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CANADIAN SPECIES INDEX

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

CANADIAN SPECIES INDEX

September 2023

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Canadian species index

Animal wildlife is one of the most visible and well-studied aspects of biodiversity. The 2022 Living Planet Index, which tracks populations of vertebrate species, indicates an average global decline of 69% in the relative abundance of monitored wildlife populations since 1970.

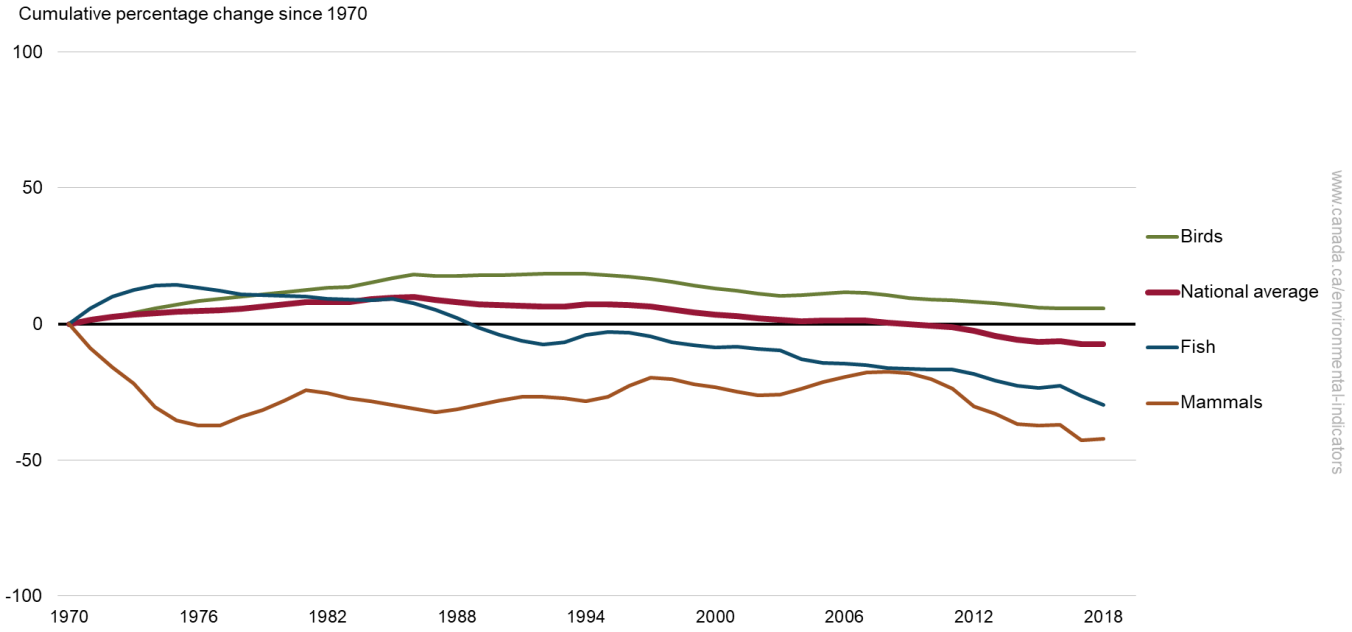
The Canadian species index indicator uses similar methods to the Living Planet Index but is based on a selection of Canadian species. It shows whether the population abundance[1] of monitored vertebrate species have increased or decreased since 1970. The index is an "average of trends", rather than a measure of change in the total number of animals: each species, whether it is common or rare, has the same effect on the index. This, in turn, provides an integrated measure of the condition of our environment.

Key results

Between 1970 and 2018,

- the population abundance of all monitored vertebrate species declined by 7% on average
- the population abundance of monitored mammal and fish species decreased by 42% and 30% on average, respectively

Figure 1. Canadian species index, 1970 to 2018



Data for Figure 1

Note: Trends are calculated based on the proportional change in population abundance for monitored vertebrate species. All species are weighted equally, such that a species that doubled in population would be balanced out by a species that declined by half. Direct comparisons with the previous version of the index cannot be made as there are differences across the whole time-series. See Recent changes.
Source: Zoological Society of London (2023).

The national index includes 928 species of birds, fish, mammals, amphibians and reptiles. The number of species represents 52% of the 1 798 native vertebrate species that regularly occur in Canada.[2] While there is an overall

[1] Population abundance represents the relative size of the population of a species in an area. It can be measured in various ways, including population size (the number of individuals in a population) and population density (the number of individuals of a species in an area).

[2] The number of native vertebrate species that regularly occur in Canada is based on the Wild Species 2020 report and does not include species classified as "Presumed Extirpated", "Probably Extirpated" and "Not Applicable."

decrease in the national average trend across all monitored species, some species are increasing while others are decreasing.

The bird index includes 397 species and represents the largest number of species in the indicator. This accounts for 87% of native bird species. The average change in bird species populations is moderately positive, in part due to the increases in populations of waterfowls, birds of prey, and wetland birds and seabirds.[3] However, populations of shorebirds, grassland birds and aerial insectivores are in steep decline,[3] as are some of Canada's most common bird species (such as the Dark-eyed Junco, a forest bird).[4]

The fish index includes 375 species of freshwater and marine fish, and accounts for 35% of native fish species. The decline in the population abundance of fish species is mainly attributed to the decline in the population of marine fish species.

The mammal index includes 108 species, which make up 55% of native mammal species. The decline of many mammal species is mainly attributed to fragmentation and loss of remaining habitat. A wide range of species, from large bears to small squirrels, can have difficulty surviving in isolated and fragmented habitats.[5]

Amphibians and reptiles are included in the national Canadian species index. However, given the poor geographical extent and coverage across the reporting period, the index for amphibians and reptiles may not be representative and is therefore not shown separately. Amphibians and reptiles have a high proportion of species at risk of extinction. The General status of wild species indicator shows that 67% (33 of 49) of reptile species and 40% (19 of 47) of amphibian species are at risk of disappearing.[6]

[3] North American Bird Conservation Initiative Canada (2019) State of Canada's Birds 2019. Environment and Climate Change Canada.

[4] Rosenberg KV et al. (2019) Decline of the North American avifauna. Science 366(6461): 120-124. Retrieved on May 4, 2023.

[5] Parks Canada (2022) Stressors. Retrieved on May 4, 2023.

[6] Species considered as at risk of disappearing include those with the NatureServe conservation status rank of Vulnerable, Imperiled, Critically imperiled, Potentially extirpated and Presumed extirpated.

