Animal Conservation (2004) **7**, 79–92 © 2004 The Zoological Society of London. Printed in the United Kingdom DOI:10.1017/S1367943003001215

Priority conservation areas for butterflies (Lepidoptera: Rhopalocera) in the Philippine islands

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(Received 7 January 2003; accepted 6 August 2003)

Abstract

Effective representation of all species in local conservation planning is a major challenge, particularly in poorly known but highly fragmented biological 'hotspots'. Based on 105 months of studies over 49 years, we reviewed the status of 915 species and 910 subspecies of butterflies known in the Philippines. We identified 133 globally threatened and conservation-dependent endemic Philippine taxa. The current system of 18 priority protected areas provides at least one protected area for 65 of these but no areas for 29 species and 39 subspecies. Of the 133 taxa, 71% do not have a stable population inside a priority site. A total of 29 taxa is endangered or critically endangered; 83% of these do not occur within a priority site. Least protected are the lowland taxa. The minimum network required to include each threatened and conservation-dependent taxon of butterfly within at least one area would comprise 29 sites. The Sulus and Mindanao hold disproportionate numbers of threatened butterflies. Our findings suggest limited cross-taxon congruence in complementarity-derived priority sets. A large proportion of the priority areas for Philippine butterflies do not coincide with known priority areas for mammals and birds. We demonstrate that a better resolved species level classification could reveal numerous 'new' priority areas. In tropical island and mountain regions where the distinctiveness of butterfly subspecies is high, significant evolutionary units may be lost unless fine-scale conservation planning pays attention to well-defined subspecies.

INTRODUCTION

In recent years, there has been considerable progress in developing quantitative techniques for assessing conservation priorities based on species distribution data (Williams *et al*., 1996; Jennings, 2000; Margules & Pressey, 2000; Fairbanks, Reyers & van Jaarsveld, 2001). There are few examples of applying these methods in tropical regions on a sufficiently fine scale to be useful for conservation action.

The Philippines have an extraordinary biological diversity with, for example, 362 species and 1079 taxa (including subspecies) of butterfly found nowhere else (Treadaway, 1995). The country ranks high in terms of both rate of deforestation and extent of area deforested (FAO, 2001). Not surprisingly, it is among the world's top priority countries for conservation (ICBP, 1992; Olson & Dinerstein, 1998; Myers *et al*., 2000).

Countries contracting to the Convention on Biological Diversity are obliged to develop strategies that will preserve all biodiversity. Invertebrates dominate the animal community in terms of species richness, abundance and biomass (Wilson, 1987) but no such study has been carried out for Philippine invertebrates, although priority-setting workshops with wider expert input have been convened (DENR, Conservation International & University of the Philippines, 2002). Previously, priority areas for bird conservation have been identified (Hauge *et al*., 1986; Stattersfield *et al*., 1998; Peterson, Ball & Brady, 2000; Mallari, Tabaranza & Crosby, 2001; Curio, 2002) and gaps in the protection of mammals have been assessed (Heaney & Mallari, 2002).

The number of officially listed Philippine protected areas is large (DENR, 1998), but many have received virtually no real protection for many years (DENR *et al*., 2002). Since 1995, most protection efforts have been focused on 18 Priority Sites with funding from the Philippine government, the World Bank/Global Environment Facility and the European Union (DENR & UNEP, 1997) and targeted through the NIPAS legislation (DENR, 1992). Four of these sites are marine (Apo Reef, Coron, Siargao and Turtle Islands), leaving 14 sites or approximately 800 000 ha of reserved or proposed reserved land on which much of the current efforts to protect the terrestrial fauna depend (see Fig. 1(a) and Appendix).

In this paper, we explore the extent to which the current system of Priority Sites may be successful in protecting the Philippine butterflies. How many species of threatened

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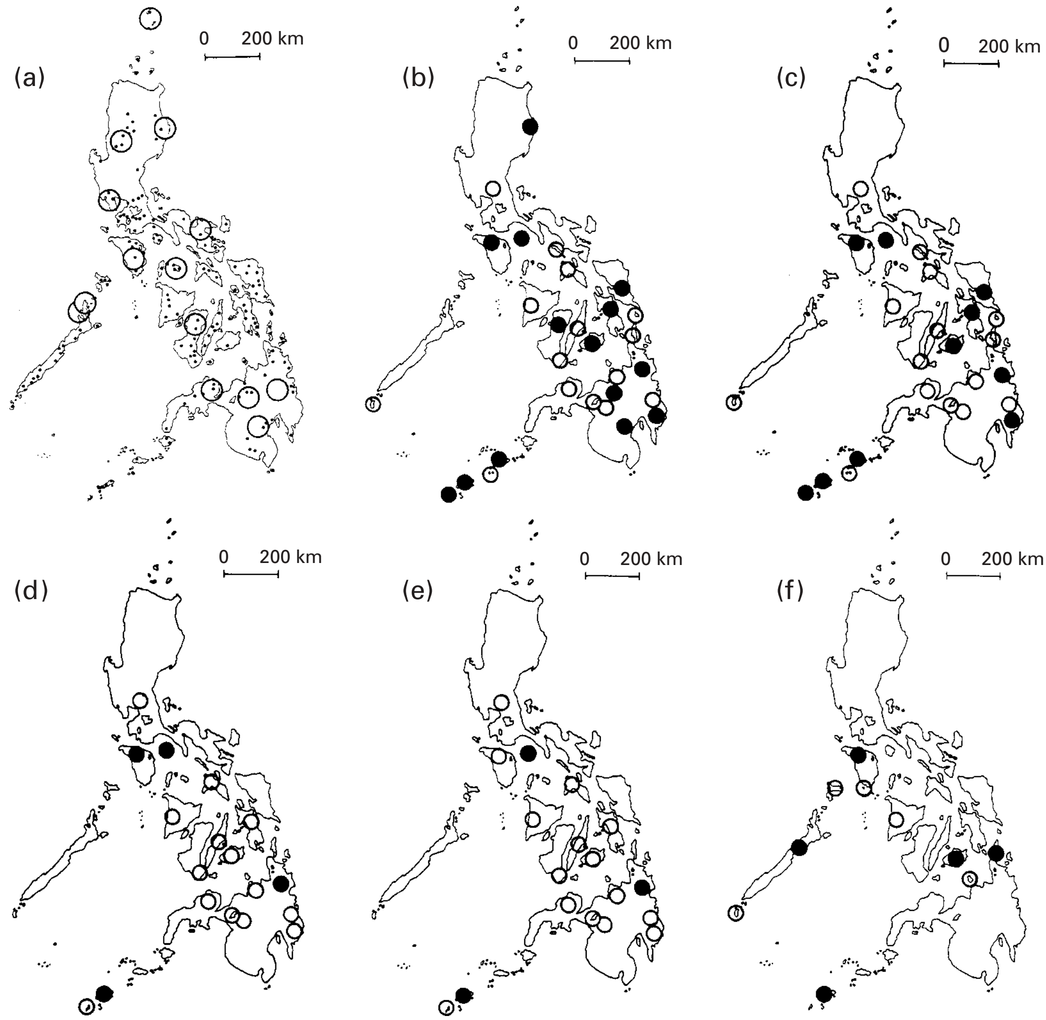

Fig. 1. (a) Location of the 14 terrestrial Priority Sites (○) and the observing and collecting sites for butterflies (●) in the Philippines. The names of the Priority Sites are provided in the footnotes to the Appendix. (b)–(f) Maps of the pattern of irreplaceability. The symbols indicate the irreplaceability values of sites, based on the number of taxa that are confined to, or possibly confined to, each site. The areas indicated by the circles are totally irreplaceable: if they are not conserved, one (open circles) or more (filled circles) taxa will not be covered. (b) and (c) are based on threatened/conservation-dependent species/subspecies of butterflies. (b) shows the overall pattern of irreplaceability, irrespective of the existing Priority Site network, whereas (c) shows the irreplaceability pattern on sites other than the Priority Sites. (d), (e) and (f) are based on full species of threatened/conservation-dependent (d) and threatened (e) butterflies and of threatened terrestrial mammals (f), on sites other than the Priority Sites (mammal data from Heaney & Mallari, 2002).

butterflies are known to occur within the 14 terrestrial Priority Sites? How many of those occurrences are likely to represent populations that will be stable indefinitely, given current circumstances? From the answers to these questions, we then also ask: how many additional areas are critical and where should these areas be located? We use threatened and conservation-dependent species and subspecies of butterflies as surrogate information to identify alternative Priority Sites.

