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DEFINING PRIORITIES IN THE MIDST OF UNCERTAINTY: THE CEPF ECOSYSTEM PROFILE PROCESS FOR WALLACEA

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Abstract
Conservation priorities in Wallacea were identified to inform planning of a Critical Ecosystem Partnership Fund (CEPF) grants facility. Priorities were defined using locality data for 560 globally threatened species which occur in Wallacea, as defined by IUCN. 251 terrestrial and freshwater Key Biodiversity Areas (KBAs) were identified. Locality records also allowed the identification of 74 marine KBAs, and information on range and habitat was used to identify a further 66 candidate marine KBAs. Approximately one-third of terrestrial KBAs have protected area status. To help focus conservation efforts, twenty-four terrestrial KBAs with single-site endemics and critically endangered species were identified. The study highlights the lack of data on many species, and the lack of a centralized repository for biodiversity information on Wallacea. Urgent research needs include survey work to confirm the presence of species in more sites, taxonomic work to clarify the status of some species and sub-species, and expert-lead threat assessments to update the Red List.

***Key words*:** Biodiversity, conservation, KBA, Red Data Book, Threatened species,

Background

No location in Wallacea is further than 100 km from the coast, and the fragmentation of the region into thousands of islands has had a defining influence on the social, political and economic landscapes. The majority of the region's 30 million people live in coastal areas, and many still derive their living from farms, forests and inland wetlands, as well as the sea. However, the

region is changing rapidly. Makassar, a city of more than a million people, is the centre of economic development in eastern Indonesia, and another four cities—Ambon, Manado, Mataram and Kupang—are nearing populations of 500,000. For centuries, these cities have been centres for the export of natural resources from Wallacea. Originally these were sandalwood, nutmeg and cloves, but now copra, coffee, minerals, timber and fish are the main exports.

Most of the participants in the Indonesian Science Association conference in Wakatobi will have made the flight from Makassar to Kendari and then to the island of Wangi-wangi. The view from the plane gave a glimpse of the natural wealth and the pressures on this extraordinary region. Deep seas, tiny islands, and coral reefs contrasted with forested hills, including some of the region's most dramatic karst scenery. Yet in each case there was also a threat – mining and quarrying; land clearance producing silt which muddies coastal waters; hills denuded and ringed by huge terraces, ready for planting with oil palm; expanding urban fringes, or rural smallholders clearing forest.

Biodiversity and the threats to it are not distributed evenly over the face of the globe. Conservation organizations can maximize the effectiveness of their limited funds by focusing on the places that are most important and where action is most urgent. Wallacea is one of thirty-five biodiversity hotspots, defined as regions that have at least 1,500 endemic plants species and have lost more than 70% of their natural habitat, that have been identified globally (Myers *et al.*, 2000; Mittermeier *et al.*, 2004). They cover only 2.3% of the Earth's surface but contain a disproportionately high number of species, many of which are threatened with extinction. Hotspots, therefore, are global priorities for conservation. The region's thousands of islands, covering a total of 33.8 million hectares supports highly diverse biological communities with many unique species. More than half of the mammals, 40% of the birds and 65% of the amphibians found in Wallacea do not occur outside the hotspot. Many of these species are endemic not only to the hotspot but also to single islands or mountains within it. Such species are highly vulnerable to habitat loss, hunting, collection and other pressures.

The study described in this paper was carried out for the Critical Ecosystem Partnership Fund (CEPF). CEPF provides grants to non-governmental and private sector organizations, communities and individuals so they can conserve critical ecosystems, located in biodiversity hotspots. The fund will start making grants to support conservation action in Wallacea in late 2014, and commissioned the writing of an 'ecosystem profile' (including this study) to ensure that grants are directed towards the most urgent and effective actions. Data for this study was collected from published and unpublished sources, through consultation with experts, and through an extensive process of public consultation through workshops in the region. Overall, 301 organizations and individuals not associated with any organizations participated in the ecosystem profile process.

The IUCN list of globally threatened species (those in the 'critically endangered', 'endangered' or 'vulnerable' categories of the IUCN Red List) was used as a reference for the identification of priority sites and actions within the hotspot. There are 560 such species in Wallacea, 308 of them terrestrial or freshwater species and 252 marine. Priority conservation actions were divided into species conservation actions, site conservation actions, and corridor conservation actions. The large number of conservation actions identified meant that further prioritisation was necessary to identify a set of priorities

which could feasibly be funded by CEPF given the funding (around 6 million USD) and time (four years) available.

