Chapter 1
Birdwing Butterflies and Their Conservation Needs

1.1 Introduction

Butterflies are undoubtedly the single most popular group of insects, and this status has fostered considerable and widespread sympathies for their conservation in many parts of the world. The foundations of butterfly conservation – indeed of wider invertebrate conservation – have been set amongst studies of butterflies in northern temperate regions, predominantly those of the United Kingdom, parts of western Europe and North America. These foundations have most commonly reflected concerns for individual butterfly species (or subspecies) that are perceived to have declined in distribution and abundance and for which management can be based on reasonably sound biological and distributional information in well-documented faunas. They have led to emulative projects in southern temperate regions, predominantly South Africa and Australia, the latter additionally encompassing the sub-tropical and tropical forest regions that are the major focus of this account. For many individual butterfly species and subspecies in parts of the northern temperate regions, detailed conservation programmes and recovery plans can be based on an understanding of their ecology, distribution, and threats to their welfare, accumulated over many years.

Some butterfly conservation cases are models of how the minutiae of ecological information can be incorporated into practical and successful management, with the success of conservation depending heavily on attention given to ecological detail, as well as community and political support. Most such focal taxa (species or subspecies) have been threatened predominantly by loss of habitat, both in extent and quality, and much remedial effort has necessarily focused on the few small sites on which the threatened taxa have been known to occur. Many of the threatened species and subspecies involved have demonstrably declined to the extent that their distributions have become fragmented and confined to small habitat patches, on which they now occur only as small remnant populations that are increasingly vulnerable to processes such as bush fires, invasions by alien animals and plants, and stochastic loss. Much of the development of butterfly conservation has been driven by

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'crisis-management' exercises for taxa that have already suffered substantial loss and, in many instances, have become highly susceptible to inbreeding effects, extirpation or even extinction. Habitat security and restoration of critical resources are recurring themes in butterfly conservation.

Over much of the rest of the world, including the tropics, far higher butterfly species richness and far less biological knowledge go hand-in-hand. Resident lepidopterists are almost invariably fewer in tropical regions than in northern temperate regions. Societal demands, capabilities and priorities are commonly very different, so that 'conservation' is an activity far secondary to meeting human needs. Very few individual butterfly taxa have been the focus of serious conservation efforts, despite the clear needs for these. The most familiar global scenario of butterfly species-level conservation in a region has thus become largely site-based conservation management, with token acknowledgement that the wider landscape provides an enveloping context for this, and thus that landscape-level manipulations may then be critical in countering the consequences of site or population isolation. Although many butterflies are indeed relatively sedentary, not all species are strictly site-bound and the above emphasis on species that are ecologically specialised and those presumed to be poor dispersers, represents only one facet, albeit an important one, of butterfly conservation. For most taxa, the form and dynamics of any metapopulation structure remains unknown and can only be inferred. Other taxa may range widely as strong flyers (and closely related butterflies may differ dramatically in their dispersal ability), and their conservation necessitates a wider perspective on landscapes to reflect major vegetation types and their dispersion. Some are now restricted to remnant corridors or patches, and to habitats that are vulnerable – so that, of greatest relevance here, tropical forests have been extensively cleared in the interests of agricultural, forestry, industrial and urban development. Both site-based and landscape-based conservation measures are needed.

Forest loss has undoubtedly become the major threat to a considerable variety of forest-dwelling animals and plants. Practical consequences include the inevitable transition to site-focus as such formerly extensive biotopes become reduced to discrete fragments remaining as their only representatives. This site focus couples with need to maintain connectivity on a wider scale wherever possible, to facilitate normal dispersive behaviour between those remnant patches. One outcome of habitat fragmentation and loss of connectivity is change of population structure, whereby previously functional metapopulations may be transformed into residual closed populations. Some migratory butterflies have had their dispersive behaviour disrupted by habitat loss. For example, the Brown awl (*Badamia exclamationis* (Fabricius) (Hesperiidae)) in Queensland is believed to have suffered from progressive isolation of populations on small habitat patches (Valentine 2004), so that its characteristic long distance migrations can no longer take place. Declines in abundance, or extirpation, can potentially result through genetic isolation and inbreeding depression in this, and many other species.

Within any habitable area, the critical, and often specific, consumable resources needed are food plants for the larvae and nectar sources for the adult stage. Birdwing larvae feed exclusively on forest vines of the family Aristolochiaceae, and many of the species of birdwing butterflies only develop on one or two species. These vines usually grow in rainforest where they have suffered heavily from extensive forest clearing. In addition, very few vines remain protected in national parks. The food plant vines used by Australian birdwings often occur on steep slopes and prefer basaltic soils, but grow also on rich alluvial loams bordering rivers and streams. Unfortunately, in many countries where the birdwings occur, the areas with such rich soils were eagerly sought and disturbed in various ways for forest timber plantations, agricultural purposes or oil palm plantations.

1.2 The Birdwing Butterflies

The birdwings are one of the paramount groups of flagship insect species, believed to have suffered very severely from extensive forest clearing over many parts of their collective range. They include the largest and most spectacular of all tropical strongly-flying butterflies, as a much-admired group of swallowtail butterflies (Papilionidae). They are restricted to the Indo-Australian region of the Old World tropics and subtropics, with species occurring from northern India and southern China, extending from Indonesia, Malaysia, Philippines, the Solomon Islands (Tennent 2002) and Papua New Guinea to tropical and sub-tropical eastern Australia. Females of Queen Alexandra's birdwing (*Ornithoptera alexandrae* Rothschild) are the largest butterflies known, with wingspans sometimes approaching 30 cm! Within their broader generic ranges, most species are very restricted in distribution.

The birdwing butterflies (now generally appraised as comprising members of three genera, *Ornithoptera* Boisduval, *Troides* Hubner and *Trogonoptera* Rippon) have aroused wonder amongst generations of naturalists since they were first known, and the writings of pioneer collectors (such as Meek 1913) reveal the excitement and emotions accompanying sightings and capture of these remarkable insects. That sense of wonder is summarised well by accounts of early collectors, whose words have been quoted repeatedly to convey the sentiments to more recent readers. Thus, Wallace (1869) recorded his reaction to his discovery and initial capture of the first golden-orange coloured male of *Ornithoptera croesus* Wallace as one of 'intense excitement', as (p. 336) 'On taking it out of my net and opening the glorious wings, my heart began to beat violently, the blood rushed to my head, and I felt much more like fainting than I have done when in apprehension of immediate death. I had a headache for the rest of the day, so great was the excitement produced by what will appear to most people a very inadequate cause'. He went on to describe his endeavours to capture a series of specimens 'obtaining on an average one specimen a day' for a long time, but 'on good days two or three specimens'. Meek's (1913, p. 142) reaction to receiving a captured male of *Ornithoptera chimaera* Rothschild rivals Wallace's sentiments, as 'I felt more pleased than if I had been left a fortune … A fine discovery of that sort stirs the heart of a collector. He forgets hardships and troubles …'. Collecting series of such elusive species is hard work, and even viewing individuals in remote areas is notoriously unreliable. As another famous quotation, Meek (1913, p. 161) again reported that, having encountered a female of *Ornithoptera alexandrae*, '…it was not until a year or two afterwards that I obtained a male specimen'. The appeals to collectors based on appearance, size and rarity, and the romanticism associated with exploration and unusual collecting methods, such as shooting high-flying specimens with dust shot (the method used to obtain the type specimens of both *O. alexandrae* and *O. victoriae* Gray), commenced from the earliest years of their discovery, and has persisted.