There is currently no single species concept that can be adopted by consensus (Crowe, 1999). With few exceptions (Peterson & Navarro-Sigüenza, 1999; Fjeldså, 2000, 2003), previous analyses of priority conservation areas have used a standard classification, which generally follows the Biological Species Concept (Mayr, 1942) or have not specified what species concept was employed. However, under this concept, many subspecies may represent significant evolutionary units (Zink, 1997). This concept is challenged by phylogenetic systematists who advocate the Phylogenetic Species Concept, which recognises all diagnosable populations as species (Cracraft, 1983; Zink & McKitrick, 1995). The distinctiveness of many subspecies in tropical island and mountain faunas is such that the subspecies may represent full species under the Phylogenetic Species Concept. In this paper, we use data on both biological species and subspecies and evaluate the effects of taxonomic level on identifying priority areas.

We introduce a database on butterflies to the vertebrate-dominated Philippine conservation 'scene'. Butterflies are important herbivores and pollinators and the most charismatic insect group to non-entomologists (New & Collins, 1991). We hope this data will form a source of conservation motivation by paving the way for local decision-making. We also hope this paper will demonstrate the usefulness of rigorous analysis of species distribution data on the basis of check-lists and field notes for designing reserve networks.

METHODS

Information about the Philippine butterflies is accumulating rapidly. The Philippine Red List (Lastimosa, 1997) is out of date. We used a checklist (Treadaway, 1995), supplemented by new data from C. G. T. and others. The status of the 915 species and 910 subspecies of butterflies known from the Philippines was reviewed by C. G. T. using the international categories (IUCN, 1994). On this basis, we include 133 taxa (64 species and 69 subspecies) of globally threatened and conservation-dependent butterflies, including 100 taxa that are endemic to the Philippines at species-level and 33 at subspecies-level (see Appendix).

For each taxon, we indicate endemicity, known island and altitudinal distribution, whether it is known to occur in one of the 14 terrestrial Priority Sites, whether the population in the Priority Site is likely to be and remain stable in the future given current trends, status using the IUCN Categories (including the criteria the taxon has been judged to satisfy) and the name of the Priority Site where the taxon is known to occur (see Appendix).

In some cases, the occurrence is inferred. In such cases, we indicate (in the Appendix) that the occurrence is possible (P). In some instances, we are reasonably certain that they do not occur in a Priority Site (indicated as N).

We consider populations that exist within priority sites to be unstable if they are subject to continuing habitat destruction, as documented in recent publications. Statements of stability assume that the priority sites are, and will remain, well protected from mining, large-scale logging, large-scale clearing for agriculture and other major habitat disturbance. We used the same criteria as Heaney & Mallari (2002) so that direct comparison with their assessment of gaps in the protection of mammals was possible.

Complementary areas, determined by manual analysis, were used to find the minimum number of areas in which all threatened and conservation-dependent butterflies would be represented once (the near-minimum set).

The material is based on approximately 61 months of fieldwork and 44 months of setting and studying material caught during the 49 years that C. G. T. and co-workers observed and collected butterflies in the Philippines (Fig. 1(a)). Additional data were provided from Tsukada (1980, 1981, 1982, 1985, 1991), Eliot & Kawazoe (1983), Eliot (1986), Page (1987, 1997), de Jong & Treadaway (1993), Page & Treadaway (1995, 2003), Schroeder & Treadaway (2001), Takanami & Seki (2001) and the collections at the Senckenberg Museum and the British Museum (Natural History).

Nomenclature follows Treadaway (1995), except for the Papilionidae (Page & Treadaway, 2003). To minimise the risk to rare species, point record distribution data are not provided.

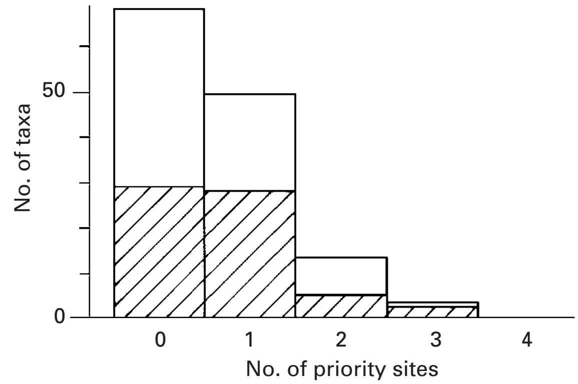

Fig. 2. Coverage of threatened/conservation-dependent butterfly species (shaded) and subspecies (open) in the 14 terrestrial Priority Sites in the Philippines.

RESULTS

Occurrence in the 14 Priority Sites

A total of 29 (21.8%) of the 133 threatened or conservation-dependent taxa is known to occur within one or more of the 14 terrestrial Priority Sites while another 36 is likely to do so. Of the threatened/conservation-dependent taxa, 16 (12%) occur or probably occur in more than one Priority Site (Fig. 2), while 68 (51%) of the 133 taxa do not occur in any of the Priority Sites. For these 68 taxa, the additional critical areas for protection are lowland forest in the Sulu archipelago (22 taxa), lowland and montane forests on Mindanao (18), lowland forest on Leyte (8), Samar (8) and Marinduque (3), montane forest on Mindoro (3), lowland forest on Bohol (2), Luzon (1), Burias (1), Masbate (1) and Panay (1), forest on Cebu (1) and lowland forest on Negros (1), Homonhon (1), Dinagat (1) and Balabac (1).

Some of these sites are officially protected but few receive active protection. There is minimal overlap between any of these areas in terms of the taxa that each protect: four of the taxa on Mindanao also occur on Samar (*Agatasa chrysodonia chrysodonia*, *Pirdana fusca*) and Leyte (*Chilana osmana*, *Halpe dante tilia*, *Pirdana fusca*). In addition, one species on Samar also occurs on Leyte (*Halpe inconspicua*). One species (*Ixias clarki*) is too poorly known to identify critical sites. Camiguin de Luzon (Babuyan) and Panaon (Misamis Occidental) each hold one threatened species that does not occur in the Priority Sites but which occurs on the larger islands, where there is a better chance of protecting them. We have therefore disregarded these islands in the analysis.

Stable populations in the 14 Priority Sites

Of the 133 taxa, 39 (29.3%) are believed to have populations within one of the 14 Priority Sites that will, or probably will, remain indefinitely stable, given current conditions. A total of 94 taxa (71%) do not have stable populations within one of the Priority Sites, either because they do not occur in a priority site (68 taxa), or because the population in the protected area is judged not to be stable (26 taxa).

Fig. 3. For legend see facing page.

Threat status and occurrence in the 14 Priority Sites

One species (*Ixias clarki*) and one subspecies (*Pantoporia epira epira*) are probably extinct. They are unlikely to have occurred in any of the 14 Priority Sites. A further 13 taxa are considered to be critically endangered: two of these do, or possibly do, occur in one of the Priority Sites and 11 do not (Fig. 3(a)–(k)). A total of 16 taxa is considered to be endangered: three possibly occur in one of the Priority Sites and 13 do not (Fig. 3(l)–(x)). While 78 taxa are considered to be vulnerable, 39 do, or possibly do, occur in the Priority Sites and 39 do not. Finally 24 taxa are considered to be lower risk but conservation-dependent: 21 of them do, or possibly do, occur in one of the Priority Sites and three of them do not.

