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UFZ, Helmholtz Zentrum für Umweltforschung, Germany
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UCBL, Université Claude Bernard - Lyon 1, France
UPS, Université Paul Sabatier- Toulouse 3, France
ECOLOGIC, Ecologic GmbH Institut für Internationale und Europäische Umweltpolitik, Germany
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UD, University of Debrecin, Hungary
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BIOFRESH

Biodiversity of Freshwater Ecosystems: Status, Trends, Pressures, and Conservation Priorities

Project no. 226874


Large scale collaborative project

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Safeguarding Global Freshwater Biodiversity: Status, Gaps and Future Directions.

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Abstract

There are approximately 126,000 valid described freshwater species, comprising around 9.5% of described species diversity, many of which are key economic and nutritional resources for people globally. Freshwater ecosystems are often cited as being the most threatened of all systems. However, information on the conservation status and distribution of freshwater species has been extremely limited until recently. Over the last 10 years, the International Union for Conservation of Nature (IUCN) Global Species Programme Freshwater Biodiversity Unit has made significant progress to fill this information gap. From a base of only 1,422 species assessed on The IUCN Red List of Threatened Species™ (Red List) in 2002, there are now 23,291 completed species assessments for freshwater birds, amphibians, mammals, reptiles, crustaceans, plants, molluscs, odonata and fishes. Of the 23,291 species assessed by 2013, 226 freshwater species are thought to be Extinct, 16 are Extinct in the Wild and 5,320 are threatened with extinction (Critically Endangered, Endangered or Vulnerable). Supporting the Red List assessments are over 20,000 distribution maps for freshwater species that provide an ever-improving spatial understanding of freshwater species diversity. IUCN freshwater species distributions are mapped to HydroBASINS sub-catchments such that the scale of spatial information is matched to that required to underpin practical conservation decisions and management. Initiatives to identify freshwater Key Biodiversity Areas are now made possible by improvements in spatial data on diversity, threat and endemism. We review the most comprehensive collection of distribution information on global freshwater species. These advances in knowledge will not only inform but raise awareness and garner support for safeguarding freshwater biodiversity.

Key-words:

freshwater; conservation status; IUCN Red List; distributions; diversity; catchment

Introduction

The loss and value of global biodiversity has become a key focus of academic and popular science (Clausnitzer et al. 2009). In order to stem this decline there is a need to identify and safeguard the species most at risk of extinction (Olden et al., 2007). This requires access to good quality data sets representative in terms of taxonomic and geographic variation (Balmford et al. 2005; Boakes et al., 2010 and Jones et al., 2011). Unfortunately we still have an incomplete picture of global biodiversity with a distinct bias to groups of terrestrial vertebrates such as birds and mammals (Stuart et al., 2004). Many of the lesser known or more diverse groups such as invertebrates, fungi and algae are considered to be experiencing higher rates of extinction risk (Collen et al. 2012). Freshwater biodiversity, is such a group and until recently has not been afforded the focus needed (Darwall et al. 2009). Global freshwaters cover only a small fraction of the earth's surface (<1%), yet support a high richness of species from a range of taxonomic groups. Approximately 126,000 species have been described; representing 9.5% of known species diversity, yet this is likely to be a vast underestimate of true freshwater species diversity (Balian et al. 2008). Freshwater ecosystems are also subject to intense anthropogenic activity and thus freshwater biodiversity is increasingly threatened (Dudgeon et al., 2006). Vorosmarty et al. (2010) suggest that between 10,000 -20,000 freshwater species could be extinct or at risk of extinction. The level of stress experienced by freshwater biodiversity is set to increase as the demand for water rises as rivers are increasingly harnessed as an energy supply or abstracted for agriculture. Wetlands are estimated to be worth around US \$70 billion (Schuyt and Brander, 2004), with inland fisheries from Africa, Asia and Latin America alone contributing US \$5.58 billion a year to the global economy (Neiland and Béné, 2008). Despite the importance of freshwater species to ecosystem function and human livelihoods, data on freshwater biodiversity has often been piecemeal or lacking altogether (Abell, 2002).

A clear understanding of the threatening processes underlying biodiversity decline is essential for effective conservation planning (Lee and Jetz, 2011). It is fundamental to understand the level of threat, distribution of (threatened) species, the key drivers and stressors, current

conservation measures and examples of conservation success to allow for the efficient use of resources and allocations of limited conservation funds.

Recently, projects such as BioFresh have made a concerted effort to fill the gaps in knowledge and work towards building a comprehensive dataset that could highlight the global trends and status of freshwater biodiversity. During the last decade, much work has focused on improving the coverage of freshwater taxa on the IUCN Red List of threatened speciesTM (www.iucnredlist.org). Over the last forty years the information recorded for species on the Red List has become increasingly comprehensive, capturing not just information on species extinction risk but also habitat requirements, threats, conservation measures and distribution (Rodrigues et al., 2006). With such a specious realm, the task of carrying out a comprehensive assessment of freshwater species extinction risk is time and resource intensive and thus IUCN and associated partners have focused on five main taxonomic groups. These groups include freshwater fishes, molluscs, odonata, crabs and selected families of aquatic plants chosen for their economic and ecological importance and the availability of suitable taxonomic expertise (Darwall et al., 2008). Thus far regionally comprehensive assessments of these groups have been completed for Africa, Europe, IndoBurma, Western Ghats, Eastern Himalayas, Arabian Peninsula and New Zealand. Comprehensive global assessments are also available for freshwater dependent mammals, amphibians, birds, shrimps, crabs and crayfish. This paper provides a review and analysis of all the available Red List assessments providing the most comprehensive overview to date of the status of freshwater biodiversity.

Species distributions, where available, have been mapped to HydroBASINS (Lehner, 2012), a globally standard sub-catchment layer. HydroBASINS is itself a major output of the BioFresh project and a key tool in supporting the advancement of spatial analyses for freshwater systems. It is available at twelve resolutions and includes data on catchment connectivity and flow direction allowing for more integrated analyses of freshwater systems. The overarching benefit of mapping to sub-catchments is that conservation planning and practical management interventions must take place at the sub-catchment scale to be effective for freshwater biodiversity (Nel et al. 2009). Further benefit over grid-based analyses is that catchments are

ecologically defined units to which species occurrences can be mapped rather than to arbitrary grids which may span unconnected catchments where species are unable cross natural barriers and thus do not occur in both sub-catchments (Tisseuil et al. 2013). Species migrations, ecological processes and threat propagation occur via the catchment network and thus HydroBASINS provides the framework to improve the spatial understanding of the issues most pertinent to safeguarding freshwater biodiversity.

While many global analyses have been published for terrestrial vertebrates (e.g. Jenkins et al. 2013), there remains a large gap in understanding of the conservation status and distributions of freshwater biodiversity, primarily underpinned by a lack of suitably comprehensive data. As data on freshwater biodiversity has increased so too has research started to present syntheses on freshwater biodiversity, however, to date most have focused on one taxon group or have been regional or patchy in distribution (Table 1). More recently, Collen et al. (2013) and Tisseuil et al. (2013) have presented global syntheses of a wider range of freshwater groups yet the grain of analyses has remained coarse; one degree of latitude or complete river drainage basins respectively (Table 1) and so much remains to be examined at the more practically-relevant, finer grains of analysis. In a study of 7083 freshwater species, Collen et al. (2013) found a lack of congruence in spatial patterns of species richness, threatened richness and endemism among six groups of freshwater taxa (mammals, amphibians, reptiles, fishes, crabs and crayfish). A lack of congruence was also shown between prioritised freshwater KBAs and existing protected areas for African freshwaters (Holland et al. 2012) further highlighting the importance of continued efforts to map the distributions of more freshwater species at the sub-catchment scale.

Table 1: Studies examining the status of freshwater biodiversity at the global and regional scales (Jenkins et al. 2013 and Rodrigues et al. 2004 examine terrestrial vertebrates but include some freshwater species).

Study	Extent and Resolution	Taxa	Species richness metric
Tisseuil et al. 2013	global; 819 river drainage basin grain	13,413 mammals, birds, fishes, crayfish, amphibians	all, endemism
Collen et al. 2013	global; just under one degree cell	7083 species amphibians, mammals, reptiles, fishes, crabs and crayfish	all, threatened, country endemism, 25% smallest ranges
Jenkins et al. 2013	global; 10 x 10 km	birds, mammals, amphibians (terrestrial vertebrates inc, freshwater)	All, threatened, small range (< median area)
Tedesco et al. 2012	global	riverine fishes	endemism
Oberdorff et al. 2011	global and regional; 926 drainage basin grain (large grain)	riverine fishes	All
Pearson and Boyero 2009	latitude gradient	Ephemeroptera, Plecoptera, Trichoptera, Caudata, Odonata, Osteichthyes, Anura	diversity
Strayer et al. 2010	n/a	global general review with status of United States freshwater fishes, insects, crayfish and mussels based on NatureServe designations	n/a
Dudgeon et al. 2006	n/a	global general review with status of non-marine turtles in Asia based on IUCN Red list status	n/a
Rodrigues 2004 (terrestrial vertebrates)	global; quarter-degree cell / half-degree cell	freshwater turtles among others (mammals, amphibians, threatened birds)	All, threatened, small range (< 50,000km ²)
Groombridge and Jenkins 1998	global	Mainly molluscs, fishes, crustaceans	n/a
McAllister et al. 1997	n/a	overview	n/a
Present study	global; level 8 HydroBASINS sub-catchments	crayfish, reptiles (turtles), mammals, birds, amphibians, fishes, molluscs, odonata, crabs, shrimps	all, threatened, small range

The aim of this paper is not only to set out the macroecological patterns but also to highlight the value of these data sets in identifying key areas for freshwater biodiversity, gaps in knowledge, emerging trends and recommendations for moving freshwater policy and on-the ground conservation forward. We first present an analysis of the global conservation status of freshwater biodiversity, providing summaries at the class and family levels. Secondly, we present the global distributions of those species for which maps are available. Thirdly, we consider how this information has been helpful in informing freshwater biodiversity conservation thus far and how it can be used in future. Finally, we examine the most vital areas that need to be addressed towards gaining a comprehensive assessment of freshwater species.

Methods

This report summarises several aspects of the status of global freshwater biodiversity; 1) the global conservation status/extinction risk as measured by the Red List, 2) the patterns of diversity across the globe, and 3) the gaps in knowledge remaining to be filled.

