Living Planet Report 2016

Technical Supplement: Living Planet Index

Prepared by the Zoological Society of London

Contents

Living Planet Index at a glance

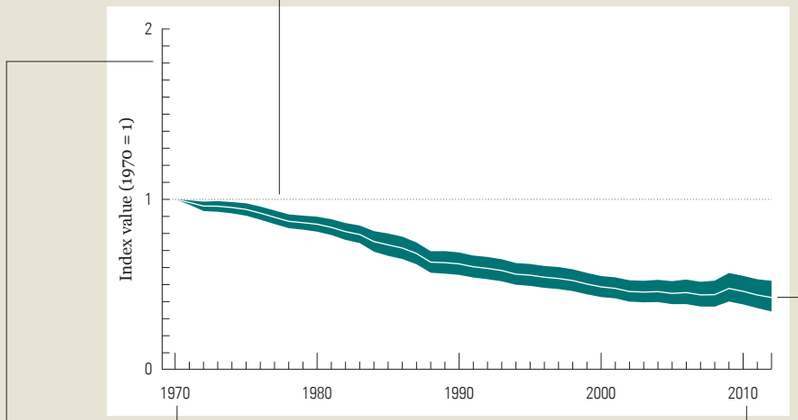
What is the Living Planet Index?

The *Living Planet Index* (LPI) is a measure of the state of the world's biodiversity that tracks trends in abundance of a large number of populations of vertebrate species. The indicator monitors changes in populations in much the same way that a stock market index tracks the value of a set of shares or a retail price index tracks the cost of a basket of consumer goods. The data used in constructing the index are time series of either population size, density (population size per unit area), abundance (number of individuals per sample) or a proxy of abundance; for example, the number of nests or breeding pairs recorded may be used instead of a direct population count.

Data for the Living Planet Index are gathered from a variety of sources such as journals, online databases and government reports that contain time series of vertebrate populations spanning any number of years between 1970 and 2012. 2012 is the most recent year for which comprehensive and reliable data is available due to the amount of time needed for data collection, publication and inclusion in the LPI database. The Living Planet Index is currently based on time-series data for 14,152 populations of 3,706 species of mammal, bird, reptile, amphibian and fish from around the globe. Using a method developed by ZSL and WWF, these species population trends are aggregated and weighted to produce the different Living Planet Indices.

Box 1: How to interpret the LPI

This annotated graph explains how to interpret the LPI graphs found in the report. It briefly explains the reasons behind the set time period and what the confidence intervals and index values show.



Confidence intervals
The shaded areas show 95 per cent confidence intervals. These illustrate how certain we are about the trend in any given year relative to 1970; in other words, the uncertainty in the LPI is cumulative throughout the time series and the intervals always widen as the uncertainty from each of the previous year is added to the current year.

Baseline
The index starts at a value of 1. If the LPI and confidence intervals move away from this baseline, we can say there has been an increase or decline compared to 1970.

Index values
These represent the average change in population abundance, so it shows the rate of change and not the absolute change in population sizes. For any given year in the time series, the index value and confidence intervals shown represent the overall trend in that year compared to 1970.

Baseline year
This is set to 1970 so the index value in any given year is always relative to 1970. This is the earliest year for which we have a good amount of data available.

Final year
The final year of the index is also set by the availability of data and it is the latest year for which we have a good amount of data. Because it takes time to collect, process and publish monitoring data, there can be a time lag before data is available for the LPI.

What subsets of the global LPI are included in the Living Planet Report 2016?

In addition to the global LPI, the 2016 report contains LPI subsets to reflect trends in:

A. Systems – freshwater, marine and terrestrial

Each population is assigned to a system depending on where the population is located, rather than where the species lives in general (more detail below). Some species can be found in more than one system, such as Pacific salmon which occurs in both freshwater and marine environments. Therefore it is possible for different populations of the same species to be included in different system indices.

B. Habitats

Habitat categories, as recorded by the IUCN Red List species assessments, were used to look at population trends in two terrestrial – tropical forest and grasslands - and one freshwater habitat – wetlands. For grasslands, species that had grassland, shrubland or savanna (or any combination of these) listed as suitable habitats by the IUCN Red List, were included. For the tropical forest LPI, populations monitored in the tropics, of species that only had forest listed as a suitable habitat by the IUCN Red List, were selected. For the wetland LPI, species that only had inland wetland recorded as suitable habitat by the IUCN Red List were used.

