

Pearson Edexcel Level 3 Certificate

Wednesday 13 May 2020

Morning (Time: 1 hour 40 minutes)

Paper Reference **7MC0/01**

Mathematics in Context

Paper 1: Comprehension

Source booklet

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Formulae sheet

There will be no credit for anything you write on this formulae sheet.

Mean of a frequency distribution $= \frac{\sum fx}{\sum f}$

Mean of a grouped frequency distribution $= \frac{\sum fx}{\sum f}$, where x is the mid-interval value

Variance $= \frac{\sum (x - \bar{x})^2}{n}$

Standard deviation (set of numbers) $\sqrt{\left[\frac{\sum x^2}{n} - \left(\frac{\sum x}{n} \right)^2 \right]}$

or $\sqrt{\left[\frac{\sum (x - \bar{x})^2}{n} \right]}$

where $\bar{x}$ is the mean of the set of values

Standard deviation
(discrete frequency distribution) $\sqrt{\left[\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2 \right]}$

or $\sqrt{\left[\frac{\sum f(x - \bar{x})^2}{\sum f} \right]}$

Spearman's rank correlation coefficient $1 - \frac{6\sum d^2}{n(n^2 - 1)}$

The product moment correlation coefficient is

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{\sum x_i y_i - \frac{(\sum x_i)(\sum y_i)}{n}}{\sqrt{\left(\sum x_i^2 - \frac{(\sum x_i)^2}{n}\right)\left(\sum y_i^2 - \frac{(\sum y_i)^2}{n}\right)}}$$

The regression coefficient of y on x is $b = \frac{S_{xy}}{S_{xx}}$

Least squares regression line of y on x is $y = a + bx$ where $a = \bar{y} - b\bar{x}$

Arithmetic series

$$u_n = a + (n - 1)d$$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n[2a + (n - 1)d]$$

Geometric series

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r}$$

$$S_\infty = \frac{a}{1 - r} \quad \text{for } |r| < 1$$

There will be no credit for anything you write in this source booklet.

SECTION A: SMARTPHONES

Data source A

The UK is now a smartphone society

Smartphones have overtaken laptops as the most popular device for getting online, with record ownership and use transforming the way we communicate.

Two thirds of people now own a smartphone, using it on average for nearly two hours every day to browse the internet, access social media, use online banking services and shop online.

Smartphones have become the hub of our daily lives and are now in the pockets of around 66% of UK adults.

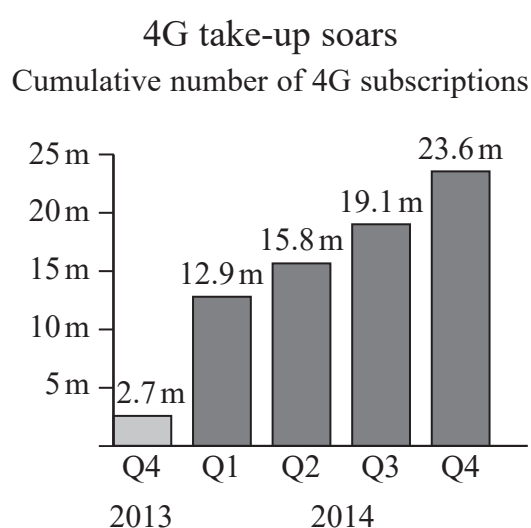
2014 statistics show that

- the vast majority of 16–24 year olds own a smartphone
- smartphone ownership of 55–64 year olds has more than doubled since 2012.

The surge is being driven by the increasing take-up of 4G mobile broadband, providing faster online access. During 2014, 4G subscriptions leapt from 2.7 million at the end of 2013 to 23.6 million by the end of 2014. These 4G subscriptions account for 28% of all mobile subscriptions recorded at the end of 2014, compared to just 3% in Q4 2013.

Short Message Service (SMS) use fell for the second consecutive year, from 129 billion messages sent in 2013 to 110 billion messages sent in 2014, largely due to increasing smartphone take-up and use of internet-based communications.