Parsons (1999) used the term 'mystique' to help convey the fascination of the birdwing butterflies for the people of Papua New Guinea, who have traditionally cultured their food plants to attract the butterflies into their gardens (Parsons 1992a; Sands and Scott 2002) and to use them for ornaments (Barrett and Burns 1951). Vividly coloured and often considered the most attractive of all butterflies, birdwings have long been desired by collectors, and specimens have been sought for displays and mounting in cabinets; their financial worth has long been a component of conservation inducement, initially puzzling but later appreciated by local people. Their 'mystique' has undoubtedly been fostered by their occurrence in some remote parts of the world (such as parts of Indonesia and Papua New Guinea), that have long been considered exotic and untamed to visitors, so that (other than the most intrepid explorers), many early expatriate collectors seeking specimens had little realistic chance even of seeing the rarer species in the wild, let alone of capturing them. Even the more common birdwings, spectacular to observe when visiting flowers, are equally impressive when seen in flight, and can be difficult to catch. Most have high-flying and colourful males, while the larger females are mostly brown/black and white, and often secretive in behaviour, and well camouflaged while they seek suitable larval food plants in the understorey, on which to lay their eggs. Fewer than 40 species of birdwings are recognised widely, but the precise number is debated continually, as the various local colour forms of species have been regarded subjectively as 'varieties', subspecies, or at times full species. The taxonomic identities of several species, status and combinations have often been modified – and will assuredly continue to be debated both objectively and at the more transient whims of collectors and dealers.

The birdwings are a potent group of insects to represent the 'small animals' in conservation advocacy, with conservation values fostered by their massive appeal both to experienced naturalists and conservationists and to people encountering them anew – including those whose directives may affect changes in land use (New 2011a, b). The limited distributions of most taxa, accompanied by severe threats to their habitats, and sometimes highly emotive debate over effects of over-collecting and illegal trade to satisfy collector demand, have given them a very high profile in insect conservation issues, as 'flagship' species. Not least, birdwings are amongst the relatively few tropical butterflies to gain high prominence in the wider discussions of insect conservation need. In Dennis' (1997) terms, birdwings have a 'high conservation load' fostered by concerns and advocacy from many parts of the world. Somewhat unusually, much of the concern for birdwing conservation has arisen from people who have not seen the butterflies in the wild but nevertheless accept the importance of conserving them, both for their own sake and as umbrella symbols for the myriad taxa associated with tropical rainforest habitats.

Outside Australia, most concerns for birdwing conservation have been for species on the mainland and islands of New Guinea (western section Papua, previously referred to as West Papua or West Irian [Indonesia]; eastern part, Papua New Guinea) where forestry activities continue to have a massive impact on their habitats. A detailed history of conservation efforts for the Papua New Guinea fauna was summarised by Parsons (1992a), Parsons (1999), drawing on his extensive earlier studies and involvement. Several features are central to constructive conservation concerns for the birdwings, and indicate how practical salvatory measures might be pursued (New 2002), as:

1. The primary habitats for many species, particularly those at higher elevations, are remote and difficult to access. This restricted access is sometimes exacerbated by the sentiments of local people and traditional landowners, who see imposed expatriate interests by visits to traditionally-owned land as interference, or threatening and exploitative to their life styles, whilst also providing landowners with little or no financial return.
2. Threats to birdwings are often unspecified beyond general comments on habitat loss through deforestation and implications of overexploitation for commercial sale of specimens.
3. Information on conservation need and the impetus for conservation management mostly arises from studies by visitors to butterfly habitats, based on relatively short-term field work that is sometimes viewed by local landowners with suspicion – notwithstanding some notable examples of conservation partnerships built on mutual trust.
4. Biological and ecological knowledge of each species is sparse, and butterfly population sizes, fluctuations and structures are extremely difficult to estimate over ranges of tens to hundreds of square kilometres of poorly explored terrain, often with unknown densities of food plants in dense forests where the levels of birdwing mobility are unknown, although inferred to be considerable, and
5. Continued pressures to circumvent well-intentioned regulations that have been instigated to counter possible overexploitation for commercial purposes.

Even the best-documented species of birdwings of conservation concern in Papua New Guinea are difficult to survey and study and, despite wide acknowledgement of needs for conservation, the lack of local priority and within-country logistic support renders local progress difficult. In this book we deal with a major exception to this scenario – the biology and conservation of a birdwing butterfly that has proved accessible to study, and is in serious need of conservation in Australia, and where conservation interests and expertise have been fostered to develop a conservation programme now in operation for more than 20 years. The endemic subtropical Richmond birdwing, *Ornithoptera richmondia* (Gray), has become a cause célèbre in Australian butterfly conservation, and the story of progress toward its conservation has much wider relevance in the development of insect conservation interest in the country. It is also providing lessons that may be transferable to aid related birdwings in other countries in the region. The study is helping to demonstrate that butterfly conservation can indeed be pursued purposefully at the landscape level.

This first chapter provides some general background and perspective to birdwing butterflies and their conservation.

1.3 Birdwing Relationships and Distribution

Adult birdwing butterflies are relatively easily recognisable amongst Papilionidae, but their precise taxonomic status has in the past been debated extensively. They are classified by most workers in the tribe Troidini in the subfamily Papilioninae, together with several other (non-birdwing) genera (*Battus* Scopoli*, Euryades* C. and R. Felder, *Cressida* Swainson, *Parides* Hubner, *Atrophaneura* Reakirt). In all of these genera the larvae feed on plants in the family Aristolochiaceae, and are thus grouped by Collins and Morris (1985) and Parsons (1996a). Weintraub (1995) reviewed some early examples of host plant misidentifications within Troidini: some errors persisted for many years, and others were presumed to represent ‘transient larvae’ – individuals feeding on small herbaceous aristolochias may need to move between different plants as they develop, in order to gain sufficient food, and so can be found resting on non-hosts during transit.

Although the ‘birdwings’ are nowadays grouped as three genera, *Troides*, *Ornithoptera,* and *Trogonoptera*, as above, some authorities (such as Hancock 1983; Miller 1986) earlier followed the precedent of Rothschild (1895) by allocating all birdwings to one single genus *Troides*. However, *Troides* and *Ornithoptera* appear very distinct based on features of both adult and larval structure (Parsons 1996a; Parsons 1999). Parsons (1996a) emphasised the differences in male hind wing androconia in the two genera, but *Troides* and *Ornithoptera* cluster together in recent phylogenetic interpretation drawing on molecular data (Braby et al. 2005), and their close taxonomic relationship seems to be well-supported. The small genus *Trogonoptera* has characteristics justifying generic separation, and may be the sister-group to ‘(*Ornithoptera* + *Troides*)’, with the three genera clearly constituting a monophyletic group within the Troidini.

Attempts to subdivide birdwings further, amongst four or five genera or subgenera (with a maximum of seven in some schemes), have generally induced confusion rather than clarity. One dilemma has been that it is possible to manipulate cross-pairings between captive *Troides* and *Ornithoptera* to produce intermediate-looking hybrid forms. Natural hybrids between the two genera occur but are rare; for example Sands and Sawyer (1977) reported a field pairing of a male *T. oblongomaculatus papuensis* Wallace with a female *O. priamus poseidon* Doubleday from Papua New Guinea, from which two hybrid males were reared. Within *Ornithoptera*, strong cases have been made that the anomalous taxon known as *O. allottei* Rothschild, is in reality a rarely-occurring hybrid from mating between *O. priamus urvillianus* (Guerin) and *O. victoriae* (McAlpine 1970). More recently in the 1980s, Ray Straatman (pers. comm. to Sands) confirmed this cross-mating of species resulted in hybrids that resemble *O. allottei*, and has left little doubt about the hybrid origin of this taxon in the wild. Since then several other cases of natural hybrids have been reported and traded as such.

