Environment and Climate Change Canada
Environnement et Changement climatique Canada

CANADIAN SPECIES INDEX

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

Suggested citation for this document: Environment and Climate Change Canada (2019) Canadian Environmental Sustainability Indicators: Canadian species index. Consulted on *Month day, year*. Available at: www.canada.ca/en/environment-climate-change/services/environmental-indicators/canadian-species-index.html.

Cat. No.: En4-311/2019E-PDF
ISBN: 978-0-660-31465-5

Environment and Climate Change Canada
Public Inquiries Centre
12th Floor Fontaine Building
200 Sacré-Coeur Blvd
Gatineau, QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-938-3860
Fax: 819-938-3318
Email: ec.enviroinfo.ec@canada.ca

Aussi disponible en français

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS
CANADIAN SPECIES INDEX

December 2019

Table of contents

List of Figures

List of Tables

Canadian species index

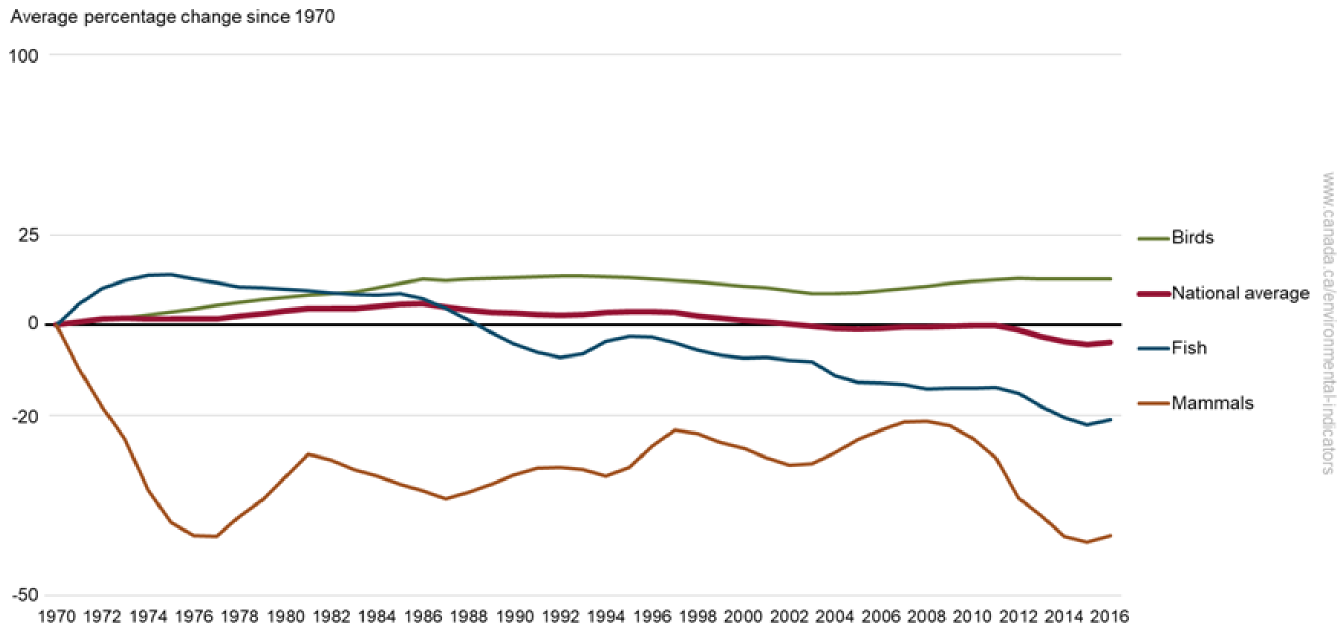
Animal wildlife is one of the most visible and well-studied aspects of biodiversity. The Canadian species index shows whether monitored vertebrate species have increasing or decreasing population size trends over time. This, in turn, provides an integrated measure of the condition of our environment.

Key results

Between 1970 and 2016,

- the population size of monitored vertebrate species declined by 4% on average
- birds showed a moderate change in average population size
- the population size of monitored mammal and fish species decreased by 42% and 21% on average, respectively

Figure 1. Canadian species index, percentage change, 1970 to 2016



Data for Figure 1

Note: Trends are calculated based on the proportional change in population size 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. The vertical axis is scaled to reflect the change in population required to balance out the opposite decrease or increase and is not symmetrical around zero. 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 (2019).

The national index includes 913 species of birds, fish, mammals, amphibians and reptiles. The number of species represents 51% of the 1 779 native vertebrate species that regularly occur in Canada.[1] While there is an overall decrease in the national average trend across all monitored species, some species are increasing while others are decreasing.

The bird index includes 393 species, and represents the largest number of species in the indicator. This accounts for 87% of native bird species. While the average change in bird species populations is moderately positive,

[1] The number of native vertebrate species that regularly occur in Canada is based on the Wild Species 2015 report and does not include species classified as "Presumed Extirpated", "Probably Extirpated" and "Not Applicable."

populations of shorebirds, grassland birds and aerial insectivores are in steep decline,[2] as are some of Canada's most common bird species (such as the Dark-eyed Junco, a forest bird).[3]

The fish index includes 367 species of freshwater and marine fish, and accounts for 35% of native fish species.