Figure 1: Cumulative number of 4G subscriptions in millions by quarter from the end of 2013 to the end of 2014



Data source B

Table 1: Battery performance comparisons of smartphones in 2017

Model	Charging time (0% to 100%) (hours)	Battery life (4G web browsing) (hours)
Apple iPhone 6S	1.9	11.2
Apple iPhone 7	2.2	13.0
Apple iPhone SE	1.7	16.5
Google Pixel XL	2.6	15.6
HTC 10	2.5	12.1
Huawei Nova	2.8	13.3
LG Leon	2.3	14.0
LG X Screen	2.1	12.3
Microsoft Lumia 650	2.9	11.4
Motorola Moto X Force	2.3	15.1
Motorola Moto Z Play	4.5	23.5
Samsung Galaxy S6 Edge	1.5	15.3
Samsung Galaxy S7 Edge	2.0	18.4
Sony Xperia X Compact	1.3	14.4
Vodafone Smart Platinum 7	1.8	13.2

Data source C

Apple App Store was created in 2008 and, since then, the number of available apps has been consistently increasing over the years.

This statistic shows the number of cumulative total app downloads from Apple’s App Store from the end of July 2008 to the end of June 2017. As of the last reported period, Apple announced that a total of 180 billion apps had been downloaded from its App Store since opening.

Figure 2: Cumulative total app downloads from Apple’s App Store from the end of July 2008 to the end of June 2017

