Swallowtail Butterflies

An Action Plan for their Conservation

Compiled by
T.R. New and N.M Collins
IUCN/SSC Lepidoptera Specialist Group

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Contents

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Cover Photo: The Homerus Swallowtail (*Papilio homerus*) is one of the most spectacular butterflies in the world, and is the largest swallowtail in the Americas. This freshly emerged female (August 1986) from the Millbank area of the John Crow Mountains in eastern Jamaica, rests on a sunlit fern frond. In flight, the adults commonly soar 30-50 feet above ground in the canopy, and the bold yellow and black pattern, combined with huge spatulate tails on the hindwings, is an unmistakable signature of the species.

Photo: © Thomas C. Emmel

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Foreword

It gives me great pleasure to write the Foreword of the first IUCN Species Survival Commission Action Plan on invertebrates. The 573 species of swallowtail butterfly are among the most spectacular invertebates and are the basis of an economically significant industry. Many of them are also extremely seriously threatened, as the reader of this document will soon learn. Throughout the world, invertebrates face the threat of extinction through the loss of their habitats. However, with the swallowtails, there is the added threat of direct over-exploitation, as a result of their high economic value in both the live and dead insect trade.

Swallowtails have also played an important role in our understanding of some fundamental evolutionary processes. Mimicry complexes, such as that surrounding *Papilio dardanus* in Africa, have provided a rare opportunity to study the principles of genetic variation and sexual dimorphism at a visual level. The analysis of these species has provided important insights that have aided our understanding of other more cryptic polymorphisms, such as human blood groups.

The conservation of swallowtails in many parts of the world entails programmes that integrate the needs of the species with those of local human communities. In the case of the swallowtails, there are considerable opportunities for such approaches. Butterfly ranching schemes, in which food-plants are selectively planted, thereby increasing the numbers of the butterflies, are becoming more common. Given time, such schemes might allow the building up of numbers of some of the rarest species, which could then become a legitimate source of income to local communities on a sustainable basis.

However, although butterfly ranching is certain to become more important, it will never substitute for the need to conserve large areas of natural forest habitat in key areas of the tropics. Not all swallowtails can be ranched, and some have very particular habitat requirements. In some cases, intensive habitat management will be required on a long-term basis.

This Action Plan is the first in a series to be produced by the IUCN/SSC Lepidoptera Group (LSG). It would never have been completed without the hard work and dedication of the former LSG Chairman, Tim New, ably backed up by Mark Collins of the World Conservation Monitoring Centre. The Action Plan flows out of the excellent IUCN Swallowtail Red Data Book: *Threatened Swallowtail Butterflies of the World*, published in 1985 and authored by Mark Collins and Michael Morris, with the assistance of many members of the then Butterfly Specialist Group. The Action Plan provides the LSG with a serious and important agenda, for it is the LSG's highest priority now to push ahead the implementation of this plan among the many organizations and governments that comprise IUCN.

It is my hope and belief that this Action Plan will be successful in challenging the conservation community to give the protection and management of these beautiful and fascinating creatures higher priority. Species such as the Homerus Swallowtail, Queen Alexandra's Birdwing, the Kaiser-I-Hind, and the Apollo are so spectacular that humankind surely has a major responsibility to ensure their survival and recovery to safe and productive population levels.

Ebbe S. Nielsen
Chairman
IUCN/SSC
Lepidoptera Specialist Group

Acknowledgements

Many people, including members of the Lepidoptera Specialist Group and other authorities, have contributed to the development of this Action Plan, and the long list of acknowledgements given by Collins and Morris (1985) is equally pertinent here, in that all those people helped to develop the data base from which we have compiled this plan. In particular we appreciate comments on early drafts by Dr K.S. Brown, Jr., Prof. M.J. Samways, Dr M.G. Morris, and Dr S.N. Stuart and his colleagues in the Species Survival Commission Office. The photographs included are acknowledged individually in the legends, and we are grateful to Dr Brown and Dr T.C. Emmel for generously providing slides for reproduction here. Ms Amie Brautigam and Dr F. Antram provided recent information on the status of swallowtails in trade. We also thank Mrs T. Carpenter and Mrs R. McLauchlan for technical and secretarial support.

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Introduction

There are several practical reasons for selecting swallowtail butterflies (Lepidoptera: Papilionidae) as the subject for the first insect Action Plan prepared by the IUCN Species Survival Commission. Of all the insects, they are perhaps the most charismatic to non-entomologists. Some are the largest butterflies which exist, and the 'birdwings' in particular, have long excited wonder and comment among naturalists of all persuasions. The general form of large, brightly-coloured, tailed butterflies is widely recognised and, in contrast to many - perhaps most - other insects, there is little conceptual difficulty for non-scientists in accepting them as animals worthy of conservation on aesthetic grounds. Secondly, because of the attraction they have had for lepidopterists over many years, their taxonomy has been extensively resolved with most species and subspecies being easily recognisable and with reasonably well-known distributions. Most have restricted geographical distributions, and many are sensitive to habitat and environmental change. Thirdly, and most importantly, a major handbook and information survey, *Threatened Swallowtail Butterflies of the World* (Collins & Morris 1985) (in the IUCN Red Data Book series), has already been prepared and highly acclaimed as an ideal data base for formulating conservation action. That book was the result of close collaboration between the World Conservation Monitoring Centre and the then SSC Butterfly Specialist Group (the precursor of the current Lepidoptera Specialist Group). The book emphasises repeatedly that many species need such measures to be implemented urgently if they are to survive, and the kinds of environmental threats faced by the swallowtails are discussed and exemplified in this Action Plan. One hundred and seventy species (out of a total of 573) are noted as meriting concern for their conservation. Swallowtails (a common name used here to include all members of the butterfly family Papilionidae) are the sole insects included in Appendices to CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora): several species have been added recently (see Table 3). In short, although butterflies have long spear-headed publicity for insect (and other invertebrate) conservation, the broad appeal of swallowtails enhances their popularity even over other families of butterflies, which themselves also need conservation Action Plans in the near future.

This Swallowtail Action Plan was conceived in 1984 by N.M. Collins, but then lapsed for some years while the Butterfly Specialist Group underwent some reorganisation. The Lepidoptera Specialist Group has now taken on the task of completing the Action Plan and promoting its implementation, as part of its broader brief of fostering the conservation of butterflies and moths. Much of the tenor of Collins's early draft is preserved, but we have attempted to update priorities and information, to the end of 1990. The taxonomy is largely the same as that of *Threatened Swallowtail Butterflies of the World*. A few taxa have been described since 1984, a number of transfers between genera have been made, and some changes of status at the species/subspecies interface have also been effected. We believe it wise to refer directly to *Threatened Swallowtails* wherever possible rather than to introduce names or status categories which may confuse the non-specialist reader: we do not anticipate any difficulty in matching the taxa as defined in *Threatened Swallowtails* with the nomenclature adopted here. However, one change of higher level classification is used: the replacement of the name 'Leptocircini' by the older name 'Lampropterini'. This tribe is not now divided into subtribes.

This document should not be regarded as complete: the lack of knowledge of many of the taxa and faunas involved renders such a task impossible. We have, rather, chosen to exemplify the wide-ranging conservation needs of swallowtails by selecting a geographically broad suite of faunas and individual taxa for priority conservation action. These examples reflect our present knowledge and limits of interpreting the biological status of what are generally poorly known, rare, and sometimes inadequately documented taxa. Unlike many less conspicuous insects, however, the documentation is commonly sufficient for this assessment to be generally realistic. We may not always know *why* a particular swallowtail species is 'rare' or 'threatened' but, with a few exceptions, we can be sure that it is so. We do not provide a time-frame for this Action Plan. However, unless many of the projects outlined can be executed soon, the opportunity may be lost for ever. Endangering processes are accelerating alarmingly in most of the regions we list for attention. Since *Threatened Swallowtails* was published, it is encouraging to note that investigations have indeed commenced on many of the taxa selected as priorities.

The Swallowtail Butterflies: A Brief Overview

The butterflies comprise the smaller part of the insect order Lepidoptera, of which the larger part is the moths. About 20,000 species of butterfly are divided amongst five families, and this Action Plan considers the best-known of these groups. The swallowtails (family Papilionidae) are predominantly tropical, but a few species extend as far as cool temperate latitudes in both hemispheres (Fig. 1). Few species are widespread, and some have extremely limited distributions. They are most diverse in equatorial rainforest zones, and the greatest numbers of species occur in parts of east and southeast Asia. Collins & Morris (1985) recognised 573 species. These are divided amongst three subfamilies, two of which are small (Table 1), as noted below:

Table 1. Classification of the swallowtail butterflies (Papilionidae).

	Number of genera	Number of species	No. in IUCN categories[1]
Subfamily: Baroniinae	1	1	1
Subfamily: Parnassiinae			
Parnassiini	3	39	2
Zerynthiini	5	14	5
Subfamily: Papilioninae			
Lampropterini	7	153	16
Troidini	8	144	24
Papilionini	1	222	27
Totals	25	573	75

[1](i.e. Threatened); See Table 2 for details

1) Baroniinae contains only one species, the most primitive living swallowtail, the Baronia, *Baronia brevicornis*. It is restricted to a small part of Mexico, where the caterpillars feed on *Acacia* trees.

2) Parnassiinae contains two tribes. Zerynthiini (which includes the festoon butterflies) comprises 14 species and occurs predominantly in extra-tropical regions of southern Europe and Asia. The most spectacular representative of this tribe is the Bhutan Glory, *Bhutanitis lidderdalei*; four other small genera are also included. Parnassiini includes three genera: *Parnassius* (the 37 species of apollo butterflies of the northern hemisphere), and two other genera which each have a single species.

3) The third subfamily, Papilioninae, is by far the most diverse and is divided into three tribes. Troidini includes eight genera, three of which (*Ornithoptera, Trogonoptera, Troides*) are the birdwings. The Lampropterini (Leptocircini) with seven genera, have sometimes been further divided into two subtribes. In Collins & Morris (1985) these were given as Leptocirciti: *Eurytides*, *Protographium*, *Graphium*, *Lamproptera*; and Teinopalpiti: *Iphiclides, Teinopalpus, Meandrusa*, but this division is not followed here. Finally, the Papilionini includes the large genus *Papilio*, with more than 200 species divided into a number of subgenera or 'sections' which some workers opt to treat as full genera.

Table 1 also indicates the numbers of species which are of current conservation concern. These vary considerably in status. They include a number for which one subspecies only may be threatened in a very small part of the species' overall range, a number whose status is profoundly unclear but which appear to be rare, and many which are undoubtedly rare, vulnerable or otherwise threatened. We list the species involved in Table 2. This list shows that nearly 14 per cent of the family (78 taxa) are believed to be threatened or declining. Appendix 1 lists another 97 taxa which require further investigations to assess their conservation status (i.e. 17% of the family. It therefore appears that around 30 per cent of all swallowtails are of some conservation concern. This should not be taken as a statement that the remaining 70 per cent of swallowtail

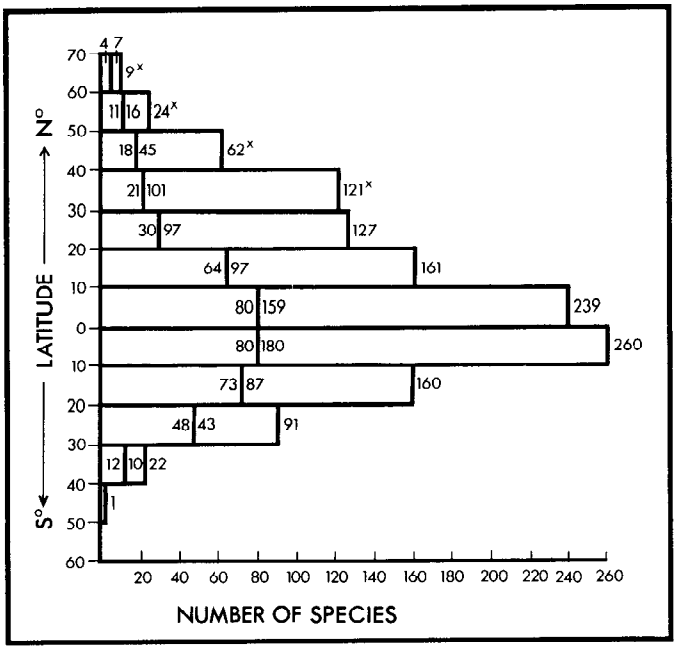


Figure 1. Latitudinal distribution of swallowtail species (data from Collins & Morris 1985). Ten degree intervals north and south of the equator (0) are shown, with numbers of species in the New World to the left and the Old World to the right of each line. The total species, given beyond each line, is sometimes less than the total of the two constituents (denoted by x) as three species occur in both these major faunal regions.

species are safe; many appear to be, but continued reductions in habitat could cause rapid adverse changes to this appraisal. Table 2 and Appendix 1 further emphasise the broad taxonomic spread of species requiring conservation action. We believe that it may be unwise at this stage to divert extremely restricted resources from the conservation of *species* to the conservation of *subspecies*, especially in cases where these are of uncertain status and may represent only a small part of a widespread species' gene pool. The number of undoubted species, or extremely well-defined subspecies, which need conservation action is large. Whilst not in any way minimising the importance of other subspecies as distinct biological entities, undue emphasis on these is not at present feasible, unless local expertise and enthusiasm which cannot be channelled to higher priorities is available.

As well as work by scientists it is important to appreciate that the role of non-professional workers is a vital resource in butterfly conservation. They have contributed very significantly to our current knowledge of swallowtails and will continue to spearhead conservation studies in many parts of the world. Coordinating and encouraging this resource is a central theme in preparing the fundamental documentation needed for conservation assessment of butterflies (New 1991).

Table 2. List of Papilionidae in threatened categories: from Collins & Morris 1985. Common names are appended for species which have them; note that no generally recognised common names exist for most swallowtails.