Troides includes about 17 species; *Ornithoptera* includes 19 species and *Trogonoptera* two, giving a global total of about 38 species, some of which are contentious in taxonomic status. Ambiguities of allocation of species names are perhaps inevitable amongst a group in which individual and local variation within putative species is high. The tendency to 'over-name' variation is understandable with the strong philatelic appeal of specimens to collectors, amongst whom the propensity to formalise trivial variety and name local populations, based on relatively small features – most commonly of wing markings or colour – is widespread. Birdwings are by no means the only group of butterflies having received such 'splitting' of taxa and proliferation of varietal names. Even amongst some European butterflies, interpretation of species limits and within-species variation remains problematical (Descimon and Mallet 2009). In short, the genetic bases for much butterfly variation are unclear, and inevitably this is much more so for species found in remote parts of the world where comprehensive field studies (and, even more, laboratory rearing studies) are extremely difficult to pursue, and for which material available for critical study may be very restricted. And, whereas many names for birdwings were introduced simply to be descriptions of local 'forms', a trinomial name is formally a subspecific and acceptable one, with the consequence that synonymising such names must result from rigid formal scientific scrutiny rather than casual opinion, as can be applied to most 'forms'. This book is not a forum to review the internal classification of birdwings, but it is important to emphasise that many strongly-held disparate views exist on the validity of particular species or subspecies, so that different compendia of taxa may present these at different levels. It is consequently important to be clear about the position adopted when discussing any individual taxon. Understanding the integrity of butterfly subspecies poses complex problems of interpretation, and much relevant discussion to their roles in conservation was given by Braby et al. (2012).

The three genera are distributed as in Fig. 1.1. The distributions of *Ornithoptera* and *Troides* overlap on the mainland of New Guinea and on some islands, but *Troides* is by far the more widespread genus, extending westward as far as northern India. The range of *Trogonoptera* is much more limited and circumscribed. The major focus here is on *Ornithoptera*, a genus with a distribution that encompasses mainland New Guinea and some island groups to the east, and which is the only birdwing genus found in Australia. According to Parsons (1996a, c), *Ornithoptera* is believed to be Gondwanan in origin and the genus evolved as the Australian plate drifted northward. Its relatively recent evolution was thus wholly independent from *Troides*, in which diversification occurred on the South-east Asian or via the Indian plates. If this is so, the most southerly Australian taxon *O. richmondia*, is likely to be an ancestral member of the genus (Parsons 1996a), representing the stem from which the more northern taxa have separated and diversified. Details of their historical biogeography are perhaps more complex (Braby et al. 2005), but with the origin of Troidini in remnant Gondwana supporting the phylogeny they advanced.

Fig. 1.1 Broad global distribution of the three recognised genera of birdwing butterflies

The striking appearance of birdwings has induced several authors to produce lavish publications in which numerous specimens are illustrated in colour, and the illustrations supported by texts of varying accuracy and complexity. As examples of these, see D'Abrera (1975, revised 2003), Haugum and Low (1978–1985) and several highly impressive Japanese books by Ohya (1983), Sumiyoshi (1989) and Matsuka (2001), some with biological information and photographs of early stages. Technical texts include a taxonomic catalogue by Ohya (2009) as well as inclusions in regional butterfly faunas (such as Braby 2000; Parsons 1999; Tennent 2002). Numerous web sites also include abundant illustrations and texts on birdwings; one of the more comprehensive is at 'www.nagypal.net' (accessed April 2010), another relating to the Richmond birdwing is at 'www.richmondbirdwing.org.au'.

1.4 Australian Birdwings and Their Identities

The Australian representatives of *Ornithoptera* are each found in relatively restricted areas of the eastern coastal regions of Queensland and northern New South Wales (Fig. 1.2), and do not extend further south. Historically, the taxonomy of the birdwings found in tropical and sub-tropical eastern Australia has been somewhat confused. Initially (as in books by Rainbow 1907; Waterhouse 1932; Braby 2000) the various populations of Australian birdwings were regarded as geographical races, subspecies or varieties of a single species, the widely-distributed *Ornithoptera priamus,* a very variable species that occurs in many parts of the New Guinea archipelago. The genera (with earlier allocations to *Papilio* or *Troides*) and species names for these birdwings were variously combined until Hancock (1991) applied the genus *Ornithoptera* to the Australian species and recognised the three taxa as distinct and allopatric species. The separation of the subtropical Richmond birdwing, *Ornithoptera richmondia* (sometimes cited as '*richmondius*') as a distinct species was first suggested by Zeuner (1943). Later, Common and Waterhouse (1981) considered *O. euphorion* Gray to be an Australian subspecies of *O. priamus* and regarded *O. richmondia* as a distinct species. Most recently, Braby (2004) recognised three of the geographically-separated populations as distinct species: *O. priamus, O. euphorion* and *O. richmondia*, and this status is now the one most widely accepted. Based on their morphological and biological characteristics, Hancock's (1983) earlier arrangement indicating that there are three allopatric Australian species of *Ornithoptera* (Figs. 1.3 and 1.4), *O. priamus* (with three subspecies: *O. p. macalpinei*, *O. p. poseidon*, *O. p. pronomus*), *O. euphorion* and *O. richmondia* is recognised widely. The latter two are distinct, endemic Australian species, whereas *O. priamus* has several subspecies extending in range from Cape York Peninsula, through the Torres Strait Islands, to New Guinea and most of the neighbouring islands. *O. richmondia* is the only species occurring in the subtropical parts of Australia, with an obligatory over-wintering pupal diapause which enables it to survive the cool winter climate. Although over-wintering pupal diapause is common in many other Papilionidae, pupae are not known to undergo diapause in the other two Australian birdwings, *O. euphorion* and *O. priamus*, in which protracted development is a well-known response to lowered temperatures, particularly during winter.

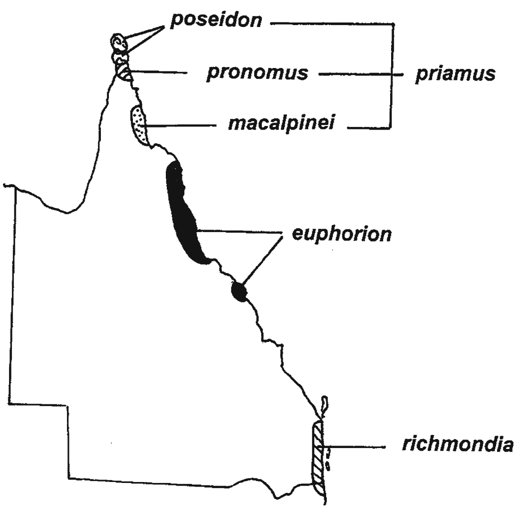

Fig. 1.2 Distribution of Australian birdwing butterflies, *Ornithoptera* spp.

The Australian taxa can be distinguished by differences in appearance and wing patterning (most easily of the upper side of either sex), as listed below (Figs. 1.3 and 1.4). Sizes overlap considerably, but *O. richmondia* is characteristically the smallest of the Australian taxa. As in other birdwings, sexual dimorphism in *Ornithoptera* is extreme – the larger females marked with cream and yellow on dark brown, and the vividly coloured males varying in the extent of iridescent green or, rarely, blue (Fig. 1.5a, b) and gold, or the yellow and black spotting on the hind wing. The colour of males of all three Australian birdwings, *O. priamus*, *O. euphorion* and *O. richmondia*, is often variable and the proportion of blue, green and yellow spots on the underside of the hind wing of *O. euphorion* and *O. richmondia* (Illidge 1927), and the gold spots on the upperside of the hindwing also vary (Fig. 1.5c). Rare forms in both species are known in which the green on the upper surface is replaced by blue (Fig. 1.5a, b) and even rarer examples are known in which the green colour is replaced by golden yellow. At the ventral base of the wings of many birdwings, including *O. richmondia*, both sexes have a distinctive red patch or spot that first becomes visible when an adult is enclosing from the pupa (Fig. 1.6). While the wings begin to expand, this red patch is very easily seen and it is believed to be a warning to would-be predators at a stage when no escape is possible. It is also considerably larger in females than males, and could possibly confer protection during oviposition.