C. Species groups

Two species-focussed LPIs were calculated. The Grassland Butterflies Indicator dataset for EU countries, used by the European Environment Agency, was the basis for the grassland butterfly LPI. This is the first time the LPI method has been applied to population trends of invertebrate species. For the migratory fish LPI, species of fish that migrate within freshwater systems or between marine and freshwater systems were included (i.e. GROMS (Global Register of Migratory Species) categories: anadromous, catadromous, potamodromous and amphidromous).

What are the main trends shown by the LPI?

The global LPI declined by 58 per cent between 1970 and 2012, using the diversity-weighted LPI methodology (LPI-D – see below). The results show that species are faring much worse in freshwater systems than in terrestrial or marine systems (Table 1). Terrestrial populations declined by an average of 38 per cent, marine populations by 36 per cent and freshwater populations by 81 per cent.

		Number of species	Per cent change 1970 - 2012	95% confidence limits	
				Lower	**Upper**
Global	Global	3,706	-58%	-66%	-48%
Systems	Terrestrial	1,678	-38%	-51%	-21%
	Freshwater	881	-81%	-89%	-68%
	Marine	1,353	-36%	-48%	-20%
Terrestrial	Tropical forest	220	-41%*	-62%	-7%
	Grassland	126	-18%	-38%	10%
	Grassland butterflies	17	-33%	-59%	10%
Freshwater	Wetland dependent species	308	-39%	-60%	-8%
	Migratory fish	162	-41%	-69%	12%
Global – projected	Global	3,706	-67%**	-75%	-59%

Table 1:
Trends in the Living Planet indices between 1970 and 2012, with 95 per cent confidence limits Positive number means increase, negative means decline (WWF, ZSL, 2016).
**Percentage change is from 1970 to 2009*
***Percentage change is from 1970 to 2020.*

Interpreting results

What do LPI trends indicate?

LPI results are calculations of average trends. For instance, in the case of the global LPI, this means that some populations and species are faring worse than a 58 per cent decline whereas others are not declining as much or are increasing. The average trend calculated for each species in the LPI shows that just over half of species in each taxonomic group are stable or increasing (Figure 1). The exception is amphibians where the average trend for over 50 per cent of these species shows a decline. As the number of species which have positive and negative trends are more or less equal, this means that the magnitude of the declining trends exceeds that of the increasing trends in order to result in an average decline for the global LPI.

This also suggests that the global LPI is not being driven by just a few very threatened species, but that there are a large number of species in each group (almost 50%) that together produce an average declining trend.

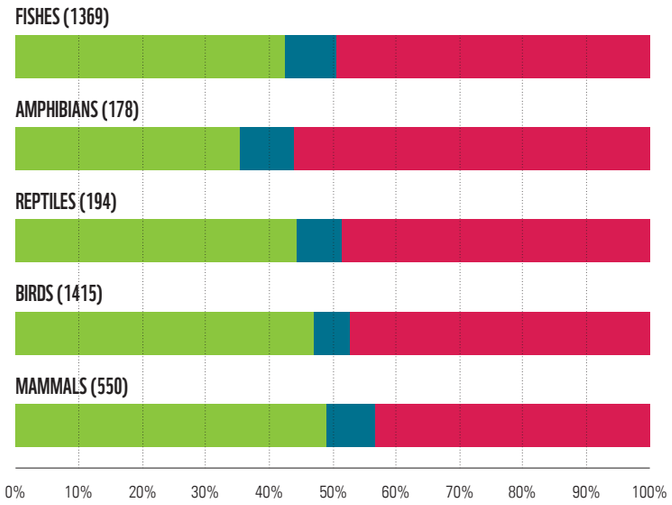


Figure 1:
The proportion of species in each taxonomic group where the average trend is an increase, is stable or a decline

Why do percentages reported for LPIs change from year to year?