Species assessment data and analyses

We summarised the extinction risk for freshwater biodiversity at three levels of aggregation; 1) for all freshwater species assessed on the Red list thus far, 2) for each taxon group [Kingdom: Plants, Phylum: Molluscs, paraphyletic group Fishes (Class: Actinopterygii - Bony Fish, Class: Sarcopterygii – inc. Lungfishes, Class: Cephalaspidomorphi - Lampreys and Class: Chondrichthyes - Cartilaginous Fish), Classes: Reptiles, Mammals, Birds, Amphibians and Order: Odonata], and 3) within each taxon group by Order and Family (see appendices). Species' extinction risk was assessed according to the IUCN Red List Categories and Criteria (IUCN, 2001) based on data collated by experts participating in regional workshops between 2002 and 2012 (plus about 1700 species that were already assessed before this time). Information collated on each species during workshops includes taxonomy, distribution, abundance, population trends, threats, habitat preferences, basic ecology, and current and recommended conservation actions. The IUCN Red List categories are Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) and Data Deficient (DD). The data on the Red List still include some Categories that have been decommissioned. These Categories

were combined with the appropriate current Red List Categories as follows; species assessed as Lower Risk/conservation dependent (LR/cd) and Lower Risk/near threatened (LR/nt) were incorporated within the current Category NT, and species assessed as Lower Risk/least concern (LR/lc) were incorporated within the Category LC. The decommissioned Categories will gradually be removed from the Red List as the species within them are reassessed according to the current Categories. All species that were tagged as 'freshwater' in the system field are included in the analysis and the data were downloaded on 30/6/2013 following the latest red list update. The percentage of threatened taxa was calculated as a mid-point (MID) estimate, i.e. assuming the DD species are threatened in the same proportion as the species for which there are sufficient data, as follows: $\% \text{ threat} = (\text{CR} + \text{EN} + \text{VU}) / (\text{total assessed} - \text{EX} - \text{EW} - \text{DD})$, a lower bound (LB) estimate, i.e. assuming no DD species are threatened, as follows: $\% \text{ threat} = (\text{CR} + \text{EN} + \text{VU}) / (\text{total assessed} - \text{EX})$, and an upper bound (UB) estimate, i.e. assuming all DD species are threatened, as follows: $\% \text{ threat} = (\text{CR} + \text{EN} + \text{VU} + \text{DD}) / (\text{total assessed} - \text{EX})$.

Species geographical data and analyses

Global summary maps were derived from over 20,000 species distribution maps collated as part of the Red List process. All species data were mapped to show their presence within individual lake or river catchments using the most accurate, globally consistent, digital catchment data set – 'HydroBASINS' (Lehner, 2012). This approach to mapping has been adopted as it is generally accepted that catchments are the appropriate management unit for on-the-ground conservation action for freshwater species (Lévêque et al., 2008). Therefore the range maps do not necessarily represent area of occupancy or extent of occurrence of a species. A catchment-scale approach to conserving freshwater fishes is required as any given stretch of freshwater will be impacted by the upstream drainage network, as well as the riparian zone and surrounding land, and downstream areas will also be important in the case of migratory species and potential invasion from alien species (Lévêque et al., 2008). The datasets collected prior to September 2012 were originally mapped to differing spatial frameworks including Hydro1k, HydroSHEDS and non-catchment polygons and thus were migrated to a standard layer for analysis - HydroBASINS level 8. The species distributions were migrated using a combination of R scripts (R Development Core team, 2010), ArcGIS 10.1 and Geospatial Modelling Environment v

0.7.2.1 (Beyer, 2009-2012). All migrated species range maps were checked against original maps for range boundary and attribute consistency, resolution of partial duplicate conflicts (i.e. conflicting attribute values assigned to the same catchment), removal of duplicate records and species names spelling consistency. Where a given species appeared in multiple regional datasets the distribution was combined into a single global distribution and the most recent data were used for any overlapping segments. All species range maps are global distributions except where indicated in the description. HydroBASINS lacks a subset of global islands and thus these were added to the migration template from a standard IUCN island GIS layer to facilitate mapping those parts of species ranges that include islands. All distribution data are available for download for non-commercial purposes from www.iucn.org/species/freshwater-Biofresh. Across the globe we mapped each taxon group's species richness overall and threatened richness as per the Red List using catchment records marked as 'Presence' 1 or 2, i.e. 'Extant' or 'Probably extant' respectively, employing ArcGIS 10.1 and custom R scripts. We eliminated introduced species (Origin = 3) and all species that are Extinct or Extinct in the Wild as we were interested in those species for which conservation management was possible and/or appropriate.

Results

Our analyses present the conservation status of 23,291 freshwater species including 390 reptiles, 1387 plants, 2196 birds, 2139 crustaceans, 6721 fishes, 3331 molluscs, 2688 insects and 4292 amphibians. Not all species that are assessed on the Red List are mapped and thus the number of species included in the status summaries may be greater than the number of species included in the maps (or vice versa e.g. turtles).

In an overview of all species tagged with ‘freshwater’ in the System field and summarised at the Class level (Table 2), we found that in the comprehensively assessed groups 40% of freshwater mammals, 30% of freshwater amphibians and 10% of freshwater birds are threatened (CR, EN or VU) based on the mid point estimate.

Results for those groups that are partially assessed are presented as a percentage of the species assessed thus far. Most notably 70% of currently assessed freshwater cartilaginous fishes (Chondrichthyes) are threatened, half of freshwater gastropods, 40% of freshwater fishes are threatened overall, 40% of freshwater reptiles and 30% of freshwater bivalves are threatened.

Summaries at the Family and Order level for a selection of comprehensively and partially assessed groups are provided in the appendices.

Table 2: Number of freshwater species per Class in each Red List Category and proportion of assessed species threatened (Upper Bound = UB; Mid point = MID; Lower Bound = LB). * = comprehensively assessed groups.

CLASS	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ACTINOPTERYGII	59	7	375	426	881	256	1526	3125	6655	0.5	0.3	0.3
AMPHIBIA*	14	2	307	412	406	272	999	1880	4292	0.5	0.3	0.3
AVES*	20	0	27	69	126	122	9	1823	2196	0.1	0.1	0.1
BIVALVIA	29	0	66	53	41	49	168	282	688	0.5	0.3	0.2
BRYOPSIDA	0	0	4	2	2	0	3	1	12	0.9	0.9	0.7
CEPHALASPIDOMORPHI	1	0	2	0	1	2	3	10	19	0.3	0.2	0.2
CHAROPHYACEAE	0	0	0	0	0	0	3	8	11	0.3	0.0	0.0
CHONDRICHTHYES	0	0	9	7	3	4	18	3	44	0.8	0.7	0.4

CLITELLATA	0	0	0	0	0	1	0	0	1	0.0	0.0	0.0
CONIFEROPSIDA	0	0	1	1	0	0	0	1	3	0.7	0.7	0.7
CRUSTACEA	11	1	112	144	331	62	777	701	2139	0.6	0.4	0.3
GASTROPODA	73	3	208	200	389	157	872	741	2643	0.6	0.5	0.3
INSECTA	14	0	57	93	136	110	786	1492	2688	0.4	0.2	0.1
ISOETOPSIDA	0	0	8	4	1	3	6	5	27	0.7	0.6	0.5
JUNGERMANNIOPSIDA	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
LILIOPSIDA	0	0	18	28	45	19	63	469	642	0.2	0.2	0.1
MAGNOLIOPSIDA	0	1	34	37	67	52	84	350	625	0.4	0.3	0.2
MAMMALIA*	3	1	3	23	28	8	19	60	145	0.5	0.4	0.4
MARCHANTIOPSIDA	0	0	0	0	0	0	4	0	4	1.0	0.0	0.0
OPHIOGLOSSOPSIDA	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
OSMUNDOPSIDA	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
POLYPODIOPSIDA	0	0	0	3	3	2	4	43	55	0.2	0.1	0.1
REPTILIA	1	1	29	42	54	44	47	172	390	0.4	0.4	0.3
SARCOPTERYGII	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
SELLAGINELLOPSIDA	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
SPHAGNOPSIDA	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
TURBELLARIA	1	0	0	0	0	0	0	0	1	NA	NA	NA

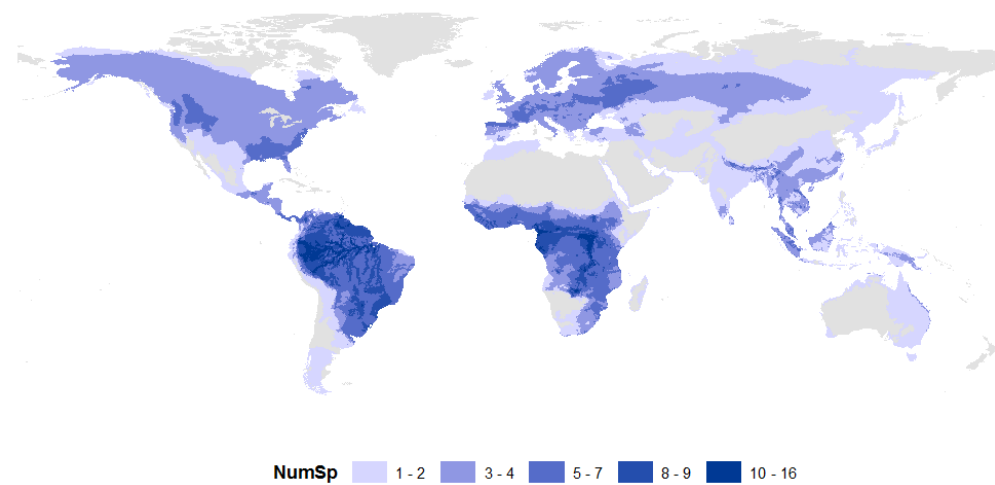
Macroecological patterns

We present a series of global maps showing the species richness and threatened species richness of freshwater taxa for comprehensively assessed groups such as freshwater mammals (Figure 1) and Crayfish (Figure 2) and partially assessed groups such as freshwater fishes (Figure 3) and freshwater turtles (Figure 4).