The mammal index includes 106 species, which make up 55% of native mammal species. Fragmentation and loss of remaining habitat are threatening many mammal species. A wide range of species, from large bears to small squirrels, can have difficulty surviving in isolated and fragmented habitats.[4]

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 Status of wild species indicator shows that 68% (30 of 44) of reptile species and 36% (17 of 47) of amphibian species are at risk of disappearing.

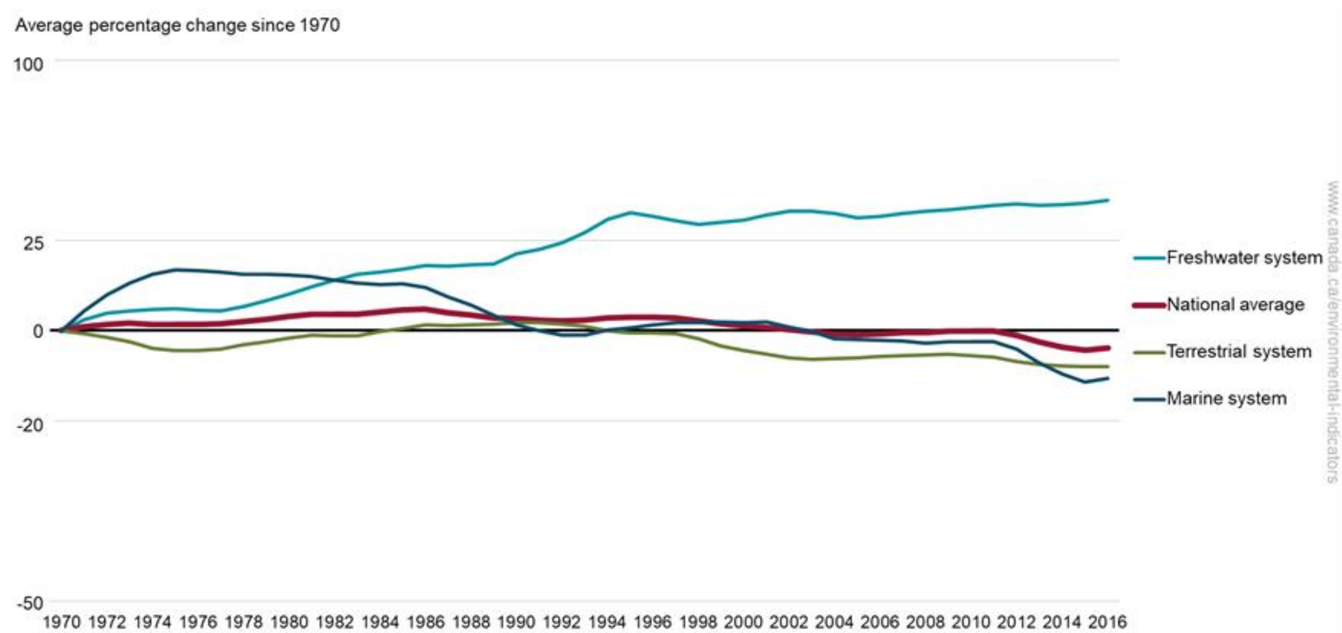
Canadian species index by system

Key results

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. From 1970 to 2016,

- the index for the terrestrial system, which includes the majority of bird and mammal populations, and some reptiles and amphibians, decreased by 9%
- the index for the marine system, which includes the majority of fish populations, mammals (such as whales and seals), birds (such as terns) and 1 reptile (the leatherback turtle), decreased by 12%
- 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 39%

Figure 2. Canadian species index by system, percentage change, 1970 to 2016



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

[3] Rosenberg KV et al. (2019) Decline of the North American avifauna. Science 366(6461): 120-124. Retrieved on November 1, 2019.

[4] Parks Canada (2017) Stressors. Retrieved in July 2019.

Data for Figure 2

Note: Trends are calculated based on the proportional change in population size 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. The vertical axis is scaled to reflect the change in population required to balance out the opposite decrease or increase and is not symmetrical around zero.
Source: Zoological Society of London (2019).

The decrease in the terrestrial and marine systems indices are comparable to the decrease in the national index. The freshwater system index increased by 39% primarily due to increases in freshwater birds. Freshwater birds, such as ducks, geese and swans, increased by 62% from 1970 to 2016.

About the indicator

What the indicator measures

The Canadian species index represents the average percent change in the sizes 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 or hunting. Trends in animal populations are a good proxy measure of overall trends in biodiversity and ecosystem health.

Healthy wildlife populations

This indicator supports the measurement of progress towards the following 2019 to 2022 Federal Sustainable Development Strategy long-term goal: All species have healthy and viable populations.

The indicator also contributes towards reporting on Target 2 of the 2020 Biodiversity goals and targets for Canada: "By 2020, species that are secure remain secure, and populations of species at risk listed under federal law exhibit trends that are consistent with recovery strategies and management plans."