Status	Taxon	Country	Critical Fauna ranking (see text)
Endangered spp.	*Ornithoptera alexandrae* (Queen Alexandra's Birdwing)	Papua New Guinea	10
	Papilio homerus (Homerus Swallowtail)	Jamaica	17
	P. hospiton (Corsican Swallowtail)	Corsica (France), Sardinia (Italy)	51
	P. chikae (Luzon Peacock)	Philippines (Luzon)	2
Endangered ssp.	*Eurytides lysithous harrisianus* (Harris' Mimic Swallowtail)	Brazil	4
	Papilio aristodemus ponceanus (Schaus' Swallowtail)	United States (Florida)	11
	P. desmondi teita (Taita Blue-banded Swallowtail)	Kenya	-
Vulnerable spp.	*Luehdorfia japonica*	Japan	23
	Eurytides marcellinus (Jamaican Kite)	Jamaica	17
	E. iphitas (Yellow Kite)	Brazil	4
	Graphium levassori	Comoro Is	28
	G. sandawanum	Philippines (Mindanao)	2
	Battus zetides (Zetides Swallowtail)	Hispaniola (Dominican Republic, & possibly Haiti)	26
	Parides ascanius (Fluminense Swallowtail)	Brazil	4
	P. burchellanus	Brazil	4
	Atrophaneura jophon (Ceylon Rose)	Sri Lanka	25
	A. schadenbergi	Philippines	2
	Troides dohertyi (Talaud Black Birdwing)	Indonesia	1
	Ornithoptera croesus	Indonesia	1
	O. meridionalis	New Guinea (Indonesia, Papua New Guinea)	1,10
	Papilio esperanza	Mexico	7
	P. himeros	Brazil	4
	P. maraho	Taiwan	8
	P. osmana	Philippines	2
	P. carolinensis	Philippines	2
	P. moerneri	Papua New Guinea	10
	P. benguetanus	Philippines	2
	P. phorbanta (Papillon La Pature)	Réunion	41
	P. morondavana (Madagascan Emperor Swallowtail)	Madagascar	5
	P. leucotaenia (Cream-banded Swallowtail)	Zaire, Uganda, Burundi, Rwanda	18,48,-,-
	P. neumoegeni	Indonesia	1

cont'd ...

Table 2, cont'd ...

Status	Taxon	Country	Critical Fauna ranking (see text)
Rare spp.	*Baronia brevicornis* (Baronia)	Mexico	7
	Parnassius autocrator	Soviet Union, Afghanistan	20,36
	P. apollo (Apollo)	[Palaearctic]	-
	Bhutanitis mansfieldi	China	3
	B. thaidina	China	3
	Teinopalpus imperialis (Kaiser-I-Hind)	Nepal, India, Bhutan, Myanmar, China	-,6,33,44,3
	Graphium idaeoides	Philippines	2
	G. meeki	Papua New Guinea, Solomons	10,35
	G. stresemanni	Indonesia	1
	G. mendana	Papua New Guinea, Solomons	
	Parides hahneli (Hahnel's Amazonian Swallowtail)	Brazil	4
	Atrophaneura luchti	Indonesia	1
	Papilio toboroi	Papua New Guinea, Solomons	10,35
	P. acheron	Malaysia (Sabah, Sarawak), Brunei	9,-
	P. jordani	Indonesia	1
	P. weymeri	Papua New Guinea	10
	P. sjoestedti (Kilimanjaro Swallowtail)	Tanzania	21
	P. antimachus (African Giant Swallowtail)	West and central	18,19 + others
	P. grosesmithi	Madagascar	5
	P. mangoura	Madagascar	5
Indeterminate spp.	*Graphium megaera*	Philippines	2
	G. procles	Malaysia (Sabah), Philippines	9
	Atrophaneura atropos	Philippines	2
	Troides andromache	Malaysia (Sabah, Sarawak)	9
	T. prattorum (Buru Opalescent Birdwing)	Indonesia (Buru)	1
	Ornithoptera rothschildi (Rothschild's Birdwing)	Indonesia	1
	O. chimaera (Chimaera Birdwing)	New Guinea (Indonesia, Papua New Guinea)	1,10
	O. paradisea (Paradise Birdwing)	New Guinea (Indonesia, Papua New Guinea)	1,10
	O. aesacus	Indonesia	1
	Papilio caiguanabus (Poey's Black Swallowtail)	Cuba	12
	P. aristor (Scarce Haitian Swallowtail)	Hispaniola	26
	P. manlius	Mauritius	40
	P. aristophontes	Comoro Is	28
Insufficiently known spp.	*Bhutanitis ludlowi*	Bhutan	33
	Luehdorfia chinensis	China	3
	Teinopalpus aureus (Golden Kaiser-I-Hind)	China	3
	Graphium epaminondas	Andaman Is (India)	16
	G. aurivilliusi	Zaire	18
	G. weberi (Weber's Swallowtail)[1]	Cameroon	19
	Parides pizarro	Peru, Brazil	29,4
	P. steinbachi	Bolivia	30
	P. coelus	French Guiana	22
	P. klagesi	Venezuela	31
	Atrophaneura palu	Indonesia	1
	Ornithoptera tithonus	Indonesia	1
	Papilio garleppi	Bolivia, Brazil, French Guiana, Guyana, Peru, Surinam	0,4,22,-,29,-
	P. maroni	French Guiana	22

[1]*G. weberi* listed here, as in Collins & Morris (1985), but now regarded as a synonym of the widespread *G. fulleri*.

Endangering Processes

Four processes have been identified as threatening the survival of swallowtails, together with many other terrestrial biota. They are discussed below. The first is the most important, and the most difficult to counter; the second and third are difficult to assess and are probably only minor threats to swallowtails, and the fourth poses problems which appear to be more severe for swallowtails than for any other insects. All are addressed in specific proposals later in this Action Plan, and this section summarises briefly the nature and likely effects of these major threats.

Habitat Change and Destruction

Many swallowtails are very restricted, both in habitat and geographical range, and the larvae of most species have a limited range of food plant taxa on which they depend totally. Some taxa are found only in montane regions or other such 'ecological islands', others on small geographical islands, and many are endemic to particular small relict tracts of tropical forests. Collins & Morris (1985) recognise four major categories of habitat alteration which represent serious threats to swallowtails:

a) deforestation
b) agricultural conversion and intensification
c) alteration of pastures
d) urbanisation and industrialisation.

All of these are linked to the needs of burgeoning human populations, and highlight the need to integrate conservation and human needs. The most relevant category to swallowtail conservation is habitat change in densely populated and economically poor regions.

The present and short-term predictions of levels of deforestation have resulted in many rainforest swallowtails being given threatened status, and these include many that are endemic to restricted areas of insular and mainland south east Asia. A high proportion of the swallowtails is dependent on forest vegetation, and its destruction is *the* major cause of concern for the continued survival of a number of important localised species. Six of the ten highest priority countries for swallowtail butterflies have *all* of the species in forest or woodland (Table 4). Numerous species are thus at risk in, for example, the Philippines, Moluccas, New Guinea, the Solomon Islands and Peninsular Malaysia. Deforestation in India and Nepal is occurring throughout the range of the Kaiser-I-Hind (*Teinopalpus imperialis*). Less information is available on African and tropical American forest swallowtails where, despite the presence of local endemics which give general cause for concern, there is little accurate documentation of their status and conservation needs. Clearly, though, some African montane forest taxa (for example in Rwanda and Burundi) are subject to substantial habitat change at present. Very simply, if present levels of tropical forest removal continue, little or no suitable habitat for many swallowtails will be available in many countries. Lowland forest in Java, for example, now occupies only some 3 per cent of its former extent. Habitat destruction on islands threatens several species. Destruction of open woodland (rather than rainforest) has led to serious decline of certain species in the Philippines, Indonesia, the Comoros, Jamaica, and Brazil.

Agricultural conversion commonly follows deforestation, and the increasing need for agricultural land is a prime cause of gradual encroachment into forests. Swallowtails susceptible to this threat occur in, for example, Malaysia and Sri Lanka, countries where such pressures for land and fuel have become intense. Associated endangering processes include uncontrolled burning, failure to sustain adequate fallow periods and the spread of shifting agriculture. In general, the latter may be one of the most important single causes of deforestation in the tropics overall (FAO/UNEP 1981). However, large economic interests sometimes destroy very large areas of forest, and the sheer scale of their operations may cause substantial ecological disruption.

In temperate regions, the recent intensification of farming practices has led to substantial reductions in available habitat. Formerly lightly-managed areas may be more intensively exploited and drainage and development of coastal swamps have been implicated in the decline of several species in various parts of the world.

Pasture alteration is particularly important for the Parnassiinae, many of which feed (as larvae) on herbaceous plants growing in open situations, particularly alpine meadows. Heavy tourist pressure, with associated trampling and erosion, is a related concern for some species in the northern Himalayas. Some pasture plants are toxic to livestock and the Endangered status of the Corsican Swallowtail (*Papilio hospiton*) in Corsica and Sardinia, for example, results in part from destruction of its foodplants by local farmers.

There are few cases of industrialisation or urbanisation specifically affecting swallowtails, but these are notable. The Schaus' Swallowtail (*Papilio aristodemus ponceanus*) has become Endangered because of demand for building land in parts of the Florida Keys and extensive spraying against mosquitoes. The range of at least one Brazilian species, the Fluminense Swallowtail (*Parides ascanius*), is contracting because of urbanisation (Otero & Brown 1986).

The above are all examples of 'direct' habitat destruction, but the more indirect influences of changing global climate resulting from release of 'greenhouse gases' is likely to become increasingly important. Many natural environments are likely to change within a few decades as a direct consequence of this, and many specialised species are likely to become at risk. Unlike many other organisms, butterflies can be monitored regularly and relatively cheaply, and have considerable value as biological indicators of general climatic and ecological trends.

Pollution

The effects of pollution on butterflies in general are poorly understood. A number of species in Europe have declined in areas which may be particularly susceptible to atmospheric pollution caused by prevailing winds. Acid rain has been implicated in the decline of the Apollo (*Parnassius apollo*) in Norway. Although not well documented, the increasing use of pesticides is a cause of serious concern for swallowtails in some environments, perhaps especially where drift of chemicals into neighbouring natural habitats such as forest edges, occurs from low-level aerial applications to crops.

Introductions of Exotic Species

The effects of introductions of exotic animals on swallowtails appear to be small, although Collins & Morris (1985) note concern over the spread of the Citrus Swallowtail (*Papilio demodocus*) from Africa to Madagascar, Mauritius and Reunion. These three islands contain threatened endemic swallowtails and the ecologically aggressive citrus swallowtail may be capable of ousting less vigorous species. No clear data are yet available.

Commercial Exploitation

Trade in swallowtails, long headed by dealers in North America and Europe, has increased recently in distribution and intensity, and much deadstock and livestock is currently exported from such countries as Taiwan, Malaysia and the Philippines. Collins & Morris (1985) recognised three categories of trade as follows: (i) low volume, high value deadstock; (ii) high volume, low value deadstock; (iii) low but increasing volume, low-medium value livestock. These are discussed in greater depth below:

Table 3. Swallowtails included in Appendices I and II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Appendix I (International commercial trade prohibited)	**Year listed**
Ornithoptera alexandrae	1987
Papilio chikae	1987
Papilio homerus	1987
Papilio hospiton	1987
Appendix II (International commercial trade monitored through CITES permits)	
Bhutanitis spp. (all) (4 spp)	1987
Ornithoptera spp. (all, except *O. alexandrae*) (12 spp)	1979
Parnassius apollo	1977
Teinopalpus spp. (all) (2 spp)	1987
Trogonoptera spp. (all) (2 spp)	1979
Troides spp. (all) (21 spp)	1979

Low Volume, High Value Deadstock

Swallowtails have long been desired by collectors, some of whom will go to enormous lengths - and pay huge sums - for examples of the rarer species. Several rare taxa regularly command more than $1,000 per specimen, and specimens of some birdwings have been advertised for up to $7,000. These sums are likely to increase as specimens become less easily available. Control of illegal exploitation and trade poses severe problems unlikely to be alleviated solely by protective legislation. Small amounts of collecting by individuals may often cause no harm, except to species which are already Vulnerable or Endangered through habitat loss. Commercial collecting, however, can cause greater harm at times. Many rare swallowtails fall into the 'low volume/ high value' category of butterfly trade, and 46 species are included in Appendices I and II of CITES (Table 3). Collins & Morris (1985) point out that more than 80 per cent of the swallowtail species were advertised by dealers in the five years to 1985. Sixty-one per cent of the species can be obtained cheaply (under about US$10 per specimen). Species which are demonstrably rare tend to command high prices, and females (which may be the more difficult sex to collect) typically fetch higher prices than males. The trade is extremely difficult to monitor, because of the ease with which 'papered' butterflies (that is, dead specimens with their wings folded and stored in envelopes before they are relaxed and pinned) can be transported. Birdwings, where they occur, are the most important component of insect trade, because of the high prices they command. For example, Queen Victoria's Birdwing, *O. victoriae*, comprised 3,764 of a total of 5,669 butterflies exported from the Solomon Islands in 1989, and 1,705 of 5,032 in 1990 (Leary 1991).

High Volume, Low value Deadstock

The scale of the butterfly trade in such countries as Malaysia and particularly Taiwan (Marshall 1982) is indeed staggering, even though most of it consists of common taxa. Large numbers of swallowtails are incorporated into ornaments or are individually boxed and offered for sale to the tourist trade. Many of these are common species, and the bulk of this trade will continue to be a drain on natural populations, because the low price per specimen does not warrant rearing them in captivity. This aspect of swallowtail trade is not compatible

with fundamental principles of conservation (Collins & Smith in press). In hotels in Kuala Lumpur in 1988, for example, it was possible to buy rare birdwings in this uncontrolled way (despite the illegality of export, and import to the home countries of many purchasers from overseas, because of CITES listing). Presumably, many of these insects are sold to people without any serious collecting or scientific interest, but who are merely seeking a decorative souvenir. The integrity of much of this trade, and the origin of specimens, is questionable: specimens of South American swallowtails offered as 'souvenirs of Malaysia' seem, to say the least, out of place.