The most widespread threat to biodiversity is loss of habitat, and the most cost-effective means of conservation is normally site-based interventions. Following the methodology of Langhammer *et al*. (2007), the study used locality records of globally threatened species and maps and satellite images to identify and delineate priority sites, known as Key Biodiversity Areas (KBAs). KBA identification incorporates the analysis of Important Bird Areas (Rombang *et al.*, 2002; Chan *et al.*, 2004; Trainor *et al.*, 2007) and the Alliance for Zero Extinction priority sites. 251 terrestrial KBAs were identified, 105 in the Lesser Sundas (82 in Nusa Tenggara and 23 in Timor-Leste), 95 in Sulawesi, and 51 in Maluku. Whilst all these sites are priorities, a sub-set of 24 was identified because they have critically endangered or endangered species, and are the only known site for at least one of the threatened species that occurs there (Table 1).

The site-based approach was more challenging for marine species, as many range widely and because locality information is heavily biased towards a small number of areas where there have been species-level studies. Confirmed location records were found for 186 of the 252 globally threatened marine species, and 74 marine KBAs were identified on this basis. To complete the marine KBA network and maximize the chance of covering the 66 species for which no locality data was available, additional candidate marine KBAs were identified with reference to existing marine protected areas, priority areas identified in recent marine priority setting processes, and proposed marine protected areas identified in that analysis. Candidate KBAs were also identified where important marine conservation values and terrestrial KBAs form a contiguous area. The analysis was discussed and refined with local stakeholders, experts and conservation organizations. In total 66 candidate marine KBAs were identified.

Table 1: List of 24 (of 251) terrestrial and freshwater KBAs prioritised because they have critically endangered or endangered species and are the only known site for at least one threatened species

Site	Province	Number of globally threatened species
Danau Poso	Central Sulawesi	21
Lore Lindu		42
Feruhumpenai–Matano		46
Morowali		25
Kokolomboi		2
Manupeu Tanadaru	East Nusa Tenggara	11
Mbeliling–Tanjung Kerita Mese		13
Ruteng		15
Manusela	Maluku	21
Pulau Buano		2
Gunung Kepala Madang		14
Gunung Batu Putih	North Maluku	8
Taliabu Utara		4
Sanana		3
Aketajawe		10
Morotai		10

Site	Province	Number of globally threatened species
Gunung Sahendaruman	North Sulawesi	11
Pulau Siau		5
Danau Tondano		4
Mahawu–Masarang		13
Danau Mahalona	South Sulawesi	14
Karaeng–Lompobattang		19
Pulau Tana Jampea		3
Pegunungan Tokalekaju	West Sulawesi	25

Priority species actions were defined for globally threatened species which would not necessarily be effectively conserved through site actions alone. These include species where individuals are collected for food or other uses, either in trade or for local use, and where such pressure is believed to be the principal cause of threat. 22 terrestrial species and 207 marine species (including 176 corals) were included on the list of species actions, which include education, policy change, enforcement, and further studies.

Finally, priority corridors were identified, defined loosely as large landscape units necessary for the maintenance ecological and evolutionary processes that species and sites depend on. Corridors can be identified for specific species that rely on larger areas of habitat than can be conserved in a single KBA, for species that are not mobile but occur at very low densities, because they provide habitat connectivity between KBAs, or because they provide environmental services, such as watershed protection, that are of ecological and economic importance.

Terrestrial corridors were defined on the basis of the presence of landscape species and for the role of the corridor in maintaining ecosystem services and connectivity between KBAs. Of 308 terrestrial globally threatened species, 26 were judged to be landscape species, either on the basis of known information about their ecology or on an assumptions based on large body size and relatively wide range. Ten landscape corridors were defined covering large, relatively contiguous areas of habitat where these species occur. In practice, the corridors cover most of the remaining forest in the large islands of the hotspot. The definition of corridor boundaries used ecological (primarily forest) boundaries where possible, but are necessarily approximate. A complementarity analysis, starting with the corridor with the highest number of threatened species, identified five corridors which between them cover all the threatened 'corridor' species: Central Sulawesi, Seram-Buru, Flores Forests, Halmahera, and Sumba.