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 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 size 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 913 (51%) of the 1 779 native regularly occurring vertebrate species has been captured in the data set.[5] Birds are the best represented species group, with about 87% of all bird species regularly occurring in Canada represented.

While many fish species are included (367 species), they account for only 35% of the total number of fish species regularly occurring in Canada.

While mammal species are included (106 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 2016, the time period where sufficient data exist for credible estimates.

Methods

The trend in the population size of each species is estimated using all the information available for that particular species. 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.[6]

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
- use units of population size 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

[5] Data derived from Canadian Endangered Species Conservation Council (2016) Wild Species 2015: The General Status of Species in Canada. National General Status Working Group.

[6] WWF-Canada (2017) Living Planet Report Canada. Retrieved in May 2019.

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 2015 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 sizes are generally interpreted as a sign of environmental improvement. However, a few bird species are known to have a population size that is above acceptable bounds (see Population status of Canada's migratory birds), and for these species, an increase in population is a negative outcome. Three (3) species, Snow Goose (both subspecies), Ross's Goose and Canada Goose, have been excluded from the index for this reason.[7]

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, 0's 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 size estimate in year *t*

$N_{(t-1)}$ = modelled population size 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.

[7] These species' scientific names are *Chen caerulescens*, *Chen rossii*, and *Branta canadensis*.

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 annual changes since 1970.

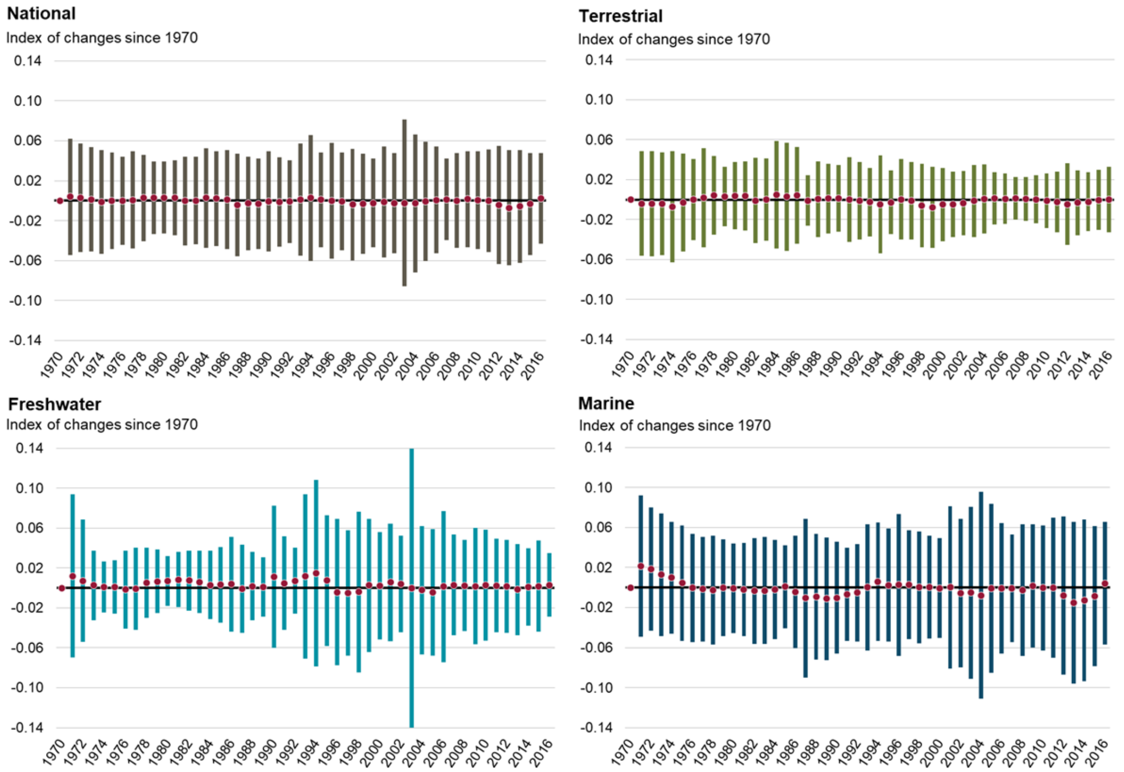
Percentage changes are calculated by taking the antilog of the index.

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.