Trade in some species is now banned in the United Kingdom, and many dealers do take a responsible attitude to monitoring trade in rare swallowtails. However, the trade in the local Rajah Brooke's Birdwing *Trogonoptera brookiana* in Malaysia, for example, is estimated to exceed 125,000 specimens per year. This species can legally be collected only under permit and it is a CITES-listed taxon. The available data from CITES records can be taken only as minimal estimates of trade, and there are often wide discrepancies between 'official' figures (for *T. brookiana* from Malaysia for the years 1983-1988, the average annual figure is only 3,037 specimens, for example).

Low - Medium Value Livestock

Exhibits of living butterflies in 'Butterfly Houses' have increased markedly during the last few years (Collins 1987). About one third of the considerable number of swallowtails exhibited in Britain are bred on site and the great majority of the rest are imported as pupae. The bulk of the trade will probably continue to be in pupae. This live trade, which seems likely to grow, involves mainly more common taxa but care may be needed to ensure that some local large showy species are not over-exploited. The conservation links of captive-breeding operations servicing this live trade are often tenuous. However, the use of such facilities should be encouraged, if only to reduce the pressure on wild stocks.

Legislative listing of rare swallowtails as protected has been promulgated in several countries, but much legislation appears to be difficult to enforce and is sometimes openly flouted. Collectors, sometimes on tours organised by specialist tour operators, visit sites likely to yield particular rare species. There are, for example, reports of encampments of foreign entomologists in Nepal waiting for hill-topping males of the Kaiser-I-Hind to appear. There is also a trend for commercial butterfly-oriented operations to be increasing in such countries as China which have been relatively inaccessible to collectors so far. This trend should be carefully monitored in such regions with poorly-known endemic faunas.

Much of the demand for rare swallowtails by collectors could be met by controlled exploitation based on ranching or farming operations. There is little evidence that this is as yet widespread, but it has been pioneered in Papua New Guinea with some of the birdwings (Parsons 1978), and similar operations have commenced in Irian Jaya (Indonesia) and Cameroon, as examples. Such operations can clearly provide an important source of income for local people and appear to be sustainable in the long term, so that a harvest of butterflies may be taken without adversely affecting the wild populations. Encouragement of this option in many parts of the world merits widespread attention, and could help to discourage the overt illegal collecting of rare species in the wild which at present occurs in many parts of the world. Excellent quality ranched or farmed individuals tend to be more valuable than field-caught butterflies, which are commonly 'worn' or damaged and, thus, less prized by collectors.

Categories of Swallowtails Needing Conservation Action

The precise conservation status of many swallowtail species is unknown and, even with the substantial data base now available, some of the following categorisations must be tentative. Table 2 lists 78 taxa divided as follows: Endangered species (4) or subspecies (3), Vulnerable (24), Rare (20), Indeterminate (13) and Insufficiently known (14). Ninety-seven other species (Appendix 1) need further monitoring and research. Some of these swallowtails are at present widespread but occur in areas where habitat destruction is accelerating, others are of doubtful taxonomic validity and still others are of concern simply because they are known only from the types or very few specimens, and their actual abundance is not known.

The IUCN Threatened Species Categories Relevant to this Action Plan

Endangered (E)

Species in danger of extinction and whose survival is unlikely if the factors causing recent decline continue to operate. This category includes taxa whose numbers have already been reduced to a critical level or whose habitats have been so changed or reduced that they may be in imminent danger of extinction. It also includes taxa which are possibly already

extinct but which do not fulfil the formal criterion for 'extinct' listing as they have been seen in the wild during the last 50 years.

Vulnerable (V)

Species which are deemed likely to become Endangered in the near future. This category includes the majority of taxa for which populations are decreasing because of environmental disturbance or over-exploitation, those which have already been seriously depleted and whose security has not been assured, and those which are still abundant but clearly under threat from severe adverse factors throughout all or most of their ranges.

Rare (R)

Species with small, often highly localised, populations which are not currently Endangered or Vulnerable but which are at risk.

Indeterminate (I)

Species which are known to be in one of the above three categories but cannot be precisely placed because of lack of information.

Insufficiently Known (K)

Species which it is suspected belong to one or other of the above categories but which cannot be precisely placed because of lack of information.

'Threatened' is a general term covering Endangered, Vulnerable, Rare and Indeterminate species. The term 'Insufficiently Known' could be applied to around one third of all swallowtail species but it is applied here much more sparingly, to taxa which are sufficiently unusual, isolated or biologically intricate that clarification of their status merits urgent attention.

Approaches to Action

Two major themes, not entirely discrete, are pursued in this Action Plan, with specific projects given for each:

Theme A: Community-orientated conservation objectives aimed at specified countries and sites which have been identified as having a number of swallowtail species of particular significance (i.e. critical faunas).

Theme B: Species-orientated programmes aimed at conservation and protection of particular taxa known to be under threat, or whose status needs urgent clarification.

The first of these themes seeks to integrate conservation of swallowtails into general conservation planning, which may sometimes be undertaken primarily for other taxa. Theme B extends this approach into some specific contexts, where swallowtails become the major focus of conservation attention as significant taxa in their own right. Both themes seek to promote national and government awareness of the importance of swallowtails and their conservation. Education is important at all levels, and the role of 'Butterfly Houses' in promoting awareness of butterfly conservation could be improved, for example by more informative labelling of exhibits and dissemination of information to the public.

Neither approach is dealt with comprehensively as the multiplicity of projects needed to cover these themes adequately is prohibitive. Rather, we outline selected examples which could be regarded as a reasonable sample of high priority projects covering all the most threatened species, and indicate the broader rationale for them. They cover a wide geographical range, and are not listed in strict priority order. Thus later listings are not to be regarded as of lower merit or conservation significance than those given earlier. Conservation priority has to be tempered by feasibility. We appreciate that many of the projects will be difficult to execute effectively in certain political and social situations, unless the conservation of swallowtails offers economic benefit to local human communities. This may often require the incorporation of swallowtail conservation needs into appropriate rural development projects, as is being done for example in the development of the Arfak Mountains Nature Reserve in Irian Jaya, Indonesia. A fuller rationale of the two themes follows.

Theme A: Critical Faunas Approach

Collins & Morris (1985) provided a distributional analysis of the world's swallowtails, and recognised 51 countries which have what they designated 'critical faunas' (see Fig. 2). Forty three of these countries support endemic species, and they can be ranked in terms of the number of these endemics (Table 4): Indonesia, with 53 endemics out of a total of 121 species, heads the list followed by the Philippines (21), China (15), Brazil (11) and Madagascar (10). These five country faunas alone contain nearly 54 per cent (309) of the world's swallowtail species. If the next five countries (India, Mexico, Taiwan, Malaysia, Papua New Guinea) are added, the representation rises to 68 per cent. Thus, if it were possible to conserve the *entire* swallowtail fauna of only the 10 countries mentioned above (Table 4), a high

1. *Ornithoptera rothschildi,* Rochschild's Birdwing, endemic to the Arfak Mountains, Irian Jaya

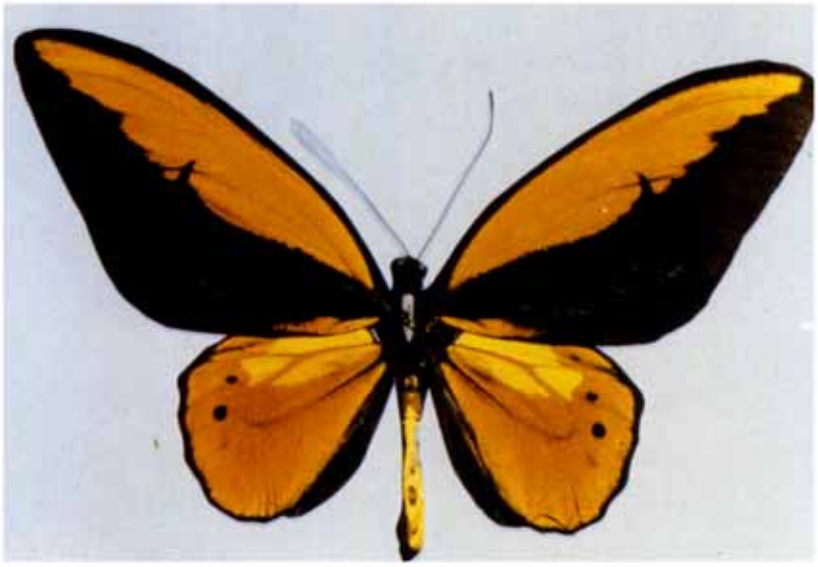
   Photo: R. Straatman, leg. N.M. Collins

2. *Ornithoptera priamus,* a widespread birdwing

   Photo: C. Darby, leg. N.M. Collins

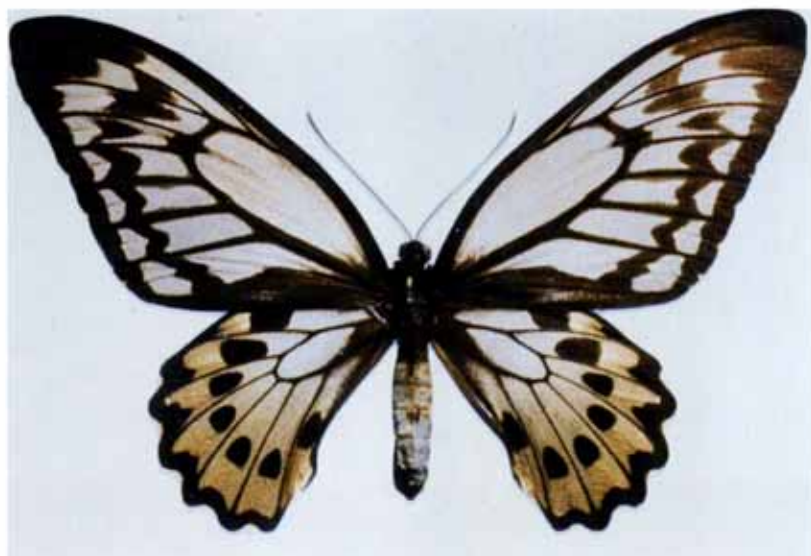
3. *Trogonoptera trojana,* a birdwing endemic to the Philippines

   Photo: R. Harvey, leg. N.M. Collins



4. *Ornithoptera croesus,* **male, a birdwing from the Moluccas (Indonesia)**

Photo: N.M. Collins



5. *Ornithoptera croesus,* **female, a birdwing from the Moluccas (Indonesia)**

Photo: N.M. Collins

6. *Ornithoptera victoriae,* **Queen Victoria's Birdwing**

Photo: N. M. Collins

Table 4. Priority countries or 'critical faunas' for swallowtail conservation (Collins & Morris 1985 and Collins & Smith in press).

Order of ranking		Number of swallowtail species			% total in forest or woodland	Number which are threatened			Ranking (from 1, highest) in terms of number of threatened species[1]
		Endemic	Total	Cumulative total		Endemic	Other	Total	
1	Indonesia	53	121	121	100	11	4	15	1
2	Philippines	21	49	146	100	9	0	9	2
3	China	15	104	222	68	3	2	5	5
4	Brazil	11	74	296	100	6	2	8	4
5	Madagascar	10	13	309	100	3	0	3	7[2]
6	India	6	77	323	79	0	1	1	
7	Mexico	5	52	365	94	2	0	2	10
8	Taiwan	5	32	370	97	1	0	1	
9	Malaysia	4	56	375	100	3	0	3	6[2]
10	Papua New Guinea	4	37	387	100	2	7	9	3

Notes:

[1]Rank 8 for threatened species = Zaire (Collins & Morris no 18): 3 threatened species, including 1/2 endemics, of a total swallowtail fauna of 48 species. Subsequent ranking of critical faunas (11-51) is: United States, Cuba, Ecuador, Colombia, Australia, Andaman & Nicobar, Jamaica, Zaire, Cameroon, (20) Soviet Union, Tanzania, French Guiana, Japan, Canada, Sri Lanka, Haiti, New Caledonia, Comoro Islands, Peru, (30) Bolivia, Venezuela, Gabon, Bhutan, Ghana, Solomon Islands, Afghanistan, South Africa, Iran, Vanuatu, (40) Mauritius, Reunion, Fiji, Western Samoa, Myanmar, Laos, Honduras, Argentina, Uganda, Ethiopia, (50) Mozambique, Italy.

Rank 9 for threatened species = French Guiana (Collins & Morris no 22): 2 threatened species, 2/2 endemics, of a total swallowtail fauna of 31 species.

[2]Ranks 6 and 7 In terms of threatened species are separated by the proportion of endemics threatened: Malaysia 3/4, Madagascar 3/10.