The global and system LPIs show a declining trend as also seen in the 2014 edition of the *Living Planet Report*. However, the magnitude of the trend differs from previous years for many LPIs. The reason for this is that the dataset is continually evolving and for each *Living Planet Report* a larger dataset is available to use for the analysis. A different composition of species and populations means that new trends are continuously being added, which can change the average value of each LPI. The new percentages stay within the same range (as measured by the confidence intervals) as previous results so there are similar overall trends even if the final percentage value is often different.

Since the 2014 edition of the *Living Planet Report* the size of the dataset has increased by 36 per cent (Figure 2).

Compared to 2014 there are:

- 22 per cent more species and 36 per cent more populations in the global LPI;
- 7 per cent more terrestrial species and 11 per cent more terrestrial populations;
- 49 per cent more marine species and 97 per cent more marine populations;
- 16 per cent more freshwater species and 8 per cent more freshwater populations.

These changes have also improved the spread of the data among different regions and different taxa. The balance between tropical and temperate species is the same as in the 2014 report – tropical species account for 51 per cent of the species in the index. Each of the taxa is also better represented: for example, fish species have increased by the greatest proportion at 62 per cent, followed by an increase in reptile species of 34 per cent. Increasing the dataset in this way generally improves the robustness of the indices.

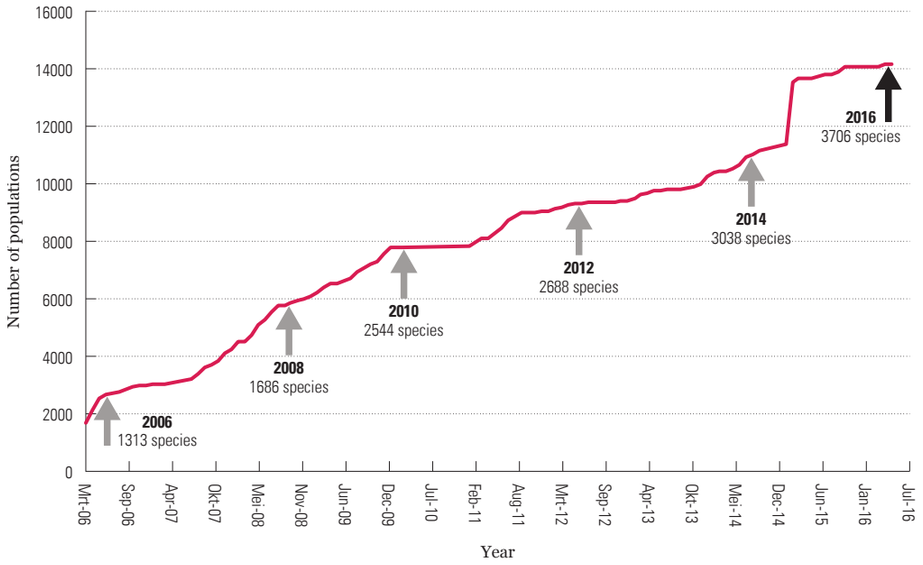


Figure 2:
The cumulative number of population time series in the LPI database and number of species in each Living Planet Report since 2006 (WWF, ZSL, 2016).

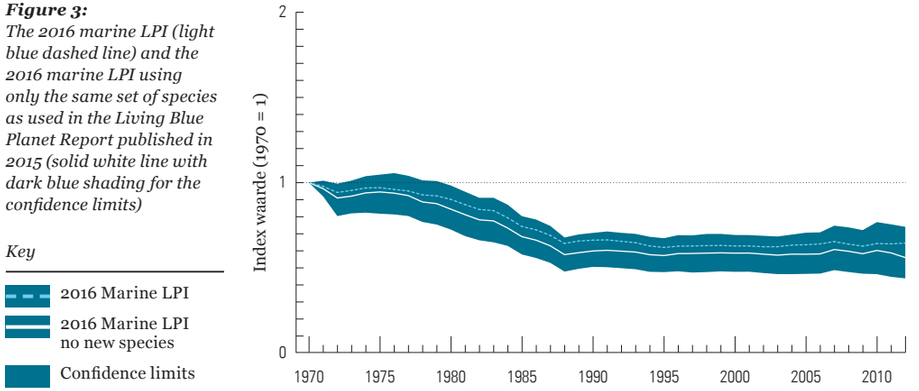
The populations in the LPI database consist of a minimum number of two population estimates (or proxies) in time. For inclusion in the LPI, these must fall within the time period 1970 to 2012, but the start and end year can be at any time during that period. This means that we don't have population data for all populations or all species for every year between 1970 and 2012. When calculating the LPI it is important to check that the changes in the data set throughout the time period, as a result of population time series starting and ending in different years, are not causing any data effects. For example if all of the population trends in the first half of the time period were declining and a different set of trends in the second half of the time period were increasing then this would create an artificial change in the LPI from a decline to an increase based on changes to the data set rather than genuine recoveries to those declining populations. This is an exaggerated example for illustration but care is taken to check that similar data effects are not influencing the trends shown in the LPI.