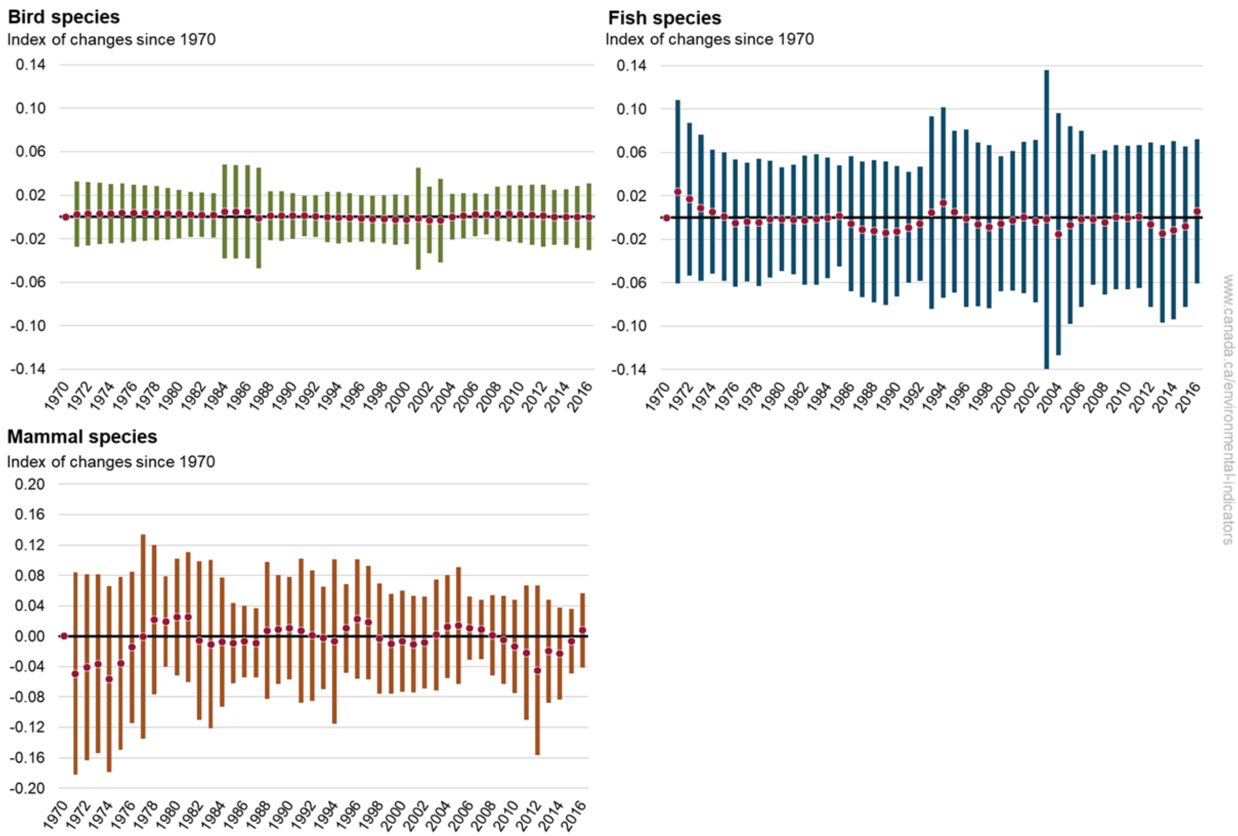
Figure 3. Distribution of species-level lambda values, national and by system, 1970 to 2016



[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 (2019).

Figure 4. Distribution of species-level lambda values, species group, 1970 to 2016



[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.
Source: Zoological Society of London (2019).

Recent changes

The previous version used the Wild Species 2005 and 2010 reports to determine regularly occurring vertebrate species in Canada. The current release uses the Wild Species 2015 report.[8] The number of regularly occurring species differs between the 2 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.

The vertical axes on the graphs in Figure 1 and 2 are labelled with the average percent change, whereas the previous version was labelled with the index of change.

The vertical axes were scaled to reflect the change in population required to balance out the opposite decrease or increase and are not symmetrical around zero. For example, a population that has increased by 100% must decrease by 50% to return to its original size.

Many of the indices for monitored bird populations use the same raw data included in the [State of Canada's Birds 2019](#) report, and were estimated using an updated population trend model. This updated population trend model uses a Generalized Additive Mixed model structure and provides a method of smoothing the temporal change, with limited assumptions about the pattern of population change.

---

[8] Canadian Endangered Species Conservation Council (2016) [Wild Species 2015: The General Status of Species in Canada](#). National General Status Working Group.

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.

Caveats and limitations

The Canadian species index was developed from the Living Planet Index. The methodology for the Canadian species index 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.

The indices may reflect changes in the trend due to real environmental change or because species with a different trajectory have been added to the index. 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.

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 and data sources, and does not incorporate estimates of uncertainty in the data.

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, Savannah Sparrow).[9]

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.[10]

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 size 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 size. 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,

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

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

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.

Resources

References

Canadian Endangered Species Conservation Council (2006) Wild Species 2005: The General Status of Species in Canada. National General Status Working Group. Retrieved in May 2019.

Canadian Endangered Species Conservation Council (2011) Wild Species 2010: The General Status of Species in Canada. National General Status Working Group. Retrieved in May 2019.

Canadian Endangered Species Conservation Council (2016) Wild Species 2015: The General Status of Species in Canada. National General Status Working Group. Retrieved in May 2019.

Collen B, Loh J, Whitmee S, McRae L, Amin R and Baillie JEM (2009) Monitoring Change in Vertebrate Abundance: the Living Planet Index. Conservation Biology 23(2): 317-327.

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

Rosenberg KV, Dokter AM, Blancher PJ, Sauer JR, Smith AC, Smith PA, Stanton JC, Panjabi A, Helft L, Parr M, Marra PP (2019) Decline of the North American avifauna. Science 366(6461): 120-124. Retrieved on November 1, 2019.