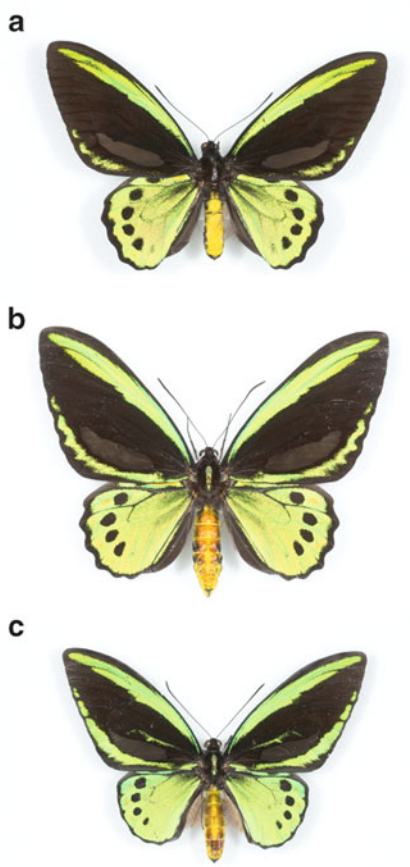

Fig. 1.3 Males of the three Australian species of *Ornithoptera*: (**a**) *O. richmondia*; (**b**) *O. euphorion*; (**c**) *O. priamus macalpinei*

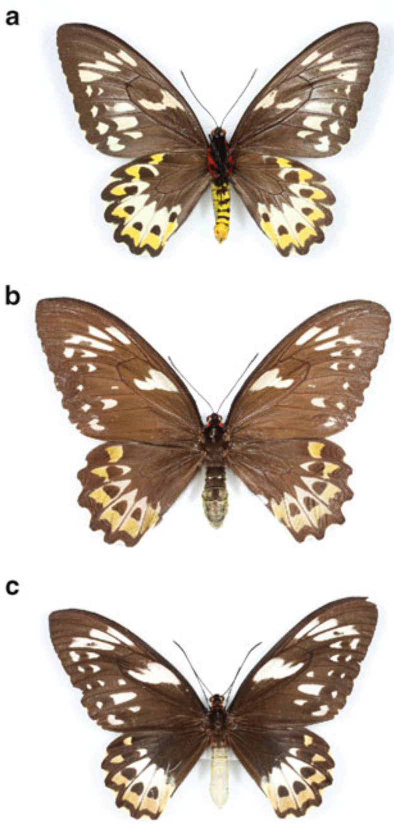

Fig. 1.4 Females of the three Australian species of *Ornithoptera*: (**a**) *O. richmondia* (underside); (**b**) *O. euphorion*; (**c**) *O. priamus macalpinei*

Some variation occurs in *O. richmondia*. The green inner marginal bands, the green termen at the tornus of the fore wing and the black inner margin spots on the hindwing all vary in *O. richmondia* and are sometimes absent. In particular specimens from Lismore, Ballina and the Richmond River generally, near the current southern limit of the range, may vary in the extent or presence of green on the inner margin with this reduced in some individuals. The "form *reducta*" of *O. richmondia* was described and figured by Haugum and Low (1979) for males with less green and wider black termen of the hind wing (Fig. 1.7). The specimens were collected many years ago near Grafton on the Clarence River but are insufficient to distinguish this possibly now-extinct population from some males now occurring near the Richmond River and in the present southern part of the range.

The type locality for *O. richmondia* is the Richmond River, New South Wales (NSW) (Howarth 1977), a region where extensive variation is commonplace. Variation within the existing range of this species does not show sufficient differences in colour and morphology to justify recognition of any distinctive subspecies in *O. richmondia*. Several other male specimens from the current southern range, for example from near Ballina and Lismore, are also without the forewing green

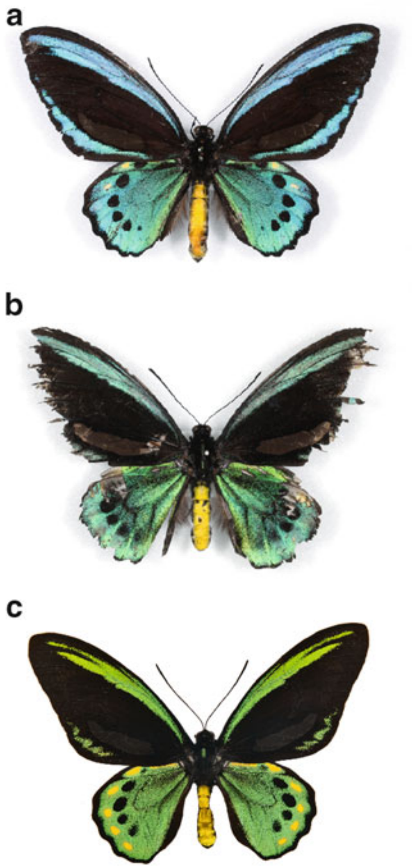

Fig. 1.5 Some colour varieties of Australian *Ornithoptera* males: (**a**) a blue *O. euphorion* [ANIC]; (**b**) a (very worn) blue *O. richmondia* (I. Gynther)*;* (**c**) a male *O. richmondia* with enlarged gold spots on hind wing (Mount Warning, T. Worden and G. Newland)

band but the black band of the hind wing is not as wide as in the original Grafton specimens and there are many examples from these localities where the areas of green are as extensive as those, for example, on specimens from Queensland. From other localities in NSW, dark male specimens are also known, suggesting dark variants are common but none are as extreme as those specimens from Grafton or the Clarence River. Unfortunately no recent specimens have been available for comparisons from the southern extreme of range, either from Grafton, NSW or the Clarence River, but several males from Mallanganee, near the upper reaches of the Richmond and Clarence Rivers, appear to be consistently darker than specimens from further north and it is possible that a partial latitudinal cline in this feature occurs, possibly related to temperature. Colour variation in female *O. richmondia* is also more common towards the southern edge of the range; particularly when the

Fig. 1.6 Living male (**a**) and female (**b**) *O. richmondia*, showing underside and ventral red thoracic patch; (**c**) mating pair (R. Booth)

extent of white patches on both wings and the black background is sometimes replaced by dark grey. For example, females from south of Murwillumbah often have few, or no pale spots in the central parts of the fore wing (as in the figure by Newland and Turnbull (2012)), and the sub-basal band may be wider (Fig. 1.8). The yellow or brownish-yellow sub-terminal spots on the hind wing are also variable in brightness and size but are consistently brighter on the underside.

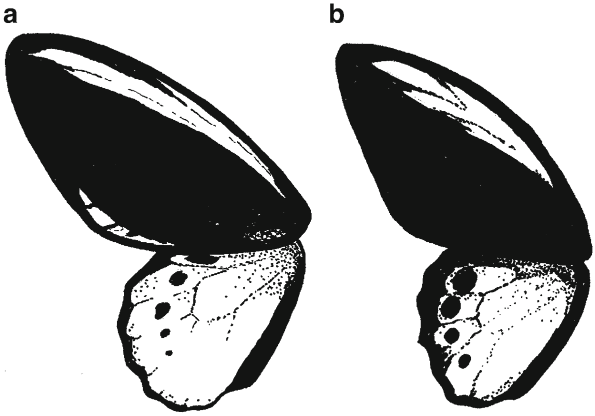

Fig. 1.7 Line drawings to show decreased marking from typical male *O. richmondia* (**a**) found in 'form *reducta*' (**b**) as diagnosed by Haugum and Low (based on Haugum and Low 1979)

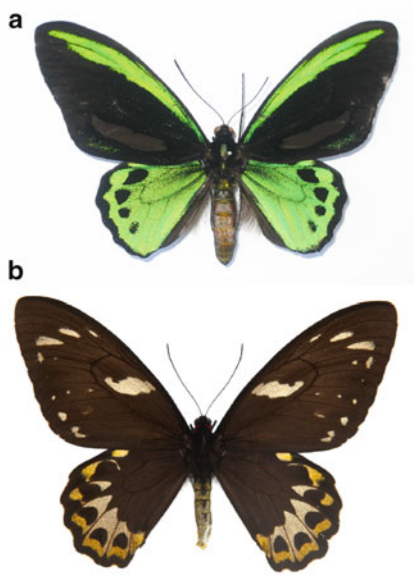

Fig. 1.8 Representatives of *O. richmondia* from southern part of range, approaching form '*reducta*' in appearance: (**a**) male from Mallanganee (D. Sands); (**b**) female from Mount Warning (T. Worden and G. Newland)

Some seasonal variation in size of *O. richmondia* is evident, with both sexes sometimes smaller when emerging in spring, compared with individuals emerging in warmer months. This can be due to loss in mass by over-wintering pupae but is also likely to be due to the low nutrient concentrations in leaves, for example, when larvae have been feeding in autumn when new growth of the food plant is retarded by lower temperatures or moisture. Temperature regimes during development can influence colours and areas of patterns in many birdwing species. In addition the black spots on the upperside of the hind wing are often larger and gold spots on the hind wing are more likely to be present and larger than specimens taken in warmer months.

