plans for Ellangowan Nature Refuge and additional sites.
3. Monitoring of colonies and habitat to ensure future identification of threatening processes.
4. Raise public awareness and education of the species and its requirements.
5. Undertake investigations to clarify the species limited distribution and guide management.
6. Investigate metapopulation modelling to determine population and habitat viability.
7. Maintenance of the recovery team.

### Biodiversity benefits

Protection of bull oak dominated remnant vegetation in Southern Brigalow Belt biogeographic region. Promotion of improved land management practices to enhance conservation values.

## 1 Introduction

The genus *Hypochrysops* belongs to the butterfly family Lycaenidae (blues and coppers) and contains 57 species world wide (Sands 1986). The majority of these are found in the neighbouring islands to the north of Australia with only one occurring west of Wallace's line. Eighteen species of *Hypochrysops* occur in Australia of which six are endemic. The remainder also occur on mainland New Guinea (Sands 1993).

The bull oak jewel butterfly (*Hypochrysops piceatus*) is an endemic species that was first discovered in 1967 and later described in 1969 by Kerr, Macqueen and Sands (Kerr *et al.* 1969). It was the last member of its genus in Australia to be described (Sands 1993) and is one of the smallest of the 18 Australian species of *Hypochrysops* that belongs to a group of closely related species containing *H. cyane*, *H. ignita*, *H. delicia* and *H. epicurus* (Sands 1986).

*H. piceatus* is currently found only near Leyburn in south-east Queensland and is now recognised as one of Australia's most threatened butterflies owing to its very restricted distribution. It is listed as endangered under Schedule 2, Division 3, Butterflies in the Nature Conservation (Wildlife) Regulation 1994 (Queensland) of the Nature Conservation Act 1992. Two other members of the genus in Australia are also listed in Queensland. *Hypochrysops apollo apollo* (North Queensland) is listed as endangered and *Hypochrysops theon cretatus* (Cape York Peninsula) as vulnerable (Schedule 3, Division 3). Environment Australia is now supporting an action plan to determine the current status of all Australian butterflies.

### 1.1 Description of species

The adult male of *H. piceatus* is dull purple on the upperside with brown-black wing margins and veins suffused orange. The underside is a pale brownish grey with orange spots and bands prominently edged in black and metallic green (Common and Waterhouse 1981). The female is larger with broader more rounded wings than the male and is bluish purple above with black suffused veins in the hindwing (Dunn and Kitching 1994, Common and Waterhouse 1981). Both sexes are characterised by the prominent black edges to the underwing markings on the basal two-thirds of the hindwing (Sands 1986, Kerr *et al.* 1969).

### 1.2 Distribution

*Hypochrysops piceatus* was originally discovered 20km SSE of Millmerran at Mt. Emlyn where it is reputedly no longer found. It was discovered 5 days later 5km NE of Leyburn on the Toowoomba-Karara Rd (140km south-west of Brisbane) and this became the type locality for the description of the species in 1969. A record of this species from Cecil Plains proved to be a female of *H. ignita* (Dunn and Kitching 1994). It is assumed that this butterfly may have been more widespread between these two locations prior to its discovery (Kitching 1993, Dunn and Kitching 1994).

### 1.3 Habitat requirements and use

The habitat requirements of *Hypochrysops piceatus* are complex involving a mutualistic relation with native plants and insects and a number of dependent factors at an intermediate stage, which is typical of lycaenid butterflies (Dunn and Kitching 1994, Greenslade 1995). It inhabits a single species of tree, the slow growing bull oak, *Allocasuarina luehmannii*, and is found on large individual trees (DBH >45cm) thought to be in the region of 200 years old (Dunn and Kitching 1994, Greenslade 1995). The butterfly is only found where there are abundant populations of an undescribed and little known ant species *Anonychomyrma* sp. (Dunn and Kitching 1994). The exact details of the relationship between the ant and the butterfly caterpillar are not known for this species.

It is characteristic of members of the *Anonychomyrma* genus to attend larvae of various lycaenid genera in Australia. For members of the itinerans group, to which *Anonychomyrma* sp. was originally assigned, this association appears to be confined to three lycaenid species which occur sympatrically at the Leyburn site - *H. piceatus*, *H. cyane*, and *Ogyris aenone* (Greenslade 1995). The ant is thought to provide necessary protection for the butterfly larvae from their many predators, including wasps and spiders, and from parasites, and in return probably earns nutritious secretions (containing sugars and perhaps more importantly, amino acids) produced by glands on the caterpillars back (Naomi Pearce pers. comm.).