Why is there such a big difference between the marine LPI in the 2015 Living Blue Planet report and the LPR 2016?

Although the marine LPI result for 2016 (36 per cent decline) is quite similar to the result in 2014 (39 per cent decline), the marine LPI from the Living Blue Planet Report published in 2015 showed a more marked decline (49 per cent). This illustrates the impact of changing the underlying data set and that such short term changes in the average decline represent changes in the available data rather than an indication of actual changes to the trends in marine species.

To illustrate the impact of adding new data, the 2016 marine LPI was re-calculated using the same set of species as used in the 2015 report, but with the addition of new populations from the 2016 dataset. The result of this exercise shows an overall decline of 44 per cent in population abundance from 1970 to 2012 (Figure 3), compared to the 49 per cent decline reported in 2015 over the same period. This suggests that the inclusion of new species within the index is responsible for the remaining 8 per cent difference in the 2016 and 2015 result.

Figure 3:
The 2016 marine LPI (light blue dashed line) and the 2016 marine LPI using only the same set of species as used in the Living Blue Planet Report published in 2015 (solid white line with dark blue shading for the confidence limits)



Why is the total number of species in the marine, freshwater and terrestrial LPIs more than that of the global index?

The system to which the population is assigned primarily depends on where the population is located. This means that some species, like Pacific salmon, can have populations in different systems (e.g. marine and freshwater), depending on where they are in their migration cycle. This effectively "double counts" the species numbers (but not the population numbers) as they appear in both the marine and freshwater LPI, but only appear once in the global species count.

If it is hard to determine the primary system where the population is located (e.g. a population is situated in a very large area with both terrestrial and freshwater habitats), a series of questions is asked before assigning the population a system:

- In which system does the species spend the majority of its time?
- Which system does the species primarily rely on to sustain itself?
- In which system does the species breed?
- In which system is the species most threatened?

Borderline cases are the hardest to assign. For example, how do you assign a system to a seabird that spends most of its time at sea (where it is at risk from longline fishing), but breeds on land (where rats prey on its eggs)? These are dealt with on a case-by-case basis and result in some species being included in more than one system, giving rise to the differences in totals seen in Table 1.

What do the new LPI subsets for habitats and species show?

There is a difference in how the terrestrial and freshwater LPIs and their subsets (grassland/tropical forest and wetland/migratory fish) are calculated. The system LPIs are calculated using the LPI-D approach whereas the habitat and species LPIs are calculated using the LPI-U approach (see LPI-D below). This is important to consider when interpreting the results as any regional or taxonomic bias in the habitat and species LPIs has not been corrected for by proportional weighting.

The tropical forest LPI contains trend data for 369 populations of 220 species. After 2009, the amount of available population data in this index halved and this made the index after this time quite unreliable and sensitive to change in abundance within a single species. For this reason this LPI was run until 2009 rather than 2012. There was a 41 per cent decline between 1970 and 2009 with a short period where the average trend was increasing between 2000 and 2006. There was no documented reason behind this increase and it wasn't confined to any set of species. The decline begins again after 2006 so it won't be possible to say with certainty whether there has been a change in the long term trend in this LPI until there are a few more years of reliable data.

The grassland LPI is dominated by data for mammals (55 species, 277 populations) and birds (58 species, 76 populations). The LPI shows an overall 18 per cent decline with a slight increasing trend from 2003 onwards which is mainly due to trends in mammal populations. This increasing trend over the most recent years is most likely due to conservation efforts that have helped stem the decline of some mammal species in Africa and it is these species driving this trend, whereas the bird populations continue to decline until 2012.