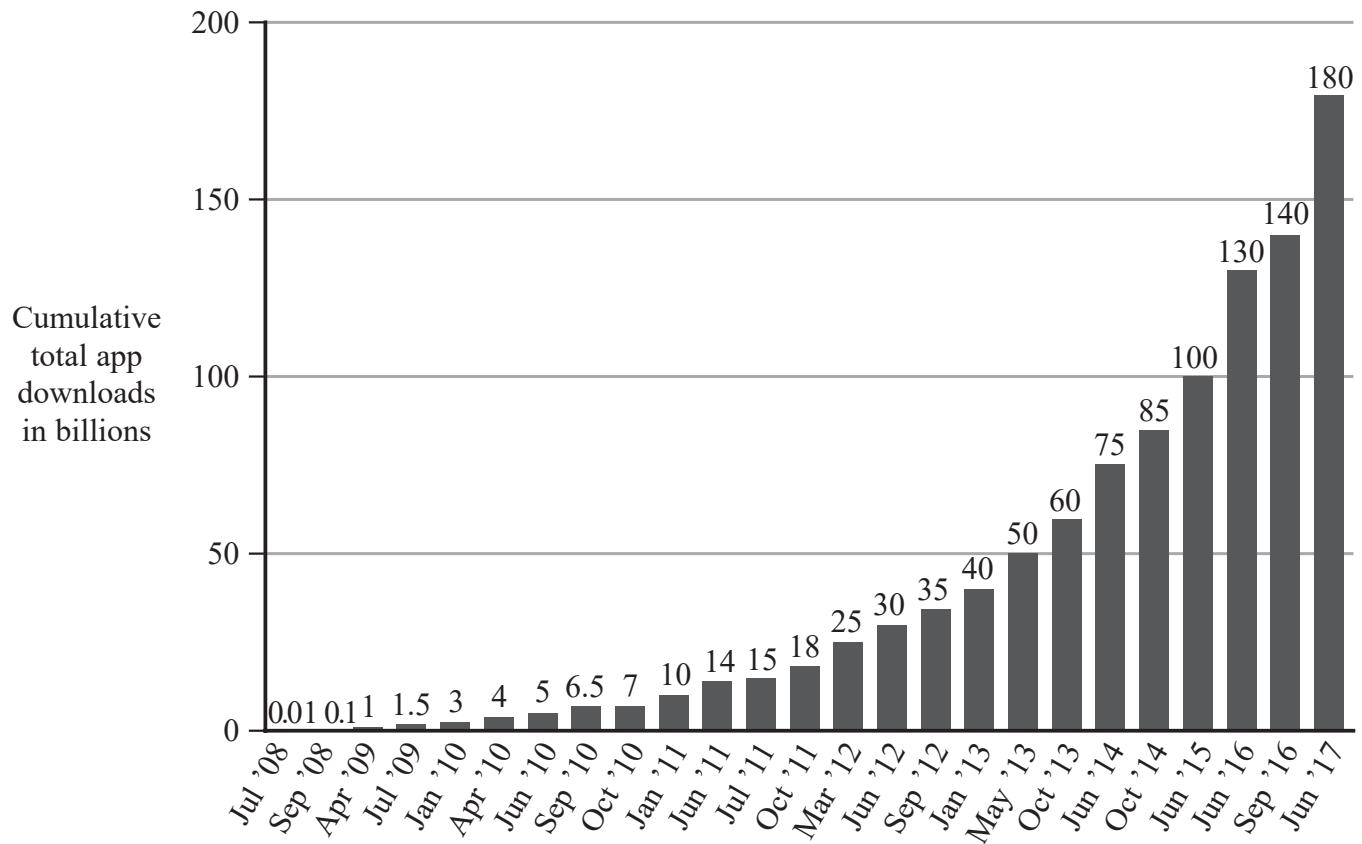
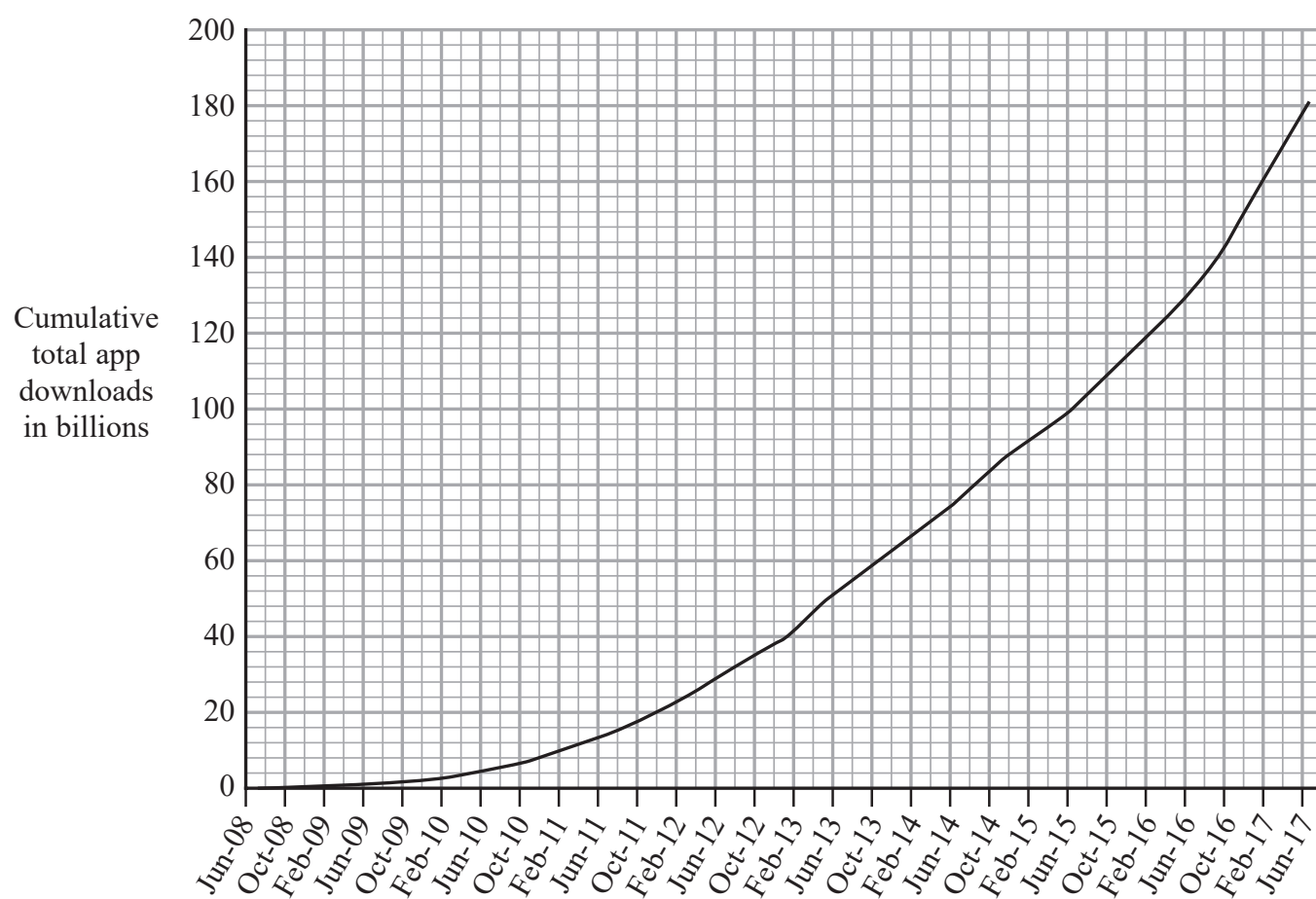