Sixteen Marine corridors were defined based on identification of areas important for groups of wide-ranging or migratory species, or for critical ecological processes, such as spawning grounds. They were defined based on inputs from marine experts, and their boundaries are approximations of the limits of the conservation value contained by the corridor. Combining expert opinion and patchy data, it was tentatively concluded that the North Sulawesi and Halmahera corridors are the highest priority.

Whilst the study distinguished terrestrial from marine KBAs for reasons of data and administrative reality, in some places these sites form contiguous 'ridge to reef' ecosystems. Such areas are of especially high priority because they offer an opportunity to conserve ecological processes which work across the

boundaries of these ecosystems. In total, there are 64 terrestrial KBAs contiguous with 58 marine KBAs. In 37 cases, the terrestrial and marine KBAs share a border, while in 27 cases the terrestrial KBA is an island entirely within the marine KBA.

***Threats and the Conservation of species and KBAs*:** Data on threats to species and KBAs was gathered from stakeholders at the seven workshops held in Wallacea Data was collected for 197 KBAs (148 terrestrial and 49 marine). Additional analysis of land-use change and forest loss in and around all KBAs was obtained by comparing Ministry of Forestry land cover maps for 2000 and 2011 (for Indonesia only).

Threats were divided into 12 categories. The KBAs assessed experienced between one and six different categories of threat (mean=2.6, n=197). In marine KBAs, the most prevalent problem by far was unsustainable local fishing, reported for 73% of marine KBAs. Hunting and collection of coral and other biota were threats at one-third of the marine KBAs. Land-based threats were also significant, with mining a problem at one-third of the marine KBAs, pollution and sedimentation at over a quarter of the sites, and settlement and tourism development reported to be a threat to just under a quarter.

The most frequent threats to the 148 sampled terrestrial KBAs were local or small-scale exploitation, with hunting and collecting, smallholder agriculture and livestock grazing, and small-scale logging each reported as a threat to about half of the KBAs. However the greatest impact was from mining, reported as a threat for 45% of terrestrial KBAs. Pollution, urbanization, industrial agriculture and forestry plantations each affected just under a fifth of all KBAs. Commercial logging, infrastructure development and invasive species were each reported to affect less than 10% of terrestrial KBAs.

The 251 terrestrial KBAs in Wallacea cover 9.5 million hectares, about 30% of the 33.8 million hectare land surface. In Indonesia, more than three-quarters of the area of terrestrial KBAs (7.9 million hectares, 88%) is within the national forest estate, with 30% in forests designated for conservation, 30% in forests designated for watershed protection, and 27% in forests where licenses for timber exploitation or conversion to non-forest uses may be granted. Thus 70% of the terrestrial KBA area in Indonesia (6.2 million hectares) is outside the formal protected areas network. Of the 2.7 million hectares of KBAs that are within conservation areas in Indonesia, half (1.4 million hectares, 52%) is within 11 national parks, each with its own management budget and human resources. The remainder (1.3 million hectares, 48%) is in strict nature reserves, wildlife reserves, and other conservation reserves that are managed by regional Natural Resource Management agency staff. Government provides some 30 million USD per year for the management of the conservation estate in Wallacea.

In Timor-Leste, 16 of a total of 35 KBAs are protected by existing legislation, and another eight (possibly more) would be legally protected by legislation which was being discussed in mid-2014. Very limited funds are available for conservation management from the government, and donor funding is concentrated on human needs and peace-building.

***Conservation prioritisation using Red Lists*:** This study identified priority sites, corridors and species action with reference to the IUCN Red List and using the methodology of Langhammer *et al*. (2007) to define Key Biodiversity Areas. Using these global standard assessments allows the threats and priorities in the Wallacea hotspot to be compared with other hotspots, and across species groups. It also strongly focuses conservation action on the fate of species which are in imminent danger of

extinction, and therefore those which most urgently need attention. Nevertheless, the approach has significant limitations:

- Not all species have been assessed to determine their Red List status. Approximately 1,600 species in Wallacea have been assessed by IUCN. There will be species in danger of extinction that are not included in the list of globally threatened species, and therefore may not be covered by the conservation actions identified.