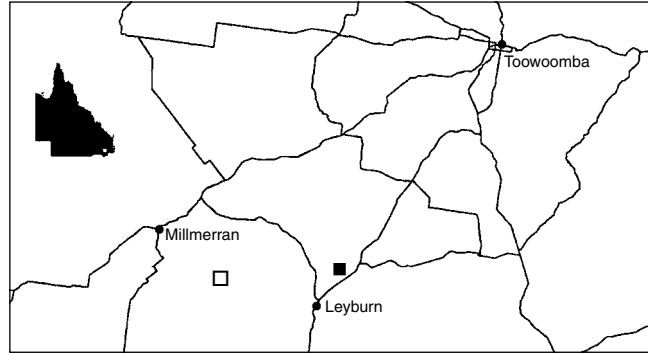


Figure 1. Map showing location of type and extant localities for bull oak jewel butterfly. (Locality were first discovered: □, Extant population & type locality: ■)

In addition the occurrence of *H. piceatus* may be enhanced by the presence of eriococcid scale insects (*Rhizococcus* sp.) which are attended by the ant and concentrate ant activity. This intense activity may permit gravid females to easily locate ant-occupied host trees on which to lay their eggs (Dunn and Kitching 1994, Greenslade 1995). Both the attendant ant and the butterfly larvae inhabit tunnels formed by moth larvae, normally in the upper branches of the bull oaks, which may explain the relationship with older trees as these individuals are riddled with the tunnels and therefore encourage nesting colonies of the ant and provide shelter for the nocturnal larvae (Dunn and Kitching 1994, Greenslade 1995).

The older bull oak trees are also often heavily infested with the mistletoe *Amyema linophyllum*, which may be an important nectar source for the adult butterfly, together with other plants which flower during adult activity in spring and late summer such as *Angophora leiocarpa* and *Jacksonia scoparia* and *Pseudococcid homoptera* (Dunn and Kitching 1994, Greenslade 1995).

The bull oak host *Allocasuarina luehmannii* requires sandy soils which are often of low fertility and is widespread in Australia. The associated ant although localised is widespread and has been found in a number of other potential sites (Dunn and Kitching 1994).

### 1.4 Life history/ecology

The butterfly larvae shelter during the day in the borer moth tunnels in the upper branches of the bull oaks, where they are attended by the ant, and emerge at night to feed on the bull oak leaves (Dunn and Kitching 1994). It is expected that the larvae over-winter in the fifth instar and probably pupate in the same shelter site as the ants (Dunn and Kitching 1994).

*H. piceatus* is regularly bivoltine with two main broods of butterflies that fly during spring (from mid October to late November) and again, in a larger brood, in mid summer to early autumn (from late January to mid April). These flight periods may be extended or contracted by occasional early or late emergences depending on the prevailing seasonal conditions (Dunn and Kitching 1994, Kitching 1994). Emergence of the larvae is mostly staggered through these two flight periods occurring in October/November and January/February with females of each batch emerging just after the main emergence of males which seems typical of many lycaenid species (Dunn and Kitching 1994).

#### **1.4.1 Diet and foraging**

*H. piceatus* adults in the spring brood often forage at either the yellow flowers of *Jacksonia scoparia*, which are the dominant flowering plants at that time of year, or species of *Eucapryptus*. *Jacksonia* is not in flower during summer and it is likely that the summer adults rely on mistletoe flowers (Dunn and Kitching 1994). *H. piceatus* is known to forage at flowers of *Amyema linophyllum* which parasitises bull oak and flowers during February to early April, although most have finished flowering by late March, and probably utilises *A. miquelii* and *A. quandang* which flower in March and April. Flowers of *Angophora* trees are also utilised by the summer brood (Dunn and Kitching 1994).

#### **1.4.2 Movement patterns and behaviour**

*Hypochrysops piceatus* is inconspicuous on the wing even when it may be present in large numbers. Males often perch, with their wings closed or partially opened in the V-shape characteristic of the other *Hypochrysops* species, in the uppermost branches of the large ant-occupied bull oaks at heights of 9-12m, sometimes up to 15m (Dunn and Kitching 1994). Males begin perching around 1100hrs and usually remain perched for extended periods in sunlit positions, occasionally darting out to investigate adults of the same species or patrolling *Ogyris* sp. (Dunn and Kitching 1994). Females can be encountered lower in the canopy flying about the tops of the shorter bull oak trees or lower branches of large trees where ant density is high (Dunn and Kitching 1994). When perched, the females remain settled for long periods often in shady or non-prominent positions (Dunn and Kitching 1994).