Figure 3: Curve fitted to Figure 2 showing cumulative total app downloads from Apple's App Store from the end of July 2008 to the end of June 2017



SECTION B: LIVING PLANET

Data source D

STATE OF THE NATURAL PLANET

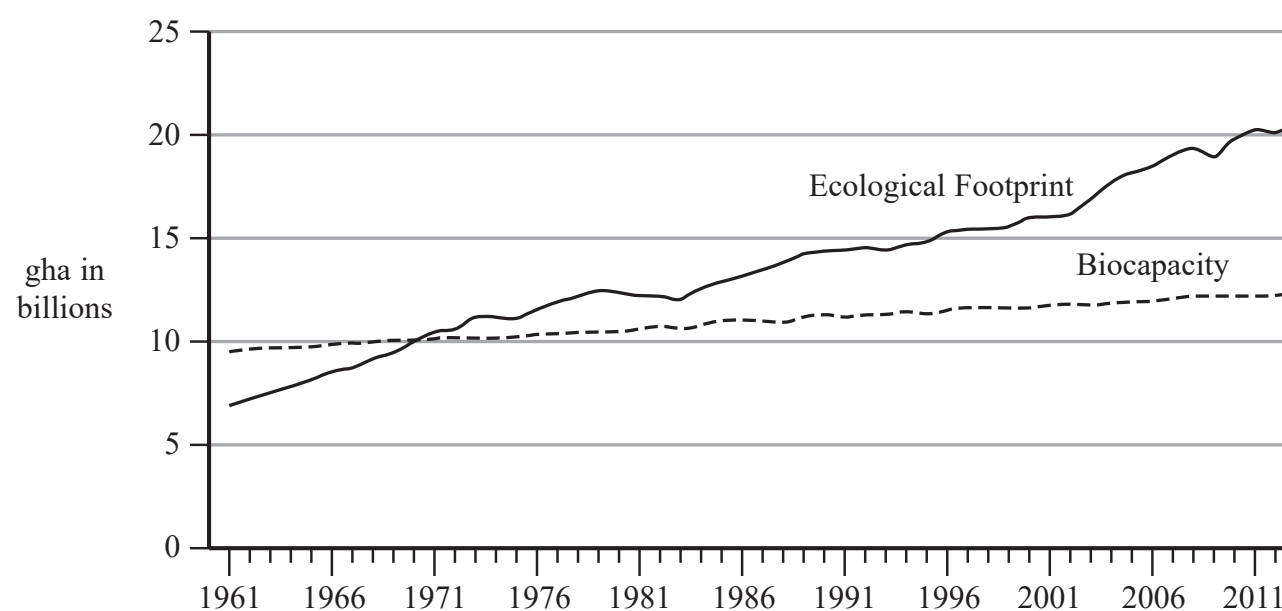
Increased human pressure threatens the natural resources that humanity depends on, increasing the risk of water and food insecurity and competition over natural resources. One way to track human demand for renewable resources and ecological services is to use footprint indicators. The general intent of the Ecological Footprint is to compare actual human consumption of renewable resources and ecological services with the Earth's total capacity to supply these resources and services. It does this by estimating the capacity of land and water surfaces needed to meet human demand and then compares that with the capacity available – the Earth's biocapacity – using global hectares (gha) as the unit of measurement. Biocapacity functions as an ecological benchmark against which we can gauge the demand that human activities place on ecosystems.

An **ecological overshoot** occurs when humanity's annual demand on the natural world exceeds what the Earth can renew in a year.

Figure 4 shows the historical trends of humanity's Ecological Footprint and the Earth's biocapacity, expressed in global hectares of bioproductive land respectively required and available, from 1961 to the latest calculated year, 2012. Since entering into a global ecological overshoot situation in 1971, humanity's demand for the Earth's regenerative capacity has steadily increased.

Under a business-as-usual path for the underlying drivers of resource consumption, assuming current population and income trends remain constant, human demand on the Earth's regenerative capacity is projected to continue growing steadily and to exceed such capacity by about 75% by 2020.