WWF-Canada (2017) Living Planet Report Canada. Retrieved in May 2019.

Related information

Arctic Species Trend Index (ASTI)

Living Planet Index for Canada

Living Planet Report 2018

Annex

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

Table A.1. Data for Figure 1. Canadian species index, percentage change, 1970 to 2016

Year	National index (percent change)	Number of species	Bird index (percent change)	Number of bird species	Mammal index (percent change)	Number of mammal species	Fish index (percent change)	Number of fish species
1970	0.00	405	0.00	296	0.00	24	0.00	85
1971	0.89	424	0.56	305	-10.71	29	5.62	90
1972	1.55	426	1.20	309	-18.74	30	9.85	82
1973	1.82	442	1.90	312	-25.26	34	12.10	96
1974	1.55	474	2.64	335	-34.37	32	13.51	107
1975	1.51	471	3.42	346	-39.60	29	13.74	95
1976	1.48	479	4.22	346	-41.62	27	12.42	104
1977	1.65	486	5.09	349	-41.70	33	11.36	102
1978	2.27	485	5.93	351	-38.67	25	10.28	108
1979	2.95	490	6.67	351	-35.94	26	9.92	113
1980	3.65	498	7.32	352	-32.17	28	9.57	117
1981	4.30	499	7.91	353	-28.14	26	9.12	118
1982	4.25	505	8.40	354	-29.11	27	8.50	121
1983	4.27	519	8.75	363	-30.83	26	8.10	127
1984	4.91	546	9.97	360	-32.04	29	8.01	154
1985	5.42	533	11.17	366	-33.46	30	8.38	129
1986	5.68	539	12.40	365	-34.53	29	6.96	138
1987	4.61	566	12.13	362	-35.88	38	4.30	158
1988	3.95	531	12.36	362	-34.77	32	1.32	130
1989	3.20	563	12.58	363	-33.41	38	-1.97	154
1990	3.00	552	12.83	366	-31.80	47	-4.79	127
1991	2.68	576	13.07	368	-30.62	42	-6.77	153
1992	2.44	566	13.24	372	-30.50	41	-7.95	140

Year	National index (percent change)	Number of species	Bird index (percent change)	Number of bird species	Mammal index (percent change)	Number of mammal species	Fish index (percent change)	Number of fish species
1993	2.66	598	13.26	372	-30.91	47	-7.00	165
1994	3.28	594	13.11	374	-32.02	51	-4.02	153
1995	3.49	591	12.88	376	-30.41	56	-2.84	140
1996	3.48	583	12.52	371	-26.66	51	-3.01	140
1997	3.33	572	12.09	372	-23.57	58	-4.37	120
1998	2.41	604	11.56	372	-24.19	55	-6.24	155
1999	1.67	578	10.96	371	-25.91	60	-7.46	121
2000	1.13	603	10.29	375	-27.02	57	-8.05	147
2001	0.82	588	9.91	374	-28.78	60	-7.99	132
2002	0.24	614	9.18	373	-30.09	56	-8.70	159
2003	-0.28	653	8.33	374	-29.83	49	-9.04	203
2004	-0.90	660	8.31	376	-27.76	51	-12.20	207
2005	-1.07	678	8.55	381	-25.41	48	-13.55	226
2006	-0.89	662	9.05	372	-23.53	43	-13.80	224
2007	-0.58	679	9.69	382	-21.95	43	-14.13	243
2008	-0.57	658	10.47	384	-21.80	36	-14.98	232
2009	-0.24	649	11.22	384	-22.66	36	-14.90	221
2010	-0.16	653	11.87	382	-25.03	41	-14.91	223
2011	-0.19	645	12.35	383	-28.70	37	-14.73	219
2012	-1.20	645	12.58	381	-35.71	27	-16.01	232
2013	-2.85	590	12.48	364	-38.59	31	-18.86	191
2014	-4.12	605	12.45	364	-41.72	26	-21.03	212
2015	-4.83	562	12.44	346	-42.59	9	-22.51	205
2016	-4.39	530	12.45	345	-41.56	20	-21.48	164

Note: Trends are calculated based on the proportional change in population size 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 (2019).

Table A.2. Data for Figure 2. Canadian species index by system, percentage change, 1970 to 2016

Year	Terrestrial index (percent change)	Number of terrestrial species	Freshwater index (percent change)	Number of freshwater species	Marine index (percent change)	Number of marine species
1970	0.00	244	0.00	67	0.00	95
1971	-0.89	252	2.81	71	5.05	103
1972	-1.83	255	4.53	75	9.62	97
1973	-2.78	259	5.16	74	12.92	110
1974	-4.38	278	5.42	73	15.51	124
1975	-5.05	282	5.64	78	16.71	112
1976	-5.01	281	5.24	79	16.59	120
1977	-4.57	285	5.05	79	16.17	123
1978	-3.62	281	6.32	76	15.47	129
1979	-2.89	283	7.94	77	15.39	131
1980	-2.00	284	9.72	83	15.20	132
1981	-1.15	285	11.86	83	14.66	132
1982	-1.33	285	13.80	80	13.76	141
1983	-1.35	293	15.35	83	12.95	144
1984	-0.19	288	16.16	85	12.42	174
1985	0.51	294	17.01	86	12.68	154
1986	1.51	294	18.01	90	11.62	157
1987	1.28	296	17.78	90	8.93	181
1988	1.39	287	18.29	91	6.59	155
1989	1.65	295	18.50	93	3.87	176
1990	1.93	304	21.58	97	1.49	152
1991	1.94	304	22.95	95	-0.08	178
1992	1.65	304	25.03	109	-1.27	154
1993	1.05	309	28.39	106	-1.22	185
1994	-0.01	313	32.85	118	0.17	164
1995	-0.62	317	35.10	117	0.75	158
1996	-0.57	308	33.79	118	1.35	158