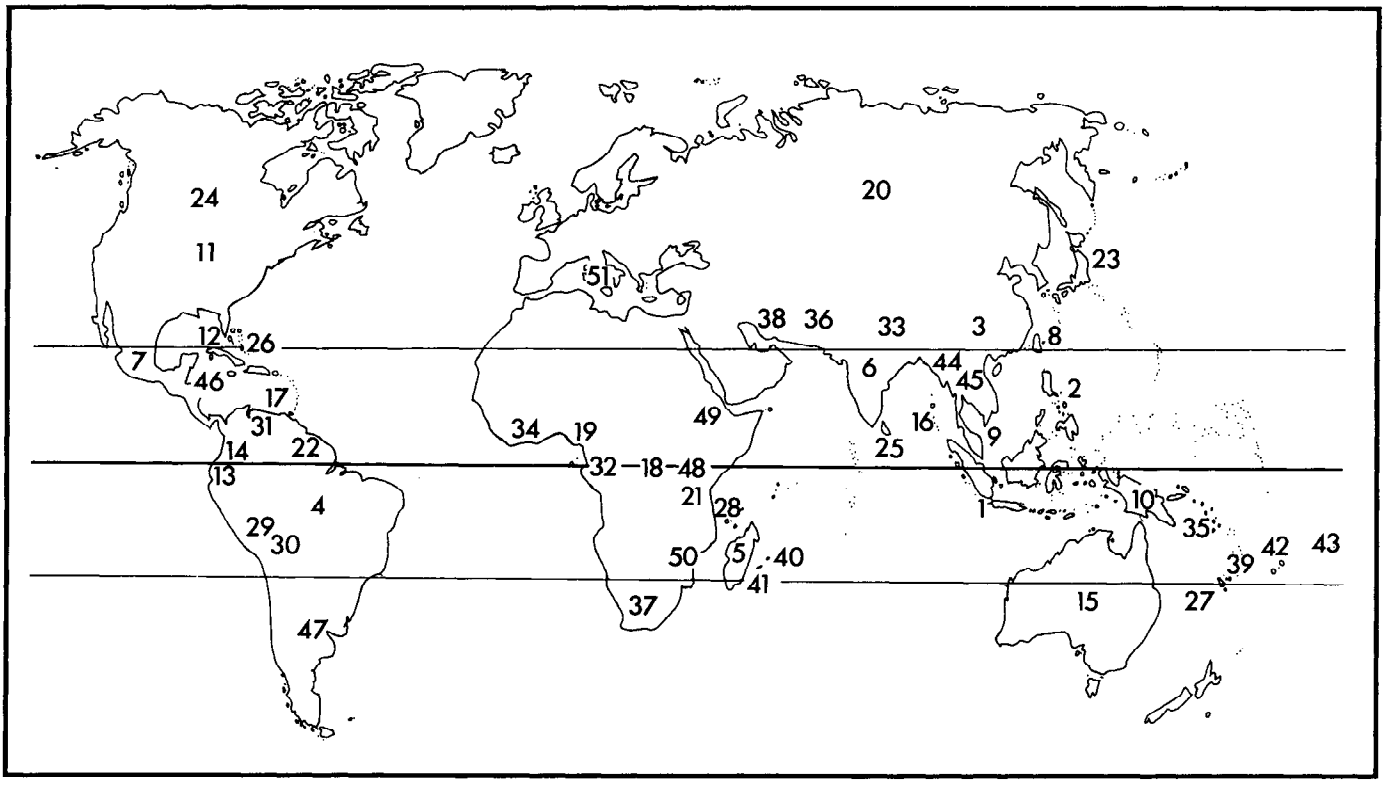


Figure 2. Distribution of critical faunas of swallowtails. Priorities range from '1' (highest) to '51'. The numbers are keyed in Tables 2 and 4 for species and countries respectively. After Collins & Morris (1985).

proportion of the world's species could be saved. Countries could continue to be added until all critical faunas were covered. Fifteen countries (rank nos 29-43) each have only one endemic species, and 11 (rank nos 18-28) countries have two.

There is considerable correspondence of high priority areas for swallowtails with those critical for other butterflies, such as the milkweeds (Danainae) (Vane-Wright et al. 1991). The aim to prevent the extinction of any swallowtail species and to restore each threatened species to viable population levels might seem ambitious, even utopian, but the data presented above emphasise the fact that incorporation of swallowtails into national conservation strategies of relatively few high priority countries could help to safeguard many species. In addition, a number of countries *without* endemic species have large swallowtail faunas (Table 5). Little is known of the status of most of these, but local habitat change could lead to substantial loss of species. Development of 'critical faunas analysis' promises to be a useful step in conservation activities.

A broad global spread of potential projects is outlined and, for each project, the general aims are:

i) To identify and establish routes of communication about swallowtail conservation, and to promote the integration of swallowtail conservation into regional conservation planning, utilising the expertise and local knowledge of IUCN and SSC members, local lepidopterists or entomological societies, and the IUCN/SSC Lepidoptera Specialist Group members.

ii) To prepare regional information packs on project priorities, including species lists, information on species in existing reserves, distributional and ecological data and, especially, to investigate the biology and needs of taxa of conservation concern.

iii) To promote the value of swallowtail butterflies in some countries as the basis of viable cottage industries based on controlled ranching or farming, and to investigate the feasibility of establishing such operations.

The selection of countries for projects should be based not only on conservation concern but also on practical considerations such as accessibility and the feasibility of implementing projects. Countries high on the 'critical faunas' list should receive priority, if feasible, and thus high priority would be accorded to areas with numerous endemic or threatened forms. Both local agencies and outside bodies should be involved, the latter only in an advisory role wherever possible.

Theme B: Threatened Species Approach

Seventy-eight species or subspecies of swallowtails have been allocated to IUCN threatened species categories (see Table 2) and the major thrust of this theme is to encourage, develop and carry out recovery plans for these. Conservation needs of particular species differ considerably, but requirements common to many are:

i) creation of protected areas to conserve prime habitat, with the provision of resources to manage these where necessary;

ii) basic research on biology, status and distribution of the species;

iii) improvement of the effectiveness of legal protection for commercially desirable species; and

iv) the promotion of regulated ranching or farming operations to replace unrestricted collecting of these species in the wild. Swallowtails are a resource with considerable commercial value, and should be promoted as such, provided all utilisation is sustainable.

Table 5. Countries with diverse faunas of non-endemic swallowtails. (Data from Collins & Morris 1985).

Country	No. of swallowtail species	
	Total	Threatened
Myanmar	68	1
Laos	48	
Argentina	37	(?1)
Honduras	34	
Uganda	32	1

This approach is exemplified later in this Action Plan by outline projects on priority species from different geographical regions. In some cases, these overlap with the broader 'theme A' projects, and sometimes this dual thrust is clearly needed. This list of suggested projects is necessarily incomplete: most of the threatened species, as well as the 100 or so uncategorised species (Appendix 1), need treatments of this sort but such an approach would be totally impracticable on any formal coordinated basis at this time.

The IUCN/SSC Lepidoptera Specialist Group provides a technical advisory service related to all the projects listed in this Action Plan. In some cases this advice might be confirmation that the species in question is indeed threatened and, therefore, a conservation priority. This confirmation can be augmented with additional comments addressing, for example, habitat and food plant needs, biological knowledge and feasibility of ranching to satisfy commercial need. When making approaches to government departments, the wisdom of constructive cooperation with local lepidopterists with practical knowledge of the species concerned will be emphasised. In attempting to update information on swallowtails over the last few years, we have been made aware that the status of several important taxa

is the subject of intense local debate or controversy, with some workers claiming a species to be widespread and not in danger whilst others consider the same species to be threatened. The Lepidoptera Specialist Group is available to arbitrate in an independent manner if such problems arise, but even with the fullest information available to us, some ambiguity persists, and this illustrates the difficulty of assessing the status of even large and charismatic invertebrates.

The butterflies targeted here represent varying degrees of conservation achievement. In some cases, habitats are already protected in national parks and other areas, and the prime need is to ensure the integrity and management of these in relation to the specialised ecological needs of particular swallowtail species there. In others, no such habitats have yet been identified or targeted for protection, and this must be the first practical step. Some examples of well-managed reserves occur in countries with a history of positive interest in butterfly conservation. In other countries, suggestions for butterfly reserves may not only be novel but may also cause a degree of conflict due to demands for multi-purpose land use. The projects listed here should be seen as proffering concerned advice rather than dictating policy, but it is hoped that responsible advice of this nature will be acted upon if at all possible and, at least, encourage local assessment of the conservation needs and effective communication of the findings of such assessments. Fuller information, including references, for each species are included in Collins & Morris (1985).

Despite the urgency and desirability of drawing attention to the needs of swallowtails in all critical faunas, the formulation of detailed projects may be premature in some cases. For these regions we provide suggestions only, which may encourage local naturalists and conservation bodies to determine practical priorities. A more detailed watching brief by concerned entomologists is needed in many countries, and funding should be sought to promote general monitoring of this kind and responsible communication of the information gained.

Priorities

The foregoing sections have indicated two possible criteria for setting priorities in swallowtail conservation: the inclusion of species in a critical fauna, and the categorisation of species according to the extent of threat. Many of the highest priority critical faunas lend themselves to more intensive analysis so that, for example, the swallowtails of Indonesia and the Philippines can be looked at in terms of occurrence on different islands or in different provinces (Collins & Morris 1985). Thus, in Indonesia, the highest numbers of endemics occur in Sulawesi (11/38 total swallowtail species), the Lesser Sundas (10/30) and the Moluccas (9/37), whereas no swallowtails are known to be endemic to Kalimantan (although three *are* endemic to Borneo, namely *Graphium procles*, *Troides andromache* and *Papilio acheron*). In the Philippines, Luzon has 4 of the 11 endemic swallowtails and 26 of the total 49 swallowtails. Such analysis can extend also to determining whether species of concern, or concentrations of endemics, occur in protected areas currently recognised: habitat security may enable a project on more detailed analysis of management needs to be undertaken. The above criteria, together with information on the degree and imminence of threats can help to indicate rational priorities within the multitude of possible projects. In the projects outlined in this Action Plan, highest priority is generally accorded to highly ranked species in highly ranked faunas, in the expectation that other species may benefit from increased awareness and practical steps taken to safeguard habitats where they coexist with the particular priority taxon. Such a simplistic scheme does not incorporate considerations of local practicalities or of values of other sorts accorded to particular species. Thus, in Table 2, if all four Endangered species were of equal degree of endangerment the Luzon Peacock (*P. chikae*) would be rated highest priority because of the high rank of the Philippines as a critical fauna. However, this could be countered by the charismatic nature of Queen Alexandra's Birdwing (the world's largest butterfly) in Papua New Guinea (even though the fauna is rated only 10: Table 4). Information on population sizes and relative endangerment of different species is generally lacking, and such fine-grain ranking is impracticable.

Use of such criteria progressively to set priorities is encouraged, but we urge that *all* threatened species and critical faunas be safe-guarded and that information be accumulated to facilitate positive steps to do this. We use four levels of priority, as a guide only, in ranking the following projects. 'Priority 1' is the highest, generally reserved for very high priority species or faunas. Priorities 2-4 are progressively lower, with '4' encompassing many of the species for which even basic knowledge is still needed to assess status properly.

Projects for Swallowtail Conservation

1. Europe General

Aim

To assess the distribution of populations, and the adequacy of protected areas for support and conservation of the Apollo, *Parnassius apollo* (Rare). Project Priority 4, but some local subspecies higher.

Background

The Apollo is very variable, with many named local subspecies and other regional populations, and is highly desired by collectors. A glacial relict species, its range in Europe is reported to have declined, with extinction and increasing vulnerability of particular subspecies. In France, for example, two subspecies are Extinct, one is Endangered and seven are Vulnerable. Despite legal protection over much of Europe (Collins 1987a), habitat change appears to be a major endangering process.

Action needed

A detailed survey of the distribution, size and vulnerability of colonies of extant subspecies of the Apollo, to determine which may be safeguarded adequately in existing protected areas and which may need urgent habitat reservation and/or management. Likely management steps needed include arresting scrub succession and avoidance of conifer afforestation in some areas.

Benefit to related swallowtails

Two other Apollos, *P. phoebus* (Small Apollo) and *P. mnemosyne* (Clouded Apollo) may also be threatened in Europe, and enhanced knowledge of their status is needed.

Procedure

Much of the needed information has already been accumulated by collectors and lepidopterists in Europe, and the main aim is to assemble and synthesise the large amount of unpublished information available. Local or country-based collection and field surveys are needed for all countries in which the Apollo occurs, and the project could perhaps be encouraged under the auspices of the Societas Europaea Lepidopterologica, and the various national entomological societies. A project in France initiated recently through the Office pour l'Information Eco-Entomologique (O.P.I.E.) and the Université de Provence, for example, is designed to investigate the status of marginal and endangered colonies of the Apollo in the Massif Central and the Vosges, and it includes appraisal of genetic structure and variations, so that conservation efforts can be focussed on populations of greatest interest. This could form the nucleus of a broader study.

Funds are needed for a local coordinator (Europe) or separate country coordinators to provide initial appraisal of (1) adequacy of information available; (2) need for field surveys and (3) priority populations/sites for investigation. Reports at that stage should assess the adequacy of habitat (condition, reserve status, management needs, knowledge needs) for each significant population and further determine local priority needs for the Apollo, including cost estimates for obtaining the necessary documentation. **Duration:** 2-3 years. More detailed proposals could then be made. **Initial cost:** US$ 20,000.

2. Corsica and Sardinia: (France, Italy)

Aim

To assess the conservation status of the Corsican Swallowtail (*Papilio hospiton*) on Corsica and Sardinia and recommend measures to improve this. Species status: Endangered. Project Priority 1-2.

Background

The Corsican Swallowtail is restricted to Corsica (France) and Sardinia (Italy), where it is localised in open mountainous country. It is endangered by habitat and foodplant destruction and is assiduously sought by collectors. It is protected by French law (decree enacted in 1979), but this offers no practical protection. No suitable nature reserves have been designated.

Action needed

A detailed survey of the distribution and population dynamics of the Corsican Swallowtail with the aim of designating particular habitat areas as protected and managing them constructively to conserve the species.

Procedure

A survey could be completed efficiently on Corsica in two field seasons by an experienced field lepidopterist, and substantial background could be obtained in only one season by a worker with good local knowledge. A similar survey is needed in Sardinia. Surveys should aim to determine, in particular (1) distribution and population sizes, (2) voltinism, as there is some suggestion that a second generation may occur on Corsica, (3) larval foodplant range and (4) highest priority areas for the species with a view to their protection. Funds are needed for fieldwork (2 or 3 x 5 months) plus travel (if non-

resident lepidopterists) and report preparation. **Initial cost:** US$25,000.

3. Kenya

Aim

To clarify the status of the Blue-banded Swallowtail, *Papilio desmondi teita* (Endangered) in the Taita Hills, Kenya, and protect its habitat. Project Priority 2.

Background

This subspecies is endemic to the Taita Hills, and is confined there to relict forests which are not well protected, and are subject to felling and other forms of exploitation. The importance of the Taita Hills for a wide range of endemic taxa (including plants, reptiles, amphibians and birds) has long been recognised, but the area is not formally protected as a conservation area.

