CRITICAL ECOSYSTEM PARTNERSHIP FUND

Red List Indices for biodiversity hotspots receiving support from the Critical Ecosystem Partnership Fund

Prepared by
BirdLife International
IUCN
Sapienza University of Rome

June 2014

IUCN

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Partnership for nature and people

SAPIENZA UNIVERSITÀ DI ROMA

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Background

IUCN Red List

The IUCN Red List is widely recognised as the most authoritative and objective system for classifying species by their risk of extinction (see, e.g. Regan *et al.* 2005, de Grammont and Cuarón, 2006, Rodrigues *et al.* 2006). It uses quantitative criteria based on population size, rate of decline, and area of distribution to assign species to categories of relative extinction risk (IUCN 2001). The criteria are clear and comprehensive but are sufficiently flexible to deal with uncertainty (Akçakaya *et al.* 2000). The assessments are not simply based on expert opinion; they must be supported with detailed documentation of the best available data, with justifications, sources, and estimates of uncertainty and data quality (IUCN 2014). Red List Authorities (e.g. BirdLife International for birds) are appointed to organise independent scientific review and to ensure consistent categorisation between species, groups, and assessments. A Red List Standards and Petitions Subcommittee monitors the process and resolves challenges and disputes to listings. Overall governance is provided by a Red List Committee, which consists of representatives from the Species Survival Commission, Global Species Programme, and representatives of the Red List Partner institutions (who have committed to provide technical or financial support, and include BirdLife International, Botanic Gardens Conservation International, Conservation International, Microsoft, NatureServe, Royal Botanic Gardens Kew, Sapienza Universita di Roma, Texas A&M University, Wildscreen, and Zoological Society of London).

Red List Index

The Red List Index (RLI) has been developed as an indicator of trends in the status of biodiversity. It illustrates the rate of biodiversity loss in terms of the rate that species are slipping towards (or away from) extinction. The index is based on the number of species in different categories of extinction risk on the IUCN Red List, and the movement of species between categories owing to genuine improvements or deteriorations in status (Butchart *et al.* 2004, 2005, 2007, 2010; see appendix for full methods). The RLI integrates the net impacts of species improving in status and being downlisted to lower categories of threat (usually a consequence of conservation interventions) and those deteriorating in status and being uplisted to higher categories of threat (owing to declining populations and increasing threats).

An RLI value of 1.0 equates to all species being categorised as Least Concern, and hence that none is expected to go extinct in the near future. An RLI value of zero indicates that all species have gone Extinct. A downwards trend in the graph line (i.e. decreasing RLI values) means that the expected rate of species extinctions is increasing, i.e. that the rate of biodiversity loss is increasing. A horizontal graph line (i.e. unchanging RLI values) means that the expected rate of species extinctions is unchanged. An upward trend in the graph line (i.e. increasing RLI values) means that there is a decrease in expected future rate of species extinctions (i.e. a reduction in the rate of biodiversity loss).

As well as monitoring global trends, the RLI can be disaggregated to compare trends for suites of species in different biogeographic regions, ecosystems, habitats, taxonomic subgroups or relevant to different international treaties. The RLI has been widely used to track progress towards biodiversity targets and goals for sustainable development (Millennium Ecosystem Assessment 2005, Butchart *et al.* 2010, Secretariat of the CBD 2010,