In drawing together the spatial data from each of the comprehensively assessed regions, Europe, Africa, United States of America, Western Ghats, IndoBurma, Oceania, New Zealand, and Eastern Himalayas, distinct patterns of spatial diversity for many freshwater groups are revealed. Even at the global scale the differences between adjacent areas are distinctly notable. For instance, the species richness of freshwater fishes (Figure 3a) is markedly variable across central Africa. This detailed spatial information is made possible by mapping to sub-catchments and demonstrates that at the coarser grain used by previous studies such as Collen et al. (2013) and Tisseuil et al. (2013), underlying patterns were obscured.

This level of detail at the global level will be used to inform conservation priorities based on the locations of concentrations of threatened species (Figures 1b, 2b, 3b, 4b). For instance, IndoBurma is most notable for high numbers of threatened freshwater fishes; more than half the region contains at least 36 threatened species in any given sub-catchment (Figure 3b).

A)



B)

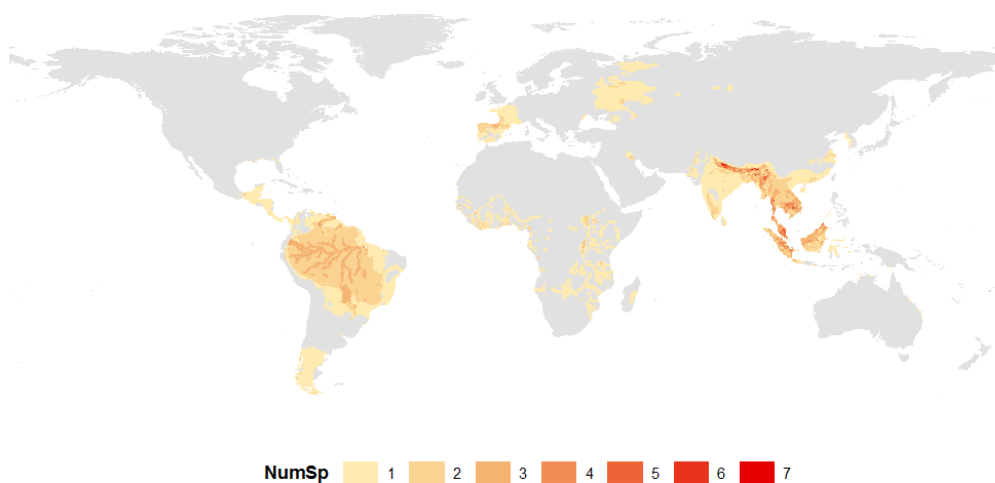
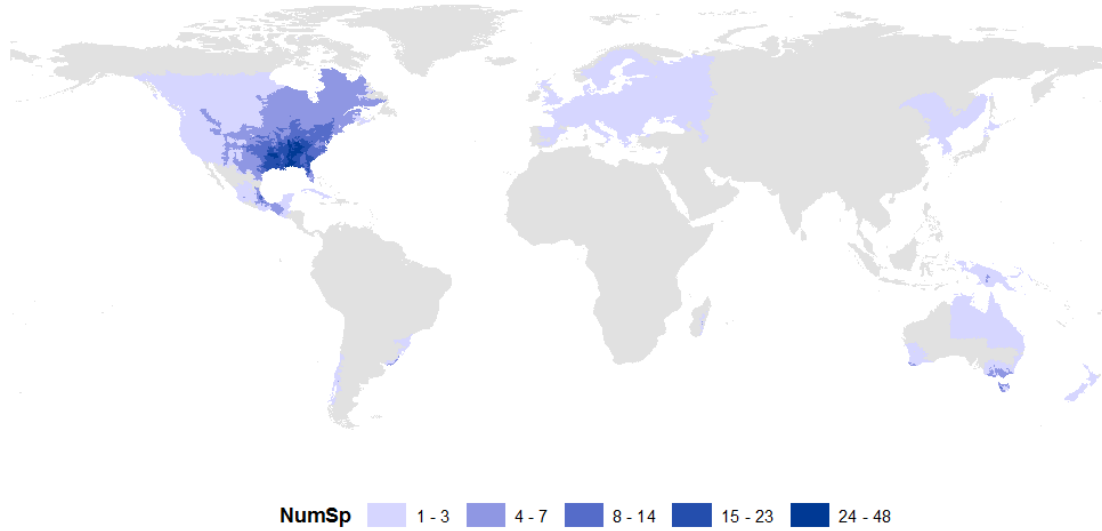


Figure 1: Global freshwater mammals have been comprehensively assessed; a) species richness b) threatened richness.

A)



B)

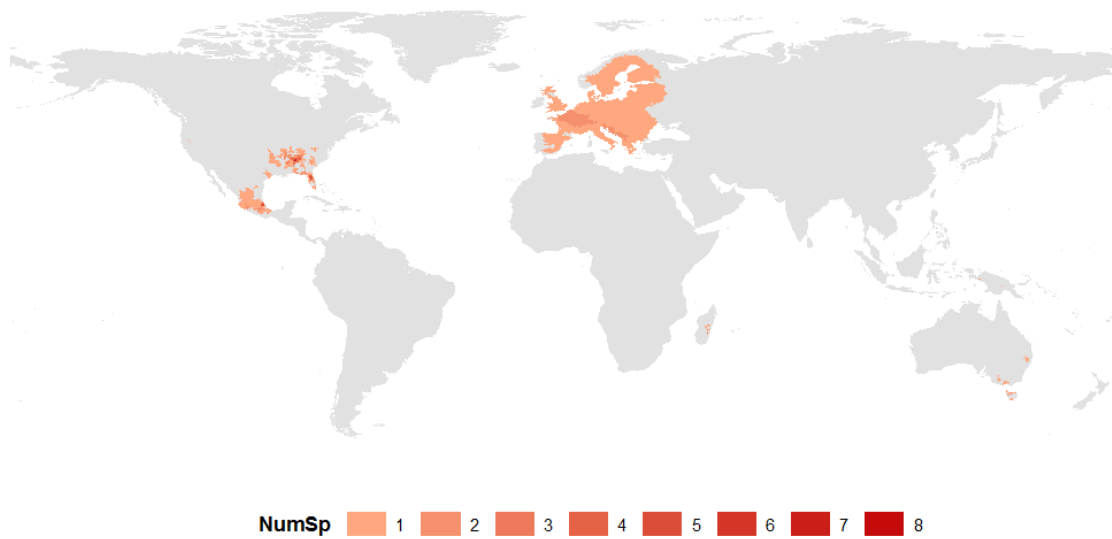
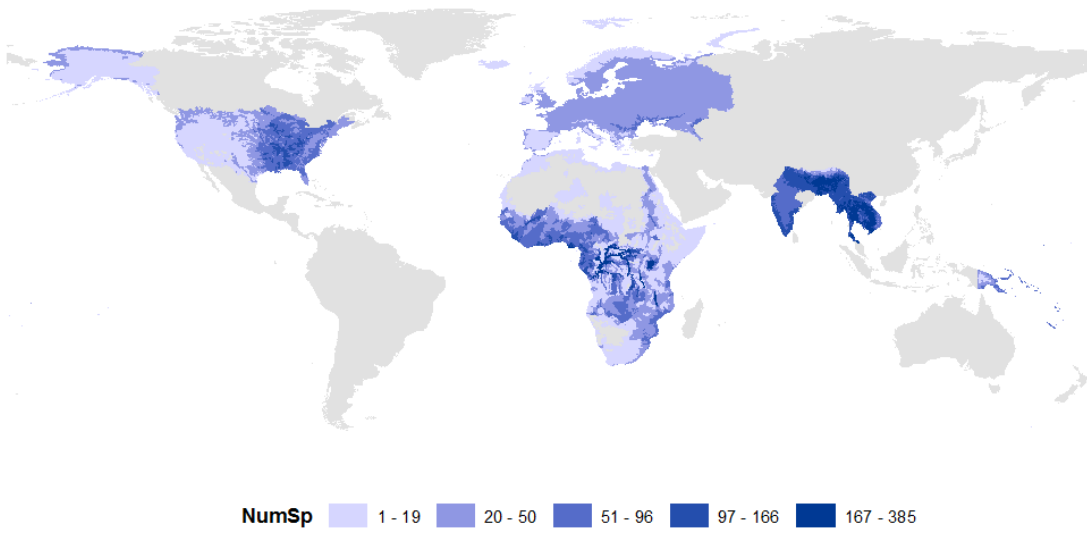


Figure 2: Global crayfish have been comprehensively assessed; a) species richness b) threatened richness.

A)



B)

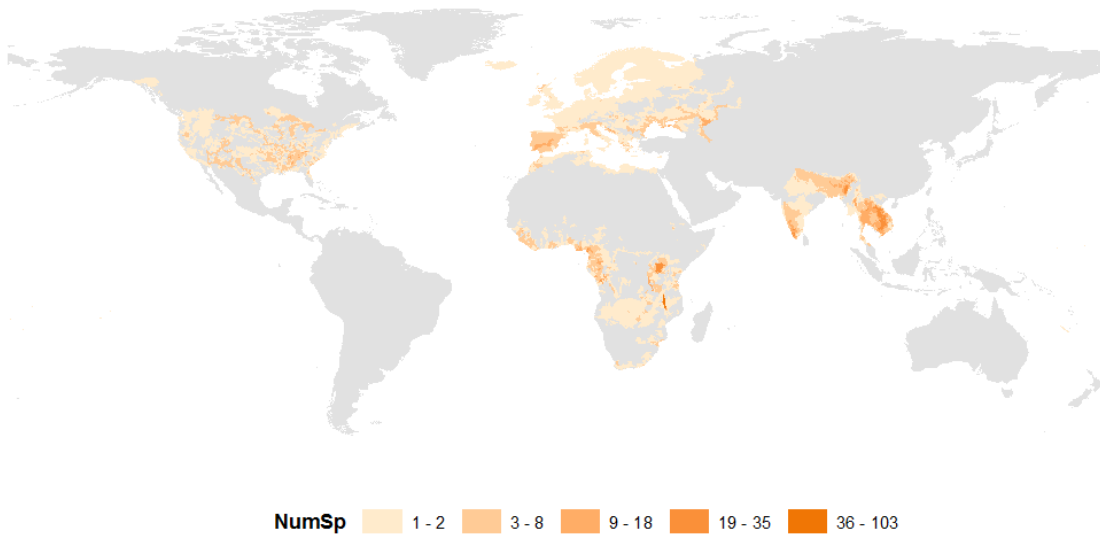
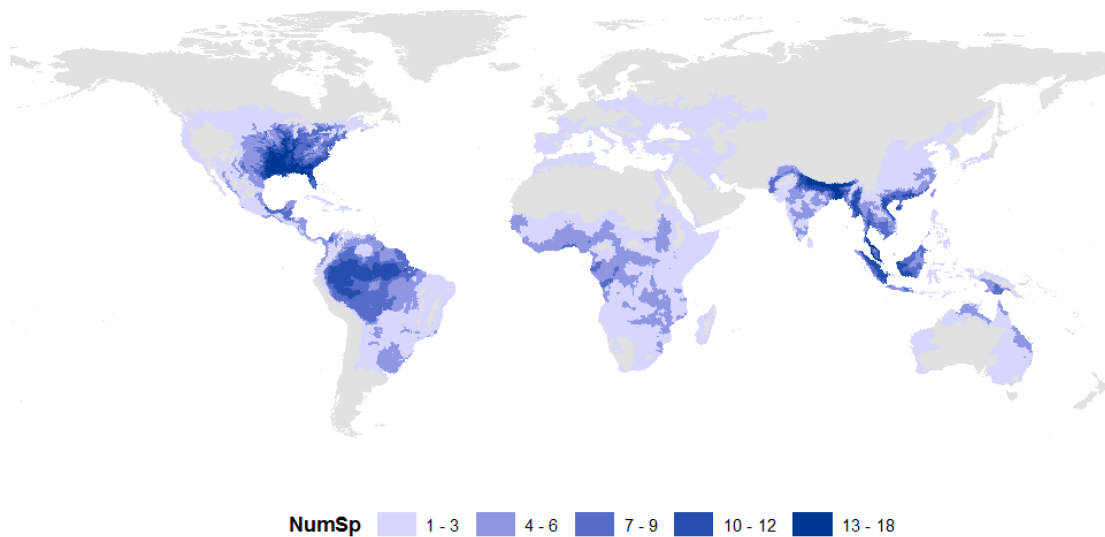