Adults of *H. piceatus* become most active in the late afternoon (De Baar 1993, Dunn and Kitching 1994). Maximum numbers of males are present between 1430h and 1730h and overt territorial behaviour seems to be confined to this period (Dunn and Kitching 1994). Male activity generally diminishes very late in the afternoon as dusk approaches. Females generally become conspicuous after 1530h and settle in shady positions on the bull oaks as dusk approaches and feed on mistletoe flowers (Dunn and Kitching 1994). It seems likely that females oviposit late in the afternoon as male territorial behaviour is diminishing as this is when most females are seen flying, confining their movements between 30-60cm above branches containing masses of ants and possibly scale insects (Dunn and Kitching 1994).

### **1.5 Reasons for listing and identified threats**

No species of butterfly in the world is currently known to have become extinct. However, the six endemic Australian species of *Hypochrysops* are all local, uncommon or rare occurring in largely undisturbed habitats (Sands 1993) and in 1993 Roger Kitching declared that the bull oak jewel butterfly "is as close to the edge as a species can get without actually being extirpated". It is one of only two full species currently listed as endangered under the Schedule 2 Division 3 Butterflies in the *Nature Conservation (Wildlife) Regulation 1994* (Queensland) of the *Nature Conservation Act 1992*, the remainder being subspecies.

Before the discovery of the bull oak jewel butterfly in 1967, the species may have been more widespread between Millmerran and Leyburn. Land use changes and the conversion to agriculture appear to be responsible for its present very restricted range (Dunn and Kitching 1994, Kitching 1993). The butterfly habitat appears to be very old and is now merely a remnant patch of native vegetation that was originally disturbed perhaps 100 years ago (Dunn and Kitching 1994). However, since its discovery, the area of bull oak woodland near Leyburn, which used to extend into the adjoining property prior to clearing for grazing circa 1980, has been further reduced and the butterfly is now estimated to occupy an area of 56,000m<sup>2</sup> (700x80m) comprising two disjunct sections separated by more than 300m (Dunn and Kitching 1994). A decline in the abundance of the butterfly at this site has been observed since its discovery (Sands 1990) and may be due to a number of factors, primarily resulting from the removal of the old ant occupied host trees.

In September 1997 Dr Chris Hill made a confirmed discovery of a second colony of the butterfly and unconfirmed reports of additional colonies exist.

Kitching (1994) states that "globally, habitat alteration and destruction is the prime threat to all lycaenids with limited distributions and low vagility, and has already been the agent of major declines of many members of this group of butterflies". The small size of the two known populations of *H. piceatus* makes it particularly vulnerable to disturbance. Potential threats to the continued existence of this species are listed below.

#### **1.5.1 Road widening**

Major disturbance to the road shoulder through and adjacent to the Leyburn butterfly colony in 1993 saw the loss of several old ant-occupied hosts on which the butterfly was known to be breeding (Dunn and Kitching 1994). Further road work planned in 1995 roused objections from interested groups and resulted in some important habitat trees being excluded from the planned clearing.

In 1998 extraction of gravel began in a cleared paddock nearby the Leyburn site in which Chris Hill found the second confirmed population on the butterfly on 25 September 1997. The necessity of including roadworks, which are generally associated with tree clearing and increased dust levels, as a threatening factor emphasises the vulnerability of a species that occurs in small and highly localised populations (New 1990).

#### **1.5.2 Tree removal**

An ongoing and major concern is the removal of bull oak trees for firewood and other wood uses (eg fence posts and wood turning). This removal of host trees is probably directly responsible for some population decline and further removal will continue to impact on the butterfly population (Sands 1990). In October 1998 five mature bull oaks were noted to have been recently removed close to a previous sighting of the butterfly.

Removal of debris from the ground could reduce mobility of the *Anonychomyrma* ant which appears to use fallen logs as travelling routes between trees (Chris Hill pers. comm.).

#### **1.5.3 Erosion**

The old road, which passes directly through the middle of the site, is now a widening and deepening erosion waterway which has not naturally revegetated. A site inspection in October 1998 noted the formation of significant banks and some of this erosion is exposing the roots of old bull oak trees.