The grassland butterfly LPI is the first LPI calculated for invertebrate species. This data set consists of 203 populations from EU countries of 17 grassland butterfly species. The data set used is the same behind the official European Grassland Butterfly Indicator (Van Swaay et al., 2015). The LPI result shows a 33 per cent decline between 1990 and 2012. There is a difference in the method used to calculate the LPI and the European Grassland Butterfly Indicator, so the latter shows a decline of 30 per cent between 1990 and 2013.

The wetland LPI is based on 308 species and 706 populations. This subset encompasses a narrower set of species than the freshwater LPI – those that are entirely dependent on inland wetlands according to information from the IUCN Red List. The main reason this LPI does not show as sharp a decline as the freshwater index is because they are not weighted in the same way, for the reasons mentioned below (see LPI-D below). This influences the wetland trend so that temperate species are more dominant in the dataset, masking a more severe decline in tropical species than in temperate species over the same time period. The overall trend shows a 39 per cent decline from 1970 to 2012 with a change in the decline after 2005. This increase towards the end of the time series is due to a change seen in the fish trend which starts to increase after 2000.

Just over 200 fish populations are increasing overall and a quarter of these are in protected areas however there is no recorded reason for the increase to document here.

The LPI for migratory fish was the first time in the LPR that a set of migratory species has been analysed separately. The index included 162 fish species and 735 populations. As for the wetland LPI, the migratory fish LPI starts to increase towards the end of the time period. Although there is little information recorded on why some populations have increased at this time, it seems to be in line with what is shown in the wetland LPI and is likely to be dominated by more positive trends in temperate species.

What role has climate change played in the overall decline of species, particularly in recent trends?

It is likely that climate change has caused a decline in populations of some species, particularly those in vulnerable ecosystems such as coral reefs, mountains and the Arctic. An analysis of the main threats affecting species populations for this report indicates that over the last 42 years, the principal causes of population decline in wild species have been habitat loss or degradation, and overexploitation of species. Climate change is ranked fourth in importance after "invasive species and disease", although it is the third most important threat for marine populations. Over the next 40 years, however, climate change is likely to become a more prevalent factor affecting population trends, as well as itself being a driver of habitat loss and alteration. Our data suggests that the potential impact of climate change is growing as it has been listed as the main threat in an increasing proportion of populations in the LPI from 2005 to 2012.

LPI database

Where does the data used in the LPI come from?

All data used in constructing the index are time series of either population size, density, abundance or a proxy of abundance. The species population data used to calculate the index are gathered from a variety of sources. Time-series information for vertebrate species is collated from published scientific literature, online databases and grey literature, totalling over 3,000 individual data sources. Data are only included if a measure of population size is available for at least two years, information is available on how the data were collected, what the units of measurement were, and the geographic location of the population. The data must be collected using the same method on the same population throughout the time series and the data source referenced and traceable.

The data are sourced from short and long-term monitoring schemes that collect data for different reasons and are continually being added to the database. Table 2 shows that most of the data sources for the LPI are scientific journal articles and, of these, most address ecological research question. The period covered by the index is from 1970 to 2012. The year 2012 is chosen as the cut-off point for the index because there is not yet enough data to calculate a robust index up to the present day.

Alongside the population data, any information on threats to that population is recorded in the database and used to produce the summary statistics shown in the report. Up to three categories of threat are recorded for each population according to information from the data source. These threats are then ranked as primary, secondary and tertiary. Threat data are not always available, in which case the population is given an 'Unknown' threat category.

		What was the data collection for?					
		Long term monitoring scheme	Ecological research	Tracking declining species	Managing species for conserva-tion	Managing species as a natural resource	Unspecified reason
Where did the data source come from?	Scientific journal	477	680	193	370	111	24
	Government report	154	12	12	105	200	6
	Other published sources*	191	67	39	121	18	35
	Personal communication	37	3	6	4	0	5
	Unpublished or unknown	102	32	17	36	9	29

Table 2:
*The origin of the data source in the LPI and the primary reason the data was collected identified for each of the 3,095 data sources. * Online database, published report, book chapter.*

How many species and populations are there in the LPI?