The following wing measurements, and colour notes, together with differences in hind wing shape, aid recognition and separation of the Australian taxa:

Males (Fig. 1.3):
O. richmondia. Wingspan ca 115–130 mm; fore wing length ca 62 mm (57–65, n = 5); fore wing with green sub-terminal band at tornus less than half length of termen, not reaching base, or absent; no median green lines on cell vein(s); hind wing termen weakly bowed.

O. euphorion. Wingspan ca 150–160 mm; fore wing length ca 76 mm (74–79, n = 5); fore wing with green sub-terminal band at tornus extending more than half length of termen, band on inner margin reaching base; no median green lines on cell vein(s); hind wing termen strongly bowed and weakly scalloped.

O. priamus:

ssp. *macalpinei*, wingspan ca 125–130 mm; fore wing length ca 64 mm (63–65, n = 5); median green line on cell vein weakly branched, less than half length of fore wing, sometimes obscure or absent; hind wing termen weakly bowed.

ssp. *pronomus*, wingspan 120–140 mm; fore wing length ca 72 mm (69–75, n = 4); fore wing (all subspecies) with green sub-terminal band at tornus more than 3/4 fore wing length, extending almost to apex, band on inner margin reaching base; median green line on cell vein(s) variable ca half length of fore wing; hind wing termen almost straight.

ssp. *poseidon*, wingspan 121–145 mm; fore wing length ca 74 mm (71–78, n = 5), similar to ssp. *pronomus*, but green areas of underside more extensive; hind wing termen weakly bowed almost straight.

Females (Fig. 1.4):
O. richmondia. Wingspan ca 130–150 mm; fore wing length ca 71 mm (69–75 , n = 5); abdomen dorsally grey-brown; fore wing black with broad grey-white median band extending ca 1/3 width from costa to cell; hind wing with broad sub-terminal white spots and patches, yellowish-brown closer to termen.

O. euphorion. Wingspan ca 160–170 mm; fore wing length ca 84 mm (82–85, n = 5); abdomen dorsally brown; fore wing dark brown with narrow pale grey median band, extending from costa to cell; hind wing with dull orange-grey sub-terminal spots and patches.

O. priamus:

ssp. *macalpinei,* wingspan ca 150–165 mm; fore wing length ca 79 mm (75–81, n = 5); abdomen dorsally pale whitish-grey; fore wing dark grey-black with white patches; well defined greyish-cream subterminal band on hind wing.

ssp. *pronomus*, wingspan ca160–190 mm; fore wing length ca 88 mm (80–100, n = 4); abdomen greyish white; fore wing dark grey with greyish white patches; broad grey-white median band extending ca ½ width from costa to cell; hind wing with sub-terminal spots and patches white and grey-brown.

ssp. *poseidon*, wingspan ca 160–195 mm; fore wing length ca 90 mm (82–102, n = 5); abdomen dorsally grey; fore wing grey-black, with broad grey-white median band extending from costa to cell; hind wing with subterminal spots and patches white and grey-brown.

In addition to the above wing features derived from series considered to represent the 'normal' range, several other distinctive characters can be used to separate the species, and include the male genitalia, colour and length of spines of larvae, and colour of pupae. Thus, spines on later larval instars of *O. richmondia* are proportionally shorter than those of *O. euphorion*, and pupae are bright green in *O. richmondia*; brown and yellow in *O. euphorion*, and variably golden brown with darker markings, and dark brown in *O. priamus*.

Authors of several books on Australia's butterflies (including Waterhouse 1932; Common and Waterhouse 1981; Braby 2000; Sands and Scott 2002) have contributed to the increasing knowledge of the systematics, biology and ecology of the birdwing butterflies, including the Richmond birdwing. The three species are very closely related (Hancock and Orr 1997). Within the New Guinea region, particularly on islands, many authors have commented on the extent of individual variation in wing colour and markings within populations of all the subspecies of *O. priamus*. The three Australian subspecies of the Cape York birdwing, *O. priamus,* are geographically distinct: *O. priamus macalpinei* occurring coastally north from Silver Plains, and from Coen to the Claudie River and Iron Range, and *O. priamus pronomus* occurring between Bamaga and Somerset on northern Cape York Peninsula and Thursday Island, and *O. priamus poseidon* on forested Torres Strait Islands, from Moa and Badu to Saibai, Darnley and Murray Islands, and also found commonly in lowland rainforests (below 1,500 m) of mainland New Guinea.

Although geographically separate from other birdwings and a distinctive taxon, *O. richmondia* has also been regarded at intervals as a subspecies of *O. priamus* (Waterhouse 1932; Matsuka 2001). Braby (2000) summarised the outcomes of hybridisation experiments undertaken by various workers between *O. priamus* subspecies and *O. richmondia* and suggested that (whilst range differences would preclude any such cases occurring naturally), further population genetics studies might be helpful in reaching a firmer consensus. Hybrids between the two were said to be sterile (Common and Waterhouse 1981) in contrast to fertile hybrids between some forms of 'true *O. priamus*' recently reported. However, hybridisation attempts between all three Australian species have not yet confirmed sterility between the species. In view of the ease with which hybridisation (also between genera) can be achieved artificially, it is clear that sterility, or fertility in hybrids between birdwing species or even genera (Sands and Sawyer 1977) especially if they allopatric, are not good indicators for specific status.

The name '*richmondia*' as applied to the Australian subtropical birdwing, has been subject to questioning for its validity. Edwards (2008) pointed out that the widely-used name for the butterfly, *Papilio (Ornithoptera) richmondia*, applied by

Gray (Fig. 1.9), was not the earliest published scientific name for this taxon. Edwards provided a fascinating insight into how in 1853, the first scientific name applied to this birdwing, *Amphrisius australis* Swainson, had been overlooked. This original name was published in a newspaper, the Sydney Morning Herald, in August 1851 in a review of a then yet-to-be published book written by A.W. Scott. Scott had allocated manuscript names, but his colour plate (Fig. 1.10) of Richmond birdwing was not included in his book. It eventually appeared in an historical retrospective by Ord (1988). Since 1851, this name has never been officially used, or re-instated as the appropriate scientific name for the Richmond birdwing butterfly! However, as Edwards (2008) indicated, the International Code for Zoological Nomenclature can allow suppression of an original scientific name when a more recent name has been more widely used – as is the case of current use of '*richmondia*'. Gray was clearly, and unsurprisingly, unaware of Swainson's earlier name.