#### 1.5.4 Weed invasion

The long term effect of exotic weeds invading the site is uncertain (Dunn and Kitching 1994). In the past the site has been invaded by exotic roadside grasses such as *Eragrostis* sp. (African lovegrass), *Bryophyllum* sp. (mother-of-millions) and by *Verbena bonariensis*, a native species which colonised along the drainage line. In 1996 a Drought Landcare Project carried out hand clearing for mother-of-millions. However, the area was heavily re-infested in early 1997 and Clifton Shire Council carried out spot spraying for this weed which now appears to be largely under control. Further investigations are needed to assess the extent of the current weed problem.

#### 1.5.5 Grazing

The Leyburn site is a designated travelling stock route. Grazing by cattle, particularly during drought periods, could damage the natural values of the site by spreading weeds, pugging the ground, increasing erosion risk and pushing over trees (Greenslade 1995). Alternatively light grazing along the road side under good conditions could reduce the dominance of exotic weed species and may be beneficial to the ant. The site of the second confirmed colony of the butterfly had been grazed for many years at the time of discovery which does not appear to have affected the ant or the butterfly and the encroaching ground cover following exclusion of cattle may adversely affect ant populations (Chris Hill pers. comm.).

#### 1.5.6 Competition among ant species

Any disturbance resulting in a change in the habitat structure of the bull oak woodland will cause a change in the structure of the ant community and alter species dominance. A large colony of meat ants (*Iridomyrmex* sp.) was observed on a cleared patch of ground in October 1998 and invasion of this species may threaten the abundance of the *Anonychomyrma* ant.

#### 1.5.7 Collecting

The existing colony of *H. piceatus* does not appear to have been affected or threatened in any way by the regular removal of adults by collectors which has occurred periodically since its discovery (Dunn and Kitching 1994). Over 90 percent of *H. piceatus* butterflies occur beyond the reach of collectors due to the species habit of flying near the tops of the mature bull oak trees. Whilst there is no evidence that collecting poses a threat to the butterflies there has been some reduction in the habitat area and abundance of the butterfly, which, of necessity, may concentrate the activities of collectors (Dunn and Kitching 1994). While collecting may pose some threat to small, localised populations, it is likely to be a minor threat acting on populations that have been reduced to the point of being threatened by any random stochastic events.

#### 1.5.8 Natural processes

Any further disturbance to the habitat of the butterfly that returns the vegetation to an earlier succession stage, such as a severe wildfire, is likely to be detrimental to the butterfly (Dunn and Kitching 1994). The likely impact of fire on the *Anonychomyrma* ant is not known but an extensive fire could eradicate those colonies nesting in crevices near the base of *Allocasuarina* and *Angophora* trees. However colonies are probably also established in upper branches and these may survive (Dunn and Kitching 1994).

Strong winds also uproot the older bull oaks as the species is shallow rooting and grows in loose sandy soils (Dunn and Kitching 1994). It is evident that the older trees are weakened by borer holes and deteriorate rapidly due to environmental affects (Dunn and Kitching 1994).

Heavy rains and floods may increase the erosion along the old road and possibly re-infest the area with weeds.

#### 1.5.9 Loss of genetic diversity and demographic stochasticity

Based on the assumed reduction in distribution and abundance of *H. piceatus* it is possible that the species has suffered some loss of genetic diversity and perhaps been through a genetic bottleneck. This is detrimental to the survival of small populations in that random demographic events ("genetic drift") can cause further rapid loss of genetic variation between individuals and this loss can diminish a species ability to adapt to changed environmental conditions and novel pathogens (O'Brien and Evermann 1988). The small size of a population can also impede any mechanisms which normally reduce levels of inbreeding which is often accompanied by reduced fitness of offspring (Reed *et al.* 1988). Furthermore, important demographic variables such as normal sex ratio and average annual reproduction may be adversely affected by random fluctuation in small populations and this enhanced fluctuation increases the likelihood of extinction (Lande 1988). At present there is no information with which to estimate what a minimum viable population size might be for this species, or even whether such a concept is relevant to insect populations. Some of the current work on butterfly conservation is based on the concept of metapopulations, ie the number and spatial distribution of populations rather than the size of a population. This concept requires additional investigation and may have major implications for conservation planning.

#### 1.6 Existing conservation measures

The listing of this species as endangered under the *Nature Conservation (Wildlife) Regulation 1994* of the *Nature Conservation Act 1992* provides for protection from exploitation and development.