The LPI is based on trends in 14,152 populations of 3,706 species of mammal, bird, reptile, amphibian and fish from around the globe. This represents a substantial increase in data from previous years (see figure 2 above).

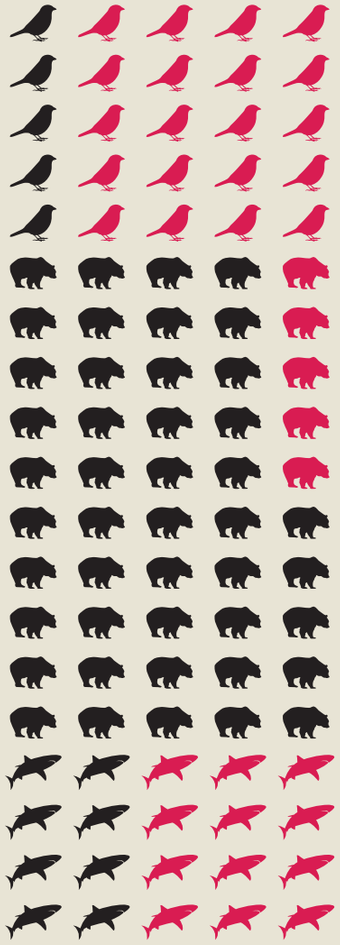
Are extinct species included in the LPI?

Yes, although there are very few. For example, the Golden toad *(Incilius periglenes)* is listed as Extinct on the IUCN Red List of Threatened Species, as extensive searches have not managed to locate any individuals of this species since 1989. In the LPI, the last recorded survey data is included, which documents the decline of this species (Crump et al., 1992). If some individuals of a species are alive only in captivity, then a species is assessed as Extinct in the wild. This is the case for the Guam rail *(Hypotaenidia owstoni)*, for which there is also data in the LPI. This species declined because of predation from an introduced brown tree-snake on the island of Guam. A captive population of the Guam rail exists in a snake proof enclosure on the island.

Calculating the LPI

Average rate of change

For each population, the rate of change from one year to the next is calculated. If the data available are from only a few, non-consecutive years, a constant annual rate of change in the population is assumed between each data year. Where data are available from many years (consecutive or not) a curve is plotted through the data points using a statistical method called generalized additive modelling. Average annual rates of change in populations of the same species are aggregated to the species level and then higher levels.



Box 2: Does the trend in the global LPI mean we have lost roughly half of all animals

This illustration explains how the LPI is calculated and highlights that an average trend in population change is reported and not an average of total numbers of animals lost. These are three example populations of three different species, all of which declined but by different percentages. The tables show that although the average percentage change is 50%, the total number of animals in the three combined populations has not halved.

	Bird population	Bear population	Shark population
Initial population size	25	50	20
Final population size	5	45	8
Number of animals lost	20	5	12
Percentage change	80%	10%	60%

Initial population size (total)	95
Final population size (total)	58
Number of animals lost (total)	37
Percentage of animals lost (total)	39%
Percentage change (average)	50%

Left: *Symbols represent individual animals in a bird, bear and shark population with the number lost highlighted in red.*

Top: *The starting and final population sizes and overall percentage change for each population*

Above: *The total values for all populations showing the initial and final population sizes and average percentage change*

The annual average trend is calculated in a similar way to how compound interest rates are calculated. The reason that we don't divide the percentage decline of the LPI by the number of years is that we are reporting the rate at which the LPI is declining each year and this value depends on the previous year's value. This is the same way that when calculating interest, that interest is added based on the percentage of an original sum of money plus interest already accrued and not based on the original sum of money.

LPI-D: a weighted LPI methodology

The LPI contains data for 3,706 out of an estimated 62,839 vertebrate species that have been described globally. There is no "perfect LPI" which has data for all species from all over the world. The challenge therefore is to represent all 62,839 species using those for which data is available. There are two ways of doing this. One is to collect more data and add to the number of species that are in the LPI, particularly from some less well represented groups like reptiles and fish. Great strides have been made in improving the taxonomic and geographic coverage of the data over the years with the intention of further, ongoing improvement.