Year	Terrestrial index (percent change)	Number of terrestrial species	Freshwater index (percent change)	Number of freshwater species	Marine index (percent change)	Number of marine species
1997	-0.77	316	32.27	122	2.02	135
1998	-2.11	312	31.06	126	2.05	167
1999	-3.85	319	31.84	121	2.21	139
2000	-4.94	318	32.59	122	2.09	163
2001	-5.96	316	34.29	130	2.15	143
2002	-6.74	316	35.56	141	0.88	157
2003	-7.04	309	35.51	142	-0.32	204
2004	-6.94	312	34.83	133	-2.07	218
2005	-6.68	312	33.42	131	-2.28	240
2006	-6.47	302	33.88	138	-2.49	226
2007	-6.17	302	34.80	120	-2.62	268
2008	-6.03	295	35.50	132	-3.19	241
2009	-5.97	294	36.06	122	-2.83	242
2010	-6.19	293	36.89	126	-2.88	241
2011	-6.66	292	37.62	120	-2.92	244
2012	-7.65	290	38.14	130	-4.68	233
2013	-8.30	287	37.61	99	-7.93	209
2014	-8.74	286	37.88	109	-10.60	214
2015	-8.84	267	38.47	96	-12.38	200
2016	-8.79	275	39.43	67	-11.52	192

Note: Trends are calculated based on the proportional change in population size 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 (2019).

Table A.3. Data for Figure 3. Distribution of species-level lambda values, national and by system, 1970 to 2016

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	405	n/a	n/a	244	n/a	n/a	67	n/a	n/a	95
1971	0.00383	0.05820	424	-0.00388	0.05216	252	0.01205	0.08182	71	0.02138	0.07060	103
1972	0.00282	0.05439	426	-0.00413	0.05278	255	0.00720	0.06130	75	0.01853	0.06156	97
1973	0.00119	0.05226	442	-0.00424	0.05156	259	0.00263	0.03475	74	0.01286	0.06146	110
1974	-0.00116	0.05203	474	-0.00721	0.05547	278	0.00105	0.02569	73	0.00983	0.05572	124
1975	-0.00017	0.04846	471	-0.00304	0.04894	282	0.00089	0.02660	78	0.00448	0.05785	112
1976	-0.00013	0.04418	479	0.00018	0.04058	281	-0.00165	0.03919	79	-0.00042	0.05423	120
1977	0.00073	0.04892	486	0.00201	0.04976	285	-0.00075	0.04128	79	-0.00157	0.05239	123
1978	0.00264	0.04329	485	0.00428	0.03916	281	0.00520	0.03520	76	-0.00264	0.05447	129
1979	0.00284	0.03654	490	0.00331	0.02975	283	0.00656	0.03180	77	-0.00028	0.04850	131
1980	0.00298	0.03612	498	0.00393	0.03346	284	0.00712	0.02509	83	-0.00072	0.04495	132
1981	0.00271	0.03767	499	0.00378	0.03471	285	0.00839	0.02781	83	-0.00202	0.04665	132
1982	-0.00024	0.04455	505	-0.00083	0.04282	285	0.00748	0.03010	80	-0.00343	0.05305	141
1983	0.00009	0.04387	519	-0.00006	0.04116	293	0.00586	0.03128	83	-0.00313	0.05352	144
1984	0.00265	0.05002	546	0.00508	0.05388	288	0.00303	0.03411	85	-0.00202	0.04972	174
1985	0.00213	0.04745	533	0.00301	0.05417	294	0.00316	0.03783	86	0.00100	0.04152	154
1986	0.00107	0.04961	539	0.00430	0.04813	294	0.00373	0.04740	90	-0.00412	0.05617	157
1987	-0.00444	0.05141	566	-0.00097	0.02524	296	-0.00088	0.04430	90	-0.01060	0.07944	181
1988	-0.00273	0.04692	531	0.00049	0.03775	287	0.00189	0.03447	91	-0.00941	0.06276	155
1989	-0.00314	0.04537	563	0.00109	0.03507	295	0.00079	0.02985	93	-0.01123	0.06155	176
1990	-0.00084	0.05022	552	0.00123	0.03315	304	0.01114	0.07134	97	-0.01008	0.05618	152
1991	-0.00137	0.04477	576	0.00002	0.04232	304	0.00485	0.04695	95	-0.00677	0.04673	178
1992	-0.00102	0.04143	566	-0.00121	0.03860	304	0.00728	0.03288	109	-0.00519	0.04865	154
1993	0.00093	0.05609	598	-0.00261	0.03407	309	0.01153	0.08248	106	0.00022	0.06304	185
1994	0.00262	0.06310	594	-0.00457	0.04906	313	0.01481	0.09348	118	0.00609	0.05927	164
1995	0.00087	0.04750	591	-0.00267	0.03193	317	0.00730	0.06559	117	0.00250	0.05634	158
1996	-0.00002	0.05793	583	0.00025	0.04017	308	-0.00423	0.07340	118	0.00256	0.07106	158
1997	-0.00065	0.04902	572	-0.00089	0.03884	316	-0.00498	0.06264	122	0.00286	0.05431	135