Pattern of irreplaceability

Overall, there are 29 totally irreplaceable areas for threatened/conservation-dependent butterflies (Fig. 1(b)), including four existing Priority Sites (Northern Sierra Madre, Mt. Canlaon, Mt. Kitanglad and Mt Apo). There is no flexibility in the choice of areas that comprise the near-minimum set.

A total of 25 areas additional to the 14 Priority Sites will need protection if all threatened/conservation-dependent species/subspecies of butterflies are to be covered (Fig. 1(c)). One area is totally irreplaceable for 11 taxa (Tawitawi/Sanga Sanga). Four of these areas are totally irreplaceable for five taxa (Mt. Yacgun/Mt. Sohoton, Mt. Hilong-hilong/Mt. Diwata, Jolo, Sibutu). One area is totally irreplaceable for four taxa (Anonang-Lobi). Two areas are totally irreplaceable for three taxa (Mt. Halcon and the forest on Marinduque, if any remains), two areas for two taxa (the forest on Bohol and Mt. Puting Bato) and 15 areas for one taxon (Fig. 1(c)). All the 'goal-essential' taxa occur, or have certainly occurred, in the irreplaceable areas, with the exception of *Delias magsadana* (exact location unknown but probably Mt. Agtuuganon/Mt. Pasian).

Effects of taxonomic level

A total of 29 (45.3%) of the 64 threatened/conservation-dependent biological species does not occur in any of the 14 Priority Sites (Fig. 2). There are 22 totally irreplaceable areas for threatened/conservation-dependent species of butterflies. If our goal is to protect only the species that are threatened/conservation-dependent, we would need to protect 18 irreplaceable sites in addition to the Priority Sites (Fig. 1(d)). This would not afford protection to seven irreplaceable areas for 15 threatened/conservation-dependent subspecies, including two areas in which five subspecies are confined (Mt. Yacgun/Mt. Sohoton and Jolo).

DISCUSSION

Three important caveats apply. First, current knowledge of the distribution, status and biogeography of Philippine butterflies is limited, with 65% of the taxa in the Appendix being described after 1980. Although surveyed sites are widely spaced and the inventories have discriminated in favour of rarities, many taxa remain poorly recorded and some presumed local endemics and disjuncts may have a wider distribution. In addition, new taxa will be discovered. Since 1990, 38 endemic species and 212 endemic subspecies have been described. Taxonomic insights and higher-resolution data may trigger changes in the IUCN categories (e.g. Possingham *et al*., 2002; Lamoreux *et al*., 2003). Some areas have also not been surveyed (Fig. 1(a)), including the island of Lubang, which is known to be important to other taxa (DENR *et al*., 2002). Some taxa may also have shifted range as environmental conditions may have changed and some sites may prove to be unexpectedly degraded or impossible to protect, so it will be necessary to identify replacements where they exist.

Second, we do not know if the records and assigned conservation status accurately reflect the true distribution and status of the taxa. The data were collected from places where C. G. T. and co-workers expected to find what they were looking for. This is a notorious bias in museum data (Nelson *et al*., 1990; Margules & Austin, 1994). The field samples represent point records but personal experience of habitat preferences and vegetation data from ESSC (1999) and Mallari *et al*. (2001) were used to 'model' wider spatial distribution patterns. More advanced methods for modelling distribution patterns (Ponder *et al*., 2001) cannot yet be applied in the Philippines because of a lack of information on vegetation and physical and climatic conditions. In fact, it may be impossible to model distribution patterns given the shifting trade winds and

Fig. 3. Endangered Philippine butterflies that do not have a population within the current system of priority protected areas. The taxa (a)–(k) are Critically Endangered and (l)–(x) are Endangered. (a) *Chilasa osmana* (FW = 45 mm), male, Leyte; (b) *Chilasa carolinensis* (FW = 50 mm), female, Mindanao; (c) *Menelaides luzviae* (FW = 50 mm), male, Marinduque; (d) *Tanaecia dodong* (FW = 36 mm), male, Masbate; (e) *T. susoni* (FW = 32 mm), male, Cebu; (f) *Charaxes sangana juwaki* (FW = 34 mm), male, Sibutu; (g) *Poritia solitaria* (FW = 16 mm), female, Luzon; (h) *Acupicta inopinatum* (FW = 17 mm), female, Mindanao; (i) *Drina borromeorum* (FW = 16 mm), male, Tawitawi; (j) *Drupadia hayashii* (FW = 11 mm), male, Sibutu; (k) *Tanaecia lupina lupina* (FW = 45 mm), female, Jolo; (l) *Tarucus waterstradti simillimus* (FW = 11 mm), female, Mindanao; (m) *Balignina neptunus matbai* (FW = 50 mm), male, Tawitawi; (n) *Pachliopta antiphus elioti* (FW = 45 mm) male, Siasi Island; (o) *Appias aegis sibutana* (FW = 22 mm), male, Sibutu; (p) *Athyma pravara arturodyi* (FW = 28 mm), male, Sibutu; (q) *Athyma reta suluana* (FW = 26 mm), male, Tawitawi; (r) *Cynitia godartii laetitae* (FW = 29 mm), male, Sibutu; (s) *Euthalia anosia tawitawia* (FW = 30 mm), male, Tawitawi; (t) *Cyaniriodes libna tawicolana* (FW = 12 mm), male Tawitawi; (u) *Liphyra brassolis hermelnuydae* (FW = 38 mm), female, Homonhon Island; (v) *Rachana jalindra obsoleta* (FW = 18 mm), male, Tawitawi; (w) *Rachana plateni parvula* (FW = 18 mm), male, Sanga Sanga; (x) *Celaenorrhinus treadawayi samarensis* (FW = 20 mm), male, Samar. FW, forewing length.

typhoons and the varying and peculiar distributions of rainfall. The long time-frame over which data were collected could also potentially limit the accuracy of distribution (Hopkinson *et al*., 2001) but this problem is minimised due to the use of data collected primarily by one person and the comprehensive geographical coverage.

Although the IUCN criteria are intended to be clear, objective and straightforward, the options and qualifications they possess mean that their consistent application is difficult (e.g. Collar, Crosby & Stattersfield, 1994; Collar, Mallari & Tabaranza, 1999). In the absence of certain knowledge of e.g. range and population size, use of inference is often required. This is extraordinarily subjective and produces highly variable classifications, even between people familiar with and experienced in criteria application (Stattersfield, 1996). In this study, this problem is minimised due to the fact that most data were collected – and evaluated – by the same person.

Third, we used butterflies as surrogate information for the overall biodiversity values. Since larvae and imagines often depend on different plants and ecological conditions, butterflies may represent biodiversity in a wider sense. But the general patterns of cross-taxon congruence between complementary sets of priority areas have not yet been established (van Jaarsveld *et al*., 1998; Lund & Rahbek, 2002). In addition, current biodiversity representation does not equate to the ultimate goal of maintaining biodiversity over the long-term. We also need to identify those natural ecological and evolutionary processes that control and maintain biodiversity (e.g. Balmford, Mace & Ginsberg, 1998). Current knowledge of such processes in the Philippines is, however, very limited. Accommodating natural processes by ensuring that conservation areas are large or span substantial environmental gradients (Noss, 1996) remains largely theoretical, mainly because of the limited extent of remaining forest and the social and economic pressure on land. In addition, there is an inherent tension between the protected area size and the local participation and financial and organisational sustainability that can be achieved. While it has long been known that protection of lowland forest is critical, even in one of the most effectively managed protected areas, Mt. Kitanglad, the forest at the lowest altitude is now well above 1200 m and largely devoid of dipterocarps (NORDECO & DENR, 1998).