Fig. 1.9 The original diagnostic plate containing *'Papilio (Ornithoptera) richmondia'* (Plate II from Gray 1953). Upper four figures are all O. *richmondia*, bottom is a female *P. euphorion*

Fig. 1.10 The plate of *O. richmondia* (labelled in footer as '*Ornithoptera australis* Scott') prepared for publication in A.W. Scott's 'Australian Lepidoptera' (Courtesy of the Australian Museum, Sydney)

1.5 Conservation Concerns

Much of the general conservation concern for birdwings flows from two main issues, namely their attraction and commercial value to collectors, and the increasing scarcity and vulnerability of various taxa as their rainforest habitats continue to suffer loss and degradation. The desirability of birdwings, arising from their spectacular appearance – in both colour and size – and their notoriety as rarities that have been difficult to obtain, has led to the scarcer and geographically more restricted species being avidly sought and traded. However, in Papua New Guinea in 1966, prices paid (or demanded) for good specimens increased dramatically when many of the rarer species were listed as protected species, so that collecting from the wild was prohibited. This led to a lucrative trade in smuggled specimens which gained momentum when all species, whether common or endangered, were listed under the Convention on International Trade in Endangered Species and Wildlife (CITES) as prohibited exports or imports. Even at that time, a single specimen of Queen Alexandra's birdwing (*Ornithoptera alexandrae*) fetched more than Au $1,000 on the black market, and considerably higher prices have appeared in dealers lists at intervals since then! Wealthy enthusiasts have long been willing to pay substantial sums for premium cabinet specimens of the rarest birdwing species, and concerns for effects of exploitation have led to formal measures to prevent or control trade, a step conducive to development of more clandestine 'black market' operations to provide specimens. However, simply legally ordaining protection of these butterflies from collecting has done little towards their survival and the number collected poses relatively little threat when compared with widespread habitat destruction. Most species of birdwings have declined in abundance from loss of their rainforest habitats and the food plants, and several species may now be threatened with extinction primarily from these impacts.

All birdwing species except one are currently listed on CITES Appendix 2, with the intention to monitor numbers legally traded. The exception is *O. alexandrae*, a species placed on Appendix 1, in which trade is fully prohibited. The strong lead given by Papua New Guinea by, in the 1960s, listing seven species of *Ornithoptera* as protected and designating them the 'National Butterflies of Papua New Guinea' (Mitchell n.d.) drew attention to the importance of these butterflies. The more controversial step of 'listing all species' under CITES, by which common and widespread species were afforded the same level of 'protection', as truly threatened taxa, reflects the practicality of monitoring the trade. Quarantine officers, border protection officers and others responsible for detecting smuggled butterflies, cannot reasonably be expected to be expert taxonomists able to differentiate closely similar and 'look alike' forms. The general appearance of birdwings, however, is unmistakable, so that the legal precaution is to attempt to avoid smuggling of threatened species by encompassing them within this broader image. Strongly antagonistic reactions occurred through collectors then not being able to obtain freely specimens of even the common species, and the practical ramifications have been discussed, inter al., by Parsons (1992a, b), Parsons (1999) and New (1997b).

Over-collecting of butterflies is an emotive topic, with concerns over its impacts a persistent theme in butterfly conservation discussions. A major dilemma in rationalising its impacts and conservation significance is that of accumulating any objective evidence that levels of collecting being undertaken in New Guinea and elsewhere are unsustainable. Whilst it may indeed be wise to take the precautions demonstrated through CITES designation in any cases of doubt, three counter-arguments are advanced frequently:

1. Prohibitions of collecting by 'protective listing' of any sort, whilst condoning continued destruction of primary habitat – in this context, of primary forest for oil palm establishment, shifting agriculture, mining and timber extraction – is a relatively minor contribution to practical conservation.
2. In Australia, and other places in which locally resident entomologists and hobbyists are able to study the birdwings, imposition of collecting bans is likely to deter the interests and enthusiasm of the very people whose dedication and goodwill is essential to gain the information that underpins enlightened conservation practice.
3. Prohibition without perceived justification or evidence that collecting is harmful is seen as unnecessary, and induces development of illegal trade through which actual take of specimens may be increased but remain clandestine and unmonitored, as a black market trade with unregulated prices.

The most innovative step taken to overcome overexploitation of birdwings by collecting from the wild was (pre-2010) in Papua New Guinea, to develop a practice of 'butterfly ranching' (or 'butterfly farming') linked with centralisation of trade in dead butterflies through a government agency (the Insect Farming and Trading Agency, IFTA). This was the main legal path for commercial export of specimens (with the requisite CITES documentation and except for approved scientific purposes) from the country, and through which the trade could be monitored. This development recognised that the birdwing butterflies are a sustainable resource with considerable financial reward, and from the outset emphasised the wellbeing of people in rural surroundings 'where there is little other chance of employment, and where the insect resources present great potential' (Pyle and Hughes 1978). Local operations provide a rationale for forest conservation, as a resource on which continuing commercial success depends.

Ranching is based on habitat enrichment, in this context by the concentrated planting of larval food plant vines in gardens and clearings, and the detailed development of the scheme is described by Parsons (1992a, 1999), based on his innovative inputs over many years. A butterfly farming manual (Parsons 1982, 1995) includes extensive practical advice of much wider relevance in birdwing conservation, in establishing suitable butterfly gardens and enriching habitats. Thus, to attract *O. priamus, O. victoriae* and *T. oblongomaculatus* Goeze, up to 500 plants of the common vine *Aristolochia acuminata* (previously known as *A. tagala*) can be planted in areas of only around 0.2 ha in the appropriate parts of Papua New Guinea, to grow upward into shade trees (such as *Leucaena*), and the whole plot surrounded by nectar-rich plants attractive to the butterflies. However, such formal 'farms' were rare in relation to the more widespread practice of simply planting vines wherever suitable support trees occurred in and around a village (Fig. 1.11). Butterflies are attracted to the concentration of planted vines, on which they oviposit, and the developing larvae can be reared under confined conditions to protect them from predators and parasitoids. A proportion of the ensuing adults are taken for trade, and others released into the field population.

Fig. 1.11 Garden cultivation of *Aristolochia acuminata* to attract birdwings in New Britain, Papua New Guinea

The wider ramifications of planting butterfly food plants to support conservation interest include:

1. Providing a tangible reward (cash for reared specimens) that is obtained from a forest product (birdwings) whose sustainability depends on continued management of key resources (vines and the forest itself), linking with -
2. A means to purchase food and other human needs, so (a) reducing needs to clear forest for agriculture and (b) providing an incentive to protect forest against wider intrusions; and
3. Emphasising the sustainable nature of birdwings as a source of income, by taking only a proportion of the reared individuals, and by releasing others, whilst also not capturing additional, often worn or damaged, specimens for sale.

These principles were amply demonstrated by Parsons (1982), and led New and Collins (1991) to suggest that the approach may have a central role in conservation practice. Social and economic changes for many human communities have been substantial, and have spurred emulation elsewhere and for a variety of commercially desirable insects that can be 'harvested' for trading without increasing the vulnerability of wild populations. Whereas the bulk of birdwing specimens passing through IFTA were common species, including the two most widespread in Papua New Guinea (*Troides oblongomaculatus*, *Ornithoptera priamus*), the experience accumulated from rearing these in quite large numbers has been important in developing parallel exercises for other species and in other places.

The foundation aims of establishing IFTA (as summarised by Parsons 1992a) thus had fundamental conservation importance. They were:

1. To promote the production and sale of butterflies as an alternative source of income for subsistence farmers, especially in less commercially advanced areas of Papua New Guinea.
2. To restrict trade in insects to Papua New Guinea citizens.
3. To ensure that fair/reasonable prices are paid to collectors and farmers and to assure expedient payments for butterflies and other insects.
4. To provide a centralised body as a communication centre for sellers and purchasers, and to serve as an official agent for business from overseas buyers.
5. To ensure the highest possible quality of stock, including locality data for specimens.
6. To act as an educational centre for instruction in insect farming and rearing methods, and to provide basic equipment for participants.
7. To ensure that insects are treated locally as a renewable resource.
8. To promote the conservation of butterflies and their habitats.

The demonstrated success of ranching birdwings based on habitat enrichment is important for the Australian study discussed in this book but, whereas the practice has become wide-ranging in both scope and purpose, it has not wholly replaced the need for additional species-focused conservation measures. Perhaps understandably, in view of the dearth of concerned resident entomologists and the pressing problems of human welfare, such conservation concerns tend not to be seen to help solve these problems in Papua New Guinea. Much butterfly conservation advocacy for the mainland of New Guinea and nearby islands has been something of an ‘armchair exercise’ urged from afar but with the practicalities and restrictions not appreciated fully by the proponents. Again, the philosophical and practical issues have been summarised effectively by Parsons (1999). Parallel cases developed later in China, and Indonesia added to the concepts and experience, with varying success (Parsons 1995).