Canadian species index by system

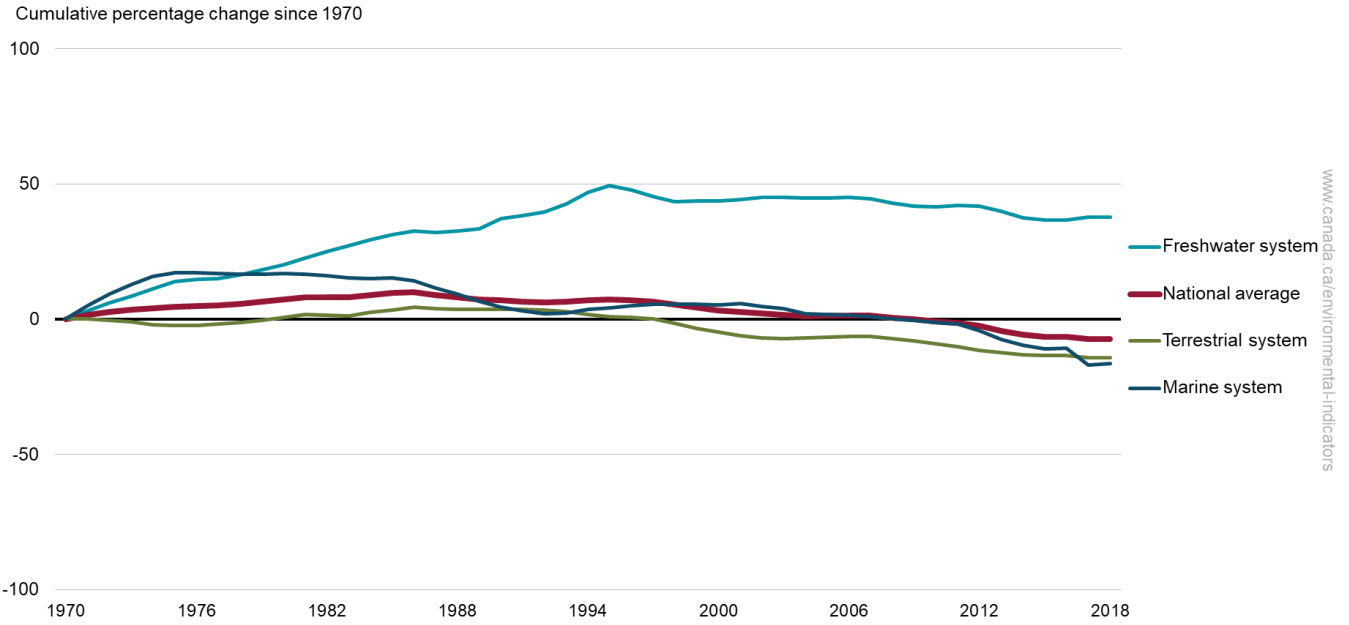
Wildlife species can be assigned to the terrestrial, freshwater or marine system based on the location where the species was monitored and the species' biology.

Key results

From 1970 to 2018,

- the index for the terrestrial system, which includes most of the bird and mammal populations, and some reptiles and amphibians, decreased by 14%
- the index for the marine system, which includes mammals (such as whales and seals), birds (such as terns), 1 reptile (the leatherback turtle) and most of the fish populations decreased by 16%
- the index for the freshwater system, which includes birds (such as waterfowl), 2 mammals (beaver and river otter), fish, and the majority of amphibian and reptile populations, increased by 38%

Figure 2. Canadian species index by system, 1970 to 2018



Data for Figure 2

Note: Trends are calculated based on the proportional change in population abundance for monitored vertebrate species. All species are weighted equally, such that a species that doubled in population would be balanced out by a species that declined by half.
Source: Zoological Society of London (2023).

In terrestrial systems (while not shown in the figure above), the decline is steep for mammals (57% decrease), and reptiles and amphibians (42% decrease). However, many groups of small mammals, reptiles and amphibians are underrepresented in this analysis and as such, the decline may be larger than reported.

In the marine environment, while the populations of marine birds have increased and that of marine mammals has remained stable, the decline in marine fish species has been the main force behind the overall decreasing trend (a decline of 40% from 1970 levels). Overfishing remains the main threat to marine fish populations, but habitat loss and degradation, pollution, interactions with farmed fishes and the presence of invasive species also have negative impacts.[7]

[7] Canadian Endangered Species Conservation Council (2023) Wild Species 2020: The General Status of Species in Canada. National General Status Working Group. Retrieved on May 4, 2023.

The freshwater system index increased by 41% primarily due to increases in freshwater birds and fish. The index for freshwater birds, such as ducks, geese and swans, increased by 53% from 1970 to 2018, and the one for freshwater fishes increased by 28%.

About the indicator

What the indicator measures

The Canadian species index represents the average percent change in the abundances of Canadian vertebrate species' populations since 1970. The index is an "average of trends", rather than a measure of change in the total number of animals: each species, whether it is common or rare, has the same effect on the index. The index reports general trends rather than progress towards desired levels.

Why this indicator is important

Animal wildlife populations depend on healthy habitats and can be negatively impacted by threats, such as pollution, habitat degradation or overhunting. The status of wildlife populations is a key factor that contribute to ecosystem health and species' resilience to threats. Trends in animal populations can provide an indication of the health of biodiversity and ecosystems in Canada.

Related initiatives

This indicator supports the measurement of progress towards the following 2022 to 2026 Federal Sustainable Development Strategy Goal 15: Life on land – Protect and recover species, conserve Canadian biodiversity.

The indicator also contributes to the Kunming-Montreal Global Biodiversity Framework. It is linked to Goal A:

- "The integrity, connectivity and resilience of all ecosystems are maintained, enhanced, or restored, substantially increasing the area of natural ecosystems by 2050;
- Human induced extinction of known threatened species is halted, and, by 2050, extinction rate and risk of all species are reduced tenfold, and the abundance of native wild species is increased to healthy and resilient levels;
- The genetic diversity within populations of wild and domesticated species, is maintained, safeguarding their adaptive potential."

It is also linked to Target 4 of the same framework: "Ensure urgent management actions, to halt human induced extinction of known threatened species and for the recovery and conservation of species, in particular threatened species, to significantly reduce extinction risk, as well as to maintain and restore the genetic diversity within and between populations of native, wild and domesticated species to maintain their adaptive potential, including through in situ and ex situ conservation and sustainable management practices, and effectively manage human-wildlife interactions to minimize human-wildlife conflict for coexistence."

Related indicators

The Species at risk population trends indicator shows whether population and distribution trends of species at risk that are listed under the *Species at Risk Act* are consistent with recovery or management objectives.

The General status of wild species indicator reports extinction risks across a broad set of species and can reveal early signs of trouble before species reach a critical condition.

The Trends in Canada's bird populations indicator reports average population trends of various groups of native Canadian bird species.

The Population status of Canada's migratory birds indicator provides a snapshot of the general state of birds in Canada that are listed in the *Migratory Birds Convention Act*.

Data sources and methods

Data sources

Data on changes in the abundance of vertebrate populations are gathered from a variety of sources and collated in the Living Planet Index database by the Zoological Society of London. Sources include peer-reviewed scientific literature, government reports, and reliable online databases. Examples of important sources include the North American Breeding Bird Survey and the Fisheries and Oceans Canada Library.