Representation of butterflies in protected areas

Despite the limitations, this study demonstrates several important points. A substantial proportion (49%) of the Philippine butterfly taxa that is considered threatened is believed to have a population in at least one of the 14 current terrestrial Priority Sites. However, 51% do not have a population within a Priority Site, demonstrating that additional areas must be conserved for the butterfly diversity of the Philippines to be maintained.

A total of 29 taxa is facing a high or extremely high risk of extinction in the wild in the immediate future. The fact that five of these are believed to occur within a Priority Site is promising for their survival but the converse observation that 24 (83%: Fig. 3) do not is yet another indication that the current system of Priority Sites is incomplete.

The existing priority sites are substantially better at protecting the montane than the lowland butterflies. While 60% of the threatened/conservation-dependent montane taxa are believed to have a population in the Priority Sites, only 36% of the lowland taxa have, or probably have, a population there. Furthermore, 48 of the threatened/conservation-dependent lowland taxa do not occur in any of the existing Priority Sites.

Cross-taxon congruence

Mammals are much better protected than butterflies in the existing Priority Sites, probably because they tend to have larger ranges. While 67% of the endangered or critically endangered terrestrial mammal species are believed to have a population in the Priority Sites (Heaney & Mallari, 2002), the corresponding figure for butterflies is only 25%.

The pattern of irreplaceability of threatened terrestrial mammals (Fig. 1(f)) shows limited coincidence with that of butterfly species of similar conservation status (Fig. 1(e)). A conservation strategy based on existing Priority Sites and irreplaceable areas for threatened terrestrial mammals and aimed at preserving all threatened taxa, would fail to capture eight critically endangered and 14 vulnerable species of butterflies. This lack of congruence suggests that in the Philippines and countries with similar biogeography and land-use intensity one group of organisms may not be a good indicator of the patterns of irreplaceability of other such groups at the fine scale of the present study. For threatened mammal and butterfly species combined, 24 areas, in addition to the 14 Priority Sites, are irreplaceable (Fig. 1(e)–(f)).

Twelve of the 25 irreplaceable sites for threatened/conservation-dependent butterfly species/subspecies (48%) have been identified as high priority areas for bird conservation based on the occurrence of significant numbers of threatened/conservation-dependent bird species (Mallari *et al*., 2001). These findings should further caution against the assumption that detailed studies of one or a few groups of organisms can serve as indicators for other such groups (Kessler *et al*., 2001).

The near-minimum network

We arbitrarily set our target level of species representation at one site. It is appropriate to ask if this is a suitable representational goal. Small numbers of species populations could easily be affected, e.g. by unpredictable catastrophic events such as fire, which may increase in frequency with climate changes (IPCC, 2001). Confining a species to one protected area may disrupt metapopulation dynamics, increasing the risk of local extinction and decreasing the chances of recolonisation (Margules & Pressey, 2000). However, the majority (58%) of the threatened/conservation-dependent Philippine butterflies are only known from one mountain or group of associated mountains. In addition, with the country's advanced state

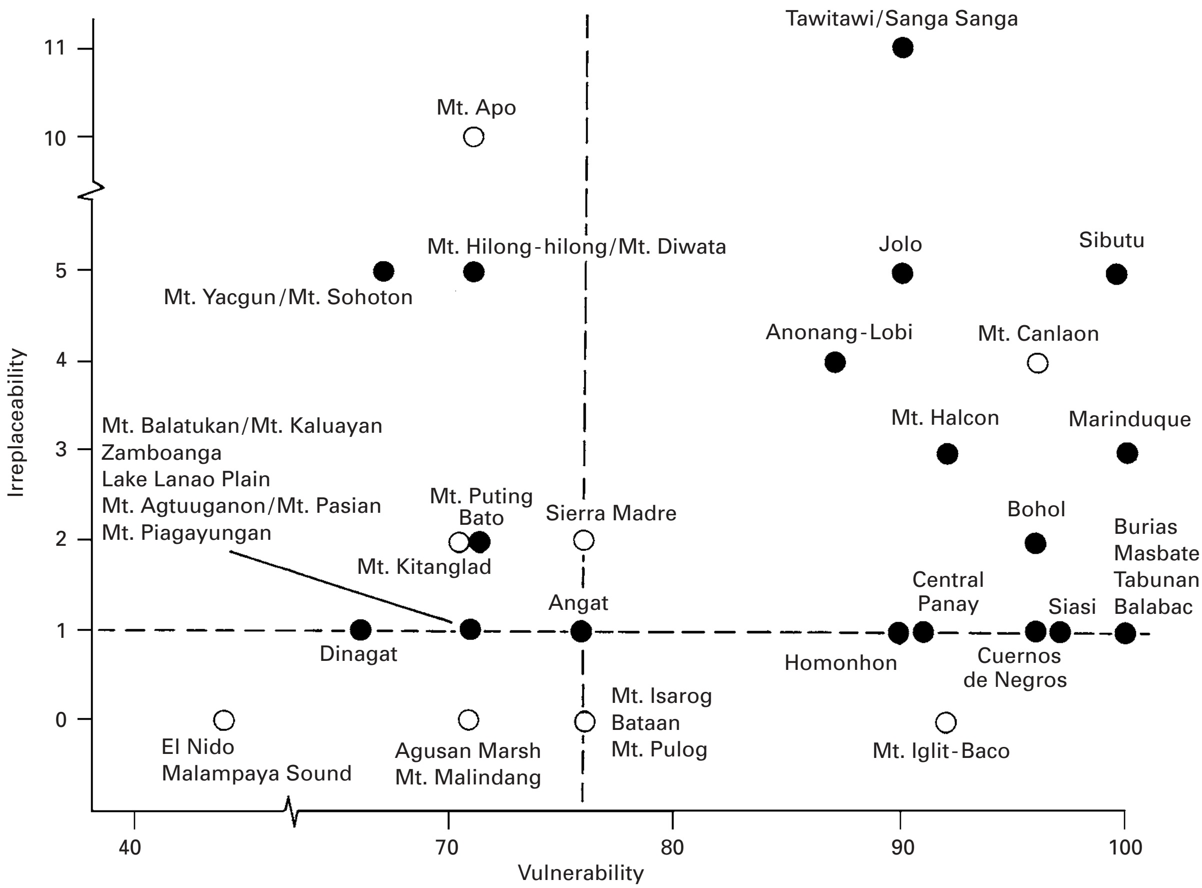

Fig. 4. The graph shows data for 12 existing (open circles) and 25 potential (filled circles) Priority Sites, each with values for irreplaceability and vulnerability. The *y*-axis shows irreplaceability, i.e. the number of threatened/conservation-dependent species/subspecies of Philippine butterflies that are confined to, or possibly confined to, each site. This indicates the extent to which the loss of the area will compromise national conservation targets. The *x*-axis plots vulnerability, i.e. the proportion of the island deforested (1987 forest cover data were taken from ESSC, 1999; data from Homonhon island (1990) and from Jolo, Siasi, Sibutu and Tawitawi/Sanga Sanga islands (1993) were from personal observation by C. G. T.). This indicates the risk of the area being transformed by extractive uses. Areas with high values of both irreplaceability and vulnerability should be prioritised for conservation action. They are the most likely to be lost and their loss will have the most serious impact on the achievement of targets. Because of lack of deforestation data, we have not included two existing Priority Sites (Batanes and Sibuyan) but both have no threatened/conservation-dependent taxa confined to their area.

of forest degradation and the limited level of protection that the existing priority protected areas afford, we think it unrealistic to aim at representation within two sites or more.