Figure 3: Global freshwater fishes comprehensively assessed regions a) species richness b) threatened richness.

A comprehensive global map of 270 freshwater turtles reveals areas of highest diversity in western United States, the Amazon basin, the Himalayas, Malaysia and Indonesia (Figure 4a). Whilst comprehensive Red List assessments are still forthcoming for freshwater turtles, a subset has been assessed and these reveal the emergent patterns of threatened richness based on knowledge thus far (Figure 4b).

A)



B)

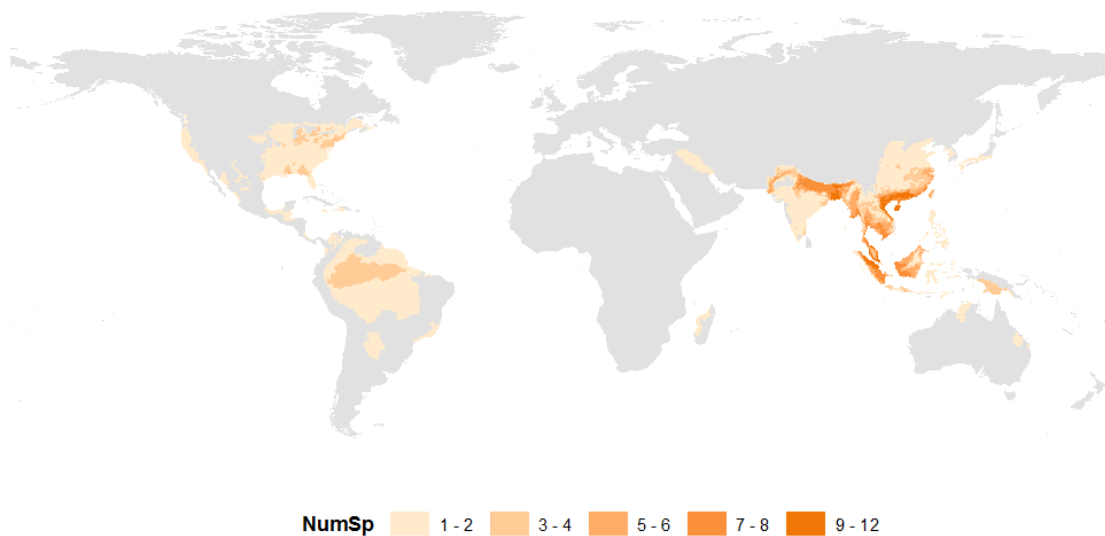


Figure 4: Global freshwater turtles a) species richness and b) threatened richness for the subset of Species with Red list assessments.

Refining spatial knowledge of freshwater species is a key prerequisite of robustly identifying areas that are most important to safeguard for freshwater biodiversity. Through the efforts of BioFresh prior standards of knowledge on the distributions of freshwater species have been improved. For instance prior knowledge on freshwater reptiles (Figure A1) can now be updated with the maps developed for freshwater turtles (Figure 4a).

Equally, previously comprehensively assessed groups such as freshwater birds (Figure A2) have now been mapped to HydroBASINS sub-catchments through the BioFresh project. Spatial distributions can now be examined with potential to perform integrated analyses with freshwater ecology based on catchment characteristics.

Discussion

Freshwater biodiversity faces many challenges. A growing global human population with an ever-increasing need to extract water for agriculture, industrial and domestic uses (IMEchE, 2013), the construction of dams and increased channelization will ensure that the challenges faced by freshwater species will only increase. Less-predictable flows, the spread of invasive species and increasing habitat loss are an inevitable consequence of growth of the global economy and development. It is therefore imperative that the knowledge of freshwater species distributions and their conservation requirements increases just as rapidly such that evidence-based management decisions can be soundly made and justified and implemented promptly.

In aiming to address conservation questions, it is important that the data used to guide decision making match the scale at which key threats and ecological process act. In this way previous studies have used too coarse a spatial grain to illicit information that is useful to inform conservation practice on the ground. With the data developed and used in this study, thanks largely to many initiatives in the BioFresh project, we are improving the ability of freshwater biodiversity researchers and practitioners to inform conservation decisions more accurately. Progress via the BioFresh project includes assessments for global shrimps, North American

fishes, New Zealand mollusc, fishes, odonata and plants and also the new global standard in freshwater catchment GIS layers; HydroBASINS.

Along with the spatial resolution of analysis, it is also important to consider the metrics used and the species groups in question. With limited funds to spend on field data collection, studies have tested for congruence among taxon groups with a view to informing decisions on a given taxon group by using a highly congruent surrogate group. Previous studies have found little congruence among groups of freshwater taxa as well as among freshwater and non-freshwater groups (Collen et al. 2013, Tissuel et al. 2013, Darwall et al. 2011). This indicates that funding must continue to be applied to field studies and mapping initiatives that inform freshwater species distribution maps. Without further effort, the ability to target conservation action will be primarily limited to those currently well-studied groups and those actions appear unlikely to benefit the less studied groups.

Many data gaps still remain and there are many key areas that need to be addressed towards gaining a comprehensive assessment of freshwater species globally. Priorities for further work include those taxonomic groups and geographic areas with a high proportion of species assessed as Data Deficient, those taxonomic groups and geographic areas with a small proportion of described species assessed on the Red List, those groups that are currently not assessed but are important for livelihoods and other provisioning ecosystem services, or indicators for ecosystem services and function. Specifically, key targets include completing a global assessment of freshwater fishes, molluscs, plants and odonata. Work towards such targets would go some way towards understanding a representative selection of freshwater taxa as these groups span a range of trophic levels and play key roles in local livelihoods and economies.

Immediate priorities for using the available data to inform the conservation of freshwater biodiversity include the identification and validation of freshwater Key Biodiversity Areas (KBAs) globally, gap analysis with the current network of protected areas and systematic conservation planning scenarios to identify a series of options which may improve the protected area network to better safeguard freshwater species. Also important is the consideration of climate

change factors on the location of species distributions and how this may necessitate changes to the protected area network in future or anticipatory adaptation sooner. Each of these lines of research are key outputs of the BioFresh project and due to be publically available in January 2014. With initiatives such as BioFresh, the understanding of the status of and emergent threats to freshwater biodiversity can continue to improve and, hopefully, with it the outlook for freshwater species globally.

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Appendices

Following is a selection of tables summarising the Red List status by Order and Family. The comprehensively assessed groups are listed first followed by those that are partially assessed (but may have comprehensively assessed regions).

Comprehensively assessed groups:

Table A1: Global Crayfish Red List status by Family.

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ASTACIDAE	1	0	1	1	1	0	3	3	10	0.7	0.5	0.3
CAMBARIDAE	3	0	19	34	19	26	91	219	411	0.4	0.2	0.2
PALINURIDAE	0	0	0	0	0	1	20	33	54	0.4	0.0	0.0
PARASTACIDAE	0	0	26	27	12	8	30	49	152	0.6	0.5	0.4

Table A2: Global Crayfish Red List status by Order.

ORDER	Red List Category									proportion threatened	
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID
DECAPODA	4	0	46	62	32	35	144	304	627	0.5	0.3

Table A3: Global Freshwater Amphibians Red List status by Family.