Action needed

Urgent efforts to protect forest environments of the Taita Hills from any further degradation. Natural forests on Ngangao and Mbololo need to be granted protected status. Further exotic tree plantations on the hills should be allowed only on the lower altitude land which has already been deforested. Further information is needed on the ecology of the swallowtail.

Procedure

Strongly advocate the value of the Taita Hills as an important locality for many biota, not only endemics, but as the type locality for many other taxa, including three mammals, and an Endangered bird, the Taita thrush *Turdus helleri*. Links should be made with other concerned biologists to urge the need for protection of the hills and for more detailed surveys of the status of many biota there. Two endemic nymphalid butterflies could be linked in seeking funding for a 'butterfly status survey' through at least one season, and this could probably be promoted through the National Museums of Kenya, which have long recognised the need to conserve the Taita Hills. **Initial cost:** US$10,000.

4. Highlands of Western Uganda, Eastern Zaire, Rwanda, Burundi

Aim

Conservation of the Cream-banded Swallowtail, *Papilio leucotaenia* (Vulnerable). Project Priority 4.

Background

This is a montane species found locally in small forest areas on the Nile/Zaire watershed in Uganda, Zaire, Rwanda and Burundi. Forest destruction is believed to be resulting in extirpation of some populations and increasing the vulnerability and fragmentation of others. The presence of this species in reserves (such as the Gorilla Game Reserve in southwest Uganda) is unknown, but several of the reserves in the region appear to be suitable for it. The Bwindi (Impenetrable) Forest Reserve (southwest Uganda) harbours the Cream-banded Swallowtail, but the species seems to be found only in highland forests which are now subject to substantial human pressure.

Action needed

Strict protection of known localities for the swallowtail, and investigation of its status and potential for captive ranching.

Procedure

Strict protection of the Nyunguwe Forest (Rwanda), an important locality for the swallowtail, is urgently needed and current efforts towards this end should be encouraged. International importance for the protection of this and other areas (such as the Bururi forest in Burundi) needs to be emphasised, and surveys for the swallowtail in all known localities should be undertaken. Little is known of the butterfly's range and status in Zaire, and investigation there is urgently needed. A broader survey of the Central African highlands for conservation priorities should heed the presence of the Cream-banded Swallowtail in assessing these. There would seem to be ample opportunity for cooperation with efforts to save other taxa in this region. **Initial cost:** US$ 25,000.

5. Tanzania

Aim

Investigation of current threats to the Kilimanjaro Swallowtail, *Papilio sjoestedti*. (Rare). Project Priority 4.

Background

This montane forest swallowtail occurs on Mount Meru, Mount Kilimanjaro and the Ngorongoro Crater Higlands in Tanzania, and has a very restricted range. It appears to be secure, as its major distribution is within national parks and other protected areas but its habitat is under constant threat, as depletion for agriculture and plantation forestry continues.

Action needed

Investigation of the adequacy of protection offered in reserves

containing this species, and the extent to which it is threatened by continuing habitat loss. An assessment of the necessary management strategy is needed, including possibility of captive ranching: little is known of the species' biology, and the immature stages and larval foodplants are unknown.

Procedure

Document destruction of apparently suitable habitat. The importance of montane forests in Tanzania as wildlife habitats and the need for their stricter conservation, using the swallowtail as one key species present, should be emphasised. The management plan for Kilimanjaro National Park does not include the forest reserve: it should do so.

A one-season survey of the butterfly in each protected area could add enormously to knowledge of its abundance and detailed distribution. Strenuous efforts to determine larval biology are needed. **Initial cost:** US$30-40,000.

6. West and Central African Rainforests

Aim

General survey of distribution and status of the African Giant Swallowtail, *Papilio antimachus* (Rare). Project Priority 3-4.

Background

The African Giant Swallowtail is confined to primary lowland tropical forest, and is widespread but scarce. Its habitat is being destroyed rapidly, and the butterfly's status could deteriorate rapidly. It is viewed as an indicator species, whose presence mirrors the 'health' of many other species in the habitat, and much more information is needed on its vulnerability to forest exploitation and on details of its distribution in Central and West Africa's forest areas. In several countries it is recorded from very few specimens or is regarded as rare to very rare, but it has also been recorded from several protected areas.

Action needed

Only Congo and Zaire (Central Africa) and Ghana and Ivory Coast (West Africa) contain reserves where this species is known to occur. All rainforest reserves in the broad distribution of the species should be checked for the swallowtail's presence, and the adequacy of the protection of its habitat assessed.

Benefit to other swallowtails

Graphium aurivilliusi (Insufficiently Known) is known only from the type series, presumed to be from Zaire, and surveys in Zaire and Congo forests for other swallowtails have potential to augment knowledge of this species. Imminent scheduling of selected forest sites in Cameroon for full protection may help to conserve other species, and a butterfly ranching facility at Korup National Park in Cameroon could be used to aid research on all local swallowtails.

Procedure

Coordinated survey could include assessment of local knowledge of this spectacular species, and systematic field work. Initial survey of habitats could emphasise value to other biota as well. Effective liaison with the proposed 'butterfly farm' at Korup, Cameroon, should be investigated, with a view to increasing knowledge of the basic biology of this species. **Initial cost:** US$20,000.

7. Madagascar

Aim

Conservation of endemic forest swallowtails. Project Priority 3.

Background

Madagascar has three important endemic swallowtails: the Madagascan Emperor Swallowtail, *Papilio morondavana* (Vulnerable), *P. grosesmithi* (Rare) and *P. mangoura* (Rare). All are forest species and the first two are sympatric in western Madagascar and *P. mangoura* occurs in the east. All are threatened by forest destruction and are desired by collectors. The main pressures are agricultural conversion and timber extraction, and these processes are common elements threatening much of Madagascar's biota. Little is known of the biology of the swallowtails.

Action needed

Clarification of the presence and status of all three species in reserves in Madagascar, and enhancement of protection of such areas. Investigations are needed into the biology of all these species and the need to control commercial over-exploitation should be assessed.

Benefit to other swallowtails

Other forest species, such as *Graphium endochus*, may be threatened in due course as forests decline. A number of endemic nymphalid butterflies could also benefit from forest conservation.

Procedure

Initiate systematic survey of the three species, and actively promote protection of forest areas, in conjunction with their value for other biota. Priority survey sites include in western

Madagascar: Reserve Naturelle Integrale de l'Ankarafantsika, R.N.I. du Tsingy de Bemaraha, and R.N.I. du Tsingy de Namorok; eastern Madagascar: Masoala peninsula, R.N.I. de Tsaratanana, R.N.I. de Marojejy, R.N.I. de Andringitra, R.N.I. de Zahamena, R.N.I. de Andohahela, but smaller areas should also be examined. Specific conservation management measures for the butterflies cannot be made until more is known of their basic life-histories and biology: this knowledge is needed as a prelude to possible commercial/conservation-orientated ranching on a sustainable basis. **Initial cost:** US$30,000.

8. Comoro Islands

Aim

Conservation and management of endemic swallowtails. Project Priority 2.

Background

The Comoro Islands have two endemic species, *Graphium levassori* (Vulnerable) (confined to Grand Comoro) and *Papilio aristophontes* (Indeterminate) (Anjouan, Moheli, Grand Comoro). Both are forest species. The former is particularly local, apparently restricted to median altitudes, and with its habitat under severe pressure from agricultural conversion and associated soil erosion. *P. aristophontes* survives in upland forests, but its distribution and biology are by no means adequately documented.

Mount Karthala (Grand Comoro) supports both species of swallowtail, and has been suggested for protection by the government: this should be undertaken with maximum expediency, and areas suitable for *P. aristophontes* on the other islands also reserved and protected from further clearance. Much of the forest on Mount Karthala has already been disturbed substantially. More information is needed on the biology of both species, and the possibility of farming *G. levassori* (perhaps on custard apple) to satisfy collector demand and relieve pressure on natural populations should be investigated.

Procedure

Survey both species in forests of Grand Comoro, particularly to determine whether protection of Mount Karthala alone would be sufficient to conserve them. If so, the protection of this area is a very high priority. Surveys of *P. aristophontes* on Anjouan and Moheli are needed to determine status and priority habitats and sites for reservation. The biology of both species should be examined, and the value of captive ranching promoted. Duration: two years, in cooperation with the Central Federal Directorate for Rural Development. Finance and technical expertise are needed to establish the protected areas suggested for the Comoros. **Initial cost:** US$25,000.

9. Réunion

Aim

Status assessment and habitat protection for the Papillon la Pature, *Papilio phorbanta* (Vulnerable). Project Priority 4.

Background

This endemic species (formerly known also from the Seychelles, but now extinct there) has been protected legally since 1979, but is seriously threatened by agricultural conversion. Deforestation, and replacement with exotic trees (particularly Japanese red cedar, *Cryptomeria japonica*) is continuing. The species may also be vulnerable to control measures used against the ecologically aggressive introduced Citrus Swallowtail, as it has adapted to breed on *Citrus*.

Action needed

Continued monitoring of the status and distribution of the swallowtail, and assessment of its security in the protected areas suggested by an Organisation de la Recherche Scientifique et Technique d'Outre-Mer (ORSTOM) survey in 1983. Some of these have since been examined by the Réunion Office National de la Forêt (ONF), who are responsible for managing reserves. There should be an investigation of the potential for captive breeding on *Citrus*, and of the efficacy of protective legislation.

Procedure

Liaison with ONF would be needed as an initial source of information to form the basis of a one-year survey of the butterfly's distribution, both within and outside protected areas. Comparative estimates are needed of abundance in natural forests and in citrus, to determine the importance of the latter as a larval foodplant, and investigation of possible competitive aggressiveness of the Citrus Swallowtail. Basic biological information is needed to estimate viability of captive ranching. There is a possible link with the Mauritius project to cover the 'Conservation of Mascarene Swallowtails'. **Initial cost:** US$30,000.

10. Mauritius

Aim

Monitoring status of *Papilio manlius* (Indeterminate) to determine any conservation need (and address this if necessary). Project Priority 4.

Background

P. manlius, endemic to Mauritius, is closely related to *P. phorbanta* (see project 9), and can also breed on citrus. Populations remaining on natural vegetation are believed to be declining, as natural vegetation is removed for agriculture, particularly for sugar cane.

The Black River Gorges area is one of few extant natural habitats, and constitutes part of the Macchabee - Bel Ombre Nature Reserve. The area is subject to invasion of introduced plants which can smother native vegetation rapidly.

Action needed

Monitoring of status of *P. manlius* in protected areas of Mauritius and clarification of the safety of its habitats. As with *P. phorbanta*, competitive interaction with the Citrus Swallowtail may be a threat, and this should also be investigated.

Procedure

Link with programmes aimed at conservation of native vegetation and fauna of Mauritius, working through the Conservator of Forests, Ministry of Agriculture and Natural Resources and the Environment, and the Nature Reserves Board. Possible link with project 9. **Initial cost:** US$30,000.

11. Andaman Islands (India)

Aim

Conservation of endemic swallowtails. Project Priority 3.

Background

Three endemic swallowtails occur on the Andaman Islands: *Graphium epaminondas* (Insufficiently Known), *Atrophaneura rhodifer* and *Papilio mayo*. All are poorly known, and little information on their status and biology is available. All may be threatened by the increasing destruction of natural forest vegetation for cultivation, timber and planting of forest monocultures. These protected areas on the Andamans are small, and their importance for butterflies has not yet been assessed.

Action needed

Recent designation of protected areas on the Andamans provides the ideal opportunity for initiating surveys to determine the security and status of *G. epaminondas* and *A. rhodifer* in particular. In 1986, sub-montane forest had not been included in protected areas, but that vegetation type was then regarded as generally secure (MacKinnon & MacKinnon 1986). An objective field assessment of all species is needed to determine needs for management.

Procedure

Map distribution of the swallowtails in protected areas and determine their presence in these and elsewhere. Determine whether any forest types are under-represented in protected areas and urge protection of such habitats. Survey the biology of the butterflies as a basis for initiating management, if needed. The primary data could probably be collected in two years. **Initial cost:** US$30,000.

12. Soviet Union, Afghanistan

Aim

Status evaluation of *Parnassius autocrator* (Rare). Project Priority 3.

Background

P. autocrator is a high altitude Apollo known from Pamir (Tadzhikistan, Soviet Union) and the Hindu Kush (Afghanistan). In the former area it is threatened by degradation of high mountain pastures, and nothing is known of its status in Afghanistan. It is listed in the Soviet Red Data Book, and is stated there to be extremely rare.

Action needed

Evaluation of status of *P. autocrator* and possible protection of its habitat in selected areas of both regions. There needs to be augmentation of limited knowledge of the species' biology and distribution, as the basis for a conservation plan.

Procedure

The practical prospects for this project are limited but, in view of current attempts being undertaken to update the Soviet Red Data Book, it should be possible to liaise with entomologists in the Soviet Union to explore feasibility, and perhaps provide subsidy for local exploration. **Initial cost:** US$10-15,000.

13. Himalayas (Nepal, India, Bhutan, Myanmar, China)

Aim

Conservation of a spectacular Himalayan swallowtail, the Kaiser-I-Hind, *Teinopalpus imperialis* (Rare). Project Priority 3.

Background

The Kaiser-I-Hind is a high altitude forest species found from Nepal to southern Myanmar, and with records (not recent) from parts of China. It is regarded as local and rare, and much of its forest habitat is being degraded through shifting cultivation. The butterfly does not persist in degraded areas. There is some possibility of commercial overexploitation, and the protective legislation enacted in India and Nepal appears not to be effective. In India, the difficulty of habitat protection is enhanced by the largely independent forestry practices of each State, so that management strategies may have to be proposed on a local, rather than national, basis.