Resources are insufficient for rapid implementation of the conservation of 25 additional areas for butterflies. Decisions are needed as to the location and relative timing of conservation action. A comparison of values on irreplaceability and vulnerability classifies the sites into four categories (see the quadrants in Fig. 4). Sites in the upper right quadrant are areas that are most likely to be lost and have the fewest replacements. Protection is urgent if targets are not to be compromised. These areas are Tawitawi/Sanga Sanga, Sibutu, Jolo, Anonang-Lobi, the forest on Marinduque, Mt. Halcon and the forest on Bohol. The area of forest at suitable altitude for the ‘goal essential’ taxa on each of these sites is estimated at less than 10 000 ha (Tawitawi/Sanga Sanga, Sibutu, Jolo, Marinduque and Bohol) and 10 000–60 000 ha (Anonang-Lobi, Mt. Halcon: from ESSC, 1999 and pers. obs.).

Sites in the lower right quadrant are areas vulnerable to loss but with more replacements. Holding measures are necessary to avoid loss of some species/subspecies. These areas are Burias (although *Pantoporia epira epira* may already be extinct because of extirpation of its habitat: lowland riverine forest), Masbate, Tabunan, Balabac, Siasi, Cuernos de Negros, Central Panay mountains and Homonhon. The area of forest on each of these sites is estimated at less than 1 000 ha (Burias, Masbate, Tabunan, Balabac, Siasi, Homonhon: from ESSC, 1999 and pers. obs.) and 20 000–40 000 ha (Central Panay mountains: from Mallari *et al.*, 2001 and pers. obs. No data from Cuernos de Negros).

Sites in the upper left quadrant are areas with a lower current risk of conversion but high irreplaceability. Protection is less urgent, but these sites may be the only ones where large numbers of particularly sensitive taxa can be retained (e.g. Balmford, 1996). Sites in the lower left quadrant are areas that are likely to be stable and require the least intervention.

Importance of taxonomic level

Although endemic species often show locally nested distributions (Fjeldså, 2000), our study indicates that large-scale changes in species limits will not only affect the details of gap analysis but may lead to the identification of a substantial number of 'new' priority areas. The number of threatened/conservation-dependent subspecies and species combined was twice as high as the number of biological species. When we used only data on biological species, we failed to identify seven out of the 29 areas (24%) comprising the minimum set of areas required to represent all threatened/conservation-dependent taxa. With a better phylogenetic resolution, the 15 subspecies of threatened/conservation-dependent butterflies confined to these seven areas may prove to represent full species. Our findings suggest that in tropical island and mountain regions where the distinctiveness of butterfly subspecies is high, site-level conservation planning should pay attention to well-defined subspecies. Otherwise, significant evolutionary units may be lost.

Management implications

The 14 existing Priority Sites where the government has focused protection efforts with support from multilateral donors cover 2.7% of the land area of the Philippines, far from the 12% of total protected land area called for by the Brundtland Commission and IUCN (WCED, 1987; Noss, 1996; Soulé & Sajayan, 1998). While protecting forest areas can take many different forms, gap analyses typically recommend the establishment of additional protected areas (Peterson *et al*., 2000; Heaney & Mallari, 2002). Establishing further protected areas may be unrealistic given that, even in the existing Priority Sites, the Philippine government has not – in the 7 years of operating conservation projects there – been able to fulfil its original commitments in terms of increasing the number of permanent protected area staff and providing funds for basic operations in the areas (World Bank, 2002). Consequently, the overall sustainability of the US $25 million of investments from the international community in these projects is questionable.

The government has made considerable efforts to curb the degradation of natural ecosystems, but the country is short of funds. In addition, the institutional capacity of the Department of Environment and Natural Resources (DENR), the Protected Area Wildlife Bureau (PAWB) and DENR's regional offices to administer and manage protected areas at the field level is limited. Fortunately, most of the sites that are important to conservation are located in remote areas (Fig. 1(b)) where access is difficult.

We recommend that the PAWB, with Philippine non-governmental organisations (NGOs), assess which of the proposed additional important sites are protected by physical barriers, such as rugged terrain/steep slopes and remoteness, or are otherwise relatively safe, e.g. because of local bylaws and the resource monitoring of indigenous people regulating natural resource management. The remaining areas where better forest protection is urgent and necessary could be protected by strengthening collaboration with indigenous people or powerful local governments (such as Sangguinang Bayans and Barangay Captains at the local level and the governors at provincial level) and encouraging the conservation of the remaining forest blocks as part of a mainstreaming of environmental concerns into the overall land-use development of these areas. The new Wildlife Conservation Act (DENR, 2001) could provide the legal basis. Cooperation with the Department of Agronomy and the Department of Interior and Local Government would be essential. In some cases, establishing new protected areas (or translating existing 'paper parks' into effectively managed protected areas) may be appropriate but in many cases careful and constructive reinforcement of community policies and traditions may work better.

Conservation action for butterflies is urgently needed on Tawitawi/Sanga Sanga, Jolo and Sibutu (Fig. 4). There are no known replacement areas for 21 threatened/conservation-dependent species/subspecies of butterflies. The islands are located within the Autonomous Region of Muslim Mindanao (ARMM). The political situation has long constrained external involvement in natural resource management. In the meantime, much of the forest has been converted (e.g. Dutson, Allen & Brooks, 1996). It is suggested that PAWB and the Philippine NGOs explore the possibility of the government inviting an independent international organisation acceptable to ARMM decision-makers to discuss realistic measures for protecting the remaining forests.

Acknowledgements

With thanks to F. Brammer, J. Fjeldså, L. Heaney, A. Jensen, N. A. Mallari and M. Poulsen for comments and inspiration and P. Alviola, D. Balete, O. Figuracion, V. Gapud, J. Lind, M. Mendoza, M. Nissen, P. Ong, J. Rasmussen, R. G. Rosell-Ambal, M. Stoltze, E. Stukenbrock and T. Heegaard for other assistance. C. G. T. is grateful to P. Ackery, the late J. N. Eliot (†), T. C. Howarth, R. Vane-Wright (UK), W. Nässig, J. Settele, H. Schröder (Germany), M. Page (Switzerland), the Arimas, Cabale, Lumawig, Mohagan, Rodriguez and Villan families and C. Baltazar, B. Cayabyab, the late H. (†) and G. (†) Nuyda and H. Schönig (†), as well as the late J. Jumalon (†) and his family (Philippines), H. Hayashi, Y. Takanami and T. Yokochi (Japan), T. Achilles (Thailand) and A. Ballantine (Hong Kong) for their helpful input and advice.

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Appendix. Occurrence of threatened and conservation-dependent endemic Philippine butterflies on existing priority protected area sites

Taxon	Endemicity[a]	Island distribution[a]	Occurrence on priority site	Altitude[b]	Threat category IUCN[c]	Population stability[b]
Balignina neptunus dacasini Schröder, 1976	○	Pal	P (EO, MS)	L	$VU_{(A1c; B1; D2)}$	US
Balignina neptunus matbai Schröder & Treadaway, 1990	○	Taw	N	L	$EN_{(A1c; B1; B2c; C2a)}$	US
Pachliopta antiphus antiphulus Fruhstorfer, 1902	○	Jol	N	L	$VU_{(A1c; B1; B2c; D2)}$	US
Pachliopta antiphus elioti Page & Treadaway,1995	○	Sis	N	L	$EN_{(B1; B2c; C2b)}$	US
Pachliopta strandi nuydaorum Page & Treadaway, 1997	●	CW/C-Luz (Bat)	P (BNP)	L	$EN_{(B1; B2c; B3a)}$	US
Pachliopta phlegon C. & R. Felder, 1864	●	W-Mno (Zmn, Zms)	N	L	$VU_{(A1c; B2c; B3a)}$	S
Pachliopta schadenbergi schadenbergi Semper, 1891	●	NW/C/E-Luz	P (BNP)	L	$VU_{(A1c; B2c; B3a)}$	S
Pachliopta schadenbergi micholitzi Semper, 1891	●	Bab, CmL, NE-Luz	Y (NSMNP)	L	$VU_{(B1; B2c)}$	S
Chilasa osmana Jumalon, 1967	●	SE-Ley, NE-Mno	N	L	$CR_{(A1c,d; B1; B2c)}$	US
Chilasa carolinensis Jumalon, 1967	●	NE/E/SE-Mno	N	L	$CR_{(A1c,d; A2; B1; B2c)}$	US
Chilasa paradoxa melanostoma Jordon, 1909	○	Pal	P (EO, MS)	L	$VU_{(A1c; B2c; B3a)}$	US
Papilio antonio negrosiana Schröder & Treadaway, 1991	●	S-Neg	P (MCNP)	L-M	$EN_{(A1c; B1; B2c; B3b)}$	US
Achillides chikae chikae Igarashi, 1965	●	N-Luz	Y (MPNP)	H	LR-cd	S
Achillides chikae hermeli Nuyda, 1992	●	N-Mdo (Hal)	N	H	$VU_{(B1; B2c; C2b)}$	S
Menelaides luzviae Schröder & Treadaway, 1991	●	Mar	N	L	$CR_{(A1c; B1; B2c)}$	US
Graphium sandawanum sandawanum Yamamoto, 1977	●	S-Mno	Y (MANP)	H	LR-cd	S
Graphium sandawanum joreli Nuyda, 1994	●	C-Mno	Y (MKRNP)	H	LR-cd	S
Pathysa euphratoides Eimer, 1889	●	C/S/E-Mno	P (MKRNP, AM, MANP)	L-M	$CR_{(A1c; B2c; B3c)}$	US
Delias hyparete lucina Distant & Pryer, 1887	○	Jol	N	L	$VU_{(D2)}$	S