In January 1995 a nomination for the listing of the Leyburn roadside site on the register of the National Estate was prepared and accepted, thus providing an enhanced degree of protection for the site (Greenslade 1995). A draft management intent has been prepared by the Environmental Protection Agency for a nature refuge encompassing the Leyburn butterfly site. Queensland Transport and Clifton Shire Council have agreed in principle to this proposal and a legally binding memorandum of understanding is currently being negotiated between all concerned parties.

Interpretative signs have been erected at the Leyburn site to inform the public of the presence of the butterfly and the importance of the area.

The site is visited at irregular intervals by several QPWS staff to monitor disturbance at the site and check for the presence of the butterfly.

Amateur butterfly enthusiasts also regularly visit the site and, presumably, would inform QPWS of disturbance events or perceived threatening processes.

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### 1.7 Strategy for recovery

This recovery plan will run for a term of 5 years from 1999 to 2003 inclusive. Five primary strategies will be pursued during this term and are presented below in order of proposed implementation. However, once commenced many of these strategies will be run concurrently.

1. Locate and confirm additional populations of the butterfly and clarify and map the present distribution of the species and habitat variables.
2. Devise and implement management plans for the conservation and management of the Ellangowan Nature Refuge and additional sites including monitoring of populations and habitat to ensure future identification of any threatening processes.
3. Raise public awareness and education of the species and its requirements and develop mechanisms to promote and encourage community participation in the recovery process.
4. Research the lifecycle, population dynamics, habitat requirements and plant/ant associations of the butterfly to clarify reasons for the current very limited distribution of the species.
5. Investigate the use of metapopulation modelling as a means of assessing the future prospects of the species based on its present distribution and to determine the minimum number of populations and habitat size necessary for sustainability of this species.

A recovery team comprising members from Queensland Parks and Wildlife Service, Queensland Transport, Clifton Shire Council, Entomological Society of Queensland, CSIRO Double Helix Science Club, Australian Entomological Society, Toowoomba Regional Environment Council and other organisations as appropriate, will be established to co-ordinate and supervise these strategies. The recovery team will report annually to Environment Australia.

## 2 Recovery objectives and criteria

### General objective

To secure and expand populations of the bull oak jewel butterfly through an integrated program of investigations, direct on-ground management activities and community education and capacity building during the life of this plan.

### Specific objectives

The objectives of this recovery plan are to:

1. Secure and maintain existing natural populations.
2. Locate additional extant populations of the butterfly.
3. Identify and manage key threats to the species' survival.
4. Gain a better understanding of the geographic distribution of the species and its habitat requirements and ecology.
5. Increase community awareness and develop mechanisms for community involvement in the recovery process.

### Recovery criteria

To downlist the species from endangered to vulnerable on the IUCN criteria: locate five colonies in quality habitat in the wild or achieve successful reintroduction of the butterfly into three more areas of suitable habitat.

### Progress criteria

1. Secure and rehabilitate the two known populations within two years including declaration of the Ellangowan Nature Refuge at the Leyburn roadside site.
2. Carry out systematic vegetation and butterfly surveys within 50km of the known populations within two years.
3. Locate at least three additional populations of the butterfly or establish at least three sustainable translocated populations within the next five years.
4. Identify and implement management of the key threats within five years and develop effective management prescriptions for the species.
5. Research and describe the lifecycle of the butterfly and the plant/ant association within five years.
6. Develop interpretative material within one year and involve community groups and amateurs in the identification of potential habitat and monitoring of populations within two years.

### 3 Recovery actions

Recovery actions for the bull oak jewel butterfly are presented below. Costings have been calculated at 1998 prices. Unless otherwise stated contributions by participating state agencies include salaries for research and technical staff. Actions undertaken as normal operations by state agency staff have not been costed. Details of costings are presented in the Implementation Schedule of this document.

#### Action 1. Locate and confirm additional populations of the butterfly and clarify and map the present distribution of the species and habitat variables

There is an urgent need to identify any other bull oak jewel butterfly populations and attempt to secure their protection. This is the major action required for downlisting of the species as its endangered status will remain unchanged while there are only two populations of limited extent. Once located the full range of management options can be explored.

Further intensive surveys of the Darling Downs will be undertaken to identify the existence of other extant populations using the following steps:

- identify sites that potentially have bull oak jewel butterfly populations (through public contact/education),
- inspect sites for evidence of the butterfly and describe site attributes,
- undertake a population census of the bull oak jewel butterfly populations.

##### Action 1.1 Surveys to locate and confirm additional populations

A survey program will be implemented in late January/February in 1999 of the sites described by Dunn and Kitching (1994) and of any other sites known or considered potential habitat by experts and collectors. An ongoing public education program will be undertaken to encourage the reporting of information to the Department. Where populations of the bull oak jewel butterfly are discovered a census of abundance and a detailed assessment of habitat and threats will be undertaken.