The predominant generalisation for conservation of New Guinea birdwings is simply that primary rainforest habitats must be protected effectively from logging and other disturbances. Although ranching is an invaluable conservation tool, not all species have yet proved amenable to this, and it cannot be viewed as a substitute for loss of resources from the wild; protection of natural forest habitats remains a paramount concern. However, it seems that in New Guinea the distribution of some birdwing species may actually have been extended by translocations of individuals undertaken to establish local populations to found ranching operations. The apparently recent expansion of *Troides oblongomaculatus* eastward may be one such case (Parsons 1999).

1.5.1 Ornithoptera alexandrae

The major focus on conservation of any individual birdwing species has been on the Queen Alexandra’s Birdwing as a leading flagship and icon species, known at least by reputation to biologists throughout the world, as well as being the largest and putatively the most threatened of all members of this group. It was first collected by A.S. Meek, perhaps the most famous of Lord Walter Rothschild’s many commercial collectors, and it appears even then (1906 on) to have been elusive. The type female, considerably smaller than many specimens captured subsequently, was from a locality far beyond the current species' range. More recently, *O. alexandrae* has been known only from parts of the Oro (formerly Northern) Province, and from only 14 of the 10×10 km square mapping units used for plotting distributions of Papua New Guinea butterflies, so appears to be highly restricted geographically. It occurs on the lowlands around Popondetta and in some highland forested areas, particularly around Afore on the Managalas Plateau, and in both these regions (separated by about 40 km) it has been the focus of considerable field survey to clarify its distribution and status. Practical conservation efforts (Parsons 1992b; Parsons 1999) later involved an international programme including Australian foreign aid to develop the 'umbrella' values of the butterfly to facilitate providing alternative livelihoods for local residents and emphasise the importance of conserving primary forest habitats, rather than continuing to see these lost for conversion to oil palm plantations (around Popondetta) or timber extraction (Managalas Plateau, with logging also around Popondetta).

A brief summary of that extensive programme (New 2007) noted some of the practical difficulties that eventuated in working toward the five main aims of this ambitious enterprise, namely:

1. Research, to enhance understanding of the distribution, biology and ecology of *O. alexandrae*.
2. Conservation of primary Habitat Areas to maintain the existence of all important primary habitat areas.
3. Education and awareness: to promote knowledge of and concern for *O. alexandrae* throughout the country.
4. Economic and social issues: to provide economic and social incentives and measures for conserving *O. alexandrae* habitat.
5. Project management: to coordinate and manage inputs and implement activities.

The project was able to draw on the extensive management recommendations arising from studies by Orsak (1992), Mercer (1992), Parsons (1992b) and others, that laid a well-informed foundation, in conjunction with capitalising on the existing notoriety of the butterfly – such as it figuring on the provincial flag. However, in common with other such elusive and wide-ranging butterflies, *O. alexandrae* is extremely difficult to survey. Its presence may be confirmed by sighting of either adults or the large larvae (through binoculars: Mercer 1992) but, as Fletcher (2002) commented on *O. paradisea* Staudinger in lowland rainforests, 'gathering quantitative data on a rare butterfly in a rainforest habitat with limited scientific resources is both difficult and time consuming'.

1.5.2 *Troides aeacus*

This very variable species has five subspecies distributed in south eastern Asia, from western China to Taiwan and Sumatra. Collector pressure is considered a primary threat to some birdwings, with collection of the more common species for construction of artifacts (such as framed 'butterfly wing pictures') a common occurrence. In China, *T. aeacus aeacus* (Felder and Felder) is used for this purpose and, although very widely distributed, some populations are probably vulnerable through being small, and their food plants in decline, and the butterfly now occurs only in remnant habitat patches within largely anthropogenic landscapes. A butterfly farming operation established in Xishuangbanna led to success in ranching *Troides helena* (L.) within a few months of planting *Aristolochia acuminata* cuttings, with similar outcome following for *T. aeacus* (Parsons 1995). This butterfly varies considerably in biology in different parts of its range in China. In the northernmost parts of its distribution (Southern Gansu province) it is univoltine, but further south (Guangzhou city) six or seven generations occur each year (Li et al. 2010). Although generally regarded as common, conservation concerns for forms of *T. aeacus* have been raised in different parts of its range; however, as with some other birdwings, contrary opinions occur. The Taiwanese subspecies *T. a. kaguya* (Nakahara and Esaki) (perhaps more properly referred to as *T. a. formosanus* [Rothschild]: see Wu et al. 2010, who emphasised the molecular delineations of subspecies, undertaken in part to monitor and trace inter-population mixtures arising from translocations associated with butterfly farming operations) was formerly considered to be threatened by trade (Collins and Morris 1985) and by over-collection from its lowland habitats. However, its conservation needs (after 30 years of protection: Wu et al. 2010) appear to be less than for the other birdwing in Taiwan, *T. magellanus* (Felder). The local Taiwanese form of that species (sometimes distinguished from the Philippines populations by the subspecies name *sonani* Matsumura), occurs only on Orchid Island (Yang and Fang 2002).

In general, the categories of conservation concern exemplified for these two taxa have been raised for other birdwing taxa, with varying parallel evidence or concern and the twin threats of habitat loss and over-collecting cited repeatedly. The Yellow birdwing, *Troides helena*, is often common and widely distributed. However, conservation concerns have arisen from its markedly reduced abundance in Penang, Malaysia, with current interest and support promoted through the Penang Butterfly Farm (Goh pers. comm. 2012; www.butterfly-insect.com). Threats listed involve changes to natural habitats, including deforestation, and forest disturbance associated with food plant losses, inbreeding resulting from population isolation, and more gradual natural environmental changes such as climate change. In common with other birdwings, *T. helena* is a protected species under the Malaysian Wildlife Conservation Act 2010.

The habitats of concern for all regional birdwings are essentially tropical or subtropical rainforest, or particular species of larval food plants. Deforestation is undoubtedly the most pervasive threat, so that – in common with many other forest inhabitants – birdwings are at one level 'flagships' or iconic species, treated as surrogates representing the vast number of other forest invertebrates, as well as biodiversity generally, occurring in this richest of all terrestrial biomes.

1.5.3 Other Non-Australian Birdwings

In their global overview of Papilionidae, Collins and Morris (1985) listed four species of birdwings as threatened. *Troides dohertyi* Rippon (the Talaud black birdwing), as 'vulnerable' was the only member of this genus so noted, as under pressure from lowland developments on the two small islands of northern Indonesia (Talaud, Sangihe) on which it occurs. The *Ornithoptera* species cited were *O. meridionalis* Rothschild and *O. croesus* Wallace as 'vulnerable', and *O. alexandrae* as 'endangered'. Another six birdwing taxa (two *Troides* spp., four *Ornithoptera* spp.) were 'indeterminate'. For several of these, Collins and Morris noted comments of possible foreboding. Thus, for *T. andromache* (Staudinger) (a high elevation species from north Borneo, notably the Mount Kinabalu region of Sabah) they noted (p. 266) 'there is little doubt that threats to its habitat are multiplying', and this sentiment has been echoed by more recent commentators, with hope that it might be practically protected within the Mount Kinabalu National Park and with support from a local butterfly tourist operation. The threats reflect increasing human populations, growth of shifting agriculture, and commercial logging. Many of these activities are predominantly at the more accessible lower elevations, so that some montane taxa may be less vulnerable. For all these species, Collins and Morris (1985) also urged the need for greater biological knowledge. Since then, some birdwings such as *O. rothschildi* Kenrick and *O. tithonus* de Haan, both locally endemic around the Arfak Mountains of Papua (Indonesia), have become the main focus for development of ranching/captive breeding exercises established near Manokwari as a World Wide Fund for Nature (WWF)-based Arfak Mountains Butterfly Farming Project, with its early development described by Craven (1989). *O. tithonus* proved unexpectedly easy to ranch, following host plant establishments, with Parsons (1995) reporting that almost every planted vine hosted a larva, and occupation probably facilitated by nearby presence of pristine forest areas. This success was mainly in mid-montane levels, whilst *O. rothschildi* was successfully ranched at upper montane levels. Other candidate taxa occurred at lower levels, and were considered likely to benefit from parallel habitat enrichment.