More information

Population data were gathered from the literature, by performing online searches and by contacting experts. Birds have been monitored at the national level since about 1970 with high-quality data readily available for this species group. Fewer data are available for other species groups. To help address the imbalance in the data available for the different species groups, targeted searches were carried out for under-represented groups. Searches were also conducted to locate data for under-represented regions.

Data include counts of individuals, as well as proxy measurements such as indices of abundance, spawning density, or detection rates of individuals. Each record is also tagged with geographical and ecological information to allow for further analysis. Together, these records form the data set used to calculate the indices.

Information for 937 (52%) of the 1 798 native regularly occurring vertebrate species has been captured in the data set.[8] Birds are the best represented species group, with about 89% of all bird species regularly occurring in Canada represented.

While many fish species are included (375 species), they account for only 35% of the total number of fish species regularly occurring in Canada.

While mammal species are included (108 species), they account for only 55% of the total number of mammal species regularly occurring in Canada.

Amphibians and reptiles are the least represented species group, as the data for the species regularly occurring in Canada have poor geographical coverage across the reporting period.

The index has been calculated for the period 1970 to 2018, as this is the time period over which sufficient data exist for credible estimates.

Methods

The trend in the population abundance of each species is estimated using all the information available for that particular species in Canada. This may include measurements from just one site/location, or measurements from a combination of sites/locations for the same species. These trends are averaged across all species to generate the Canadian species index.

The Canadian species index is broadly similar to the Living Planet Index. The Living Planet Index for Canada uses the same methods as the Canadian species index and reports different sub-indices.[9] However, the Living Planet Index excludes populations with only two data points and does not exclude overpopulated geese species.

More information

Data collection and tagging

To be included in this index, a time series, drawn from Canadian data contained in the Living Planet Index database must meet all of the following criteria:

- contain data for at least 2 points in time since 1970
- have been collected for a defined population using comparable methods across years

[8] Data derived from Canadian Endangered Species Conservation Council (2023) Wild Species 2020: The General Status of Species in Canada. National General Status Working Group.

[9] WWF-Canada (2020) Living Planet Report Canada. Retrieved on May 1, 2023.

- use units of population abundance or a reliable proxy, such as spawning biomass or density
- have a referenced and traceable source

Each time series is referred to as a "population."

Each record is tagged with contextual information such as geographical region, species group and habitat type. Data tags allow a subset of the database to be extracted for targeted analysis. Information for these tags is drawn from the original data source if possible; however, additional reference material is also used. Species that occur in more than one system type (terrestrial, freshwater or marine) are tagged as belonging to the system in which they were observed and on which they rely on for at least part of their life cycle. For example, a time series containing the number of salmon spawning in rivers would be considered freshwater, while one containing observations at sea would be considered marine. These 2 time series would be considered different populations even though they may constitute the same population in the biological sense of the term.

Preprocessing

Species selection

Data for the overall index were restricted to vertebrate species that regularly occur in Canada. Classification was based on the Wild Species 2020 report. Species that were classified as "Not Applicable" were not included in the dataset as this classification is reserved for species that are not considered a suitable target for conservation. This includes exotic, hybrid or accidental species occurring infrequently and unpredictably in Canada. Species classified as "Presumed Extirpated" or "Probably Extirpated" were also excluded from the dataset, since they no longer occur in Canada.

Increasing population abundances are generally interpreted as a sign of environmental improvement. However, a few bird species are known to have a population abundance that is above acceptable bounds (see the Population status of Canada's migratory birds indicator), and for these species, an increase in population is a negative outcome. Three (3) species, Snow Goose (*Anser caerulescens*; both subspecies), Ross's Goose (*Anser rossii)* and Canada Goose (*Branta canadensis*), have been excluded from the index for this reason.

Species whose scientific name could not be matched to the taxonomic authorities used in the Living Planet Database were also excluded.

Population modelling

For each population, a record of abundance over time is created. Modelling is used to reduce the effect of random variations and measurement noise. For time series containing at least 6 data points, trends were modelled using Generalized Additive Modelling. For shorter time series, and for any series that could not be modelled with Generalized Additive Modelling, a linear regression model was used. For time series with only 2 data values, this is equivalent to a straight line connecting the 2 points. Time series are not extrapolated beyond the start and end date of observations.

In some years and for some time series, a 0 was recorded. In a few cases, this may be due to a local extinction, but more often, it is because wildlife are not observed. A failure to observe wildlife may be because there are few wildlife to observe, which is a genuine signal of low numbers. It could also mean that wildlife were simply not detected. When this happens, for example, if unusual weather conditions made movement patterns unpredictable; then a 0 would represent a missing value. For the purposes of the indicator, 0s have been treated as missing values, resulting in a conservative estimate of change.

Calculation of the index

Trends within a time series

For each time series, proportional change d_t is calculated for each year for which data exist, as follows:

$$d_t = \log_{10}(N_t / N_{(t-1)})$$

where:

N_t = modelled population abundance estimate in year *t*

$N_{(t-1)}$ = modelled population abundance estimate in year *t*-1

Index calculation

For species with more than 1 time series, the average proportional change (lambda, λ) is calculated for each year across all time series (including all subspecies) for that species.

Formally, for species *i* in year *t*:

$$\lambda_{i,t} = \frac{1}{m}\sum_{j=1}^{m} d_{i,j,t}$$

where:

$\lambda_{i,t}$ = average proportional change for species *i* in year *t*

$d_{i,j,t}$ = proportional change for time series *j*, for species *i* in year *t*

m = number of time series for species *i* in year *t*

For a species with only 1 time series:

$$\lambda_{i,t} = d_{i,t}$$

The overall annual change is calculated as the average lambda across all species with data for that time step. In other words, the index for 2014 is the average λ_i for all species with population estimates in 2013 and 2014. Species are weighted equally, regardless of data availability.

The index for a particular year is the sum of logged annual changes since 1970.