Appendix. Continued

Taxon	Endemicity[a]	Island distribution[a]	Occurrence on priority site	Altitude[b]	Threat category IUCN[c]	Population stability[b]
Delias blanca uichanco Jumalon, 1975	○	Boh	N	L	VU$_{(A1c; B1; B2c; D2)}$	US
Delias pasithoe mera Talbot, 1928	○	Luz, Mno	P (NSMNP)	L	LR-cd	S
Delias hidecoae Nakano, 1993	●	Mdo (Hal)	N	M	LR-cd	S
Delias mandaya Yamamoto & Takei, 1982	●	SE-Mno (Put)	N	H	VU$_{(B1; B2c; D2)}$	S
Delias magsadana Yamamoto & Takei, 1995	●	SE-Mno (Mag)	N	H	VU$_{(B1; B2c; D2)}$	S
Appias aegis sibutana Schröder & Treadaway, 1989	○	Stu	N	L	EN$_{(A1c; B1; B2c; C2b)}$	US
Ixias clarki Avinoff, 1925	●	N-Luz, Mno	N	H?	EX?$_{(last\ rec. 1903)}$	US
Terinos romeo Schröder & Treadaway, 1984	●	W/NW-Pan	N	L-M	VU$_{(A1c; B1; B2c)}$	US
Athyma pravara arturodyi Schröder & Treadaway, 1991	○	Stu	N	L	EN$_{(A1c; B1; B2c; C2b)}$	US
Athyma reta suluana Schröder & Treadaway, 1991	○	Taw	N	L	EN$_{(A1c; B1; B2c; C2b)}$	US
Athyma saskia Schröder & Treadaway, 1991	●	E-Luz (Ang)	P (NSMNP)	L	VU$_{(A1c; B2c)}$	S
Tanaecia dodong Schröder & Treadaway, 1978	●	Mas	N	L	CR$_{(A1c; B1; B2c; C2a)}$	US
Tanaecia susoni Jumalon, 1975	●	Ceb	N	M	CR$_{(last\ rec. 1965) (A1c; B1; B2c; C2a)}$	US
Tanaecia lupina lupina Druce, 1874	●	Jol	N	L-M	CR$_{(last\ rec. 1874) (B1; B2c; C2b)}$	US
Cynitia godartii dhayma Fruhstorfer, 1913	○	Jol	N	L	VU$_{(B1; B2c; C2a)}$	US
Cynitia godartii laetitae Schröder & Treadaway, 2000	○	Stu	N	L	EN$_{(B1; B2c; C2b)}$	US
Euthalia mindanaensis Schröder & Treadaway, 1978	●	NE-Mno (Sur)	N	L	VU$_{(A1c; B1; B2c)}$	US
Euthalia anosia tawitawia Treadaway & Nuyda, 1994	○	Taw	N	L	EN$_{(B1; B2c; C2a)}$	US
Bassarona piratica dinagatensis Tsukada, 1991	●	Din	N	L	VU$_{(A1c; B1; B2c)}$	US
Pantoporia hordonia maria Schröder & Treadaway, 1996	○	Taw	N	L	VU$_{(B1; B2c; C2a)}$	US
Pantoporia epira epira C. & R. Felder, 1863	●	Bur	N	L	EX?$_{(last\ rec. 1863)}$	US
Pantoporia epira heliobole Semper, 1878	●	E/C/S-Mno (S Cot)	P (MKRNP, AM)	L	VU$_{(A1c; B2c)}$	S
Pantoporia epira luzonensis Eliot, 1969	●	NE-Luz	Y (NSMNP)	L	VU$_{(A1c; B1; B2c)}$	S
Pantoporia epira epirana Schröder & Treadaway, 1996	●	C-Sam	N	L	VU$_{(B1; B2c)}$	S
Lasippa pizarrasi M. & T. Okano, 1986	●	Boh	N	L	VU$_{(A1c; B1; B2c)}$	S
Neptis felisimilis Schröder & Treadaway, 1983	●	Pal	P (EO, MS)	L	VU$_{(B1; B2c)}$	S
Helcyra miyazakii Tsukada, 1991	●	NW-Luz	P (MPNP)	M-H	CR$_{(last\ rec. 1984) (A1c; B1; B2c; C2a)}$	US
Polyura moori galeoni Schröder & Treadaway, 1990	○	Taw, Sga	N	L	VU$_{(A1c; B1; B2c; D2)}$	US
Polyura schreiber praedicta Schröder & Treadaway, 1980	○	Pal	P (EO, MS)	L	LR-cd	S
Charaxes sangana sangana Schröder & Treadaway, 1988	●	Taw, Sga	N	L	VU$_{(A1c; B1; B2c; D2)}$	US
Charaxes sangana juwaki Schröder & Treadaway, 1988	●	Stu	N	L	CR$_{(last\ rec. 1990) (A1c; B1; B2c; B3a; C2b)}$	US
Agatasa chrysodonia chrysodonia Staudinger, 1890	●	Sam, NE/SE/ E-Mno	N	L	LR-cd	S