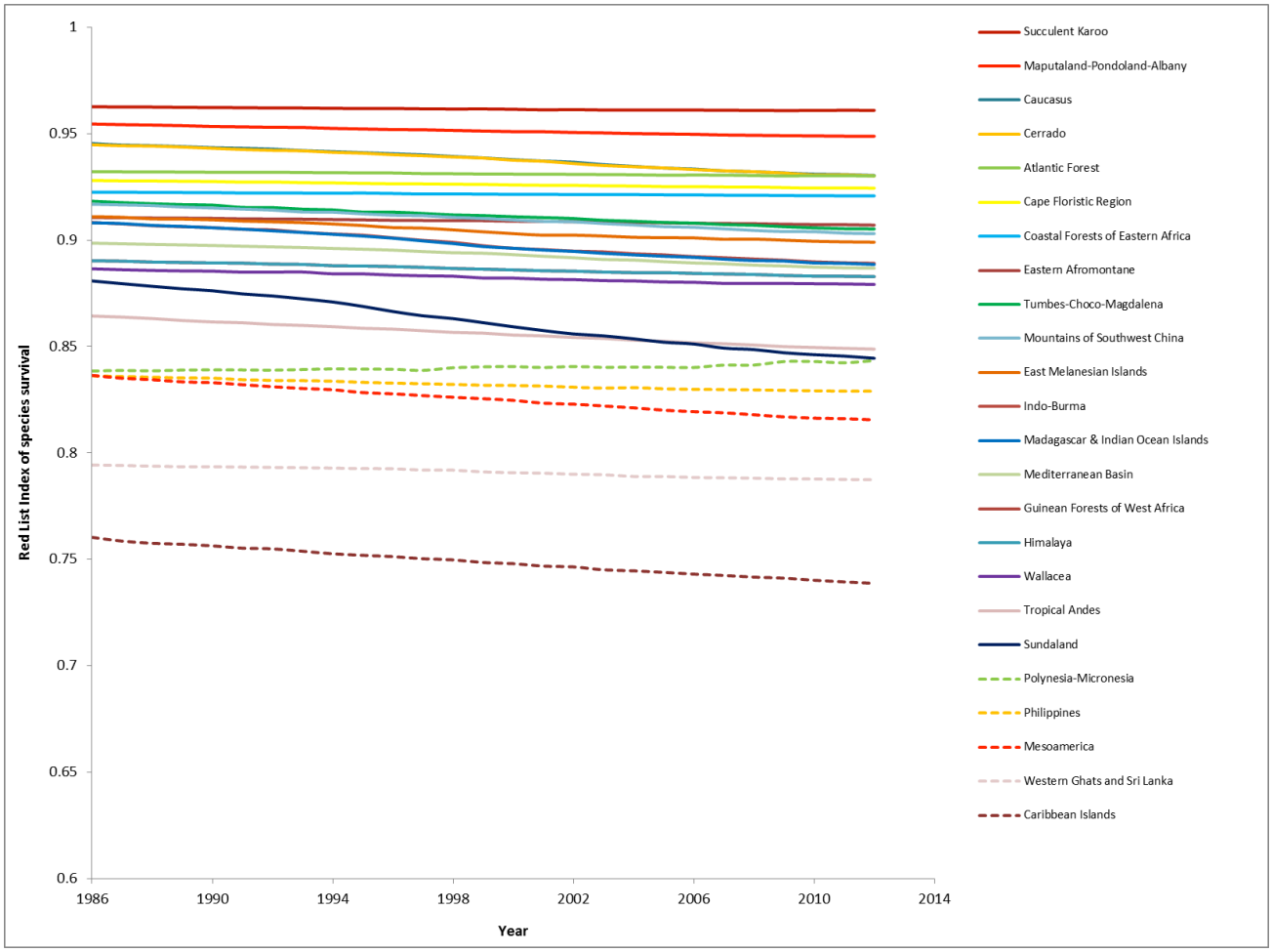
UNEP 2012, CBD 2011, United Nations 2013). In addition, RLIs based on the relevant sets of species are being used by a number of thematic or regional agreements or policy mechanisms, including the Ramsar Convention on Wetlands and the Convention on Migratory Species (including several of its agreements).

Red List Indices for biodiversity hotspots

The Critical Ecosystem Partnership Fund (CEPF) has invested over $160 million to support biodiversity conservation in over 20 hotspots since 2000. To inform monitoring of the impact of these investments, we calculated RLIs for species in these hotspots. We used data for mammals (5,400 species), birds (10,000) and amphibians (6,300): the three groups of species occurring in terrestrial ecosystems for which repeated comprehensive Red List assessments and hence RLIs are available.