Percentage changes are calculated using the following formula:

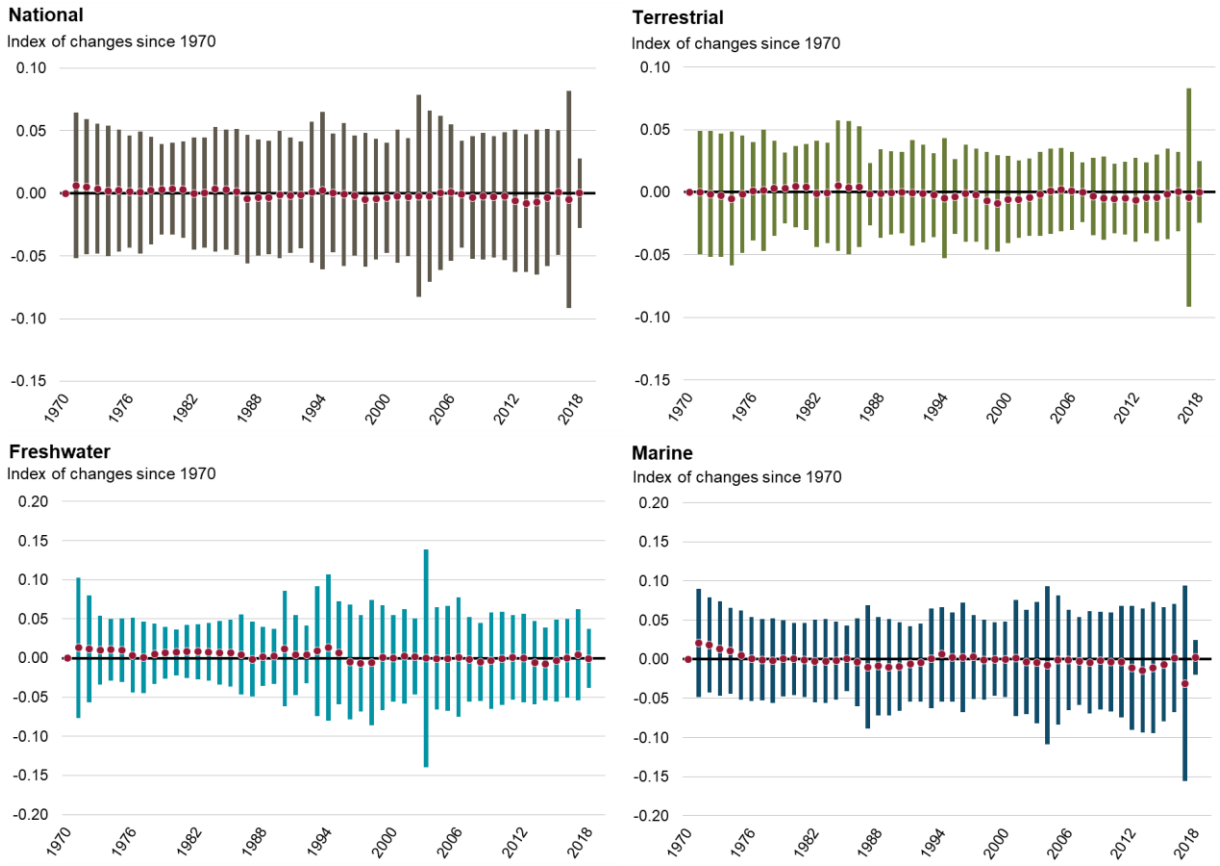
$$Percent\ change = (10^{\lambda} - 1) \times 100$$

Sub-indices are calculated using the same methodology, but for a selected subset of species or populations.

Assessment of uncertainty

The degree of variability within the species-level lambdas (λ) for a given year provides an indication of whether trends are similar across the species included in the index. A narrow interval means that most species are changing by similar proportions, while a wide interval means that there is a wide range of patterns. Because indexed species are not a random or representative selection of the species in the environment, this can only be a partial assessment of uncertainty. The uncertainty due to a non-representative sample of species cannot be measured.

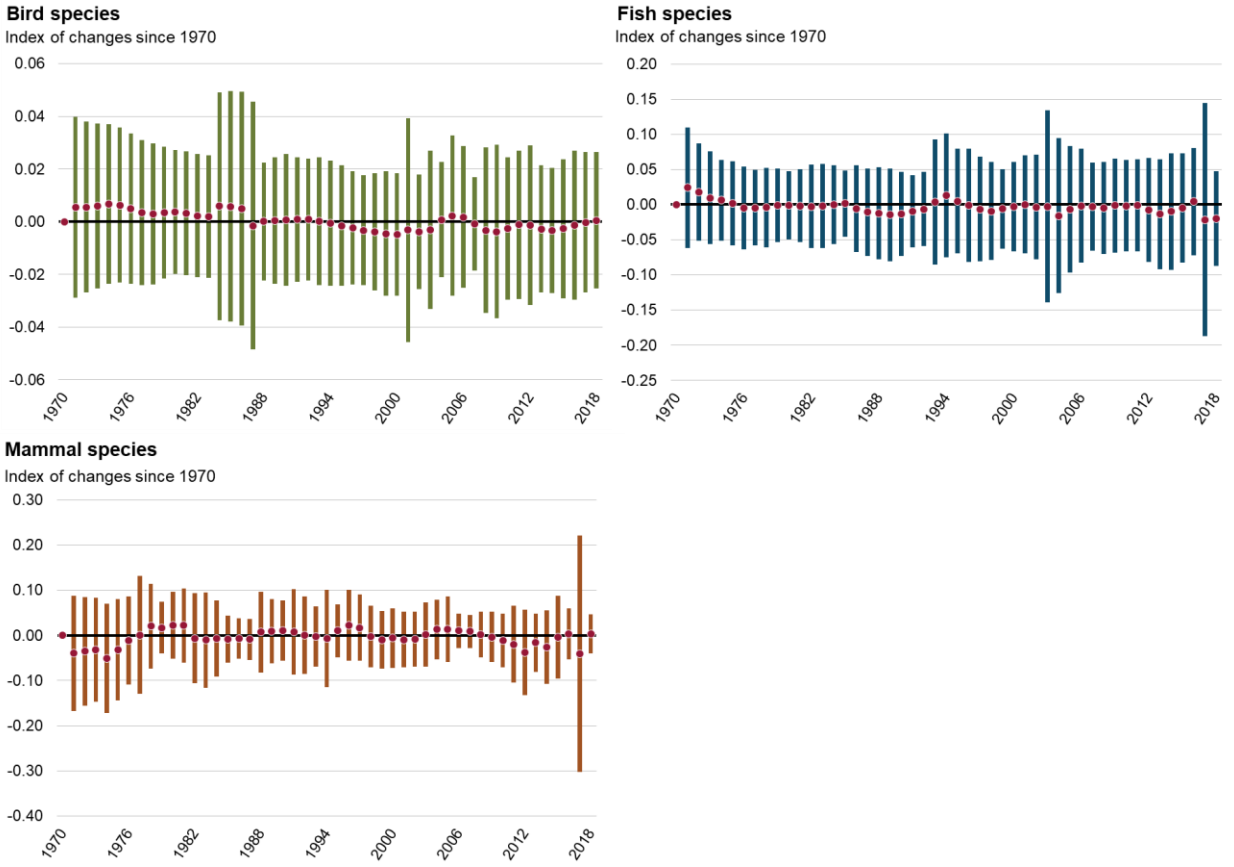
Figure 3. Distribution of species-level lambda values, national and by system, 1970 to 2018



Data for Figure 3

Note: The dots show the average annual lambda across all species; vertical bars show the standard deviation of average annual lambda across all species.
Source: Zoological Society of London (2023).