Appendix. Continued

Taxon	Endemicity[a]	Island distribution[a]	Occurrence on priority site	Altitude[b]	Threat category IUCN[c]	Population stability[b]
Agatasa chrysodonia heterodonia Semper, 1892	●	N-Mdo	P (IBNP)	L	LR-cd	S
Agatasa chrysodonia luzonensis Schröder & Treadaway, 1988	●	NE/E-Luz	Y (NSMNP) (MINP?)	L	$VU_{(A1c; B1; B2c)}$	US
Discophora sondaica samarana Schröder & Treadaway, 1995	○	Sam	N	L	$VU_{(B1; B2c)}$	S
Discophora simplex simplex Standinger, 1889	○	Pal	P (EO, MS)	L	LR-cd	S
Amathuxidia amythaon negrosensis Schröder & Treadaway, 1980	○	Neg	P (MCNP)	L	$VU_{(A1c; B1; B2c; C2a)}$	US
Zeuxidia semperi excelsa Rothschild, 1916	●	Neg	Y (MCNP)	L-M	$VU_{(A1c; B1; B2c)}$	S
Elymnias luteofasciata Okubo, 1980	●	S/E-Mno	Y (MANP)	M	$VU_{(A1c; B1; B2c)}$	US
Ptychandra ohtanii ohtanii Hayashi, 1978	●	S-Mno (MANP)	Y (MANP)	M	LR-cd	S
Ptychandra dannatti tagubensis Yamamoto &Takei, 1996	●	E/SE-Mno (Put)	N	H	$VU_{(B1; B2c)}$	S
Parantica schoenigi Jumalon, 1971	●	Mno	Y (MKRNP, MANP)	M-H	$VU_{(A1c; B2c)}$	S
Parantica davidi Schröder, 1976	●	N-Neg (MCNP)	Y (MCNP)	H	$VU_{(A1c; B1; B2c; D2)}$	US
Parantica noeli Treadaway & Nuyda, 1993	●	N-Mdo (Hal)	N	H	$VU_{(B1; B2c; B3a; D2)}$	US
Idea stolli hypata Fruhstorfer, 1910	○	Jol	N	L	$VU_{(D1,2)}$	US
Cyaniriodes libna samarana Schröder & Treadaway, 1994	○	Sam	N	L	$VU_{(B1; B2c)}$	S
Cyaniriodes libna tawicolana Schröder & Treadaway, 1994	○	Taw	N	L	$EN_{(B1; B2c; C2a)}$	US
Poritia solitaria Schröder & Treadaway, 1989	●	E-Luz (Ang)	N	L	$CR_{(only\ 1\ rec. 1988) (A1c; B1; B2c; C2b)}$	US
Poriskina phakos Druce, 1895	●	Luz, Sam, Mno	P (NSMNP)	L	$VU_{(A1c; B1; B2c)}$	US
Deramas ikedai Hayashi, 1978	●	S-Mno (MANP)	Y (MANP)	M-H	LR-cd	S
Deramas mindanensis Eliot, 1964	●	C-Mno (Lan, Kol)	N	L	$VU_{(B1; B2c)}$	US
Deramas sumikat Schröder & Treadaway, 1986	●	S-Neg (Tal)	N	L-M	$VU_{(A1c; B1; B2c; D2)}$	US
Deramas treadawayi Hayashi, 1981	●	S-Mno (MANP)	Y (MANP)	M-H	LR-cd	S
Liphyra brassolis hermelnuydae Schröder & Treadaway, 1988	○	Hom	N	L	$EN_{(A1c; B1; B2c; C2a)}$	US
Liphyra brassolis justini Schröder & Treadaway, 1988	○	E-Luz (Sie)	P (NSMNP)	L	$VU_{(A1c; B1; B2c; C2a)}$	US
Allotinus punctatus obtusus Schröder & Treadaway, 2000	●	Ley	N	L-M	LR-cd	S
Allotinus kudaratus Takanami, 1990	●	S-Mno (MANP)	Y (MANP)	H	$VU_{(B1; B2c)}$	S
Allotinus luzonensis Eliot, 1967	●	Luz	P (NSMNP, BNP, MINP)	L	LR-cd	S
Logania waltraudae Eliot, 1986	●	Sam, C-Luz	P (MINP)	L	$VU_{(A1c; B1; B2c; D1)}$	US
Lontalius eltus treadawayi Eliot, 1986	○	C-Sam	N	L	$VU_{(B1; B2c; D1)}$	US
Miletus atimonicus Murayama & Okamura, 1973	●	E-Luz, Mar, Neg, Mno	P (NSMNP, MCNP)	L	LR-cd	S
Miletus takanamii Eliot, 1986	●	NE-Mno (Sur)	N	L	$VU_{(B1; B2c)}$	US
Spalgis takanamii Eliot, 1984	●	S-Mno (MANP)	Y (MANP)	M-H	LR-cd	S
Una philippensis Schröder & Treadaway, 1986	●	C-Mno (Buk)	P (MKRNP)	M-H	$VU_{(B1; B2c; D2)}$	US

Appendix. Continued

Taxon	Endemicity[a]	Island distribution[a]	Occurrence on priority site	Altitude[b]	Threat category IUCN[c]	Population stability[b]
Prosotas maputi Semper, 1889	●	Luz, Mar, Neg, Mno	Y (MCNP)	L-M	$VU_{(A1c; B1; B2c)}$	S
Tarucus waterstradti simillimus Schröder & Treadaway, 1985	○	NE-Mno (Sur)	N	L	$EN_{(A1c; B1; B2c; C2a)}$	US
Udara aemulus Eliot & Kawazoe, 1983	●	S-Mno (MANP)	Y (MANP)	H	$VU_{(B1; B2c)}$	S
Sidima murayamai Eliot & Kawazoe, 1983	●	C-Mno (Mis)	N	L-M	$VU_{(B1; B2c; D2)}$	S
Arhopala simoni Schröder & Treadaway, 1999	●	Taw, Sga	N	L	$VU_{(B1; B2c; D2)}$	US
Arhopala luzonensis Takanami & Ballantine, 1987	●	NE/S-Luz	P (NSMNP)	L	$VU_{(B1; B2c)}$	US
Arhopala tindongani Nuyda & Takanami, 1990	●	N/NW-Luz	P (MPNP)	H	$EN_{(A1c; B1; B2c; C2a)}$	US
Arhopala ilocana Osada & Hashimoto, 1987	●	N/NW/NE-Luz	Y (NSMNP)	L	LR-cd	S
Arhopala arsenius arsenius C. & R. Felder, 1865	●	Luz	P (NSMNP, BNP, MINP)	L	$VU_{(A1c; B1; B2c)}$	S
Catapaecilma nakamotoi Hayashi, 1979	●	S/E-Mno	Y (MANP)	M-H	LR-cd	S
Catapaecilma evansi parva Schröder & Treadaway, 1988	○	N-Neg	Y (MCNP)	L	LR-cd	S
Catapaecilma nuydai Takanami, 1988	●	C-Mno (Buk)	Y (MKRNP)	M-H	LR-cd	S
Acupicta inopinatum Schröder & Treadaway, 1998	●	C-Mno (Cot)	N	M-H	$CR_{(B1; B2c; C2b)}$	US
Drina borromeorum Schröder & Treadaway, 1991	●	Taw	N	L	$CR_{(A1c; B1; B2c; B3b)}$	US
Cheritra aenea Semper, 1890	●	Mdo (Hal)	P (IBNP)	M	$VU_{(B1; B2c; D2)}$	US
Drupadia hayashii Schröder & Treadaway, 1989	●	Stu	N	L	$CR_{(A1c; B1; B2c; C1)}$	US
Pratapa tyotaroi ismaeli Hayashi, Schröder & Treadaway, 1983	●	C/S-Mno	Y (MKRNP, MANP)	M	LR-cd	S
Pratapa tyotaroi cadohaana Seki, 1997	●	Ley	N	L	$VU_{(B1; B2c)}$	US
Dacalana akayamai Hayashi, Schröder & Treadaway, 1983	●	S-Mno (MANP)	Y (MANP)	H	LR-cd	S
Dacalana halconensis Schröder, Treadaway & Nuyda, 1999	●	N-Mdo (Hal)	P (IBNP)	H	$VU_{(B1; B2c; D2)}$	US
Neocheritra manata manata Semper, 1890	●	NE/E-Mno (Sur, Dvo)	N	M-H	$VU_{(B1; B2c)}$	US
Paruparo annie Takanami, 1982	●	E-Luz	Y (NSMNP)	L	$VU_{(A1c; B1; B2c)}$	US
Paruparo rosemarie Seki, 1993	●	Ley	N	L	$VU_{(B1; B2c; D2)}$	US
Paruparo violacea Schröder & Treadaway, 1978	●	NE-Mno (Sur)	N	L-M	$VU_{(A1c; B1; B2c)}$	US
Paruparo mio Hayashi, Schröder & Treadaway, 1984	●	NE-Mno (Sur)	N	L-M	$VU_{(B1; B2c)}$	US
Rachana australis Schröder & Treadaway, 1990	●	W-Mno (Zms)	P (MMNP)	M	$VU_{(A1c; B1; B2c; D2)}$	US
Rachana jalindra balabacensis Schröder & Treadaway, 1986	○	Bal	N	L	$VU_{(A1c; B1; B2c; D2)}$	US
Rachana jalindra mindorensis Schröder & Treadaway, 1985	○	N-Mdo	P (IBNP)	L-M	$VU_{(A1c; B1; B2c)}$	S
Rachana jalindra shiraishii Takanami 1984	○	NW-Luz	P (NSMNP)	L-M	LR-cd	S
Rachana jalindra obsoleta Schröder & Treadaway, 1993	○	Taw, Sga	N	L	$EN_{(B1; B2c; B3d; C2a)}$	US
Rachana plateni parvula Schröder & Treadaway, 1989	●	Sga	N	L	$EN_{(A1c; B1; B2c; C2a)}$	US
Hypolycaena othona waltraudae Treadaway & Nuyda, 1994	○	Pal	P (EO, MS)	L-M	$VU_{(B1; B2c)}$	US