Action needed

Determination of the presence and status of the Kaiser-I-Hind in all protected areas in the region. There should be an assessment of the effects of habitat degradation and commercial collecting, and methods needed to control these threats. More effective monitoring of protective legislation is needed in India and Nepal, including strict controls on collecting from small or isolated populations. There should be an investigation of the feasibility of ranching the species. Reports of the Kaiser-I-Hind from China need investigation, and habitat reservation throughout its range is needed.

Benefits to other swallowtails

The status of *Bhutanitis ludlowi*, known only from the type locality in Bhutan (Trashiyangsi Valley), might be clarified through further surveys for swallowtails in the Himalayan region. A number of rare Apollos (*Parnassius*) also occur in the area.

Procedure

Promote awareness of protective legislation and the possibility of a sustainable cottage industry by ranching Himalayan swallowtails. Surveys of forested areas, especially those under more immediate threat, and protected areas should be initiated. Where necessary, more effective protection of these areas should be emphasised. Because of the large areas to be surveyed, at least 3-5 seasons of field work may be needed, in consultation with local workers. A coordinated plan for habitat management should be a prime aim. **Initial cost:** US$60,000.

14. Sri Lanka

Aim

Conservation of remnant populations of the endemic Ceylon Rose, *Atrophaneura jophon* (Vulnerable). Project Priority 2.

Background

This rare species is confined to rainforests in southwest Sri Lanka, habitats which have been largely removed by timber extraction and demands for agricultural land. It occurs only in dense forest, and its major centre is now the Sinharaja National Heritage Wilderness Area, which is itself subject to continuing human intrusion and disturbance: the butterfly may be declining there. Sinharaja is the last extensive tract of primary lowland tropical rainforest in the country.

Action needed

Full protection for the forest remaining in the Sinharaja. Clarification is needed of the status of the Ceylon Rose there and in other remnant patches of forest.

Benefit to other swallowtails

Sinharaja is an important habitat for many of Sri Lanka's 15 swallowtail species, and 21 butterfly species are endemic there. The Sri Lankan Five-bar Sword (*Graphium antiphates ceylonicus*), normally considered to be very rare, is not uncommon there at times (Green 1990).

Procedure

Protection of the Sinharaja has increased markedly in the last few years, with a conservation plan being carried out under a cooperative agreement between IUCN and the Sri Lankan Government. A one year survey of the distribution and status of the Ceylon Rose is needed to integrate the butterfly's major habitat into zoning and management of the area. Many other endemic biota occur, and cooperation with other biologists, and coordination through the Forest Department, should be feasible. This species could be a national emblem. **Initial cost:** US$35,000.

15. China

Aim

Investigation of status and conservation needs of rare and notable endemic swallowtails. Project Priority 2.

Background

The major species targeted are *Bhutanitis mansfieldi* (Rare), *B. thaidina* (Rare), *Luehdorfia chinensis* (Insufficiently Known) and the Golden Kaiser-I-Hind, *Teinopalpus aureus* (Insufficiently Known). Little information is available on the status of any of these: *B. mansfieldi* was rediscovered recently on Mount Gonga (Sichuan), and there is urgent need to

investigate its status, and probably institute protection, at this single locality; *B. thaidina* occurs in southwest China and Tibet, areas difficult of access, and is also commercially desirable; *L. chinensis* and *T. aureus* may both be threatened by habitat destruction, with the latter species being montane. It may already be extinct.

Action needed

Protected areas may be needed for all these species, together with improved knowledge of their biology.

Procedure

Liaison with knowledgeable Chinese and Japanese entomologists to explore the habitats and status of all these species should be encouraged. Effective trade regulation, and replacement of wild trade with captive-reared specimens should be pursued. At least three seasons of field work may be needed to assess these species in the remote areas in which they occur. **Initial cost:** US$50,000.

16. Taiwan

Aim

Investigation of conservation needs of *Papilio maraho* (Vulnerable) and other Taiwan endemic swallowtails. Project Priority 2.

Background

P. maraho is a commercially desirable montane species in the country supporting the world's largest and most intensive butterfly trade, and there is concern that intensive selective collecting in a rapidly contracting natural habitat may lead to its extinction. Other endemic Taiwan swallowtails appear not to be threatened at present, but Collins & Morris (1985) recommend monitoring of the status of *Atrophaneura febanus*, *A. horischanus*, *Papilio thaiwanus* and *P. hoppo* to assess the effects of continuing use in trade, and of continued destruction of habitat as this intensifies at higher altitudes.

Action needed

Survey of national parks of Taiwan to determine presence and status of *P. maraho* there. Surveys of other montane habitats are also needed, and protected areas should be expanded if *P. maraho* is not already secure in existing reserves. Control of the *P. maraho* trade is needed, possibly through banning it (as was done for an endemic Taiwan birdwing (*Troides aeacus kaguya*) by the former British Association of Entomological Suppliers), and there should be an investigation of captive breeding potential.

Procedure

Liaise (possibly through the Taiwan Museum) to organise a one-or-two season survey for *P. maraho* in suitable areas, including national parks. Biological studies on *P. maraho* should be carried out to plan a management strategy, and to replace wild-caught individuals in trade with captive-reared ones. **Initial cost:** US$ 40,000.

17. Japan

Aim

Conservation of *Luehdorfia japonica* (Vulnerable) and *L. puziloi inexpecta*. Project Priority 4.

Background

Changes in forest management are causing accelerated loss of suitable habitat for *L. japonica* in western Honshu, to which it is endemic. Open forest habitats were formerly thinned regularly to obtain timber and charcoal. They are now left to reach dense climax stages which are not suitable for the butterfly. This habitat decline, which is reportedly accelerating, requires management action. Golf course establishment has also been associated with a decline. *L. puziloi inexpectata* has declined around Mt Akagi-San because of urbanisation and over-collection: some colonies are already extinct and others threatened with extinction (Fuse 1990). The two species can hybridise, and the latter is also declining elsewhere.

Action needed

Protection of sufficient suitable habitat for both species to thrive, and security from over-collection.

Procedure

The Lepidopterological Society of Japan is aware of, and concerned with, threats to these species, as part of the recent strong interest in butterfly conservation in the country. The needs of both these species are now well-publicised. Protection from collecting seems to be imminent, and it may be possible to rear *Luehdorfia* in captivity for augmentation of field populations when secure sites are available. **Initial cost:** US$15-20,000.

18. Luzon (Philippines)

Aim

Conservation of the Luzon Peacock, *Papilio chikae* (Endangered), in Luzon. Project Priority 1.

Background

The Luzon Peacock is one of the most commercially desirable of the large Philippines swallowtail fauna, and is known from a few localities in northern Luzon. It has CITES Appendix I listing. Unusually, overcollecting may be a more serious threat than habitat destruction, though the latter is also occurring. Its detailed distribution is unknown, as is its larval biology, and there are no effective protected areas within its known range.

Action needed

Survey of species distribution and biology and protection of key habitat areas. There should be an investigation of the feasibility of ranching, once larval foodplants have been determined, to replace trade in wild-caught specimens.

Procedure

Some Japanese lepidopterists have recent information on the status of the Luzon Peacock, and believe it to be far more common than implied here. It is important to assess this knowledge, in conjunction with a field survey (one year) in Luzon. It might be possible to promote the conservation of the species as the basis of a sustainable ranching industry in Luzon. In view of the putative scarcity of the species, assessment of its status is urgent. See also project 19. **Initial cost:** US$35,000.

19. Philippines General

Aim

Provision of protected habitat for important endemic swallowtails. Project Priority 1.

Background

The Philippines has one of the highest ranked critical faunas of swallowtails, and many endemic species are threatened by habitat destruction. Important species are: *Graphium idaeoides* (Rare, several islands); *G. megaera* (Indeterminate, Palawan); *G. sandawanum* (Vulnerable, Mindanao); *Atrophaneura schadenbergi* (Vulnerable, Luzon and Babuyan); *A. atropos* (Indeterminate, Palawan); *Papilio osmana* (Vulnerable, Leyte, Mindanao); *P. carolinensis* (Vulnerable, Mindanao); and *P. benguetanus* (Vulnerable, Luzon). Several of these are endemic to single islands and have very restricted distributions there. Parts of the Philippines swallowtail fauna are very poorly known, and undescribed species may yet be found there. Rapid depletion of natural habitat, including the lack of management of protected areas (such as parts of Mt Apo National Park: habitat of *G. idaeoides, G. sandawanum*), suggests that the future for much of the notable Philippines biota is bleak.

Action needed

Sound protection of natural forest habitats in many parts of the Philippines, and assessment of the distribution of endemic swallowtails.

Procedure

Immediate emphasis should be on securing current protected areas against human intrusion, in conjunction with a broader attempt to conserve Philippines rainforest habitats. In important sites where no reserves exist, protected area establishment should be urged for endemic swallowtails. Surveys lasting from six months to one year should be pursued for each of the species listed above as a basis for formulating more detailed management plans. See parallel project for Indonesia, no. 20. **Initial cost:** US$45,000.

20. Indonesia

Aim

Integration of swallowtails into national conservation planning, and identification of centres of diversity. Project Priority 1.

Background

Indonesia is a key region for swallowtail conservation, and many species are extremely localised within the archipelago. Many provinces already contain substantial reserves which, if adequately buffered and protected, could ensure the conservation of a high proportion of the national swallowtail fauna. Land-use conflicts, however, and the intensity of impacts known to be causing additional habitat loss, need to be resolved. Areas which do not have sufficient protected areas include the Lesser Sundas (although the National Conservation Plan for Indonesia, 1981-82, recommends many new reserves and parks) and the Moluccas, especially the northern islands. The possibility of new reserves is a major theme of the eight volume Conservation Plan. Many of these proposed new reserves seem likely to incorporate areas of high swallowtail diversity.

Action needed

Urge the implementation of the provisions of the National Conservation Plan for Indonesia as a matter of urgency for

swallowtails. Investigation is needed of the status of endemic species and surveys should be carried out to detect, or enhance, knowledge of centres of diversity in most provinces. The possibility of commercial ranching of selected species should be explored.

Procedure

The Indonesian authorities should recognize their unique swallowtail fauna, and ensure attention to the conservation of swallowtails throughout the country. The WWF/PHPA Arfak Mountains Butterfly Farming Project, which is initiating such work in Irian Jaya as part of the Arfak Mountains Nature Conservation Area Management Plan 1988-92, and centres on an important habitat for birdwings, including the locally endemic Rothschild's Birdwing (*Ornithoptera rothschildi)* should be continued.

There should be an initial assessment of existing knowledge and further surveys (where needed) for: *Graphium stresemanni* (Rare, Seram); *Atrophaneura luchti* (Rare, east Java); *A. palu* (Insufficiently Known, Sulawesi); *Troides prattorum* (Indeterminate, Buru); *T. dohertyi* (Indeterminate, Talaud, Sangihe); *Ornithoptera tithonus* (Insufficiently Known, Irian Jaya); *O. aesacus* (Indeterminate, Obi); *O. croesus* (Vulnerable, Moluccas); *Papilio jordani* (Rare, Sulawesi); and *P. neumoegeni* (Vulnerable, Sumba). Priority should be given to those ranked highest in IUCN categories, and at least six months fieldwork is likely to be needed for each species. Projects on these species could sometimes be combined geographically, as for the Philippines (project 18). See also project 24 (Malaysia). **Initial cost:** US$45,000.

21. Papua New Guinea (1)

Aim

Conservation of Queen Alexandra's Birdwing, *Ornithoptera alexandrae* (Endangered). Project Priority 1.

Background

The world's largest butterfly has lost much habitat by conversion of forest to oil palm cultivation. It is now restricted to small areas near Popondetta (Northern Province) and has received considerable attention since it was proclaimed as protected fauna in 1966. However, it remains poorly known, because of its extreme rarity, and additional surveys of important habitat areas are needed. Proposals for reserves for this species already exist (Parsons 1983,1984) and studies on biology and conservation requirements are summarised by Parsons (1984). Three areas are proposed for designation as Queen Alexandra's Birdwing reserves, and these would offer substantial protection if they were a) gazetted, b) extempted from logging and road access and c) planted with stocks of the major larval foodplant, *Aristolochia dielsiana* (=*A. schlechteri*). Such Wildlife Management Areas (WMAs) are essential for butterfly conservation, and the existing WMA of some 11,000ha near Popondetta contains areas known to be frequented by the birdwing. Protection of some other areas is needed urgently. Once the likelihood of this species' long-term survival has been improved, measures should be taken to investigate Queen Alexandra's Birdwing's potential for ranching for commercial sale and augmentation of natural populations.

Action needed

Establishment of the reserves suggested by Parsons, especially the reserves proposed within the Kumusui Timber Area as well as safeguarding the existing WMA, and clarification of the status of the species there. A captive breeding facility should be established.

Procedure

Plans for the conservation of Queen Alexandra's Birdwing are well-defined, and the unusually high 'charismatic' appeal of this species should be of value in seeking sponsorship. The Fauna and Flora Preservation Society has recently supported surveys for 1991 and 1992, and other work is being funded by Conservation International. These field surveys should clarify the distribution of the species further. The proposed captive breeding facility in Papua New Guinea (the species cannot be exported legally at present) is likely to need very large flight cages, for which considerable funds will be needed. **Initial cost:** US$20,000 for surveys; up to US$100,000 for flight cages.

22. Papua New Guinea (2)

Aim

Conservation of native swallowtail species, particularly birdwings, and further integration of these into national conservation planning. Project Priority 1.

Background

Several species of birdwings (*Ornithoptera*) besides Queen Alexandra's Birdwing (project 21) have been heralded as Papua New Guinea's 'national butterflies' since they were proclaimed as protected fauna in 1966. Considerable impetus to the conservation of these, and of other species, has been given primarily through the marketing and ranching programme coordinated by the Insect Farming and Trading Agency (IFTA) at Bulolo, Morobe Province. There is considerable potential to augment this scheme, which has demonstrated to local people the practical economic potential for controlled harvesting of collector-desired species, by extending the programme carefully to include other rare species. Protection of habitat is essential for the conservation of threatened birdwings in Papua New Guinea.