Figure 4. Distribution of species-level lambda values, species group, 1970 to 2018



Data for Figure 4

Note: The dots show the average annual lambda across all species; vertical bars show the standard deviation of average annual lambda across all species. Given the poor geographical extent and coverage across the reporting period, data for amphibians and reptiles may not be representative and is therefore not shown in the figure.
Source: Zoological Society of London (2023).

Recent changes

The previous version of the indicator used the previous Wild Species reports to determine regularly occurring vertebrate species in Canada. The current release uses the Wild Species 2020 report. The number of regularly occurring species differs between the versions of the indicator, because one of the goals of the Wild Species report series is to continually increase the number of species assessed until coverage is complete.

Caveats and limitations

The Canadian species index indicator was developed from the Living Planet Index. The methodology for the indicator has been improved and revised, so the 2 indices are not comparable.

The national trend is the average rate of change across all monitored vertebrate species. The indices may reflect changes in data availability. Data are not available for all species and do not always cover the geographic range of each species or the whole time period reported.

While large scale trends broadly reflect environmental change, smaller scale subindices can be subject to change if species with a different trajectory are added. Often, these 2 factors are both present.

The index uses previously collected data. It is therefore biased towards certain species (for example, species that are easy to observe, species that are managed for human use or for conservation, and species with aesthetic appeal). Birds are well represented, but most other vertebrate groups are not. Some species are represented by data that come from a local study involving a small part of the total population. While there is considerable

uncertainty surrounding the trends for these species, combining data for many species leads to more interpretable results.

This indicator only captures recent changes in biodiversity and likely underestimates the overall anthropogenic impact on species.

The index should be interpreted with these limitations in mind.

There are similarities with the Canadian species index and the indicators used in the State of Canada's Birds report, in that both are averages of trends. However, there are also differences, as the Canadian species index for birds includes a slightly different set of species (408 species compared to 349 for the State of Canada's Birds) and data sources and does not incorporate estimates of uncertainty in the data. Species whose range expanded into Canada after 1970 were not included in the analysis. These are: Wild Turkey, Anna's Hummingbird, Black-necked Stilt, Great Egret, Red-bellied Woodpecker, Bushtit, Carolina Wren, Blue-gray Gnatcatcher, and Blue-winged Warbler. The Canadian species index also includes populations with only two data points.

The Canadian species index does not measure the change in the total number of birds or other species groups. By contrast, a recent scientific study showed an overall decline in birds because it was much more sensitive to changes in populations of abundant species than changes in rare species, and many of our most abundant species have declined (for example, Dark-eyed Junco and Savannah Sparrow).[10]

Finally, new data for earlier time periods continue to be added to the database, improving estimates of change over time. For these reasons, direct comparisons with the previous version of the index cannot be made.

More information

The Canadian species index has been developed from the Living Planet Index, originally conceived by the World Wildlife Fund and now developed in partnership with the Zoological Society of London. The index is based on a peer-reviewed method that can integrate many types of population measurements.[11]

The index is descriptive. Because the underlying data have been collected for other purposes, the set of species contained in the index has unknown sampling biases. For this reason, it does not meet the requirement for randomized sampling that is necessary for traditional statistical hypothesis testing, and changes in the index cannot be tested for statistical significance. Trends in the index provides an indication of trends in the environment, and can be used to identify where additional analysis or information is required.

Averaging trends across all populations within each species can obscure important variability among subspecies, varieties or geographic regions. Averaging trends across species may also obscure important information. Analysis of different parts of the dataset can help uncover these patterns.

Population abundance measurements always include some uncertainty, because not every individual animal can be found and counted at every sampling interval. The effect of uncertainty in measurement cannot be separated from genuine changes in population abundance. Random variability may lead to a few more or less individuals being counted. If this variability leads to a large proportional change, as is the case when the average number of individuals found is small, the resulting uncertainty in the index can be large. However, uncertainty does average out over longer time series and over species. For this reason, interpretation of small subsets of data must be done with an understanding of the context of the biology of the species that are included and the strengths and weaknesses of the monitoring protocols.

Only vertebrate species are included in the index, because they are the only group with sufficient population-level data. Invertebrates and plants tend to be monitored using area of occurrence, a type of data not readily integrated into the index.

[10] Rosenberg KV et al. (2019) Decline of the North American avifauna. Science 366(6461): 120-124.

[11] Collen B et al. (2009) Monitoring Change in Vertebrate Abundance: the Living Planet Index. Conservation Biology: 23(2): 317-327.

Resources

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North American Bird Conservation Initiative Canada (2019) The State of Canada's Birds 2019. Environment and Climate Change Canada.

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WWF-Canada (2020) Living Planet Report Canada. Retrieved on May 4, 2023.

Related information

Arctic Species Trend Index (ASTI)

Living Planet Report 2022

Annex

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. Canadian species index, 1970 to 2018

Year	National index (percent change since 1970)	Number of species	Bird index (percent change since 1970)	Number of bird species	Mammal index (percent change since 1970)	Number of mammal species	Fish index (percent change since 1970)	Number of fish species
1970	0.00	449	0.00	337	0.00	27	0.00	85
1971	1.45	460	1.27	339	-8.81	31	5.68	90
1972	2.66	461	2.57	342	-15.93	32	10.05	82
1973	3.52	475	3.96	342	-21.93	37	12.51	96
1974	3.98	498	5.58	357	-30.66	34	14.15	107
1975	4.53	493	7.11	365	-35.58	32	14.51	95
1976	4.85	497	8.36	362	-37.31	29	13.21	104
1977	5.03	505	9.23	364	-37.22	37	12.08	102
1978	5.59	503	9.96	367	-34.21	27	10.97	108
1979	6.34	509	10.83	367	-31.60	29	10.66	113
1980	7.25	517	11.78	369	-28.08	30	10.37	117
1981	8.03	519	12.60	369	-24.41	29	9.93	119
1982	8.01	524	13.19	371	-25.55	28	9.31	122
1983	8.11	535	13.70	378	-27.30	26	8.83	128
1984	8.97	565	15.24	376	-28.47	30	8.78	156
1985	9.70	551	16.79	381	-29.85	31	9.11	131
1986	10.02	558	18.13	381	-31.00	29	7.70	141
1987	8.85	585	17.71	377	-32.44	39	5.10	161
1988	8.06	549	17.72	376	-31.30	33	2.14	133
1989	7.23	579	17.83	376	-29.88	38	-1.21	157
1990	6.96	567	18.03	378	-28.17	47	-4.13	130
1991	6.58	590	18.27	379	-26.92	42	-6.27	156
1992	6.30	580	18.49	384	-26.80	41	-7.61	142
1993	6.50	613	18.56	384	-27.25	47	-6.81	168