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ALYTIDAE	0	0	1	0	2	4	0	5	12	0.3	0.3	0.3
AMBYSTOMATIDAE	0	0	9	2	3	2	3	16	35	0.5	0.4	0.4
AMPHIUMIDAE	0	0	0	0	0	1	0	2	3	0.0	0.0	0.0
AROMOBATIDAE	0	0	10	16	9	4	34	15	88	0.8	0.6	0.4
ARTHROLEPTIDAE	0	0	4	21	16	8	10	38	97	0.5	0.5	0.4
BOMBINATORIDAE	0	0	0	2	2	0	0	3	7	0.6	0.6	0.6
BRACHYCEPHALIDAE	0	0	0	0	0	0	1	0	1	1.0	NA	0.0
BUFONIDAE	4	2	85	51	41	26	60	167	436	0.5	0.5	0.4
CAECILIIDAE	0	0	0	1	1	0	12	15	29	0.5	0.1	0.1
CALYPTOCEPHALELLIDAE	0	0	1	1	2	0	0	0	4	1.0	1.0	1.0
CENTROLENIDAE	0	0	6	16	30	7	57	30	146	0.7	0.6	0.4
CERATOBATRACHIDAE	0	0	0	0	0	1	3	4	8	0.4	0.0	0.0
CERATOPHRYIDAE	0	0	10	25	16	6	16	11	84	0.8	0.8	0.6
CRAUGASTORIDAE	2	0	19	12	2	1	6	3	45	0.9	0.9	0.8
CRYPTOBRANCHIDAE	0	0	1	0	0	2	0	0	3	0.3	0.3	0.3
CYCLORAMPHIDAE	0	0	7	4	5	8	31	28	83	0.6	0.3	0.2
DENDROBATIDAE	0	0	8	12	6	13	56	37	132	0.6	0.3	0.2
DICROGLOSSIDAE	1	0	2	14	21	18	40	60	156	0.5	0.3	0.2
ELEUTHERODACTYLIDAE	0	0	9	3	0	0	1	6	19	0.7	0.7	0.6
HELEOPHRYNIDAE	0	0	1	1	0	0	0	4	6	0.3	0.3	0.3
HEMIPHRACTIDAE	0	0	1	8	7	3	9	9	37	0.7	0.6	0.4
HEMISOTIDAE	0	0	0	0	1	0	4	4	9	0.6	0.2	0.1
HYLIDAE	1	0	69	49	29	22	180	451	801	0.4	0.2	0.2
HYLODIDAE	0	0	0	0	0	1	28	11	40	0.7	0.0	0.0
HYNOBIIDAE	0	0	5	10	12	2	8	12	49	0.7	0.7	0.6
HYPEROLIIDAE	0	0	3	18	19	11	48	105	204	0.4	0.3	0.2
ICHTHYOPHIIDAE	0	0	0	0	2	0	39	6	47	0.9	0.3	0.0
LEIOPELMATIDAE	0	0	0	0	1	0	0	2	3	0.3	0.3	0.3
LEIUPERIDAE	0	0	1	1	1	2	23	51	79	0.3	0.1	0.0
LEPTODACTYLIDAE	0	0	2	0	3	1	14	64	84	0.2	0.1	0.1
LIMNODYNASTIDAE	0	0	1	5	1	1	1	35	44	0.2	0.2	0.2
MANTELLIDAE	0	0	5	14	17	6	27	66	135	0.5	0.3	0.3
MEGOPHRYIDAE	0	0	3	14	27	14	39	41	138	0.6	0.4	0.3
MICRIXALIDAE	0	0	1	1	3	1	4	0	10	0.9	0.8	0.5
MICROHYLIDAE	0	0	2	11	11	12	42	89	167	0.4	0.2	0.1
MYOBATRACHIDAE	3	0	6	4	5	3	7	50	78	0.3	0.2	0.2
NASIKABATRACHIDAE	0	0	0	1	0	0	0	0	1	1.0	1.0	1.0
NYCTIBATRACHIDAE	0	0	1	5	3	0	4	2	15	0.9	0.8	0.6
PELOBATIDAE	0	0	0	1	0	1	0	2	4	0.3	0.3	0.3
PELODYTIDAE	0	0	0	0	0	1	0	2	3	0.0	0.0	0.0
PETROPEDETIDAE	0	0	2	5	2	2	0	4	15	0.6	0.6	0.6
PHRYNOBATRACHIDAE	0	0	2	5	7	3	25	30	72	0.5	0.3	0.2
PIPIDAE	0	0	2	2	0	1	5	22	32	0.3	0.1	0.1
PLETHODONTIDAE	1	0	2	6	14	4	6	36	69	0.4	0.4	0.3
PROTEIDAE	0	0	0	1	1	1	0	3	6	0.3	0.3	0.3
PTYCHADENIDAE	0	0	0	1	0	3	12	32	48	0.3	0.0	0.0
PYXICEPHALIDAE	0	0	1	4	3	3	12	37	60	0.3	0.2	0.1

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
RANIDAE	1	0	12	25	36	32	61	152	319	0.4	0.3	0.2
RANIXALIDAE	0	0	2	3	1	0	2	2	10	0.8	0.8	0.6
RHACOPHORIDAE	0	0	2	13	10	17	46	52	140	0.5	0.3	0.2
RHINATREMATIDAE	0	0	0	0	0	0	5	4	9	0.6	0.0	0.0
RHINOPHRYNIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
RHYACOTRITONIDAE	0	0	0	0	1	2	0	1	4	0.3	0.3	0.3
SALAMANDRIDAE	1	0	4	8	10	13	2	28	66	0.4	0.3	0.3
SCAPHIOPODIDAE	0	0	0	0	0	1	0	6	7	0.0	0.0	0.0
SIRENIDAE	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
SOOGLOSSIDAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
STRABOMANTIDAE	0	0	5	16	22	8	16	20	87	0.7	0.6	0.5

Table A4: Global Freshwater Amphibians Red List status by Order.

ORDER	Red List Category									proportion threatened (%)		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ANURA	12	2	286	384	362	245	924	1753	3968	0.5	0.3	0.3
CAUDATA	2	0	21	27	41	27	19	102	239	0.5	0.4	0.4
GYMNOPHIONA	0	0	0	1	3	0	56	25	85	0.7	0.1	0.0

Table A5: Global Freshwater Birds Red List status by Family.

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ACANTHISITTIDAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
ACANTHIZIDAE	0	0	0	0	0	0	0	9	9	0.0	0.0	0.0
ACCIPITRIDAE	0	0	1	3	8	8	0	65	85	0.1	0.1	0.1
AEGITHALIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
AEGOTHELIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
ALAUDIDAE	0	0	0	0	0	0	0	8	8	0.0	0.0	0.0
ALCEDINIDAE	0	0	1	0	4	4	1	46	56	0.1	0.1	0.1
ALCIDAE	0	0	0	1	0	0	0	0	1	1.0	1.0	1.0
ANATIDAE	5	0	6	11	11	8	0	121	162	0.2	0.2	0.2
ANHIMIDAE	0	0	0	0	0	1	0	2	3	0.0	0.0	0.0
ANHINGIDAE	0	0	0	0	0	1	0	3	4	0.0	0.0	0.0
ANSERANATIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
APODIDAE	0	0	0	0	1	1	0	16	18	0.1	0.1	0.1
ARAMIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
ARDEIDAE	4	0	1	5	3	2	0	49	64	0.2	0.2	0.2
ARTAMIDAE	0	0	0	0	0	0	0	5	5	0.0	0.0	0.0
ATRICHORNITHIDAE	0	0	0	1	0	0	0	0	1	1.0	1.0	1.0
BALAENICIPITIDAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
BOMBYCILLIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
BUCCONIDAE	0	0	0	0	0	0	0	16	16	0.0	0.0	0.0
BUCEROTIDAE	0	0	0	0	1	0	0	11	12	0.1	0.1	0.1
BUCORVIDAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
BURHINIDAE	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
CAMPEPHAGIDAE	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
CAPRIMULGIDAE	0	0	0	0	0	1	0	17	18	0.0	0.0	0.0
CARDINALIDAE	0	0	0	0	0	0	0	5	5	0.0	0.0	0.0
CATHARTIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
CHARADRIIDAE	0	0	1	1	2	4	0	43	51	0.1	0.1	0.1
CHIONIDAE	0	0	0	0	0	1	0	0	1	0.0	0.0	0.0
CHLOROPSEIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
CICONIIDAE	0	0	0	3	2	2	0	12	19	0.3	0.3	0.3
CINCLIDAE	0	0	0	0	1	0	0	4	5	0.2	0.2	0.2
CISTICOLIDAE	0	0	0	0	1	1	0	39	41	0.0	0.0	0.0
COLIIDAE	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
COLUMBIDAE	0	0	0	0	1	0	0	28	29	0.0	0.0	0.0
CONOPOPHAGIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
CORACIIDAE	0	0	0	0	0	0	0	5	5	0.0	0.0	0.0
CORCORACIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
CORVIDAE	0	0	0	0	0	1	0	16	17	0.0	0.0	0.0
COTINGIDAE	0	0	0	1	0	0	0	13	14	0.1	0.1	0.1
CRACIDAE	0	0	0	1	1	0	0	2	4	0.5	0.5	0.5
CRACTICIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
CUCULIDAE	0	0	0	0	1	0	0	32	33	0.0	0.0	0.0
DASYORNITHIDAE	0	0	0	1	0	0	0	0	1	1.0	1.0	1.0
DENDROCOLAPTIDAE	0	0	0	0	0	1	0	6	7	0.0	0.0	0.0
DICAEIDAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
DONACOBIIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
EMBERIZIDAE	0	0	0	0	2	6	0	39	47	0.0	0.0	0.0
ESTRILDIDAE	0	0	0	0	2	1	1	32	36	0.1	0.1	0.1
EUPETIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
EURLAIMIDAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
EURYPYGIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
FALCONIDAE	0	0	0	1	1	1	0	18	21	0.1	0.1	0.1
FORMICARIIDAE	0	0	0	0	0	0	0	6	6	0.0	0.0	0.0
FRINGILLIDAE	0	0	0	0	0	0	0	10	10	0.0	0.0	0.0
FURNARIIDAE	0	0	3	0	2	7	0	33	45	0.1	0.1	0.1
GALBULIDAE	0	0	0	0	0	0	0	13	13	0.0	0.0	0.0
GAVIIDAE	0	0	0	0	0	1	0	4	5	0.0	0.0	0.0
GLAREOLIDAE	0	0	0	0	1	1	0	10	12	0.1	0.1	0.1
GRUIDAE	0	0	1	3	7	0	0	4	15	0.7	0.7	0.7
HAEMATOPODIDAE	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
HELIORNITHIDAE	0	0	0	1	0	0	0	2	3	0.3	0.3	0.3
HEMIPROCNIIDAE	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
HIRUNDINIDAE	0	0	1	1	1	0	1	58	62	0.1	0.0	0.0
IBIDORHYNCHIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
ICTERIDAE	1	0	0	1	2	0	0	20	24	0.1	0.1	0.1
INDICATORIDAE	0	0	0	0	0	1	0	4	5	0.0	0.0	0.0
JACANIDAE	0	0	0	0	0	1	0	7	8	0.0	0.0	0.0
LANIIDAE	0	0	0	0	0	0	0	6	6	0.0	0.0	0.0
LARIDAE	0	0	0	3	2	3	0	40	48	0.1	0.1	0.1
MALACONOTIDAE	0	0	0	0	0	1	0	7	8	0.0	0.0	0.0
MALURIDAE	0	0	0	0	0	0	0	10	10	0.0	0.0	0.0
MEGAPODIIDAE	0	0	0	2	0	0	0	3	5	0.4	0.4	0.4
MELIPHAGIDAE	0	0	0	0	0	1	0	10	11	0.0	0.0	0.0
MEROPIDAE	0	0	0	0	0	0	0	19	19	0.0	0.0	0.0
MOMOTIDAE	0	0	0	0	1	0	0	1	2	0.5	0.5	0.5
MONARCHIDAE	0	0	1	0	2	0	0	8	11	0.3	0.3	0.3
MOTACILLIDAE	0	0	0	0	0	2	0	21	23	0.0	0.0	0.0
MUSCICAPIDAE	0	0	0	0	2	2	1	29	34	0.1	0.1	0.1
MUSOPHAGIDAE	0	0	0	0	0	0	0	6	6	0.0	0.0	0.0
NECTARINIIDAE	0	0	0	0	0	1	0	39	40	0.0	0.0	0.0
NUMIDIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
OPISTHOCOMIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
ORIOIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
ORTHONYCHIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
OTIDIDAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
PACHYCEPHALIDAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
PARDALOTIDAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
PARIDAE	0	0	0	0	0	1	0	8	9	0.0	0.0	0.0
PARULIDAE	0	0	0	2	1	2	0	14	19	0.2	0.2	0.2
PASSERIDAE	0	0	0	0	0	0	0	7	7	0.0	0.0	0.0
PELECANIDAE	0	0	0	0	1	2	0	5	8	0.1	0.1	0.1
PETROICIDAE	0	0	0	0	0	0	0	6	6	0.0	0.0	0.0
PHALACROCORACIDAE	0	0	0	0	0	0	0	12	12	0.0	0.0	0.0
PHASIANIDAE	0	0	0	0	3	0	0	12	15	0.2	0.2	0.2