Responsibility: QPWS Southern Region.

Cost:	1999	2000	2001	2002	2003
Total Cost	\$20,225	\$20,330	\$21,130	NIL	NIL

##### Action 1.2 Spatial mapping and predictive modelling

Some spatial mapping and predictive modelling can be carried out at present based on the previous surveys by Dunn and Kitching (1994) and the two known habitats. However, the accuracy of any predictions will improve if more populations are discovered and added to the database. Spatial mapping will also be utilised to plan programs for habitat management, rehabilitation and the creation of habitat corridors.

Responsibility: QPWS Southern Region.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	\$7,480	\$7,780	NIL	NIL

#### Action 2. Devise and implement management plans for the conservation and management of the Ellangowan Nature Refuge and additional sites

Develop a plan of management for all known butterfly sites for conservation of viable populations of the butterfly. This will include manipulation of all or selected areas of habitat to enhance its suitability for the species and management actions such as fire, erosion and weed control.

##### Action 2.1 Ellangowan Nature Refuge

This site is the type locality of the species and possibly a source of individuals dispersing to the nearby, smaller gravel pit site. Within current knowledge it is considered critical that this population persists if the species is to survive. Some active management within the Nature Refuge will be necessary.

Responsibility: QPWS Southern Region, Queensland. Transport, Clifton Shire Council.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	\$10,880	\$11,330	\$11,780	\$12,250

##### Action 2.2 Warwick Shire Council Gravel Reserve - fencing of a portion from stock to aid recruitment

The butterfly has managed to survive at this site despite its degraded state. The paddock has been grazed by cattle for several decades without causing any apparent harm to the butterfly or the older bull oak trees. However, future management will be necessary to ensure the butterfly continues to persist at this site.

The site will require some management of grazing to ensure there is recruitment of bull oak trees for habitat viability, and to ensure the ground cover remains suitable for the *Anonychomyrma* ant. It is likely that some grazing of the ground cover favours the persistence of the ant. Given that the area has been grazed for so long in the past and that this stand of trees is important as shade for the cattle, only a portion of the habitat will be fenced to allow for some recruitment of the bull oak trees. If natural recruitment rates remain low direct seeding and/or planting trials using local native provenance stock would be undertaken.

Responsibility: QPWS Southern Region.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	\$5,400	\$3,000	\$1,600	\$1,700

##### Action 2.3 Other sites

To protect any populations of the bull oak jewel butterfly that may occur outside protected areas a co-ordinated strategy of preservation of identified populations and suitable habitat for the species is required. This may involve the development of Conservation Agreements with landholders and the implementation of management and rehabilitation programs similar to those described in 2.2.

Responsibility: QPWS Southern Region.

Cost:	1999	2000	2001*	2002*	2003*
Total Cost	NIL	NIL	\$5,400	\$3,000	\$3,100

\* Approximate costs based on estimates for initial works at Gravel Reserve Site

**Action 3. Monitoring of populations and habitat to ensure future identification of threatening processes**

As protection and enhancement of the butterfly populations are primary goals of the recovery plan it is essential to monitor as precisely as possible the abundance of the bull oak jewel butterfly in order to:

- (a) determine the relative importance of threatening processes at specific locations,
- (b) ensure that management prescriptions are appropriate,
- (c) provide an early warning system in case of decline,
- (d) build an information base on the population dynamics of the species.

**Action 3.1 Design and implement a monitoring program for existing butterfly populations**

Due to the complicated life-cycles and dynamic nature of invertebrate populations conventional population monitoring techniques which attempt to derive population estimates by censusing adult populations are of limited value. The most appropriate technique for monitoring the status of the species would be one assessing the continued presence/absence of the species at a number of sites across its range. In some instances and for key sites it may be useful to monitor numbers and relative abundance of the butterflies for a given area or habitat. Transect counts are an apparently simple technique that is now used extensively in surveying and monitoring butterfly populations and communities and is, essentially, a relative method of very considerable value when accurate population estimates are not needed but trends in abundance between years or differences between sites are needed (New 1991). The method is much less expensive and intensive than mark-release-recapture studies and is easily repeatable. The transects need to be standardised within limits to counter some of the influences of weather and activity periods of the butterfly (New 1991).