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
1998	-0.00387	0.05602	604	-0.00588	0.04171	312	-0.00399	0.08041	126	0.00016	0.05594	167
1999	-0.00316	0.05015	578	-0.00780	0.04055	319	0.00258	0.06676	121	0.00065	0.05149	139
2000	-0.00231	0.04434	603	-0.00496	0.03643	318	0.00246	0.05378	122	-0.00051	0.04966	163
2001	-0.00133	0.05572	588	-0.00469	0.03278	316	0.00554	0.05914	130	0.00025	0.08098	143
2002	-0.00252	0.05026	614	-0.00361	0.03216	316	0.00411	0.04855	141	-0.00540	0.07412	157
2003	-0.00225	0.08376	653	-0.00138	0.03631	309	-0.00016	0.13959	142	-0.00523	0.08582	204
2004	-0.00271	0.06920	660	0.00045	0.03459	312	-0.00220	0.06421	133	-0.00770	0.10338	218
2005	-0.00071	0.05989	678	0.00121	0.02605	312	-0.00455	0.06355	131	-0.00090	0.08434	240
2006	0.00077	0.05340	662	0.00096	0.02513	302	0.00149	0.07581	138	-0.00095	0.06525	226
2007	0.00134	0.04112	679	0.00141	0.02152	302	0.00295	0.05047	120	-0.00054	0.05383	268
2008	0.00005	0.04743	658	0.00064	0.02171	295	0.00225	0.04565	132	-0.00256	0.06597	241
2009	0.00142	0.04829	649	0.00031	0.02402	294	0.00181	0.05829	122	0.00160	0.06161	242
2010	0.00034	0.04891	653	-0.00102	0.02755	293	0.00264	0.05550	126	-0.00021	0.06249	241
2011	-0.00013	0.05143	645	-0.00220	0.03028	292	0.00231	0.04687	120	-0.00020	0.07010	244
2012	-0.00441	0.05928	645	-0.00461	0.04093	290	0.00162	0.04686	130	-0.00790	0.07902	233
2013	-0.00727	0.05772	590	-0.00311	0.03242	287	-0.00167	0.04551	99	-0.01506	0.08088	209
2014	-0.00573	0.05654	605	-0.00205	0.02970	286	0.00088	0.03874	109	-0.01280	0.08106	214
2015	-0.00324	0.05121	562	-0.00048	0.03008	267	0.00183	0.04578	96	-0.00872	0.07010	200
2016	0.00204	0.04533	530	0.00025	0.03279	275	0.00302	0.03176	63	0.00421	0.06142	192

Note: n/a = not applicable.
Source: Zoological Society of London (2019).

Table A.4. Data for Figure 4. Distribution of species-level lambda values, species group, 1970 to 2016