Appendix. Continued

Taxon	Endemicity[a]	Island distribution[a]	Occurrence on priority site	Altitude[b]	Threat category IUCN[c]	Population stability[b]
Hypolycaena irawana Hayashi, Schröder & Treadaway, 1984	●	C-Pal	P (EO, MS)	L	$VU_{(A1c; B1; B2c)}$	US
Hypolycaena schroederi Hayashi, 1984	●	Sam, C/S-Mno	Y (MANP)	L-H	$VU_{(A1c; B1; B2c)}$	S
Hypolycaena shirozui madilima Treadaway & Nuyda, 1995	●	Neg	Y (MCNP)	L-M	$VU_{(B1; B2c)}$	S
Virachola masamichii Okubo, 1983	●	SE-Mno (Dvn)	P (MANP)	M	$VU_{(B1; B2c)}$	S
Araotes perrhaebis Semper, 1890	●	Mno, Bas	Y (MANP)	M-H	$VU_{(A1c; B1; B2c)}$	S
Rapala masara Osada, 1987	●	S/E-Mno	Y (MANP)	M-H	LR-cd	S
Celaenorrhinus treadawayi samarensis de Jong & Treadaway, 1981	●	Sam	N	L	$EN_{(A1c; B1; B2c)}$	US
Coladenia igna marinda de Jong & Treadaway, 1992	●	Mar	N	L	$VU_{(A1c; B1; B2c; D2)}$	US
Thoressa justini justini Inoue & Kawazoe, 1969	●	N-Luz	P (MPNP)	M-H	$VU_{(A1c; B1; B2c)}$	US
Thoressa justini raphaeli Nuyda & Kitamura, 1994	●	Ley	N	L-M	$VU_{(B1; B2c)}$	S
Halpe dante dante Evans, 1949	●	Neg	P (MCNP)	L	$VU_{(A1c; B1; B2c; D2)}$	US
Halpe dante tilia Evans, 1949	●	Ley, W-Mno	N (LSeb?)	L-M	$VU_{(B1; B2c)}$	S
Halpe inconspicua de Jong & Treadaway, 1993	●	Sam, Ley, Pao	N	L	$VU_{(B1; B2c)}$	US
Notocrypta howarthi Hayashi, 1980	●	Mno	P (MKRNP, MANP)	M	$VU_{(B1; B2c)}$	US
Zographetus pallens de Jong & Treadaway, 1993	●	CmL, Mar	N	L	$VU_{(A1c; B1; B2c; D2)}$	US
Pyroneura toshikoae Hayashi, 1980	●	S-Mno	Y (MANP)	M-H	$VU_{(B1; B2c)}$	S
Pirdana fusca de Jong & Treadaway, 1993	●	Sam, Ley, Mno	N	L-M	$VU_{(B1; B2c)}$	S
Potanthus niobe niobe Evans, 1934	●	Sib, Neg, Din, Mno	P (MGGNP, MCNP)	L-M	$VU_{(A1c; B1; B2c)}$	US

[a] From Treadaway (1995) and C. G. Treadaway, unpublished results.
[b] Personal experience C. G. T.
[c] Personal experience C. G. T. using the categories and criteria of IUCN (1994).
Endemicity abbreviations are: ●, endemic to the Philippines at species level; ○, endemic to the Philippines at subspecies-level but not at species-level.
Island distribution range abbreviations are: N, north; W, west; E, east; S, south; C, central.
Ranges on Luzon and Mindanao are broken down into the following general areas: on Luzon, Isabela and Cagayan provinces are 'North East'; the provinces of Aurora and Quezon south to Lucena are 'East'; the subprovince Apayao and the provinces Kalinga and Ifugao are 'North'; Ilocos Norte and Sur, Abra and Benguet are 'North West'; Nueva Vizcaya and Pangasinan southwards to Batangas are 'Central West and Central'; the provinces of Quezon south of Lucena and Camarines Norte and Camarines Sur southwards to Sorsogan are 'South'. On Mindanao, the area north of a line from Iligan City to Prosperidad City and extending to the east coast is 'North'; the provinces of Occidental Misamis, Zamboanga del Norte, Zamboanga del Sud and Davao City limits are 'West'; the area between the line joining Iligan to Prosperidad extended to the east coast and the line joining Cotabato City to Davao City are 'Central'; the area east of a line joining Prosperidad and Davao cities is 'East'; the area south of a line joining Cotabato to Davao cities is 'South'.
Island distribution abbreviations are: Ang, Angat Dam (Sierra Madre); Bab, Babuyan; Bal, Balabac; Bas, Basilan; Bat, Batangas; Boh, Bohol; Buk, Bukidnon; Bur, Burias; CmL, Camiguin de Luzon; Ceb, Cebu; Cot, Cotabato; Din, Dinagat; Dvo, Davao Oriental; Dvn, Davao del Norte; Hal, Mt. Halcon; Hom, Homonhon; Jol, Jolo; Kol, Kolambugan; Lan, Lanao; Ley, Leyte; LSeb, Lake Sebu; Luz, Luzon; Mag, 'Mt. Magsad' (location believed to be Mt. Agtuuganon/Mt. Pasian); Mar, Marinduque; Mas, Masbate; Mdo, Mindoro; Mis, Misamis; Mno, Mindanao; Neg, Negros; Pal, Palawan; Pan, Panay; Pao, Panaon; Put, Mt. Puting Bato (= Mt. Tagubud); Que, Quezon National Park; Sam, Samar; Sga, Sanga Sanga; Sib, Sibuyan; Sie, Sierra Madre Range; Sis, Siasi (Sulu); Soh, Sohoton Bridge National Park; Stu, Sibutu; Sur, Surigao; Tal, Mt. Talinis; Taw, Tawitawi; Zmn, Zamboanga del Norte; Zms, Zamboanga del Sur.
Occurrence on Priority Site abbreviations are: Y, Yes; N, No; P, Possibly.
Priority Site abbreviations are: AM, Agusan Marsh Natural Park; BNP, Bataan Natural Park; BPLS, Batanes Protected Landscape and Seascape; EO, El Nido Managed Resource Protected Area; IBNP, Iglit-Baco National Park; MANP, Mt. Apo Natural Park; MCNP, Mt. Canlaon Natural Park; MGGNP, Mt. Guiting-Guiting Natural Park (Sibuyan); MINP, Mt. Isarog National Park; MKRNP, Mt. Kitanglad Range Natural Park; MMNP, Mt. Malindang National Park; MPNP, Mt. Pulag National Park; MS, Malampaya Sound; NSMNP, Northern Sierra Madre Natural Park.
Altitude abbreviations are: L, lowland (0–700 m asl); M, medium (700–1500 m asl); H, high altitude (above 1500 m asl); asl, above sea level.
Threat category abbreviations are: EX, extinct; CR, critically endangered; EN, endangered; VU, vulnerable; LR-cd, lower risk-conservation dependent.
Population stability abbreviations are: S, probably stable; US, probably unstable.