7. *Parnassius apollo,* the Apollo

Photo: N.M. Collins

8. *Papilio chikae,* the Luzon Peacock

Photo: N.M. Collins

9. *Papilio himeros,* male, from Brazil

Photo: K.S. Brown, Jr.

10. *Parides ascanius,* **Fluminense Swallowtail, from Brazil - mating pair**

Photo: K.S. Brown, Jr.

11. *Papilio esperanza,* **from Mexico**

Photo: K.S. Brown, Jr.

12. *Parides pizarro*, **from Brazil**

Photo: K.S. Brown, Jr.

Action needed

Establishment of a fuller network of reserves to contain prime habitat for birdwings, using Parsons' (1983) proposals as a basis for discussions. The reserves should, therefore, include:

(a) Chimaera Birdwing, *Ornithoptera chimaera*, (Indeterminate). Reserves at Telefomin, Bundi, Naniwe Mission, Tapini-Woitape and Central Huon.

(b) Paradise Birdwing, *O. paradisea* (Indeterminate). Reserves at South Vanimo, Maprik, Frieda River, Lake Kutubu and East Erave.

(c) *O. meridionalis* (Vulnerable). Reserves at Frieda River, Lake Kutubu, Cape Rodney, Mamai Plantation, and Brown and Vanapa Rivers.

Procedure

The Papua New Guinea Government should recognize the outstanding international importance of rare birdwings, both as cultural symbols and as an economically significant natural resource which, through ranching and controlled sales, could bring benefit to many people in remote areas. The above potential reserves could all participate in expanding the current enterprise. The proposed Brown River reserve could receive priority, since it is close to Port Moresby, where it could form the basis of an important tourist attraction if the habitat could be enriched by foodplant cultivation. **Initial cost:** US$20,000.

23. Papua New Guinea/Solomon Islands

Aim

Conservation of rare swallowtails of Bougainville and the Solomon Islands. Project Priority 2.

Background

A number of significant swallowtail species occur in these two political units and for some of these it is not yet clear which country may be the more important for their conservation. The species involved include *Graphium meeki* (Rare), *G. mendana* (Rare) and *Papilio toboroi* (Rare). In addition, two localised Papua New Guinea species, *Papilio moemeri* (Vulnerable, New Ireland) and *P. weymeri* (Rare, Admiralty Islands), face similar needs of habitat protection, further survey work, and investigation of feasibility for captive ranching.

Action needed

Detection and protection of prime habitat for all species. Surveys of each species are needed to determine detailed distribution and basic biology as the basis for reserve establishment and possible captive breeding.

Procedure

In Papua New Guinea increased interest should be promoted through the IFTA and government officials. Surveys for all species should be carried out. *P. moemeri* has not been seen since 1924, for example, and may persist in parts of highland New Ireland. A proposed Wildlife Management Area in central Manus should be urgently declared, and would also benefit other Admiralties endemic biota. The Solomon Islands Government is receptive to the potential for commercial butterfly ranching but there is an urgent need for more reserved prime habitat, safe from forestry intrusions, to ensure the sustainable nature of this. *O. victoriae* is the main butterfly export from the Solomons. As in Papua New Guinea, much of the trade could be in the more common birdwings and other local swallowtails. **Initial cost:** US$20,000.

24. Malaysia

Aim

Conservation of rare montane swallowtails of East Malaysia. Project Priority 3.

Background

Three swallowtail species, *Graphium procles* (Indeterminate, Sabah), *Troides andromache* (Indeterminate, Sabah and Sarawak) and *Papilio acheron* (Rare, Sabah and Sarawak) are poorly known threatened montane butterflies in East Malaysia. Research and surveys are needed as a basis for practical conservation measures to be undertaken. All occur in the Mount Kinabalu National Park, and should be sought elsewhere in Borneo, including Kalimantan (Indonesia).

Action needed

Investigation of the status and habitat requirements of all three species on Mount Kinabalu, and enhancement of protection of the park from peripheral intrusion for agriculture. The Pinosuk Plateau may be particularly important for *T. andromache* and *P. acheron*. Both these species may also need protection on mountains in Sarawak, most likely in the Mount Mulu National Park.

Procedure

The conservation authorities in Sarawak and Sabah both encourage scientific research, and could help substantially with local facilities and expertise. Promotion of this project, and funding provision to these bodies for a one year survey of the

swallowtails, could provide the data needed. The initial priority should be study of the butterflies on Mount Kinabalu. **Initial cost:** US$15,000.

25. United States

Aim

Management of Schaus' Swallowtail, *Papilio aristodemus ponceanus* (Endangered). Project Priority 1.

Background

Schaus' Swallowtail is known only from Florida, United States, and was formerly much more widespread than it is at present. It has been federally listed as protected in the United States since 1976, and is a tropical species resident in a very peripheral habitat severely threatened by environmental degradation. The swallowtail appears to be declining even in the Biscayne National Park.

A recovery plan formulated by the United States Department of the Interior Fish and Wildlife Service (USDI 1982) includes a) protection of existing colonies and b) reestablishment of colonies within the species' recent historical range in Florida. Current work on population dynamics of the swallowtail is alleviating deficiencies in basic knowledge.

Action needed

Monitoring of the effectiveness of legislation banning collecting of all life stages of Schaus' Swallowtail, as part of the need to enhance legislative and voluntary protection efforts on behalf of the species. There should be studies of the species' amenability to captive rearing, for commerce, for release to augment existing populations, and as the source of material for reintroduction to historical sites. The species is not threatened in an overall sense, as it is widespread in the Bahamas.

Procedure

Encourage local voluntary conservation through increased public awareness, in part through effective liaison between local authorities and planners. Funds should be sought for the study of captive breeding potential. There should be continued monitoring of the species and its habitat. **Initial cost:** US$40,000.

26. Mexico

Aim

A conservation plan for *Papilio esperanza* (Vulnerable). Project Priority 2.

Background

This extremely rare species is now know from only one locality in Oaxaca State and, since the discovery of the species (described only in 1975), the Sociedad Mexicana de Lepidopterología has maintained watch over the type locality. Details of the precise site are kept secret, to prevent commercial collecting. A conservation plan is needed to ensure persistence of the species. The habitat may be vulnerable to human intrusions.

Action needed

A secure reserve should be established encompassing the butterfly's habitat in the Sierra de Juarez, and management for *P. esperanza* within this.

Procedure

Plans for a suitable reserve were proposed some years ago, and the importance of executing these plans need to be stressed. The Sociedad Mexicana de Lepidopterología is well-placed to provide details of the requirements of the species and of assistance required. See also project 27. **Initial cost:** US$5,000.

27. Mexico (2)

Aim

Monitoring of population trends of the Baronia, *Baronia brevicornis* (Rare). Project Priority 4.

Background

Although categorised by Collins & Morris (1985) as 'Rare', the Baronia is seemingly widely distributed and under no immediate threat, although some local populations may need to be protected. This primitive endemic species is of considerable scientific interest.

Action needed

Little, other than monitoring to increase ecological and biological knowledge of the species as an aid to any future conservation need.

Procedure

Record presence of the Baronia in reserves in Mexico, and (possibly through the Sociedad Mexicana de Lepidopterología) aid synthesis of available biological and distributional information. **Initial cost:** US$5,000.

28. Jamaica (1)

Aim

A conservation strategy for the Homerus Swallowtail, *Papilio homerus* (Endangered). Project Priority 1.

Background

This large and spectacular endemic species, listed by IUCN on its 'Top 12 Endangered Species List' in 1988, is threatened by destruction of its habitat and by commercial collecting in the small remaining populations. The basic biology of the species is now well-known (Emmel & Garraway 1990), and it may be amenable to ranching as a commercial venture (see also project 29).

Action needed

Formulation of a conservation management strategy. In December 1990 a project commenced on the Homerus Swallowtail at the University of the West Indies, funded by the Jamaica Agricultural Development Foundation, to study further its distribution and biology, and explore the establishment of a cottage industry farming programme. The Xerces Society has also (1991) commenced a major investigation on this species. Emmel & Garraway (1990) highlight the following objectives for a conservation biology programme:

a) intensive study of population ecology and environmental factors characteristic of habitat areas where Homerus occurs;

b) precise determination of the critical features of the life cycle which might contribute to increased survival;

c) negotiation with the Jamaican government to preserve the montane forest in and around the eastern habitats, and suspend cutting or conifer planting;

d) investigation of a captive breeding programme;

e) undertaking an international campaign to raise funds for habitat preservation - including the last significant virgin montane forest in Jamaica.

Procedure

Unusually, knowledge of the target species is already available, and relevant projects are underway. The establishment of a Jamaican Mountain National Park is very important. Current projects should be augmented to ensure that they are sufficiently well funded to achieve the major aims listed above. Current local moves to declare *P. homerus* the national butterfly of Jamaica should be supported. **Initial cost**: US$30,000.

29. Jamaica (2)

Aim

Conservation of the Jamaican Kite, *Eurytides marcellinus* (Vulnerable). Project Priority 2.

Background

The main stronghold of this endemic species is threatened by loss of the larval foodplant tree (*Oxandra lanceolata*) to cultivation. Populations fluctuate considerably for unknown reasons and the species can be locally common around Roselle, but is rare elsewhere on the island. A small reserve has recently been set aside for conservation of the larval foodplant, but larger well-protected habitats are needed.

Action needed

Protection of existing patches of *Oxandra* within the species' range, and a survey to determine distribution of this foodplant. Establishment of *Oxandra* on additional sites near the main colony should be pursued, and an investigation of the factors contributing to high mortality of the early life stages should be carried out. There should be investigation into possibilities of captive breeding, which are apparently restricted by the difficulty of containing the adults. Could link with project 28.

Procedure

Coordinate, possibly through the University of the West Indies and/or the Natural Resources and Conservation Department of Jamaica, attempts to preserve habitat and to extend plantings of *Oxandra* in particular sites. Funds are needed for site purchase and foodplant establishment. Increased study of the species' biology is needed, preferably of populations in secured habitats, and permanent protection of breeding colonies should be the major priority for the Jamaican Kite. **Initial cost:** US$20,000.

30. Hispaniola (Dominican Republic and Haiti)

Aim

Status evaluation and conservation of the Zetides Swallowtail, *Battus zetides* (Vulnerable). Project Priority 2.

Background

The Zetides Swallowtail has been recorded from both Haiti and the Dominican Republic, but may already be extinct in

Haiti because of destruction of its montane deciduous forest habitat. The largest population known in the Dominican Republic is on a bauxite mining concession on the Massif de La Selle, a site which also contains populations of rare mammals and thus has other significant factors to support its conservation. Recent work has revealed other colonies in the Republic, and some aspects of *B. zetides* biology have been studied, so that continued monitoring in relation to environmental change is important as well as ensuring habitat protection.

Action needed

Further survey for *B. zetides*, and clarification of its status in protected areas in the Dominican Republic and Haiti. Protection of the known habitat on the Massif de La Selle is essential. There should be continued monitoring of distribution and population trends of the swallowtail, and further studies of its biology.

Benefit to other Swallowtails

Could link with surveys for the scarce Haitian Swallowtail, *Papilio aristor* (Indeterminate).

Procedure

Continue international collaboration with local lepidopterists, and seek funds to sponsor objective study of the status of *B. zetides* in the Dominican Republic. Although there is a need to know whether or not it still exists in Haiti, that survey should be secondary. Increased protection should be given to national parks in the Dominican Republic, and there should be liaison with the National Parks Authority to initiate surveys within those areas. **Initial cost:** US$35,000.

31. Cuba

Aim

To obtain further information on the status and distribution of Poey's Black Swallowtail, *Papilio caiguanabus* (Indeterminate). Project Priority 4.

Background

The Cuban endemic Poey's Black Swallowtail is rare, but very little is known of any possible threats to this species, or of its presence in reserves.

Action needed

Survey of the status of the species, especially in protected areas in Cuba to determine whether it is secure there. An investigation is needed of the biology of *P. caiguanabus*, and of the seriousness of any threats to its populations.

Procedure

Initial surveys of protected areas in Cuba to determine whether populations there are secure and seek to increase protection, if needed. Such populations could then be targeted for more intensive biological study. If no populations are found in reserves, a more extensive survey (of perhaps two years) should be carried out. **Initial cost:** US$20,000.

32. Brazil (1)

Aim

Protection of Harris' Mimic Swallowtail, *Eurytides lysithous harrisianus* (Endangered) and the Fluminense Swallowtail, *Parides ascanius* (Vulnerable). Project Priority 1.

Background

The only known site of the formerly more widespread Harris' Mimic Swallowtail is undergoing development as a recreational area. The subspecies is of special significance in the study of mimicry systems in butterflies. As it is highly likely that it will become extinct within a very few years, urgent studies on its protection and ecology are needed. The model for the mimic swallowtail, namely the Fluminense (or Ascanius) Swallowtail, is more widely distributed but threatened by swamp draining and reclamation for building purposes or recreation. Both species were nominated for the official list of Brazilian animals threatened with extinction.

Action needed

E.l. harrisianus: protection of the sole known colony by preserving its habitat. Urgent studies are needed on management ecology. *P. ascanius*: protection is needed of the few swamps where it is known to occur. In particular, urgent surveys should be carried out of about 1000 km^2 of swamps in Rio de Janciro, where other colonies might exist (Otero & Brown 1986). Link with project 33.

Procedure

Promote urgent protection of known sites and ensure the integrity of existing reserves including, for the Fluminense Swallowtail: the Federal Biological Reserve of Poco das Antas and the Parque Reserva Marapendi. Monitoring of populations should continue and captive breeding of this species should be investigated through liaison with the Sociedad Brasiliera de Zoologia, which has been active in promoting butterfly conservation in Brazil and has a standing committee on threatened species. **Initial cost:** US$40,000.

33. Brazil (2)

Aim

Status clarification and conservation of rare swallowtails, excluding species in Project 32. Project Priority 3.