Year	National index (percent change since 1970)	Number of species	Bird index (percent change since 1970)	Number of bird species	Mammal index (percent change since 1970)	Number of mammal species	Fish index (percent change since 1970)	Number of fish species
1994	7.07	606	18.38	385	-28.45	51	-3.99	154
1995	7.15	603	17.98	387	-26.79	56	-2.91	141
1996	6.95	595	17.32	380	-22.86	52	-3.20	142
1997	6.52	583	16.44	381	-19.82	58	-4.60	122
1998	5.27	617	15.40	381	-20.35	56	-6.64	157
1999	4.17	592	14.20	381	-22.16	61	-7.95	123
2000	3.31	616	12.93	383	-23.21	59	-8.55	149
2001	2.77	601	12.11	382	-24.94	62	-8.49	134
2002	2.07	625	11.12	381	-26.32	56	-9.22	161
2003	1.59	664	10.34	381	-26.01	51	-9.73	204
2004	1.07	675	10.53	385	-23.76	53	-12.97	210
2005	1.17	695	11.11	391	-21.41	51	-14.30	229
2006	1.32	676	11.57	381	-19.55	44	-14.61	227
2007	1.17	696	11.36	388	-17.97	45	-15.23	246
2008	0.43	678	10.53	389	-17.57	38	-16.16	242
2009	-0.14	670	9.55	389	-18.24	40	-16.39	230
2010	-0.76	680	8.89	388	-20.36	46	-16.69	234
2011	-1.28	674	8.59	388	-23.88	43	-16.88	231
2012	-2.59	679	8.25	388	-30.32	33	-18.36	245
2013	-4.32	631	7.56	377	-32.89	36	-20.90	207
2014	-5.86	652	6.74	377	-36.83	37	-22.69	229
2015	-6.61	634	6.08	377	-37.45	26	-23.58	223
2016	-6.44	602	5.73	375	-36.99	32	-22.80	187
2017	-7.48	378	5.67	314	-42.68	26	-26.55	29
2018	-7.43	325	5.79	310	-42.26	7	-29.81	7

Note: Trends are calculated based on the proportional change in population abundance for monitored vertebrate species. All species are weighted equally, such that a species that doubled in population would be balanced out by a species that declined by half. Direct comparisons with the previous version of the index cannot be made as there are differences across the whole time-series. See Recent changes.
Source: Zoological Society of London (2023).

Table A.2. Data for Figure 2. Canadian species index by system, 1970 to 2018

Year	Terrestrial index (percent change since 1970)	Number of terrestrial species	Freshwater index (percent change since 1970)	Number of freshwater species	Marine index (percent change since 1970)	Number of marine species
1970	0.00	270	0.00	74	0.00	106
1971	-0.04	274	3.08	76	4.88	112
1972	-0.35	276	5.94	80	9.42	106
1973	-0.90	278	8.47	79	12.88	119
1974	-2.05	292	11.19	75	15.69	132
1975	-2.40	295	13.82	80	17.08	119
1976	-2.22	290	14.79	81	17.21	127
1977	-1.90	295	15.01	81	16.95	130
1978	-1.15	290	16.40	78	16.47	136
1979	-0.40	293	18.19	79	16.70	138
1980	0.65	294	20.21	85	16.85	139
1981	1.60	295	22.56	86	16.60	139
1982	1.34	294	24.85	83	15.93	148
1983	1.23	299	27.16	86	15.28	151
1984	2.44	296	29.24	89	14.88	181
1985	3.27	301	31.14	90	15.12	161
1986	4.31	301	32.47	94	14.09	165
1987	3.93	303	32.04	94	11.51	189
1988	3.72	293	32.61	95	9.29	163
1989	3.63	299	33.30	97	6.67	184
1990	3.60	309	37.03	99	4.39	160
1991	3.48	308	38.27	97	2.95	186
1992	3.25	309	39.67	110	1.93	162
1993	2.72	314	42.55	108	2.12	193
1994	1.60	316	46.97	119	3.61	172
1995	0.79	322	49.31	116	4.24	166
1996	0.59	313	47.62	117	4.84	166

Year	Terrestrial index (percent change since 1970)	Number of terrestrial species	Freshwater index (percent change since 1970)	Number of freshwater species	Marine index (percent change since 1970)	Number of marine species
1997	0.07	320	45.40	121	5.51	143
1998	-1.52	318	43.43	125	5.37	175
1999	-3.56	325	43.60	120	5.36	148
2000	-4.88	323	43.54	122	5.26	171
2001	-6.10	322	44.34	130	5.67	150
2002	-6.99	320	45.04	140	4.77	165
2003	-7.28	313	44.99	142	3.79	211
2004	-7.09	319	44.83	133	1.97	226
2005	-6.64	320	44.67	131	1.73	250
2006	-6.40	309	45.09	143	1.45	235
2007	-6.42	308	44.46	124	0.89	274
2008	-7.14	301	42.89	137	-0.03	253
2009	-8.14	301	41.76	129	-0.43	252
2010	-9.21	303	41.63	136	-1.22	253
2011	-10.23	301	41.93	129	-1.93	258
2012	-11.49	299	41.85	142	-4.35	246
2013	-12.39	296	39.87	112	-7.47	229
2014	-13.28	300	37.56	125	-9.77	237
2015	-13.55	294	36.56	122	-11.12	222
2016	-13.44	301	36.52	90	-10.82	214
2017	-14.25	255	37.83	86	-16.94	37
2018	-14.21	237	37.71	66	-16.49	22

Note: Trends are calculated based on the proportional change in population abundance for monitored vertebrate species. All species are weighted equally, such that a species that doubled in population would be balanced out by a species that declined by half.
Source: Zoological Society of London (2023).

Table A.3. Data for

Figure 3. Distribution of species-level lambda values, national and by system, 1970 to 2018**8**