The second approach is to use the LPI-D method – a weighting system that allows the adjustment of the calculation of the LPI to provide a better representation of the results we would expect if a complete dataset was available – containing all vertebrate species. The unweighted LPI (LPI-U) methodology presented up till the *Living Planet Report* 2012 makes calculations based on the average rate of change across all species from year to year. The index is set equal to 1 in 1970, and the average annual rate of population change is used to calculate the index value in each successive year (for more details: see Collen et al., 2009).

The LPI-D is an adapted version of this method (for more details: see McRae et al., 2016). The LPI-D attempts to make the indicator more representative of vertebrate biodiversity by accounting for the estimated diversity of species globally. Because the LPI dataset is not uniformly distributed across regions and species (LPR 2016: Figure 3), this new approach is being employed to calculate indices that reflect the number and distribution of vertebrate species in the world. The LPI-D method involves a system of weighting that reflects the actual proportions of species found in each taxonomic group and realm[1]. These proportions allow the index to be weighted accordingly.

[1] Species estimates taken from Wildfinder (WWF, 2006), IUCN Red List (IUCN, 2013), Freshwater Species of the World (WWF/TNC, 2013) and the Ocean Biogeographic Information System (OBIS, 2012)

Table 3 shows the proportion by realm of the total number of species found in each taxonomic group. The greater the number for a given group, the more weight given to the population trends of those species. For example, fish species represent the largest proportion of vertebrate species in both freshwater and marine biogeographic realms so this group is given most weight in the index calculation for each realm. In the terrestrial realms, reptiles and amphibians are the largest vertebrate group in the tropical realms (Afrotropical, Neotropical, Indo Pacific), whereas birds are the largest group in the temperate realms (Nearctic, Palearctic).

This provides a means of reducing bias in groups such as temperate birds, which have previously dominated some of the global and regional LPIs. As an example, there are 360 terrestrial Palearctic species in the LPI, of which 70 per cent are birds, 26 per cent are mammals, and 4 per cent are reptiles and amphibians. The LPI-U method would have weighted each group in these proportions. The LPI-D method reflects the proportion of species that should be found in each group. This gives 43 per cent of the weight to bird species, 32 per cent to reptiles and amphibians and 25 per cent to mammals (Table 3a). In other words, the LPI-D method gives reptiles and amphibians more weight and birds and mammals less weight, to better reflect the actual diversity of species.

Because of their low representation in the total numbers of species and populations, reptiles and amphibians are combined into a herpetofaunal group; and data from Indo-Malaya, Australasia and Oceania is grouped into an Indo-Pacific realm. In addition, the individual classes of fish have been aggregated into one group encompassing all fish species.

The LPI-D method has been used for the global, projected global and system LPIs in this report. For the habitat and species group LPIs, the LPI-D approach could not be used, so the LPI-U is used instead. The LPI-D approach requires the data set to be divided into subsets and in the case of the habitat and species group LPIs, these data sets are too small to subset in the same way as the global and system LPIs.

a. Terrestrial realm weightings applied to data:

	Afrotropical	Nearctic	Neotropical	Palearctic	Indo-Pacific
Birds	0.387	0.376	0.387	0.433	0.396
Mammals	0.197	0.249	0.127	0.249	0.172
Reptiles and amphibians	0.414	0.373	0.484	0.316	0.431

b. Freshwater realm weightings applied to data:

	Afrotropical	Nearctic	Neotropical	Palearctic	Indo-Pacific
Fishes	0.590	0.565	0.584	0.592	0.493
Birds	0.192	0.203	0.107	0.211	0.176
Mammals	0.009	0.013	0.010	0.015	0.008
Reptiles and amphibians	0.207	0.217	0.298	0.179	0.321

c. Marine realm weightings applied to data:

	Arctic	Atlantic North Temperate	Atlantic Tropical and Sub-tropical	Pacific North Temperate	Tropical and Sub-tropical Indo-Pacific	South Temperate and Antarctic
Fishes	0.792	0.920	0.922	0.892	0.940	0.922
Birds	0.172	0.068	0.069	0.080	0.048	0.054
Mammals	0.035	0.009	0.006	0.025	0.004	0.022
Reptiles	0	0.001	0.001	0.001	0.005	0.001

How are different LPIs calculated?