- For those species that have been assessed as globally threatened, data on population size, threats and trends are rarely available. The possibility of errors in assigning threat status, therefore, cannot be eliminated.

- The identification of KBAs based on locality data, not range maps, is a conservative approach which avoids the risk of conserving a site where a species is assumed to exist but may not. However it risks missing important sites because data on distribution is often incomplete.

- The dependence on species as the basis for defining conservation outcomes means that the discovery of new species and changes in species taxonomy, particularly splitting one species into several, will affect the selection and prioritization of conservation outcomes.

None of these limitations invalidates the approach, and alternative approaches also have risks associated with them, including the possibility that when conservation efforts are focused on the largest or most diverse sites, highly specialized, scarce species may be missed. The limitations do, however, suggest that the study should be viewed as one of several different ways of identifying conservation priorities in Wallacea. The following actions are priorities for improving the effectiveness of the definition of conservation actions:

- Implement studies, and publish existing studies, to describe new species and clarify the taxonomic status of many known species.

- Complete Red List assessments for more species in the Wallacea region, with special emphasis on (a) those species groups that have not yet been widely assessed, and (b) data-deficient species which apparently have limited ranges and small populations.

- Carry out field work to improve knowledge of the status and distribution of threatened species, particularly those known only from a single to a few KBAs.

- Review the distribution of non-globally threatened endemic species within Wallacea. Identify further restricted range species, and review how well these are covered in the existing network of KBAs.

- Develop a mechanism to locate, store and facilitate access to relevant data, and use this to periodically re-evaluate the conservation outcomes.

The lack of data on the range of globally threatened species was a major constraint in the identification and prioritization of KBAs. For six terrestrial globally threatened species, no data was found to support the identification of site outcomes in Wallacea (Table 2). It is likely that these species already occur in existing KBAs, but field work is needed to confirm this and thus ensure that the protection of these species is addressed. In addition, 143 species in Wallacea are defined by IUCN as data deficient. All of them require further work to clarify their status and distribution, but 34 species are prioritized because available information suggests they are very rare or have a limited range (Table 3). They are thus strong candidates to be assessed as globally threatened species once adequate data is available.

Table 2: Terrestrial Globally Threatened Species in Wallacea for Which No KBAs Could Be Identified; EN, endangered; VU, vulnerable, CR, critically endangered; ENT, East Nusa Tenggara; WNT, West Nusa Tenggara; P, Pisces; L, Lepidoptera; M, Mammalia.

Scientific Name & status (Common Name & Group)	Distribution	Action Required
Pandaka pygmaea **CR** Dwarf pygmy goby (P)	Indonesia, Philippines, Fiji, New Guinea	Clarification of distribution and reassessment of threat status
Euploea caespes **EN** Murphy's crow (L)	Adonara, Sumba, Pura, ENT	Surveys to locate sites for the species
Parantica philo **VU** Sumbawa tiger (L)	Sumbawa, WNT	
Parantica timorica **EN** Timor yellow tiger (L)	Timor, ENT, Timor-Leste	
Rhinolophus canuti **VU** Canoet's horseshoe-bat (M)	Timor, ENT, Timor-Leste	Single record from Timor may be a distinct form; requires further survey and clarification of taxonomy

Table 3: Candidate Species Outcomes for Data-Deficient Terrestrial Species Likely to Be Assessed as Globally Threatened; A, Amphibia; O, Odonata, P, Plantae; R, Reptilia; L, M, the same as Table 2.

Scientific Name (Common Name / Group)	Site (Islands)	Note (source: IUCN Red List)
Rhacophorus edentulous (A)	Sulawesi	Known only from holotype
Mycalesis tilmara (L)	Sangihe Siau	This species is endemic to the islands of Sangihe and Siau
Crocidura tenuis Timor shrew (M)	Timor	So far known from only two locations, but expected to occur more widely on the island, especially at higher elevations
Crunomys celebensis Sulawesi shrew mouse (M)	Sulawesi	Known from three specimens collected in the mid-1970s, captured accidentally. There has been limited survey work involving appropriate survey techniques
Melomys cooperae Yamdena Island melomys (M)	Yamdena	Known only from holotype
Prosciurillus abstrusus Secretive dwarf squirrel (M)	Sulawesi	Known only from the type locality
Rattus timorensis Timor forest rat (M)	Timor	Known only from holotype
Rhinolophus montanus Timorese horseshoe bat (M)	Timor	The species is known only from holotype, collected in 1979
Rousettus linduensis Linduan Rousette (M)	Sulawesi	Known only from holotype
Tarsius lariang Lariang tarsier (M)	Sulawesi	Recently described, population status cannot be reasonably estimated. Additional surveys are needed
Tarsius pumillus Pygmy tarsier (M)	Sulawesi	Known only from three museum specimens, and presumed to be extinct
Tarsius wallacei Wallace's tarsier (M)	Sulawesi	Recently described, population status cannot be reasonably estimated. Additional surveys are needed
Argiolestes alfurus (O)	Bacan	Known only from the type-series (20 males and one female): North Moluccas, Indonesia