For each hotspot, we determined which species in these three groups occurred in the hotspot (by overlaying digital distribution maps of all species onto a digital map of hotspot boundaries *sensu* Mittermeier *et al*. 2004). The overlapping taxa contributed to the calculation of the RLI for the relevant hotspot. However, for those taxa undergoing a genuine change in status since they were first assessed for the Red List (219 mammals, 416 birds, 454 amphibians), we incorporated the relevant category changes into the index for the relevant hotspot only if the processes driving the change (worsening threats for species deteriorating in status, or threats successfully addressed for those species improving in status) occurred within the relevant hotspot. In this way, the RLI for each hotspot reflects the total pool of species occurring in the hotspot, but with the RLI trends driven only by processes operating within the hotspot boundary, and not by processes impacting some of the same species in other parts of their distributions.

Figure 1. Red List Index of species survival for mammal, bird and amphibian species in hotspots supported by CEPF.



The results show that mammals, bird and amphibians are, on average, most highly threatened on the Caribbean islands, Western Ghats and Sri Lanka, Mesoamerica and the Philippines. They are least threatened in the Succulent Karoo, Maputaland-Pondoland-Albany and Caucasus (the height on the vertical axis indicates overall degree of threat, with lower values relating to more threatened faunas). For example, in the Caribbean Islands, 80% of amphibians, 30% of mammals and 9% of birds are threatened with extinction (i.e. in the categories of Critically Endangered, Endangered and Vulnerable; excluding Extinct, Possibly Extinct and Data Deficient species in each case).

The slope of the RLI relates to the speed with which species are moving towards (or away from) extinction. The steepest declines were found for hotspots covering Sundaland (4.1% during 1986-2012), Caribbean Islands (2.8%), Mesoamerica (2.5%), Madagascar and the Indian Ocean Islands (2.2%) and Indo-Burma (2.1%). While these percentage declines are small in absolute terms, they reflect substantial shifts in extinction risk for the sets of species concerned. For example, in Sundaland, 78 bird, 54 mammal and 34 amphibian species have each moved at least one category closer to extinction in the last three decades.

The only positive slope, i.e. improving trends, was found for the Polynesia-Micronesia hotspot, for which the RLI increased by 0.6%.This hotspot has very poor diversity of mammals and amphibians, and the change is driven by five bird species improving in status (Polynesian Megapode, Cook's Petrel, Marquesan Imperial-pigeon, Samoan Flycatcher and Rarotonga Monarch, the latter improving in status and being 'downlisted' by two Red List categories since 1988).

While these RLIs are useful for comparing hotspots in the overall degree of threat and rate of deterioration of the species occurring within them, it is important to note that as an indicator, the RLI has moderate sensitivity: it is not highly sensitive to small-scale changes in the status of species (as may be picked up by population trend-based indicators). However, it has global scope and coverage, and hence is not biased by data availability in the way that population trend-based indicators may be. Until comprehensive population time-series datasets are available for a large majority or representative suite of species in each hotspot (and from representative locations within them), the RLIs presented here represent the best available tool for tracking trends at a species-level in each hotspot.

It is also worth noting that CEPF investments commenced in 2000, whereas the trends shown here cover the period 1986-2012, although the ranking of hotspots by their % decline changes vary little if based on the period 2000-2012. The declines in nearly all RLIs do not mean that CEPF investments have had no impact: it is not straightforward to calculate counterfactual RLIs to show what the trends would have been in the absence of CEPF investment (following the approach of Hoffmann *et al.* 2010), but these could well show that declines would have been even steeper in the absence of CEPF-funded interventions.

New data points for these RLIs will be available for mammals in 2015, and amphibians and birds in 2016. Furthermore, RLIs will become available in the next few years for conifers, cycads and a number of other groups, allowing these indices to be updated to show trends for a more representative suite of taxa. They could usefully be complemented by indicators showing trends at a site-scale, illustrating the trends in the state of biodiversity, the pressures upon it and the responses in place at Key Biodiversity Areas, following the approach of Mwangi *et al.* (2010).