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	296	n/a	n/a	24	n/a	n/a	85	n/a	n/a	no data
1971	0.00241	0.02996	305	-0.04918	0.13283	29	0.02375	0.08424	90	n/a	n/a	no data
1972	0.00276	0.02902	309	-0.04095	0.12219	30	0.01704	0.07033	82	n/a	n/a	5
1973	0.00301	0.02822	312	-0.03630	0.11754	34	0.00882	0.06726	96	-0.00469	0.01304	0
1974	0.00316	0.02733	335	-0.05646	0.12253	32	0.00544	0.05721	107	-0.00469	0.01304	0
1975	0.00329	0.02742	346	-0.03610	0.11397	29	0.00087	0.05937	95	-0.00469	0.01304	1
1976	0.00335	0.02622	346	-0.01472	0.09968	27	-0.00507	0.05879	104	-0.02763	0.05739	2
1977	0.00360	0.02555	349	-0.00062	0.13466	33	-0.00411	0.05473	102	-0.05254	0.08420	2
1978	0.00344	0.02486	351	0.02197	0.09832	25	-0.00426	0.05869	108	-0.00469	0.01304	1
1979	0.00301	0.02373	351	0.01894	0.05981	26	-0.00140	0.05358	113	-0.00232	0.01302	1
1980	0.00264	0.02205	352	0.02484	0.07681	28	-0.00138	0.04765	117	-0.00232	0.01302	2
1981	0.00239	0.02070	353	0.02505	0.08533	26	-0.00179	0.05072	118	0.00206	0.01499	3
1982	0.00196	0.02026	354	-0.00589	0.10430	27	-0.00248	0.05953	121	-0.04480	0.12127	3
1983	0.00140	0.02063	363	-0.01068	0.11062	26	-0.00162	0.06012	127	0.01417	0.04175	3
1984	0.00484	0.04344	360	-0.00765	0.08500	29	-0.00034	0.05583	154	-0.00271	0.02227	8
1985	0.00474	0.04300	366	-0.00920	0.05254	30	0.00149	0.04685	129	-0.04859	0.12987	7
1986	0.00475	0.04281	365	-0.00700	0.04694	29	-0.00572	0.06218	138	0.00603	0.04988	8
1987	-0.00104	0.04642	362	-0.00905	0.04569	38	-0.01095	0.06241	158	-0.00290	0.03467	7
1988	0.00092	0.02249	362	0.00743	0.09042	32	-0.01259	0.06571	130	-0.00578	0.03202	8
1989	0.00083	0.02263	363	0.00897	0.07158	38	-0.01435	0.06633	154	-0.00909	0.02838	12
1990	0.00097	0.02104	366	0.01038	0.06713	47	-0.01265	0.05988	127	0.06451	0.18152	13
1991	0.00091	0.01876	368	0.00743	0.09489	42	-0.00912	0.05106	153	0.00534	0.11790	13
1992	0.00066	0.01918	372	0.00075	0.08565	41	-0.00554	0.05275	140	0.00534	0.06283	14
1993	0.00006	0.02308	372	-0.00254	0.06749	47	0.00444	0.08872	165	-0.00929	0.07872	16
1994	-0.00057	0.02371	374	-0.00703	0.10826	51	0.01370	0.08783	153	-0.02330	0.13241	19
1995	-0.00088	0.02260	376	0.01015	0.05857	56	0.00533	0.07471	140	-0.03138	0.09135	21
1996	-0.00137	0.02133	371	0.02280	0.07849	51	-0.00077	0.08182	140	-0.03077	0.12852	22
1997	-0.00169	0.02134	372	0.01792	0.07480	58	-0.00613	0.07558	120	0.00206	0.03809	22

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
1998	-0.00203	0.02228	372	-0.00354	0.07247	55	-0.00859	0.07511	155	-0.00247	0.13914	26
1999	-0.00237	0.02317	371	-0.00996	0.06558	60	-0.00567	0.06250	121	0.01459	0.12944	24
2000	-0.00263	0.02269	375	-0.00656	0.06643	57	-0.00277	0.06431	147	0.01483	0.05636	22
2001	-0.00148	0.04699	374	-0.01059	0.06372	60	0.00027	0.06975	132	0.01576	0.05409	26
2002	-0.00290	0.03044	373	-0.00807	0.06064	56	-0.00337	0.07495	159	0.02319	0.05813	27
2003	-0.00341	0.03841	374	0.00158	0.07285	49	-0.00160	0.13777	203	0.00219	0.12631	26
2004	-0.00006	0.02107	376	0.01265	0.06812	51	-0.01536	0.11135	207	0.02273	0.08651	23
2005	0.00094	0.02071	381	0.01391	0.07689	48	-0.00675	0.09102	226	-0.00714	0.04999	23
2006	0.00200	0.01974	372	0.01081	0.04178	43	-0.00124	0.08121	224	-0.01994	0.06699	11
2007	0.00255	0.01856	382	0.00889	0.03894	43	-0.00166	0.06018	243	-0.00072	0.02613	6
2008	0.00307	0.02491	384	0.00085	0.05302	36	-0.00435	0.06635	232	0.00731	0.03113	8
2009	0.00295	0.02588	384	-0.00481	0.05809	36	0.00042	0.06653	221	0.00144	0.05920	7
2010	0.00253	0.02642	382	-0.01352	0.06120	41	-0.00003	0.06598	223	-0.00769	0.08619	6
2011	0.00187	0.02746	383	-0.02182	0.08862	37	0.00088	0.06575	219	-0.00070	0.07243	5
2012	0.00088	0.02866	381	-0.04493	0.11187	27	-0.00653	0.07590	232	0.03154	0.03578	4
2013	-0.00040	0.02541	364	-0.01990	0.06814	31	-0.01500	0.08166	191	-0.01140	0.10135	3
2014	-0.00011	0.02578	364	-0.02276	0.06047	26	-0.01180	0.08192	212	-0.00670	0.05906	2
2015	-0.00005	0.02843	346	-0.00655	0.04247	9	-0.00822	0.07388	205	0.02471	0.02207	1
2016	0.00006	0.03083	345	0.00779	0.04896	20	0.00574	0.06616	164	0.00955	n/a	1

Note: No species data was available for reptiles and amphibians for 1970 and 1971. n/a = not applicable.
Source: Zoological Society of London (2019).

Additional information can be obtained at:

Environment and Climate Change Canada
Public Inquiries Centre
12th Floor, Fontaine Building
200 Sacré-Coeur Blvd
Gatineau, QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-938-3860
Fax: 819-938-3318
Email: ec.enviroinfo.ec@canada.ca