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
PHOENICOPTERIDAE	0	0	0	0	1	3	0	2	6	0.2	0.2	0.2
PHOENICULIDAE	0	0	0	0	0	0	0	5	5	0.0	0.0	0.0
PICATHARTIDAE	0	0	0	0	2	0	0	0	2	1.0	1.0	1.0
PICIDAE	0	0	0	0	1	2	0	25	28	0.0	0.0	0.0
PIPRIDAE	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
PITTIDAE	0	0	0	0	2	2	0	3	7	0.3	0.3	0.3
PLATYSTEIRIDAE	0	0	0	1	0	0	0	2	3	0.3	0.3	0.3
PLOCEIDAE	0	0	0	0	2	2	1	50	55	0.1	0.0	0.0
PODICIPEDIDAE	3	0	2	1	2	0	0	14	22	0.3	0.3	0.3
POMATOSTOMIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PROCELLARIIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PRUNELLIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PSITTACIDAE	0	0	1	0	3	0	0	22	26	0.2	0.2	0.2
PTEROCLIDIDAE	0	0	0	0	0	0	0	5	5	0.0	0.0	0.0
PTILONORHYNCHIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PYCNONOTIDAE	0	0	0	1	1	1	1	20	24	0.1	0.1	0.1
RALLIDAE	4	0	1	7	11	7	1	80	111	0.2	0.2	0.2
RAMPHASTIDAE	0	0	0	0	1	1	0	16	18	0.1	0.1	0.1
RECURVIROSTRIDAE	0	0	1	0	0	0	0	7	8	0.1	0.1	0.1
REMIZIDAE	0	0	0	0	0	0	0	5	5	0.0	0.0	0.0
RHEIDAE	0	0	0	0	0	1	0	0	1	0.0	0.0	0.0
RHINOCRYPTIDAE	0	0	0	1	0	0	0	4	5	0.2	0.2	0.2
RHIPIDURIDAE	0	0	0	0	0	1	0	5	6	0.0	0.0	0.0
ROSTRATULIDAE	0	0	0	1	0	0	0	2	3	0.3	0.3	0.3
SAPAYOAIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
SCOLOPACIDAE	2	0	2	1	3	8	0	56	72	0.1	0.1	0.1
SCOPIIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
SITTIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
STERCORARIIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
STRIGIDAE	0	0	0	1	1	0	1	36	39	0.1	0.1	0.1
STURNIDAE	0	0	0	0	0	1	0	18	19	0.0	0.0	0.0
SULIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
SYLVIIDAE	0	0	1	4	9	5	1	55	75	0.2	0.2	0.2
THAMNOPHILIDAE	0	0	1	1	3	4	0	32	41	0.1	0.1	0.1
THINOCORIDAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
THRAUPIDAE	0	0	0	0	1	0	0	9	10	0.1	0.1	0.1
THRESKIORNITHIDAE	1	0	2	3	0	2	0	20	28	0.2	0.2	0.2
TIMALIIDAE	0	0	0	0	5	5	0	29	39	0.1	0.1	0.1
TROCHILIDAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
TROGLODYTIDAE	0	0	0	2	0	0	0	5	7	0.3	0.3	0.3
TROGONIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
TURDIDAE	0	0	0	1	0	3	0	21	25	0.0	0.0	0.0
TURNICIDAE	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
TYRANNIDAE	0	0	0	2	8	4	0	96	110	0.1	0.1	0.1
TYTONIDAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
VIDUIDAE	0	0	0	0	0	0	0	5	5	0.0	0.0	0.0
ZOSTEROPIDAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0

Table A6: Global Birds Red List status by Order.

ORDER	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ANSERIFORMES	5	0	6	11	11	9	0	124	166	0.2	0.2	0.2
APODIFORMES	0	0	0	0	1	1	0	23	25	0.0	0.0	0.0
CAPRIMULGIFORMES	0	0	0	0	0	1	0	18	19	0.0	0.0	0.0
CHARADRIIFORMES	2	0	4	7	8	18	0	178	217	0.1	0.1	0.1
CICONIIFORMES	5	0	3	11	5	6	0	81	111	0.2	0.2	0.2
COLIIFORMES	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
COLUMBIFORMES	0	0	0	0	1	0	0	33	34	0.0	0.0	0.0
CORACIIFORMES	0	0	1	0	7	4	1	87	100	0.1	0.1	0.1
CUCULIFORMES	0	0	0	0	1	0	0	39	40	0.0	0.0	0.0
FALCONIFORMES	0	0	1	4	9	9	0	84	107	0.1	0.1	0.1
GALLIFORMES	0	0	0	3	4	0	0	18	25	0.3	0.3	0.3
GAVIIFORMES	0	0	0	0	0	1	0	4	5	0.0	0.0	0.0
GRUIFORMES	4	0	2	11	18	7	1	95	138	0.2	0.2	0.2
PASSERIFORMES	1	0	7	20	50	55	6	860	999	0.1	0.1	0.1
PELECANIFORMES	0	0	0	0	2	3	0	22	27	0.1	0.1	0.1
PHOENICOPTERIFORMES	0	0	0	0	1	3	0	2	6	0.2	0.2	0.2
PICIFORMES	0	0	0	0	2	4	0	74	80	0.0	0.0	0.0
PODICIPEDIFORMES	3	0	2	1	2	0	0	14	22	0.3	0.3	0.3
PROCELLARIIFORMES	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PSITTACIFORMES	0	0	1	0	3	0	0	22	26	0.2	0.2	0.2
STRIGIFORMES	0	0	0	1	1	0	1	39	42	0.1	0.0	0.0
STRUTHIONIFORMES	0	0	0	0	0	1	0	0	1	0.0	0.0	0.0
TROGONIFORMES	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0

Partially assessed (some comprehensively assessed regions):

Table A7: Global Freshwater Reptiles Red List status by Family.

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ACROCHORDIDAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
AGAMIDAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
ALLIGATORIDAE	0	0	1	0	0	1	0	6	8	0.1	0.1	0.1
BOIDAE	0	0	0	0	0	0	1	0	1	1.0	NA	0.0
CARETTOCHELYIDAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
CHELIDAE	0	0	3	4	6	7	2	3	25	0.6	0.6	0.5
CHELYDRIDAE	0	0	0	0	2	0	0	1	3	0.7	0.7	0.7
COLUBRIDAE	0	0	0	1	0	1	0	4	6	0.2	0.2	0.2
CROCODYLIDAE	0	0	4	1	3	0	1	5	14	0.6	0.6	0.6
CYLINDROPHIIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
DERMATEMYDIDAE	0	0	1	0	0	0	0	0	1	1.0	1.0	1.0
DIPSADIDAE	0	0	0	0	0	0	0	9	9	0.0	0.0	0.0
ELAPIDAE	0	0	0	0	3	0	5	8	16	0.5	0.3	0.2
EMYDIDAE	0	0	1	10	10	8	2	11	42	0.5	0.5	0.5
GAVIALIDAE	0	0	1	0	0	0	0	0	1	1.0	1.0	1.0
GEOEMYDIDAE	0	0	14	17	9	9	0	2	51	0.8	0.8	0.8
GERRHOSAURIDAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
HOMALOPSIDAE	0	0	0	2	1	0	13	20	36	0.4	0.1	0.1
KINOSTERNIDAE	0	0	1	0	2	6	3	11	23	0.3	0.2	0.1
LAMPROPHIIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
NATRICIDAE	0	0	0	0	3	6	17	61	87	0.2	0.0	0.0
PELOMEDUSIDAE	1	0	0	0	1	0	1	3	6	0.4	0.3	0.2
PLATYSTERNIDAE	0	0	0	1	0	0	0	0	1	1.0	1.0	1.0
PODOCNEMIDIDAE	0	0	1	1	4	1	0	0	7	0.9	0.9	0.9
POLYCHROTIDAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
PSEUDOXENODONTIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PSEUDOXYPHIIDAE	0	0	0	0	0	0	0	9	9	0.0	0.0	0.0
SCINCIDAE	0	0	0	0	0	2	0	3	5	0.0	0.0	0.0
TRIONYCHIDAE	0	1	2	5	6	3	1	5	23	0.6	0.6	0.6
VARANIDAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
VIPERIDAE	0	0	0	0	0	0	1	2	3	0.3	0.0	0.0
XENODERMATIDAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0

Table A8: Global Freshwater Reptiles Red List status by Order.