**Action 3.2 Design and implement a habitat monitoring program**

It will be necessary to monitor the habitat in conjunction with butterfly populations in order to gain a better understanding of habitat requirements, particularly during any management actions or habitat manipulation undertaken

Responsibility (actions 3.1 and 3.2 combined): QPWS Southern Region.

Cost:	1999	2000	2001	2002	2003
Total Cost	\$8,560	\$8,900	\$9,250	\$9,620	\$10,000

**Action 3.3 Train community groups and schools in monitoring**

To facilitate broader community involvement in the monitoring and to ensure there are a sufficient number of trained observers to assist in monitoring an increasing number of dispersed sites, which will hopefully be detected from surveys for the species, training workshops will be initiated focussing on local community and school groups. These workshops will be led by relevant professional and amateur lepidopterists.

Responsibility: QPWS Southern Region.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	NIL	\$5,380	NIL	\$2,000

**Action 4. Raise public awareness and education of the species and its requirements**

The bull oak jewel is a small cryptic butterfly that occurs in habitat that does not have high aesthetic value. It is therefore necessary to raise public awareness and education of the species in order to gain public support for its conservation. Signs have been erected at the Leyburn site explaining its significance yet removal of mature bull oak trees continues within this habitat. Further information signs will be erected here with the opening of the Ellangowan Nature Refuge.

**Action 4.1 Production of promotional and educational material**

A full colour publicity brochure for the butterfly is being prepared for distribution to schools, community groups, tourist information centres and shire libraries. The brochure will be produced in 2000 for distribution in early 2001.

Responsibility: QPWS Southern Region.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	NIL	\$1,180	NIL	NIL

**Action 4.2 CSIRO Double Helix Science Club**

The CSIRO Double Helix Club is operated by the CSIRO Education Division and provides a mechanism for linking schools and the general community with real research and recovery projects being conducted by some of Australia's leading scientists. Double Helix also provides resources to schools and provides opportunities for students to participate in or contribute to projects relevant to their local area. Within Queensland CSIRO Double Helix has successfully integrated elements of the recovery program for the Richmond birdwing butterfly into school based activities. It is hoped that similar school and community based activities will be developed and implemented for the bull oak jewel butterfly.

Responsibility: QPWS Southern Region, CSIRO Double Helix Science Club.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	TBC	TBC	TBC	TBC

*TBC = Costs to be calculated. Double Helix component based on identification and adoption of relevant school based projects on an annual basis.*

**Action 4.3 Media and extension campaigns**

The opening of the Ellangowan Nature Refuge in 1999 was publicised, including a field day showing members of the public how to identify the butterfly on the wing. Additional media and extension activities are proposed on an annual basis in conjunction with the activities of regional extension officers, Bushcare officers, NatureSearch officers, Land for Wildlife Officers and Greening Australia staff.

Responsibility: QPWS Southern Region.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	\$1,180	\$1,180	\$1,180	\$1,300

**Action 5. Undertake ecological investigations of the life cycle, population dynamics, dispersal ability, habitat requirements and plant/ant associations of the butterfly to clarify reasons for the current very limited distribution of the species and guide future management**

There is a recognised lack of information on the general biology of the bull oak jewel butterfly.

**Action 5.1 Life-cycle**

The lifecycle of *H. piceatus* is poorly known and needs basic investigation to determine appropriate management actions and timing of those actions. Research is especially needed on egg and larval stages as these are the least mobile and likely to be the most vulnerable to threatening processes.

**Action 5.2 Population dynamics and dispersal ability**

Data on population dynamics and dispersal is essential in building population models, designing refuge systems, assessing threats, and in evaluating management actions. Such work would also serve to identify and quantify threats to the survival of the butterfly. The proposed study would also investigate alternative techniques for estimating abundance as current methods including line transect counts and mark-recapture techniques have well documented limitations.

**Action 5.3 Habitat requirements**

This is basic information that is required for several aspects of the recovery plan. It is necessary in order to determine reasons for the butterfly's very limited distribution and allow predictive modelling of potential habitat and the impacts of threatening processes. This information should be available from the results of surveys of butterfly populations and the associated habitats.

**Action 5.4 Plant/ant associations**

The bull oak jewel is a monophagous species with an obligate association with an undescribed ant. It is therefore critical to its conservation to gain a better understanding of this ecological relationship.

It is proposed that these important ecological questions could be addressed by tertiary level projects over the life of the plan. The costs have therefore been calculated as annual input by QPWS and university staff and resources to support honours level research investigations.