Celebophlebia dactylogastra (O)	Sulawesi	Known from three records from two localities
Diplacina cyrene (O)	Buru	Known from two records from two localities
Drepanosticta berlandi (O)	Lombok	Known from two records (prior to 1900)
Gynacantha arthuri (O)	Sumba	Known only from the holotype (male) and paratype (female)
Huonia ferentina (O)	Halmahera	Known only from the holotype
Ictinogomphus celebensis (O)	Sulawesi	Known only from two records both prior to 1934
Nannophlebia buruensis (O)	Buru	Known from three records prior to 1930
Neurothemis nesaea (O)	Sulawesi	Known only from two males and one female
Palaiargia optata (O)	Obi	Known only from two records prior to 1954
Palaiargia tanysiptera (O)	Halmahera	Known from two localities from 1951
Pseudagrion schmidtianum (O)	Timor	Known only from the syntype
Zygonyx ilia (O)	Sulawesi	Known only from the holotype (male)
Daemonorops schlechteri (P)	Sulawesi	Known only from holotype
Drymophloeus oliviformis (P)	Ambon	Confined to Ambon Island. The genus is in need of taxonomic revision
Nephentes nigra (P)	Sulawesi	Newly described species, no data on population
Cyrtodactylus deveti Moluccan bow-fingered gecko (R)	Morotai	Endemic to Morotai, Halmahera. Known only from few specimens
Cyrtodactylus gordongekkoi (R)	Lombok	Known only from two specimens from Lombok
Cyrtodactylus wetariensis Wetar bow-fingered gecko (R)	Wetar	Known only from its type locality on Wetar Island
Enhydris matannensis Matano mud snake (R)	Sulawesi Muna	Known from the type locality, Lake Matana, Sulawesi, and near Raha on Muna Island
Lepidodactylus oortii (R)	Banda Damar Yamdena	The habitat preferences of this species are unknown, but it is known to be arboreal and insectivorous
Luperosaurus iskandari (R)	Sulawesi	Known only from the holotype, collected in 1998 (Brown *et al*. 2000). Members of genus are rare and secretive

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Literature Cited

Chan, S., M. J. Crosby, M. Z. Islam, and A. W. Tordoff, 2004. *Important bird areas in Asia: Key sites for conservation* (Conservation Series 13). BirdLife International, Cambridge.

Langhammer, F. P., M. I. Bakarr, L. A. Bennun, T. M. Brooks, R. P. Clay, and W. Darwall, 2007. Identification and gap analysis of key biodiversity areas: Targets for comprehensive protected area systems. *In*: Valentine, P. (ed.). *Best Practice Protected Area Guideline Series No*, *15*. IUCN, Gland.

Mittermeier, R. A., G. P. Robles, M. Hoffmann, J. Pilgrim, T. Brooks, and C. G. Mittermeier, 2004. Hotspots Revisited. Mexico City, Mexico: CEMEX.

Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonesca, and J. Kent, 2000. Biodiversity hotspots for conservation priorities. *Nature*, 403: 853–858.

Rombang, W. M., C. Trainor, and D. Lesmana, 2002. *Daerah Penting bagi Burung: Nusa Tenggara (Important Bird Areas of Indonesia: Nusa Tenggara).* PKA and BirdLife International, Bogor.

Trainor, C. R., F. Santana, Rudyanto, A. F Almeida, P. Pinto, and G. F. de Oliveira, 2007. *Important bird areas in Timor-Leste: Key sites for conservation*. BirdLife International, Cambridge.