ORDER	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
CROCODYLIA	0	0	6	1	3	1	1	11	23	0.5	0.5	0.4
SQUAMATA	0	0	0	3	10	9	37	125	184	0.3	0.1	0.1
TESTUDINES	1	1	23	38	41	34	9	36	183	0.6	0.6	0.6

Table A9: Global Freshwater Plants Red List status by Family.

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ACANTHACEAE	0	0	1	0	6	2	7	37	53	0.3	0.2	0.1
ACORACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
ALISMACEAE	0	0	0	1	4	1	2	14	22	0.3	0.3	0.2
AMARANTHACEAE	0	0	0	0	2	0	0	2	4	0.5	0.5	0.5
AMARYLLIDACEAE	0	0	0	1	1	0	1	6	9	0.3	0.3	0.2
AMBLYSTEGIACEAE	0	0	1	1	1	0	2	0	5	1.0	1.0	0.6
ANTHERICACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
APONOGETONACEAE	0	0	0	3	3	0	1	14	21	0.3	0.3	0.3
ARACEAE	0	0	0	1	0	2	5	34	42	0.1	0.0	0.0
ASCLEPIADACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
ASPHODELACEAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
AVICENNIACEAE	0	0	0	0	1	0	0	1	2	0.5	0.5	0.5
AZOLLACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
BALSAMINACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
BIGNONIACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
BORAGINACEAE	0	0	0	0	0	1	0	4	5	0.0	0.0	0.0
BRACHYTHECIACEAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
BURMANNIACEAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
CALLITRICHACEAE	0	0	1	2	0	1	3	3	10	0.6	0.4	0.3
CAMPANULACEAE	0	0	0	0	1	2	3	4	10	0.4	0.1	0.1
CARYOPHYLLACEAE	0	0	0	0	2	0	0	1	3	0.7	0.7	0.7
CERATOPHYLLACEAE	0	0	0	0	0	0	1	2	3	0.3	0.0	0.0
CHARACEAE	0	0	0	0	0	0	3	8	11	0.3	0.0	0.0
COMMELINACEAE	0	0	0	0	1	0	2	18	21	0.1	0.1	0.0
COMPOSITAE	0	0	4	1	9	6	5	40	65	0.3	0.2	0.2
CONVOLVULACEAE	0	0	1	0	0	0	0	3	4	0.3	0.3	0.3
CRASSULACEAE	0	0	0	0	0	0	2	4	6	0.3	0.0	0.0
CRUCIFERAE	0	0	2	3	2	0	0	1	8	0.9	0.9	0.9
CUPRESSACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
CYATHEACEAE	0	0	0	1	0	0	0	1	2	0.5	0.5	0.5
CYPERACEAE	0	0	3	4	14	6	17	167	211	0.2	0.1	0.1
DENNSTAEDTIACEAE	0	0	0	0	0	1	0	1	2	0.0	0.0	0.0
DICRANACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
DROSERACEAE	0	0	2	1	1	0	1	3	8	0.6	0.6	0.5
DRYOPTERIDACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
ELATINACEAE	0	0	0	0	0	1	0	1	2	0.0	0.0	0.0
ERICACEAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
ERIOCAULACEAE	0	0	6	5	7	1	3	41	63	0.3	0.3	0.3
EUPHORBIACEAE	0	0	0	0	1	0	1	5	7	0.3	0.2	0.1
FISSIDENTACEAE	0	0	1	0	0	0	0	0	1	1.0	1.0	1.0
GENTIANACEAE	0	0	1	0	0	1	0	5	7	0.1	0.1	0.1
GESNERIACEAE	0	0	0	0	0	0	2	0	2	1.0	NA	0.0
GOODENIACEAE	0	0	1	0	0	0	0	0	1	1.0	1.0	1.0
GRAMINEAE	0	0	3	6	6	3	2	52	72	0.2	0.2	0.2
GRAMMITIDACEAE	0	0	0	0	0	0	1	1	2	0.5	0.0	0.0
GUTTIFERAE	0	0	0	0	0	1	0	2	3	0.0	0.0	0.0
HAEMODORACEAE	0	0	0	0	0	0	1	0	1	1.0	NA	0.0

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
HALORAGACEAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
HANGUANACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
HYACINTHACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
HYDROCHARITACEAE	0	0	0	0	1	1	13	27	42	0.3	0.0	0.0
HYDROPHYLLACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
HYMENOPHYLLACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
HYPNACEAE	0	0	0	0	0	0	1	0	1	1.0	NA	0.0
HYPOXIDACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
IRIDACEAE	0	0	1	1	2	0	0	1	5	0.8	0.8	0.8
ISOETACEAE	0	0	8	4	1	3	6	5	27	0.7	0.6	0.5
JUNCACEAE	0	0	1	0	2	2	1	16	22	0.2	0.1	0.1
LABIATAE	0	0	0	0	1	2	2	6	11	0.3	0.1	0.1
LEGUMINOSAE	0	0	2	1	2	0	0	29	34	0.1	0.1	0.1
LEJEUNEACEAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
LEMNACEAE	0	0	0	1	0	0	1	13	15	0.1	0.1	0.1
LENTIBULARIACEAE	0	0	0	2	4	2	1	14	23	0.3	0.3	0.3
LIMNOCHARITACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
LOMARIOPSIDACEAE	0	0	0	0	0	0	2	7	9	0.2	0.0	0.0
LYGODIACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
LYTHRACEAE	0	0	2	3	4	2	0	22	33	0.3	0.3	0.3
MARSILEACEAE	0	0	0	2	2	1	0	12	17	0.2	0.2	0.2
MENYANTHACEAE	0	0	2	1	1	1	1	9	15	0.3	0.3	0.3
NECKERACEAE	0	0	2	1	0	0	0	0	3	1.0	1.0	1.0
NYMPHAEACEAE	0	1	0	0	0	0	3	7	11	0.3	0.0	0.0
ONAGRACEAE	0	0	1	0	0	1	1	2	5	0.4	0.3	0.2
OPHIOGLOSSACEAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
ORCHIDACEAE	0	0	1	2	1	1	0	6	11	0.4	0.4	0.4
OSMUNDACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
OXALIDACEAE	0	0	2	0	1	0	1	2	6	0.7	0.6	0.5
PALMAE	0	0	2	2	0	1	3	4	12	0.6	0.4	0.3
PANDANACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PARKERIACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PLANTAGINACEAE	0	0	0	0	1	0	0	1	2	0.5	0.5	0.5
PLUMBAGINACEAE	0	0	1	1	3	2	1	0	8	0.8	0.7	0.6
PODOCARPACEAE	0	0	1	1	0	0	0	0	2	1.0	1.0	1.0
PODOSTEMACEAE	0	0	9	13	20	6	29	41	118	0.6	0.5	0.4
POLYGONACEAE	0	0	1	1	0	1	1	6	10	0.3	0.2	0.2
POLYPODIACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
PONTEDERIACEAE	0	0	0	0	0	0	0	7	7	0.0	0.0	0.0
POTAMOGETONACEAE	0	0	0	1	0	0	1	17	19	0.1	0.1	0.1
PRIMULACEAE	0	0	0	0	0	4	0	1	5	0.0	0.0	0.0
PTERIDACEAE	0	0	0	0	1	0	0	3	4	0.3	0.3	0.3
RANUNCULACEAE	0	0	0	0	1	1	3	8	13	0.3	0.1	0.1
RIELLACEAE	0	0	0	0	0	0	4	0	4	1.0	NA	0.0
ROSACEAE	0	0	0	0	0	1	0	0	1	0.0	0.0	0.0
RUBIACEAE	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
SALICACEAE	0	0	0	0	0	1	0	1	2	0.0	0.0	0.0
SALVINIACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0

FAMILY	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
SAXIFRAGACEAE	0	0	0	0	0	1	0	0	1	0.0	0.0	0.0
SCROPHULARIACEAE	0	0	1	3	0	2	14	59	79	0.2	0.1	0.1
SELAGINELLACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
SPHAGNACEAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
STERCULIACEAE	0	0	0	2	0	0	0	0	2	1.0	1.0	1.0
TECOPHILAEACEAE	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
THELYPTERIDACEAE	0	0	0	0	0	0	1	4	5	0.2	0.0	0.0
TILIACEAE	0	0	0	0	0	1	1	0	2	0.5	0.0	0.0
TRAPACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
TYPHACEAE	0	0	0	0	0	0	0	8	8	0.0	0.0	0.0
UMBELLIFERAE	0	0	0	3	3	9	0	10	25	0.2	0.2	0.2
URTICACEAE	0	0	0	0	0	0	1	0	1	1.0	NA	0.0
VERBENACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
VIOLACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
WOODSIACEAE	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
XYRIDACEAE	0	0	1	0	1	1	9	8	20	0.6	0.2	0.1
ZANNICHELLIACEAE	0	0	0	0	0	0	1	2	3	0.3	0.0	0.0
ZINGIBERACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
ZOSTERACEAE	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0

Table A10: Global Freshwater Plants Red List status by Order.