Year	National index, average lambda	National index, standard deviation	National index, number of species	Terrestrial index, average lambda	Terrestrial index, standard deviation	Terrestrial index, number of species	Freshwater index, average lambda	Freshwater index, standard deviation	Freshwater index, number of species	Marine index, average lambda	Marine index, standard deviation	Marine index, number of species
1970	n/a	n/a	449	n/a	n/a	270	n/a	n/a	74	n/a	n/a	106
1971	0.00623	-0.05201	460	-0.00015	0.04915	274	0.01318	0.08973	76	0.02070	0.06897	112
1972	0.00517	-0.04889	461	-0.00136	0.05023	276	0.01188	0.06847	80	0.01838	0.06061	106
1973	0.00364	-0.04832	475	-0.00241	0.04943	278	0.01027	0.04414	79	0.01354	0.06055	119
1974	0.00190	-0.05032	498	-0.00505	0.05356	292	0.01076	0.03944	75	0.01067	0.05510	132
1975	0.00230	-0.04649	493	-0.00160	0.04684	295	0.01015	0.04050	80	0.00518	0.05726	119
1976	0.00132	-0.04341	497	0.00081	0.03925	290	0.00369	0.04780	81	0.00049	0.05369	127
1977	0.00077	-0.04802	505	0.00142	0.04855	295	0.00081	0.04595	81	-0.00095	0.05199	130
1978	0.00228	-0.04075	503	0.00332	0.03803	290	0.00522	0.03862	78	-0.00179	0.05400	136
1979	0.00311	-0.03308	509	0.00329	0.02839	293	0.00664	0.03303	79	0.00085	0.04871	138
1980	0.00366	-0.03286	517	0.00454	0.03246	294	0.00736	0.02926	85	0.00057	0.04602	139
1981	0.00316	-0.03537	519	0.00409	0.03440	295	0.00839	0.03415	86	-0.00093	0.04719	139
1982	-0.00006	-0.04491	524	-0.00111	0.04244	294	0.00807	0.03545	83	-0.00253	0.05272	148
1983	0.00040	-0.04364	535	-0.00046	0.04004	299	0.00796	0.03682	86	-0.00243	0.05360	151
1984	0.00344	-0.04633	565	0.00512	0.05213	296	0.00703	0.04060	89	-0.00149	0.04982	181
1985	0.00287	-0.04495	551	0.00353	0.05332	301	0.00633	0.04315	90	0.00091	0.04211	161
1986	0.00126	-0.04895	558	0.00435	0.04815	301	0.00439	0.05115	94	-0.00392	0.05610	165
1987	-0.00462	-0.05617	585	-0.00161	0.02465	303	-0.00140	0.04798	94	-0.00993	0.07889	189
1988	-0.00316	-0.04954	549	-0.00086	0.03541	293	0.00186	0.03780	95	-0.00872	0.06279	163
1989	-0.00338	-0.04874	579	-0.00039	0.03328	299	0.00226	0.03533	97	-0.01054	0.06172	184
1990	-0.00110	-0.05200	567	-0.00011	0.03253	309	0.01200	0.07374	99	-0.00941	0.05668	160
1991	-0.00154	-0.04748	590	-0.00049	0.04233	308	0.00391	0.05132	97	-0.00601	0.04791	186
1992	-0.00114	-0.04372	580	-0.00098	0.03893	309	0.00438	0.03690	110	-0.00433	0.04995	162
1993	0.00082	-0.05535	613	-0.00225	0.03353	314	0.00886	0.08262	108	0.00082	0.06377	193
1994	0.00234	-0.06045	606	-0.00473	0.04784	316	0.01326	0.09327	119	0.00629	0.06023	172
1995	0.00033	-0.04686	603	-0.00348	0.02997	322	0.00685	0.06578	116	0.00260	0.05704	166

Year	National index, average lambda	National index, standard deviation	National index, number of species	Terrestrial index, average lambda	Terrestrial index, standard deviation	Terrestrial index, number of species	Freshwater index, average lambda	Freshwater index, standard deviation	Freshwater index, number of species	Marine index, average lambda	Marine index, standard deviation	Marine index, number of species
1996	-0.00083	-0.05801	595	-0.00085	0.03880	313	-0.00494	0.07324	117	0.00249	0.07020	166
1997	-0.00176	-0.04975	583	-0.00226	0.03716	320	-0.00657	0.06152	121	0.00280	0.05393	143
1998	-0.00512	-0.05852	617	-0.00695	0.03901	318	-0.00595	0.08006	125	-0.00060	0.05096	175
1999	-0.00457	-0.05267	592	-0.00913	0.03852	325	0.00053	0.06733	120	-0.00004	0.04687	148
2000	-0.00358	-0.04743	616	-0.00595	0.03480	323	-0.00019	0.05529	122	-0.00040	0.04813	171
2001	-0.00227	-0.05530	601	-0.00563	0.03097	322	0.00240	0.06047	130	0.00170	0.07399	150
2002	-0.00297	-0.05024	625	-0.00415	0.03095	320	0.00212	0.04897	140	-0.00373	0.06675	165
2003	-0.00206	-0.08261	664	-0.00134	0.03374	313	-0.00015	0.13929	142	-0.00410	0.07763	211
2004	-0.00223	-0.07043	675	0.00089	0.03408	319	-0.00050	0.06535	133	-0.00766	0.10071	226
2005	0.00042	-0.06099	695	0.00211	0.03346	320	-0.00048	0.06721	131	-0.00103	0.08241	250
2006	0.00066	-0.05380	676	0.00110	0.03111	309	0.00128	0.07665	143	-0.00120	0.06401	235
2007	-0.00063	-0.04345	696	-0.00009	0.02389	308	-0.00189	0.05419	124	-0.00239	0.05634	274
2008	-0.00320	-0.05213	678	-0.00333	0.03081	301	-0.00477	0.04995	137	-0.00400	0.06556	253
2009	-0.00245	-0.05306	670	-0.00469	0.03315	301	-0.00343	0.06152	129	-0.00175	0.06229	252
2010	-0.00271	-0.05107	680	-0.00510	0.02785	303	-0.00039	0.05917	136	-0.00347	0.06305	253
2011	-0.00230	-0.05349	674	-0.00491	0.02906	301	0.00091	0.05374	129	-0.00312	0.07107	258
2012	-0.00578	-0.06255	679	-0.00613	0.03353	299	-0.00025	0.05664	142	-0.01087	0.07934	246
2013	-0.00779	-0.06261	631	-0.00445	0.02836	296	-0.00610	0.05315	112	-0.01439	0.07953	229
2014	-0.00705	-0.06494	652	-0.00445	0.03452	300	-0.00725	0.04644	125	-0.01093	0.08397	237
2015	-0.00348	-0.05819	634	-0.00133	0.03632	294	-0.00314	0.05246	122	-0.00654	0.07323	222
2016	0.00080	-0.04894	602	0.00054	0.03156	301	-0.00015	0.05038	90	0.00147	0.06882	214
2017	-0.00482	-0.09135	378	-0.00407	0.08732	255	0.00416	0.05836	86	-0.03087	0.12522	37
2018	0.00021	-0.02749	325	0.00018	0.02469	237	-0.00040	0.03807	66	0.00236	0.02230	22

Note: n/a = not applicable.
Source: Zoological Society of London (2023).