The more recent and extended accounts of *O. croesus* and *O. meridionalis* by Parsons (1999) give a somewhat more reassuring impression of their status than earlier assessments had done. *O. croesus*, taxonomically, was believed to 'almost certainly' represent a distinct form of *O. priamus*, with the early stages of the two butterflies being very similar. *O. meridionalis* was known to Parsons from three areas of Papua in Indonesia, and 'at least seven localised populations' in Papua New Guinea, so that it is far more widespread than realised previously; in some places it 'appears to be reasonably common'.

1.6 Conservation of Australian Birdwings

Within Australia, most attention to butterfly conservation has been concentrated on the southern half of the continent, predominantly on members of endemic radiations of the families Hesperiidae, Nymphalidae: Satyrinae and Lycaenidae (Sands and New 2002; New and Sands 1996, 2002a, b; New 2011c). Some threatened species in these groups have proven to be of serious concern and have become important flagships for insect conservation in the region. Papilionidae are not within that regional spectrum of priority concern, and many of the above species occur only on small, remnant habitat patches – in some instances within or near urban regions – so that the conservation needs are strongly site-orientated and remedial measures can be defined clearly. Very local endemism of many of the taxa ensures that even whole-of-range conservation management is focused within rather small areas and, sometimes, very restricted biotopes. Several are known from only single sites or other tiny areas, reflecting small natural distribution or consequences of extensive habitat loss.

The two endemic tropical species of birdwings found in eastern Australia, *O. priamus* and *O. euphorion*, have not been considered to be at risk (Sands and New 2002), due to their ability to breed on several different and relatively common species of Aristolochiaceae. These plants often occur in a range of different plant communities. For example in north eastern Queensland, *Aristolochia acuminata*, the most common food plant for both birdwings, is widespread in the lowlands and is not confined to rainforest. *Pararistolochia deltantha* (F. Muell) Michael J. Parsons continues to be a common food plant on the ranges. While the tropical birdwings prefer rainforest habitats, representative areas of their rainforest habitats in northern Queensland have been protected from destruction. In addition, there are several different *Aristolochia* spp. that serve as food plants in dry woodlands. One notable example is *A. pubera* R. Br., a food small plant for *O. euphorion* noted by Waterhouse (1938) and probably the main food plant species on Magnetic Island near Townsville (Common and Waterhouse 1981). *A. chalmersii* O.C. Schmidt is a semi-deciduous woodland food plant for *O. priamus macalpinei* occurring near Coen, and other localities west of the Main Divide on Cape York Peninsula (Sands and Kerr unpublished). An unidentified species of woodland *Aristolochia* also appears to be an important food plant for *O. priamus macalpinei* near Iron Range, northern Queensland (unpublished).

The Cairns birdwing, *O. euphorion* is widely distributed in northern Queensland from south and west of Mackay, to north of Cooktown (Braby 2000). While the species and its food plants are secure (within the 'Wet Tropics' protected areas) over much of the range, near Mackay many of its habitats have been cleared for farmlands. The Cairns birdwing has several generations each year on the coast and offshore islands, but breeds only in the warmer months on the mountains. Its food plants include *Aristolochia* spp. and *Pararistolochia* spp., vines that are common in rainforest. However, several low-growing species of *Aristolochia* (for example, *A. pubera* and *A. thozetii* F. Muell.), also serve as food plants for the Cairns birdwing in moist woodlands (Waterhouse 1937; Braby 2000). The toxic introduced *Aristolochia* species, *A elegans* Mast[1] and *A. ringens* Vahl, are poisonous to the larvae, when larvae hatching from eggs deposited on the leaves of these species of vines attempt to feed. Both species are common weeds in northern Queensland and may potentially become 'threatening' in peri-urban areas where the indigenous food

[1] Throughout this book we use the name '*Aristolochia elegans* Mast' for the introduced Dutchman's Pipe vine of concern in conservation of *O. richmondia* in Australia. Application of this name does not follow the conventional synonymy of *A. elegans* (named in 1885) with *A. littoralis* Parodi 1878 as the earlier available name. The two have sometimes been considered separate species (for example, by Hou 1983) and we are aware of debate over the integrity of the species involved. The name '*elegans*' has been used almost universally in literature (for example in Bostock and Holland 2010) when related to butterfly biology in Australia. It is used here for familiarity and convenience, and no formal taxonomic action or revision is intended by this use.

plants are sometimes low in density and where the habitats have been invaded by weeds. Should those weeds invade natural ecosystems, the level of threat to the birdwings is likely to increase. These threats from exotic aristolochias may be offset by the popularity of growing *A. acuminata* as a vine for cultivation on fences and in gardens, where for example, *O. euphorion* has been observed by Peter Bakker, Peter Valentine, and Steve Johnstone breeding successfully in heavily disturbed suburbs near Townsville.

Ornithoptera euphorion, and the three *O. priamus* subspecies have until recently, been considered threatened in Queensland but this may have been due to the concerns about excessive collecting of specimens for trade, rather than the threats from loss of habitats, while *O. richmondia* is considered vulnerable and a ‘protected species’ in Queensland but not in New South Wales. Thus, formal concerns for the wellbeing of *Ornithoptera* were controversial. In 1974, birdwing butterflies, together with the Ulysses swallowtail (*Papilio ulysses joesa* Butler, a notable tourist icon) were added to Queensland’s list of protected fauna under the Fauna Protection Act, apparently on the grounds that they were likely to be overexploited. This move was undertaken without consultation with the Queensland entomological fraternity, and was opposed by the Entomological Society of Queensland. One outcome was a compulsory royalty of Au$20/specimen for every individual captured or retained in a collection, after permits were selectively granted for this. This was later deferred. Moreover, New South Wales legislation was subsequently proposed in 1970, to list several insect species (including *O. richmondia*) as protected under the New South Wales National Parks and Wildlife Act. Whilst the National Parks Service acknowledged that this legislation was not meant to impede genuine research and that their reaction would be sympathetic to entomological interests, adverse comments from entomologists led to its non-formalisation.

In a broad survey in which Australian entomologists were asked to nominate insects thought to be of genuine conservation concern in Australia, no respondent to Hill and Michaelis (1988) mentioned any birdwing or other papilionid. *O. euphorion,* and the Australian subspecies of *O. priamus* are now regarded as ‘common’ and no longer attract conservation concerns. Although they are seasonally rare at times and during drought, they are not considered to be at risk. The abundance of *O. euphorion* and *O. priamus* is mostly related to the abundance of food plants and the appropriate phenotypic expression (for example, toughness) of leaves, and some ant predators (such as *Oecophylla smaragdina* (Fab.), attacking larvae) and mites (*Charletonia* sp., attacking eggs), rather than natural enemies of other Papilionidae such as hymenopterous parasitoids, which are relatively uncommon and do not significantly reduce the survival of larvae and pupae. In contrast, the Richmond Birdwing has become of serious conservation concern, and the focus of one of the most enduring campaigns for conservation of any butterfly in Australia. The conservation campaign discussed in this book is the first such long-term study of any threatened birdwing butterfly in a region where such an exercise is both socially acceptable and logistically possible. It covers the history of attempts to recover the Richmond birdwing, methods to stimulate community awareness, and how State agencies can work together with the wider community towards recovering the butterfly from threats of extinction.