Realm LPIs are calculated using the LPI-D method described above. Terrestrial and freshwater populations are combined to produce LPIs for the Afrotropical, Nearctic, Neotropical, Palearctic and Indo-Pacific realms using the weighting values for each species group in table 3a and 3b. Marine realm LPIs are also calculated using proportional weighting of the species groups in table 3b. In the table below, the Arctic, Atlantic north temperate and Pacific north temperate realms were combined and the two tropical realms were combined to show results for three marine areas – North temperate and Arctic; Tropical and subtropical; and South temperate and Antarctic.

System LPIs are calculated by first producing realm indices using the LPI-D method as described above. The system LPIs are then calculated using a weighted average of the realm LPIs for that system. The values for the weighting are equivalent to the proportion of vertebrate species each realm contains compared to the estimated total number of vertebrate species for that system (Table 4).

Table 3: The proportion of species by group and realm for (a) terrestrial species, (b) freshwater species and (c) marine species
The values also represent the weighting applied to the data for each species group when calculating the global and system LPIs (WWF, ZSL, 2016). Species estimates taken from Wildfinder (WWF, 2006), IUCN Red List (IUCN, 2013), Freshwater Species of the World (WWF/ TNC, 2013) and the Ocean Biogeographic Information System (OBIS, 2012)

For example, the Neotropics carry the most weight and the Nearctic the least in the terrestrial and freshwater LPIs; the Tropical and subtropical Indo-Pacific is the realm given the most weight in the marine LPI.

The global LPI is an average of the terrestrial, freshwater and marine LPIs, giving an equal weight to each. Similarly, the system LPIs are averaged to obtain the temperate and tropical LPIs.

The 2020 projection of the global LPI was calculated using the same approach as the recent paper by Tittensor et al., 2014. An analysis framework was used to estimate the trajectory of the global LPI to 2020 based on the annual rates of change in the LPI between 1970 and 2012. This extrapolation is entirely based on the pattern of the LPI between 1970 and 2012 and does not take any predicted changes in environmental pressures into account. The index values of the LPI were fitted using a number of different models which allow for a variety of possible trend patterns from 1970 to 2020. The outputs from these models were then averaged to produce the estimated LPI values from 1970 to 2020 and 95 per cent confidence intervals.

Table 4: The proportion of species by realm for (a) terrestrial and freshwater species and (b) marine species
The values also represent the weighting applied to the data for each realm when calculating the system LPIs (WWF, ZSL, 2014).

a. Terrestrial and freshwater realm weightings applied to data:

	Afrotropical	Nearctic	Neotropical	Palearctic	Indo-Pacific
Terrestrial LPI	0.189738	0.061683	0.321132	0.116431	0.292168
Freshwater LPI	0.211701	0.060853	0.365550	0.123314	0.225576

b. Marine realm weightings applied to data:

	Arctic	Atlantic North Temperate	Atlantic Tropical and Sub-tropical	Pacific North Temperate	Tropical and Sub-tropical Indo-Pacific	South Temperate and Antarctic
Marine LPI	0.014541	0.146489	0.214706	0.068026	0.456553	0.099685

References

Collen, B., Loh, J., McRae, L., Whitmee, S., Amin, R. & J. Baillie. 2009. Monitoring change in vertebrate abundance: the Living Planet Index. Conservation Biology 23: 317-327.

Crump, M.L., Hensley, F.R. and Clark, K.L. 1992. Apparent decline of the golden toad: Underground or extinct? *Copeia*: 413-420

McRae L, Deinet S, Freeman R. 2016. The diversity weighted Living Planet Index: controlling for taxonomic bias in a global biodiversity index. PeerJ Preprints 4:e2214v1 https://doi.org/10.7287/peerj.preprints.2214v1

Tittensor et al. 2014. A mid-term analysis of progress toward international biodiversity targets *Science* 10 Oct 2014: Vol. 346, Issue 6206, pp. 241-244 DOI: 10.1126/science.1257484

Van Swaay, C.A.M., Van Strien, A.J., Aghababyan, K., Åström, S., Botham, M., Brereton, T., Chambers, P., Collins, S., Domènech Ferrés, M. et al. 2015. *The European Butterfly Indicator for Grassland species 1990-2013*. Report VS2015.009. De Vlinderstichting, Wageningen, The Netherlands.