Table A.4. Data for

Figure 4. Distribution of species-level lambda values, species group, 1970 to 2018**8**

Year	Bird index, average lambda	Bird index, standard deviation	Bird index, number of species	Mammal index, average lambda	Mammal index, standard deviation	Mammal index, number of species	Fish index, average lambda	Fish index, standard deviation	Fish index, number of species	Reptile and amphibian index, average lambda	Reptile and amphibian, standard deviation	Reptile and amphibian, number of species
1970	n/a	n/a	337	n/a	n/a	27	n/a	n/a	85	n/a	n/a	no data
1971	0.00546	0.03433	339	-0.04005	0.12784	31	0.02398	0.08550	90	n/a	n/a	no data
1972	0.00555	0.03233	342	-0.03529	0.12042	32	0.01761	0.06936	82	n/a	n/a	5
1973	0.00586	0.03131	342	-0.03216	0.11567	37	0.00961	0.06597	96	-0.00469	0.01304	1
1974	0.00669	0.03022	357	-0.05152	0.12123	34	0.00628	0.05732	107	-0.00469	0.01304	2
1975	0.00626	0.02936	365	-0.03194	0.11213	32	0.00136	0.05982	95	-0.00469	0.01304	1
1976	0.00502	0.02851	362	-0.01183	0.09719	29	-0.00494	0.05889	104	-0.02763	0.05739	2
1977	0.00351	0.02756	364	0.00059	0.13062	37	-0.00435	0.05378	102	-0.05254	0.08420	2
1978	0.00290	0.02683	367	0.02033	0.09406	27	-0.00433	0.05701	108	-0.00469	0.01304	1
1979	0.00340	0.02496	367	0.01693	0.05752	29	-0.00124	0.05222	113	-0.00232	0.01302	1
1980	0.00370	0.02360	369	0.02179	0.07419	30	-0.00114	0.04824	117	-0.00232	0.01302	2
1981	0.00319	0.02339	369	0.02160	0.08235	29	-0.00170	0.05162	119	0.002059	0.01499	3
1982	0.00225	0.02344	371	-0.00661	0.09936	28	-0.00249	0.05904	122	-0.0448	0.12127	3
1983	0.00195	0.02318	378	-0.01029	0.10544	26	-0.00190	0.05983	128	0.014166	0.04175	3
1984	0.00586	0.04327	376	-0.00707	0.08389	30	-0.00020	0.05583	156	-0.00271	0.02227	8
1985	0.00581	0.04372	381	-0.00845	0.05229	31	0.00133	0.04698	131	-0.04859	0.12987	7
1986	0.00495	0.04435	381	-0.00720	0.04532	29	-0.00566	0.06197	141	0.006028	0.04988	8
1987	-0.00156	0.04698	377	-0.00912	0.04489	39	-0.01062	0.06231	161	-0.0029	0.03467	7
1988	0.00006	0.02231	376	0.00725	0.08938	33	-0.01242	0.06562	133	-0.00578	0.03202	8
1989	0.00038	0.02395	376	0.00888	0.07085	38	-0.01446	0.06612	157	-0.00909	0.02838	12
1990	0.00074	0.02502	378	0.01044	0.06714	47	-0.01306	0.05972	130	0.064507	0.18152	13
1991	0.00089	0.02361	379	0.00751	0.09489	42	-0.00976	0.05121	156	0.005342	0.11790	13
1992	0.00080	0.02315	384	0.00072	0.08562	41	-0.00627	0.05315	142	0.005337	0.06283	14
1993	0.00024	0.02423	384	-0.00270	0.06742	47	0.00373	0.08886	168	-0.00929	0.07872	16
1994	-0.00064	0.02374	385	-0.00721	0.10821	51	0.01298	0.08804	154	-0.0233	0.13241	19
1995	-0.00149	0.02288	387	0.00998	0.05854	56	0.00483	0.07434	141	-0.03138	0.09135	21

Year	Bird index, average lambda	Bird index, standard deviation	Bird index, number of species	Mammal index, average lambda	Mammal index, standard deviation	Mammal index, number of species	Fish index, average lambda	Fish index, standard deviation	Fish index, number of species	Reptile and amphibian index, average lambda	Reptile and amphibian, standard deviation	Reptile and amphibian, number of species
1996	-0.00242	0.02147	380	0.02271	0.07847	52	-0.00130	0.08065	142	-0.03077	0.12852	22
1997	-0.00327	0.02093	381	0.01679	0.07371	58	-0.00632	0.07419	122	0.002059	0.03809	23
1998	-0.00390	0.02217	381	-0.00289	0.06863	56	-0.00941	0.06974	157	-0.00247	0.13914	27
1999	-0.00453	0.02361	381	-0.01000	0.06445	61	-0.00612	0.05680	123	0.014264	0.12727	25
2000	-0.00487	0.02315	383	-0.00587	0.06595	59	-0.00285	0.06334	149	0.01513	0.05531	23
2001	-0.00317	0.04253	382	-0.00993	0.06152	62	0.00031	0.06934	134	0.016325	0.05287	27
2002	-0.00385	0.02173	381	-0.00802	0.06068	56	-0.00349	0.07451	161	0.026375	0.05720	28
2003	-0.00306	0.03007	381	0.00178	0.07136	51	-0.00247	0.13632	204	0.00729	0.12411	27
2004	0.00077	0.02191	385	0.01301	0.06601	53	-0.01585	0.11009	210	0.022808	0.08504	24
2005	0.00224	0.03036	391	0.01322	0.07289	51	-0.00669	0.09002	229	0.004862	0.06084	24
2006	0.00180	0.02695	381	0.01012	0.03798	44	-0.00158	0.08077	227	-0.01603	0.06846	17
2007	-0.00079	0.01774	388	0.00847	0.03683	45	-0.00313	0.06255	246	0.013398	0.06342	9
2008	-0.00327	0.03136	389	0.00207	0.05030	38	-0.00481	0.06582	242	0.013682	0.04450	11
2009	-0.00385	0.03293	389	-0.00352	0.05522	40	-0.00120	0.06699	230	0.014622	0.04890	12
2010	-0.00264	0.02695	388	-0.01142	0.05993	46	-0.00156	0.06518	234	0.005242	0.05635	12
2011	-0.00121	0.02809	388	-0.01964	0.08538	43	-0.00099	0.06557	231	0.007925	0.03762	13
2012	-0.00135	0.03029	388	-0.03835	0.09461	33	-0.00781	0.07374	245	0.01602	0.02236	11
2013	-0.00279	0.02413	377	-0.01633	0.06479	36	-0.01373	0.07834	207	-0.00113	0.05669	9
2014	-0.00333	0.02384	377	-0.02630	0.08097	37	-0.00996	0.08295	229	0.000906	0.03780	8
2015	-0.00270	0.02648	377	-0.00426	0.09150	26	-0.00502	0.07769	223	0.007909	0.02944	8
2016	-0.00142	0.02828	375	0.00318	0.05715	32	0.00443	0.07619	187	0.010938	0.03060	9
2017	-0.00025	0.02672	314	-0.04110	0.26147	26	-0.02162	0.16581	29	-0.0014	0.03435	1
2018	0.00050	0.02587	310	0.00319	0.04316	7	-0.01977	0.06707	7	0.02739	0.01304	1

Note: No species data was available for reptiles and amphibians for 1970 and 1971. n/a = not applicable.
Source: Zoological Society of London (2023).

Additional information can be obtained at:

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