Finally, as a concluding remark, it is worth noting that CEPF funding has been integral to supporting the IUCN Red List assessment processes themselves, providing key support, in particular, to the Global Amphibian and Global Mammal assessments. It is through the support of CEPF investment in such assessment work that the generation of these Red List Indices is possible.

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Appendix: Methods

Calculating the RLI

The RLI is calculated from the number of species in each Red List category (Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered), and the number changing categories between assessments as a result of genuine improvement or deterioration in status (category changes owing to improved knowledge or revised taxonomy are excluded). The original methodology was described in detail in Butchart *et al*. (2004, 2005), and revised in Butchart *et al.* (2007): the latter is used here. An RLI value is calculated as follows:

$$RLI_t = 1 - \frac{\sum_s W_{c(t,s)}}{W_{\mathrm{EX}} \cdot N}$$

where $Wc(t,s)$ is the weight of category c for species s at time t, which ranges from 1 for Near Threatened to 5 for Extinct (W_{EX}), and N is the number of assessed (non-data deficient) species. Put simply, the number of species in each Red List category is multiplied by the category weight, these products are summed, divided by the maximum possible product (the number of species multiplied by the maximum weight), and subtracted from one. This produces an index that ranges from 0 to 1 (see below).

These conditions are met by back-casting all non-genuine category changes to the year of first assessment. In other words, we assume that species should have been classified at their current Red List category since 1988 for birds, 1980 for amphibians and 1996 for mammals, apart from those species for which genuine category changes have occurred, in which case they are assigned to appropriate time periods, corresponding to the dates in which all species were reassessed (1988, 1994, 2000, 2004, 2012 for birds, 1996, 2004 for mammals, 1980, 2004 for amphibians). To determine these genuine cases, all category changes were assigned a 'reason for change', allowing genuine ones to be distinguished from those resulting from improved knowledge or taxonomic revisions (see Butchart *et al*. 2004, 2005, 2007 for further details).

Aggregating RLIs for mammals, birds and amphibians

An aggregated RLI for all three species groups considered was calculated as the arithmetic mean of modelled RLIs for these four groups, following Butchart et al. (2010), as follows. RLIs for each taxonomic group were interpolated linearly for years between data points and extrapolated linearly (with a slope equal to that between the two closest assessed points) back to 1986 and forwards to 2008 for years for which estimates were not available. The start year of the aggregated index was set as 1986 because ten years was set as a limit for extrapolation. The RLIs for each taxonomic group for each year were modelled to take into account various sources of uncertainty: (*i*) Data Deficiency: Red List categories (from Least Concern to Extinct) were assigned to all Data Deficient species, with a probability proportional to the number of species in non-Data Deficient categories for that taxonomic group. (*ii*) Extrapolation uncertainty: although RLIs were extrapolated linearly based on the slope of the closest two assessed point, there is uncertainty about how accurate this slope may be. To incorporate this uncertainty, rather than extrapolating deterministically, the slope used for extrapolation was selected from a normal distribution with a probability equal to the slope of the closest two assessed points, and standard deviation equal to 60% of this slope (i.e., the

CV is 60%). (*iii*) Temporal variability: the 'true' RLI likely changes from year to year, but because assessments are repeated only at multi-year intervals, the precise value for any particular year is uncertain. To make this uncertainty explicit, the RLI value for a given taxonomic group in a given year was assigned from a moving window of five years, centred on the focal year (with the window set as 3-4 years for the first two and last two years in the series). Note that assessment uncertainty cannot yet be incorporated into the index.

Practically, these uncertainties were incorporated into the aggregated RLI as follows: Data Deficient species were allotted a category as described above, and an RLI for each taxonomic group was calculated interpolating and extrapolating as described above. A final RLI value was assigned to each taxonomic group for each year from a window of years as described above. Each such 'run' produced an RLI for the complete time period for each taxonomic group, incorporating the various sources of uncertainty. Ten thousand such runs were generated for each taxonomic group, and the mean was calculated. Confidence intervals were set as the 2.5 and 97.5 percentiles.

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