Responsibility: QPWS Southern Region, University of Queensland, Griffith University, University of Southern Queensland.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	\$5,250	\$5,450	\$5,660	\$5,880

**Action 6. Investigate the use of metapopulation modelling as a means of assessing the future prospects of the species based on its present distribution and to determine the minimum number of populations and habitat size necessary for sustainability of the species**

**Action 6.1 Metapopulation and population viability monitoring**

It is proposed to initiate a grant application under the Australian Research Council - Strategic Partnerships with Industry for Research and Training (ARC-SPIRT) to support at least a masters level postgraduate study to investigate the use of metapopulation modelling as a means of assessing the future prospects of the species based on its present distribution and to determine the minimum number of populations and habitat size and continuity necessary for sustainability of this species.

Responsibility: QPWS Southern Region, University of Queensland, Griffith University, University of Southern Queensland.

Cost:	1999	2000	2001	2002	2003
Total Cost	NIL	NIL	NIL	\$60,150	NIL

**Action 7.0 Maintenance of the recovery team**

The recovery team shall contain representatives from Queensland Parks and Wildlife Service, Queensland Transport, Clifton Shire Council, Entomological Society of Queensland, CSIRO Double Helix Science Club, Australian Entomological Society, Toowoomba Regional Environment Council and other organisations as appropriate. In addition members with particular expertise shall be invited to participate as required.

Funds would be required to enable core members of the recovery team to meet on at least an annual basis to review the progress of the recovery plan. Venues would be chosen to minimise travel expenses and non-core members would be required to meet their own costs for attendance.

Responsibility: QPWS Southern Region, Queensland Transport, Clifton Shire Council.

Cost:	1999	2000	2001	2002	2003
Total Cost	\$2,600	\$2,700	\$3,900	\$3,100	\$3,200

## 4 Implementation Schedule

Action#	Description	Priority	Feasibility (%)	1999	2000	2001	2002	2003	Total
<b>1</b>	<b>Butterfly distribution and habitat</b>								
1.1	Surveys to locate and confirm additional populations	1	100	20,225	20,330	21,130	NIL	NIL	61,685
1.2	Spatial mapping and predictive modelling	2	90	NIL	7,480	7,780	NIL	NIL	15,260
<b>2</b>	<b>Management plans for Ellangowan Nature Refuge and other sites</b>								
2.1	Ellangowan Nature Refuge	1	90	NIL	10,880	11,330	11,780	12,250	46,240
2.2	Clifton Shire Council Gravel Reserve	1	100	NIL	5,400	3,000	1,600	1,700	11,700
2.3	Other sites	1	100	NIL	NIL	5,400	3,000	3,100	11,500
<b>3</b>	<b>Monitoring of populations and habitat</b>								
3.1 & 3.2	Design and implement a monitoring program for existing butterfly populations	1	100	8,560	8,900	9,250	9,620	10,000	46,330
	Design and implement a habitat monitoring program	2							
3.3	Train community groups, schools in monitoring	1	100	NIL	NIL	5,380	NIL	2,000	7,380
<b>4</b>	<b>Public awareness and education of the species</b>								
4.1	Production of promotional and educational material	1	100	NIL	NIL	1,180	NIL	NIL	1,180
4.2	CSIRO Double Helix Science Club	2	100	NIL	NIL	TBC	TBC	TBC	TBC
4.3	Media and extension campaigns	1	100	NIL	1,180	1,180	1,180	1,300	4,840
<b>5</b>	<b>Undertake ecological investigations</b>								
5.1 & 5.2	Life cycle & Population dynamics	2	90	NIL	5,250	5,450	5,660	5,880	22,240
5.3 & 5.4	Habitat requirements Plant / ant associations	2							
<b>6</b>	<b>Metapopulation modelling and population viability</b>								
6.1	Metapopulation and population viability modelling	3	80	NIL	NIL	NIL	60,150	NIL	60 150
<b>7</b>	<b>Recovery team administration</b>	1	100	2,600	2,700	3,900	3,100	3,200	15,500
	<b>SUMMARY</b>		<b>TOTAL</b>	<b>31,385</b>	<b>62,120</b>	<b>74,980</b>	<b>96,090</b>	<b>39,430</b>	<b>304,005</b>

**Participating Organisations:**  
 Queensland Parks and Wildlife Service; Biodiversity Group Environment Australia; University of Queensland; Clifton Shire Council;  
 Queensland Transport; Butterfly and other Invertebrates Club; CSIRO Double Helix Science Club.

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## 5 Acknowledgements

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