ORDER	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
ALISMATALES	0	0	0	1	4	1	2	15	23	0.3	0.2	0.2
APIALES	0	0	0	3	3	9	0	10	25	0.2	0.2	0.2
ARALES	0	0	0	2	0	2	6	49	59	0.1	0.0	0.0
ARECALES	0	0	2	2	0	1	3	4	12	0.6	0.4	0.3
ASTERALES	0	0	4	1	9	6	5	40	65	0.3	0.2	0.2
BLECHNALES	0	0	0	0	0	0	3	15	18	0.2	0.0	0.0
CALLITRICHALES	0	0	1	2	0	1	3	3	10	0.6	0.4	0.3
CAMPANULALES	0	0	1	0	1	2	3	4	11	0.5	0.3	0.2
CAPPARALES	0	0	2	3	2	0	0	1	8	0.9	0.9	0.9
CARYOPHYLLALES	0	0	0	0	4	0	0	3	7	0.6	0.6	0.6
CHARALES	0	0	0	0	0	0	3	8	11	0.3	0.0	0.0
COMMELINALES	0	0	1	0	2	1	11	26	41	0.3	0.1	0.1
CONIFERALES	0	0	1	1	0	0	0	1	3	0.7	0.7	0.7
CYATHEALES	0	0	0	1	0	0	0	1	2	0.5	0.5	0.5
CYPERALES	0	0	6	10	20	9	19	219	283	0.2	0.1	0.1
DICKSONIALES	0	0	0	0	0	1	0	1	2	0.0	0.0	0.0
DICRANALES	0	0	1	0	0	0	0	1	2	0.5	0.5	0.5
ERICALES	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
ERIOCAULALES	0	0	6	5	7	1	3	41	63	0.3	0.3	0.3
EUPHORBIALES	0	0	0	0	1	0	1	5	7	0.3	0.2	0.1
FABALES	0	0	2	1	2	0	0	29	34	0.1	0.1	0.1
GENTIANALES	0	0	1	0	0	1	0	6	8	0.1	0.1	0.1
GERANIALES	0	0	2	0	1	0	1	3	7	0.6	0.5	0.4

ORDER	Red List Category									proportion threatened		
	EX	EW	CR	EN	VU	NT	DD	LC	TOT	UB	MID	LB
HALORAGALES	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
HYDROCHARITALES	0	0	0	0	1	1	13	27	42	0.3	0.0	0.0
HYMENOPHYLLALES	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
HYPNALES	0	0	3	2	2	0	3	0	10	1.0	1.0	0.7
ISOETALES	0	0	8	4	1	3	6	5	27	0.7	0.6	0.5
JUNCALES	0	0	1	0	2	2	1	16	22	0.2	0.1	0.1
LAMIALES	0	0	0	0	2	3	2	12	19	0.2	0.1	0.1
LILIALES	0	0	1	2	5	0	2	19	29	0.3	0.3	0.3
MALVALES	0	0	0	2	0	1	1	0	4	0.8	0.7	0.5
MARSILEALES	0	0	0	2	2	1	0	12	17	0.2	0.2	0.2
MYRTALES	0	0	3	3	4	3	1	26	40	0.3	0.3	0.3
NAJADALES	0	0	0	4	3	0	3	34	44	0.2	0.2	0.2
NEPENTHALES	0	0	2	1	1	0	1	3	8	0.6	0.6	0.5
NYMPHAEALES	0	1	0	0	0	0	4	9	14	0.3	0.0	0.0
OPHIOGLOSSALES	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
ORCHIDALES	0	0	1	2	1	1	0	9	14	0.3	0.3	0.3
OSMUNDALES	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PANDANALES	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
PLANTAGINALES	0	0	0	0	1	0	0	1	2	0.5	0.5	0.5
PLUMBAGINALES	0	0	1	1	3	2	1	0	8	0.8	0.7	0.6
PODOSTEMALES	0	0	9	13	20	6	29	41	118	0.6	0.5	0.4
POLYGONALES	0	0	1	1	0	1	1	6	10	0.3	0.2	0.2
POLYPODIALES	0	0	0	0	0	0	1	3	4	0.3	0.0	0.0
PORELLALES	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
PRIMULALES	0	0	0	0	0	4	0	1	5	0.0	0.0	0.0
PTERIDALES	0	0	0	0	1	0	0	4	5	0.2	0.2	0.2
RANUNCULALES	0	0	0	0	1	1	3	8	13	0.3	0.1	0.1
ROSALES	0	0	0	0	0	2	2	4	8	0.3	0.0	0.0
RUBIALES	0	0	0	0	0	0	0	3	3	0.0	0.0	0.0
SALICALES	0	0	0	0	0	1	0	1	2	0.0	0.0	0.0
SALVINIALES	0	0	0	0	0	0	0	4	4	0.0	0.0	0.0
SCHIZAEALES	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
SCROPHULARIALES	0	0	2	5	10	6	24	111	158	0.3	0.1	0.1
SELAGINELLALES	0	0	0	0	0	0	0	2	2	0.0	0.0	0.0
SOLANALES	0	0	3	1	1	1	1	13	20	0.3	0.3	0.3
SPHAEROCARPALES	0	0	0	0	0	0	4	0	4	1.0	NA	0.0
SPHAGNALES	0	0	0	0	1	0	0	0	1	1.0	1.0	1.0
THEALES	0	0	0	0	0	2	0	3	5	0.0	0.0	0.0
TYPHALES	0	0	0	0	0	0	0	8	8	0.0	0.0	0.0
URTICALES	0	0	0	0	0	0	1	0	1	1.0	NA	0.0
VIOLALES	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0
ZINGERBERALES	0	0	0	0	0	0	0	1	1	0.0	0.0	0.0

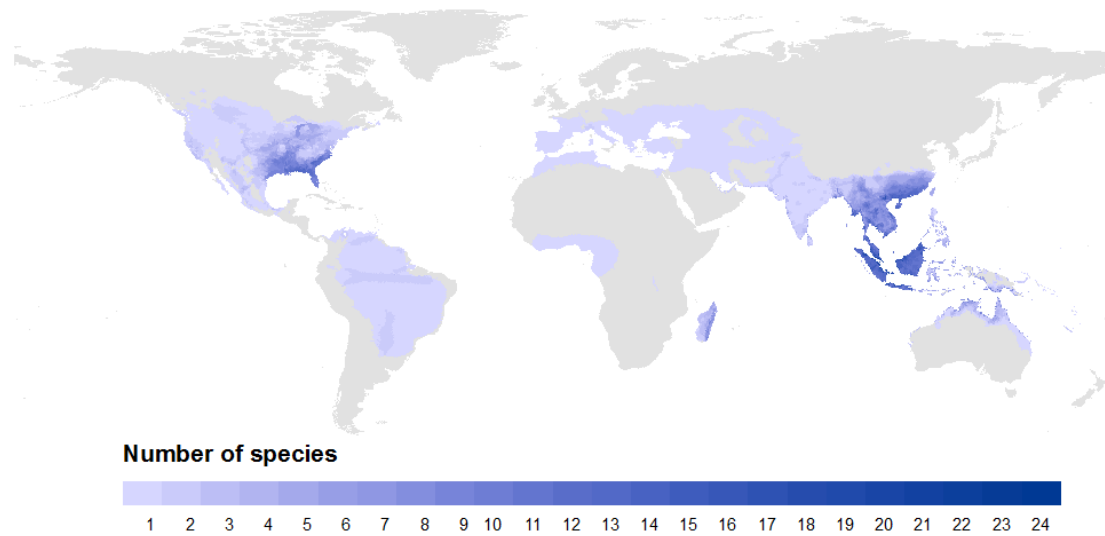
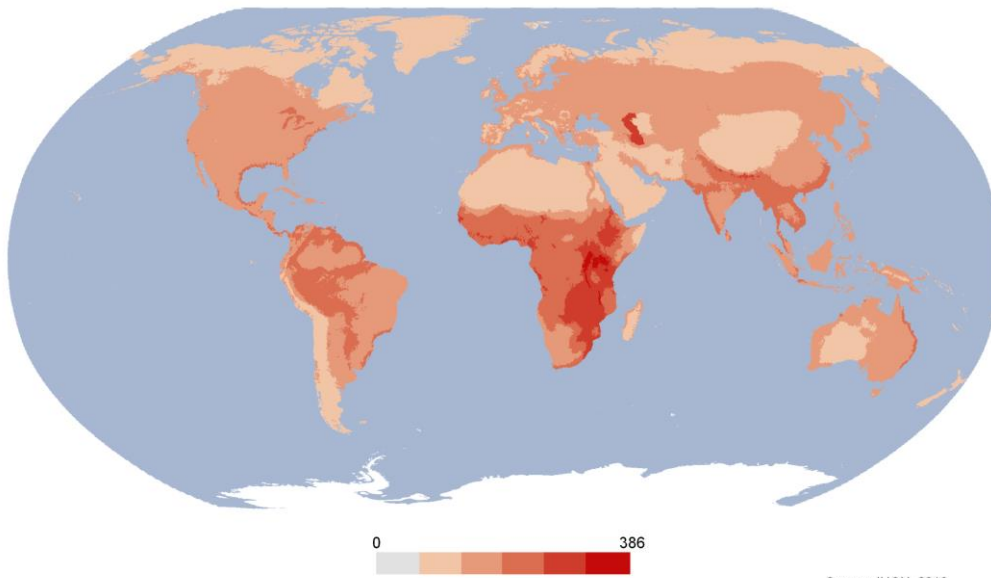


Figure A1: Global freshwater reptiles have not been comprehensively assessed. This figure shows species richness knowledge prior to this status report – many new turtle maps are not included here.

A)

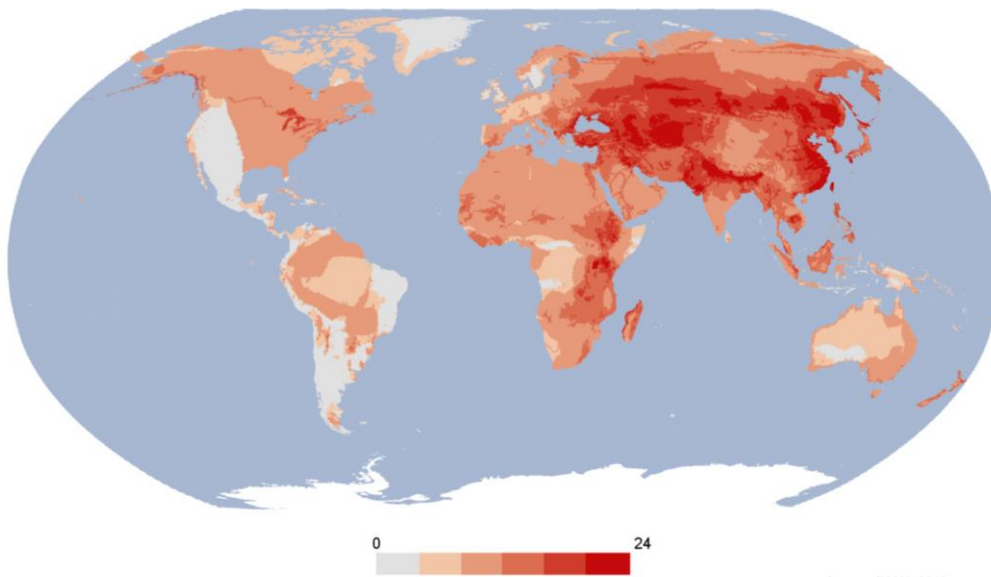
Global Freshwater Birds



Source: IUCN, 2013

B)

Global Threatened Freshwater Birds



Source: IUCN, 2013

Figure A2: Global freshwater birds have been comprehensively assessed; a) species richness b) threatened richness.