Background

Brazil's rich fauna of 74 swallowtail species includes eight threatened species, two of which are dealt with in the previous project. Information on most of these is fragmentary, and the general comments here exemplify the kinds of problems associated with the conservation of threatened neotropical butterflies. The species involved are:

The Yellow Kite, *Eurytides iphitas* (Vulnerable) is endemic to southeast and east central Brazil, but has not been seen for many years. As it may be a relict species with a naturally small range, a coordinated search for extant colonies is needed urgently. The habitats of any populations which exist should be protected.

Hahnel's Amazonian Swallowtail, *Parides hahneli* (Rare) is known only from three localities in Amazonas, and is threatened by commercial exploitation. Protection of its habitat is needed, together with measures to prevent over-exploitation.

Parides pizarro (Insufficiently Known) occurs also in Peru, where it may be effectively protected in the Tambopata Nature Reserve. The status of this species is unclear and needs fuller documentation.

Parides burchellanus (Vulnerable) is very rare in central Brazil, where it is associated with gallery forest in cerrado, and is vulnerable to flooding and forest cutting.

Papilio garleppi (Insufficiently Known) has an extensive distribution through Brazil, Peru, Bolivia and Guyana, but appears to be extremely rare. Nothing is known of its biology, or of its presence in any existing reserve.

Papilio himeros (Vulnerable) is also extremely poorly known, and has now disappeared from some of its former range. It is not known whether it is present in any of the various national parks in southeastern Brazil.

Summary of action needed for above

The above notes exemplify the overall lack of detailed knowledge of the status of many swallowtails in Brazil. The main initial needs are to safeguard habitat by establishment of reserves where necessary, but in some cases extensive searches are needed to determine where (and if) populations exist. As in Project 32, knowledgeable local lepidopterists are best placed to assess priorities. **Initial cost:** US$30,000.

34. South America, other than Brazil

Aim

Status clarification and conservation of selected rare swallowtails. Project Priority 3.

Background

Several other neotropical swallowtails have problems similar to those exemplified in Project 33, but may not be as amenable to investigation or documentation. Each of the following needs surveys to determine its status, and biological investigation.

Parides steinbachi (Insufficiently Known, Bolivia) is closely related to *P. pizarro*, and very little is known of its distribution or biology.

Parides coelus (Insufficiently Known, French Guiana) is also very poorly known, and any conservation recommendations are premature.

Parides klagesi (Insufficiently Known, Venezuela) has been recorded from several areas of north and east Venezuela, but it is not yet possible to evaluate its status with any confidence.

Papilio maroni (Insufficiently Known, French Guiana) is known from very few specimens from the west of the country. Reasons for its apparent rarity are not understood.

Initial cost: US$20,000 for each species.

Budgets

Assessing the level of funds needed for any of the projects discussed in this Action Plan is very difficult, and the figures provided should be regarded solely as a 'working guide' to minimal funding required. Estimates for many projects may need to have additional air fare and subsistence components if they are undertaken by expatriate workers. There are difficulties in assessing local logistic costs and the level of local support which may be available. In some instances, a small amount of external funding may prime local support, but many projects will need to be funded wholly from outside.

The projects have overlapping needs and, thus, common funding requirements. The factors include:

i) Coordination of local knowledge.

ii) Field work, often in remote and 'difficult' areas. Surveys are sometimes desirable over extensive regions, including some which pose political difficulties of access at present. Some surveys would extend over more than one season.

iii) Assessment of effects of specific impacts or threats.

iv) Habitat protection: we have not presumed to consider budgets for this, but costs of land acquisition may be high.

v) Captive rearing trials, which may include the need for special facilities, such as large flight cages for birdwings.

Conclusion

The above examples of the kinds of project, which could be designed for a much broader range of taxa in many parts of the world, cover only those which are considered to be both practical and of broad significance in swallowtail conservation. Collectively they serve as a series of priorities in the broader field of conservation needs, and could markedly enhance knowledge for application to other taxa. Some demonstrate clearly the problems of trying to conserve species which are extremely poorly known. The CITES Appendix II species are not highlighted in these projects, but opportunity should be sought to consider these in any relevant surveys of suitable habitat or country. Clarification of their status is likely to result in some of these species receiving greater priority in the future.

It is no longer practicable to assume that swallowtails (or other invertebrates) vulnerable to outside pressures will be conserved automatically once their populations are included in a National Park or similar reserve. In many cases this is a vital first step; without a place to live, sometimes with very precise ecological requirements, a species cannot survive, and creating reserves is the most practical way to buy time for threatened swallowtails and the vast range of other invertebrates which need conservation. Swallowtails, though, should not be merely passengers in habitats reserved for other taxa, even though those others can be invaluable in endorsing the value of that habitat to a broader public. In some cases, as noted earlier, reserves need to be established urgently, primarily or solely for particular swallowtail species, if these butterflies are to survive.

Constructive management for each species can come only from a sound understanding of its biology. Some generalisations are possible, but details of the ecology of each species are ultimately unique, and practical field data are essential. In general, at least two seasons of information-gathering will be needed for each species, after initial appraisal, and a number of possible avenues could be followed in order to accomplish this:

i) Direct employment of scientists to do this work.

ii) Liaison with local scientific/naturalist groups, with provision of funding to coordinate searches and prepare reports.

iii) Funding of postgraduate studies in the increasing number of university departments willing to undertake studies of this nature. There are precedents, such as World Wide Fund for Nature UK support for butterfly studies.

iv) The possibility of ranching is a major practical spin-off from other conservation activities for swallowtails. There are concerned entrepreneurial lepidopterists in many parts of the world, and support specifically for ranching of particular species seems to be warranted. Such operations in areas coinciding with 'centres of diversity' or critical faunas would be of special merit.

The 'critical faunas' approach has considerable potential for identifying high priority habitats and areas for the conservation of many invertebrate groups, and its use and development should be encouraged strenuously on progressively local scales, or in association with particular ecosystems or major vegetation types.

We regret that much of the 'protective' legislation for swallowtails, whilst undoubtedly well-intentioned, has been based on unsound scientific appraisal and has been considered unnecessary by experienced lepidopterists. It has sometimes hindered more constructive conservation effort by alienating scientific and collector interest. In other cases, such legislation has served a valuable purpose in enhancing public awareness (Collins 1987a). There is a need for review of such legislation in many countries and the determination to make it effective; listing of species as protected should be augmented by funding and broader logistic support; and the conservation needs of the species listed must be clarified, to ensure their future survival. Local resources should be utilised wherever feasible to foster this aim and to ensure that such legislation is both appropriate and can be used as a tool in conservation management.

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Appendix 1. Papilionidae that need further investigation in order to determine their conservation status

Many of these are included because they are very poorly known, in some cases from very few specimens. Others (marked with an asterisk) are not immediately threatened, but need monitoring to establish status and decline in areas where habitats are being destroyed or where commercial collecting is intense.(After Collins & Morris, 1985)

SPECIES	LOCALITIES	NOTES
Parnassius delphius (Banded Apollo)	Soviet Union, Afghanistan, Pakistan, India, Bhutan, China	In Soviet Red Data Book. Protected legally in India.
P. stoliczkanus (Ladak Banded Apollo)	Afghanistan, India, Pakistan, China	Protected legally in India.
P. inopinatus	Afghanistan	Very localised. ?Rare.
P. loxias	Soviet Union, China	Possibly Rare.
P. acco (Varnished Apollo)	Pakistan, India, Nepal, China	Apparently Rare. One sub-species legally protected in India.
P. hannyngtoni (Hannyngton's Apollo)	India, China, ? Bhutan	Protected legally in India.
P. felderi	Soviet Union	
P. bremeri	Soviet Union, China, N & S. Korea, ?Japan, ?Mongolia	Declining in Korea, where proposed for legal protection and captive breeding.
P. actius	Soviet Union, Afghanistan, Pakistan, China	In Soviet Red Data Book. Declining in Soviet Union.
P. tianschanicus (Large Keeled Apollo)	Soviet Union, Afghanistan, Pakistan, India, China	In Soviet Red Data Book. Declining in Soviet Union.
Sericinus montela	Soviet Union, China, N & S Korea	In Soviet Red Data Book. Threatened by habitat change.
**Allancastria cerisy* (Eastern Festoon)	Balkans & Middle East	In Soviet and Ukraine Red Data Books. Protected legally in Greece.
A. caucasica	Soviet Union, Turkey	
A. louristana	Iran	
**Zerynthia polyxena* (Southern Festoon)	S. Europe to Balkans and Soviet Union	Vulnerable in Europe. In Soviet Red Data Book. Protected legally in Czechoslovakia, Greece, Hungary, parts of Austria.
**Bhutanitis lidderdalei* (Bhutan Glory)	Bhutan, India, Thailand,China	Protected legally in India. Threatened in Thailand?
**Luehdorfia puziloi*	Soviet Union, China, N & S Korea, Japan	In Soviet Red Data Book. ?Threatened in Japan and Korea. Proposed for legal protection and captive breeding in Korea.
Meandrusa sciron (Brown Gorgon)	China, India, Bhutan,Thailand, Myanmar	Protected legally in India.
Eurytides xanticles	Colombia, Panama	
E. bellerophon	Argentina, Brazil,? Paraguay	
E. earis	Ecuador, Brazil	
E. pausanias	Costa Rica to Brazil	

cont'd ...

Appendix 1, cont'd ...

SPECIES	LOCALITIES	NOTES
**Protographium leosthenes*	Australia	
Graphium mandarinus (Spectacle Swordtail)	China, Myanmar, Nepal	
G. alebion	China, Taiwan	
G. tamerlanus	China	
G. dorcus	Indonesia (Sulawesi)	
G. phidias	Vietnam, ?Laos	
G. olbrechtsi	Zaire	} Probably conspecific
G. auriger	Gabon	
G. pelopidas	Tanzania (Pemba)	
G. nigrescens (Dusky Swordtail)	Cameroon, Gabon, Zaire	
**G. gudenusi* (Kigezi Swordtail)	Zaire, Uganda, Rwanda, Burundi	
**Battus devilliers* (Devilliers Swallowtail)	Cuba, Bahamas	
B. eracon	Mexico	
**Parides gundlachianus* (Gundlach's Swallowtail)	Cuba	
P. phalaecus	Ecuador, Peru	? Rare
P. mithras	Guyana, Surinam, French Guiana, Brazil, Peru, Ecuador	
P. chabrias	Peru, Ecuador	
P. quadratus	Brazil, Peru	
P. orellana	Brazil, Peru	
P. cutorina	Peru, Ecuador	
P. phosphorus	Colombia, ?Venezuela, Guyana, Brazil, Ecuador, Peru	
P. castilhoi	Brazil	
**Atrophaneura antenor*	Madagascar	
A. daemonius	China	
**A. plutonius* (Chinese Windmill)	China, India, Nepal, Bhutan	Two subspecies protected legally in India
A. polla (De Nicéville's Windmill)	India, Myanmar, ?China, ? Indochina	Protected legally in India.
A. crassipes (Black Windmill)	India, Myanmar, ? China	Protected legally in India
	Indochina	? Very rare in China
A. adamsoni (Adamson's Rose)	Myanmar, Thailand	
A. laos	Thailand, Laos	
A. mencius	China	
A. impediens	China, Taiwan	
**A. febanus*	Taiwan	
A. hedistus	China	
A. kuehni	Sulawesi (Indonesia)	

cont'd ...

Appendix 1, cont'd ...

SPECIES	LOCALITIES	NOTES
A. priapus (White-head Batwing)	Java, Sumatra (Indonesia)	
**A. horishanus*	Taiwan	
A. dixoni	Sulawesi (Indonesia)	
A. rhodifer (Andaman Clubtail)	Andaman Islands	
A. oreon	Lesser Sundas (Indonesia)	
**Troides minos*	India	
**T. riedeli*	Tanimbar (Indonesia)	Protected legally in Indonesia.
**T. plato*	Timor (Indonesia)	Protected legally in Indonesia.
**Ornithoptera euphorion* (Cairns Birdwing)	Australia	Protected legally in Queensland.
**O. richmondia* (Richmond Birdwing)	Australia	Protected legally in Queensland.
Papilio ascolius	Central America to Ecuador	
P. neyi	Ecuador	
P. xanthopleura	Peru, Ecuador	
P. euterpinus	Colombia, Ecuador, Peru	
P. thersites (Thersites Swallowtail)	Jamaica	
P. oxynias (Cuban Black Swallowtail)	Cuba	
P. epenetus	Ecuador	
P. dospassosi	Colombia	
P. elwesi	China	
**P. demetrius*	Japan, N & S Korea, China	Extinct or Endangered in Korea?
**P. lampsacus*	Java (Indonesia)	
**P. thaiwanus*	Taiwan	
P. mayo (Andaman Mormon)	Andaman Islands (India)	Protected legally in India.
P. noblei (Noble's Helen)	Burma, Thailand, Loas, Vietnam	
P. antonio	Philippines	
P. biseriatus	Timor (Indonesia)	
P. diophantus	Sumatra (Indonesia)	
P. mahadeva (Burmese Raven)	Myanmar, Indochina, Malaysia	
P. hipponous	Talaud, Sangihe (Indonesia)	
P. heringi	Indonesia (Halmahera)	
P. godeffroyi	Western Samoa	
P. gambrisius	Seram, Ambon, Buru (Indonesia)	
P. aethiopsis (Abyssinian Blue-banded Swallowtail)	Ethiopia, Somalia	
**P. thuraui* (Blue-spotted Black Swallowtail)	Tanzania, Malawi, Zambia	
P. interjecta	Uganda, Kenya	

cont'd ...

Appendix 1, cont'd ...

SPECIES	LOCALITIES	NOTES
P. maesseni	Ghana, Togo	
**P. blumei*	Sulawesi (Indonesia)	
P. elphenor (Yellow- or Black-crested Spangle)	India, Myanmar, Thailand	Protected legally in India
P. kama	Palawan, Malaysia, Brunei, Indonesia	
P. hoppo	Taiwan	
**P. montrouzieri*	New Caledonia	

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