Figure 4: Historical trend of Ecological Footprint and Earth's biocapacity over time



Data source E

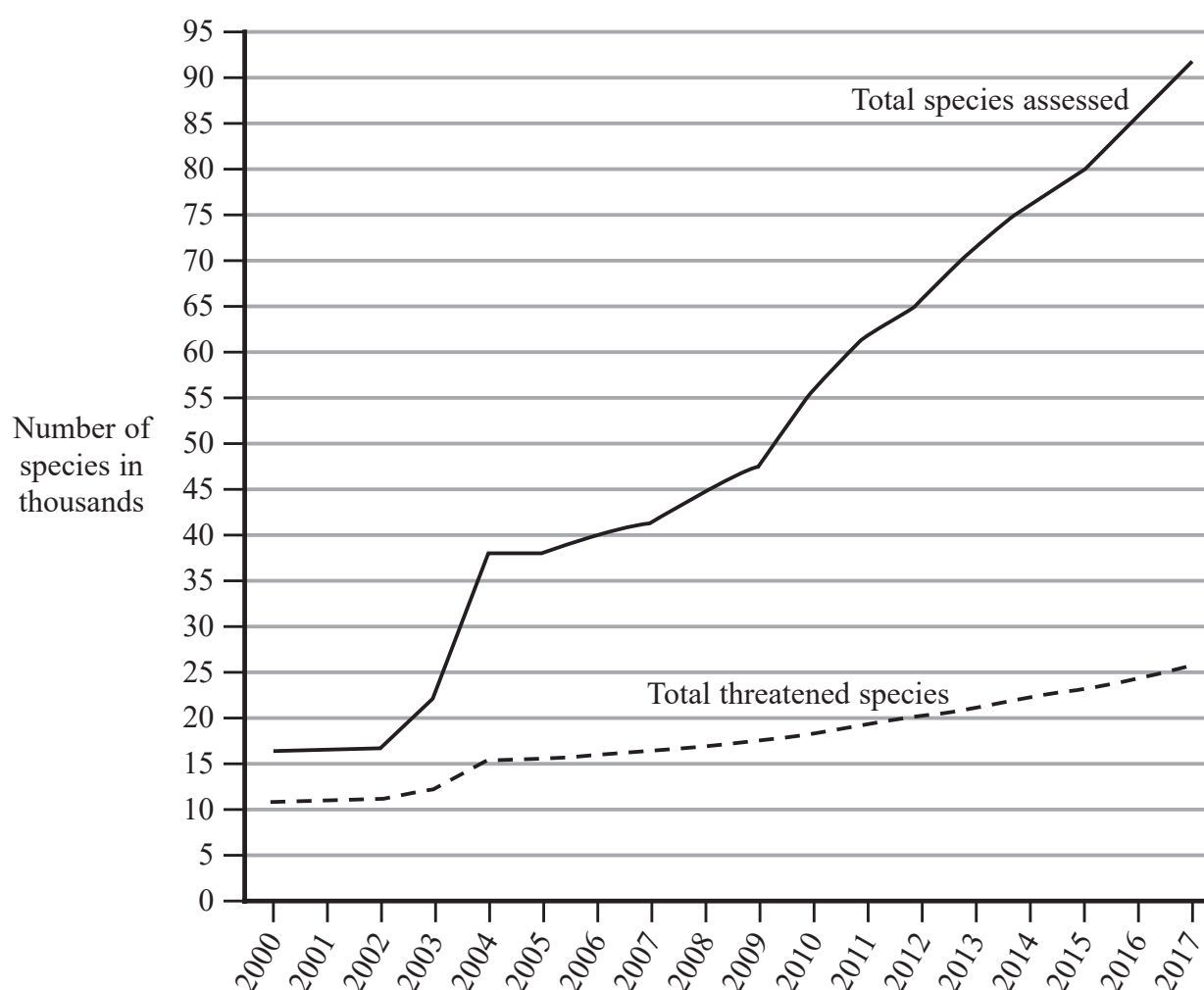
The International Union for the Conservation of Nature (IUCN) has been assessing the conservation status of living things on a global scale for the past 50 years in order to highlight populations of species threatened with extinction, and thereby promote their conservation. Plants and animals identified as having a higher risk of extinction are placed on the IUCN Red List.

Living things that are naturally related are classified into groups such as vertebrates (mammals, birds, reptiles, amphibians and fish).

Not all groups have been completely assessed. It is important to consider this when looking at the numbers of species in each Red List category; although the IUCN Red List gives a good snapshot of the current status of species, it should not be interpreted as a full and complete assessment of the world's biodiversity.

In addition to species changing status, the IUCN Red List grows larger with each update as more species are assessed for the first time (Figure 5). The IUCN and its partners are working to expand the number of groups that have full and complete Red List assessments in order to improve our knowledge of the status of the world's biodiversity.

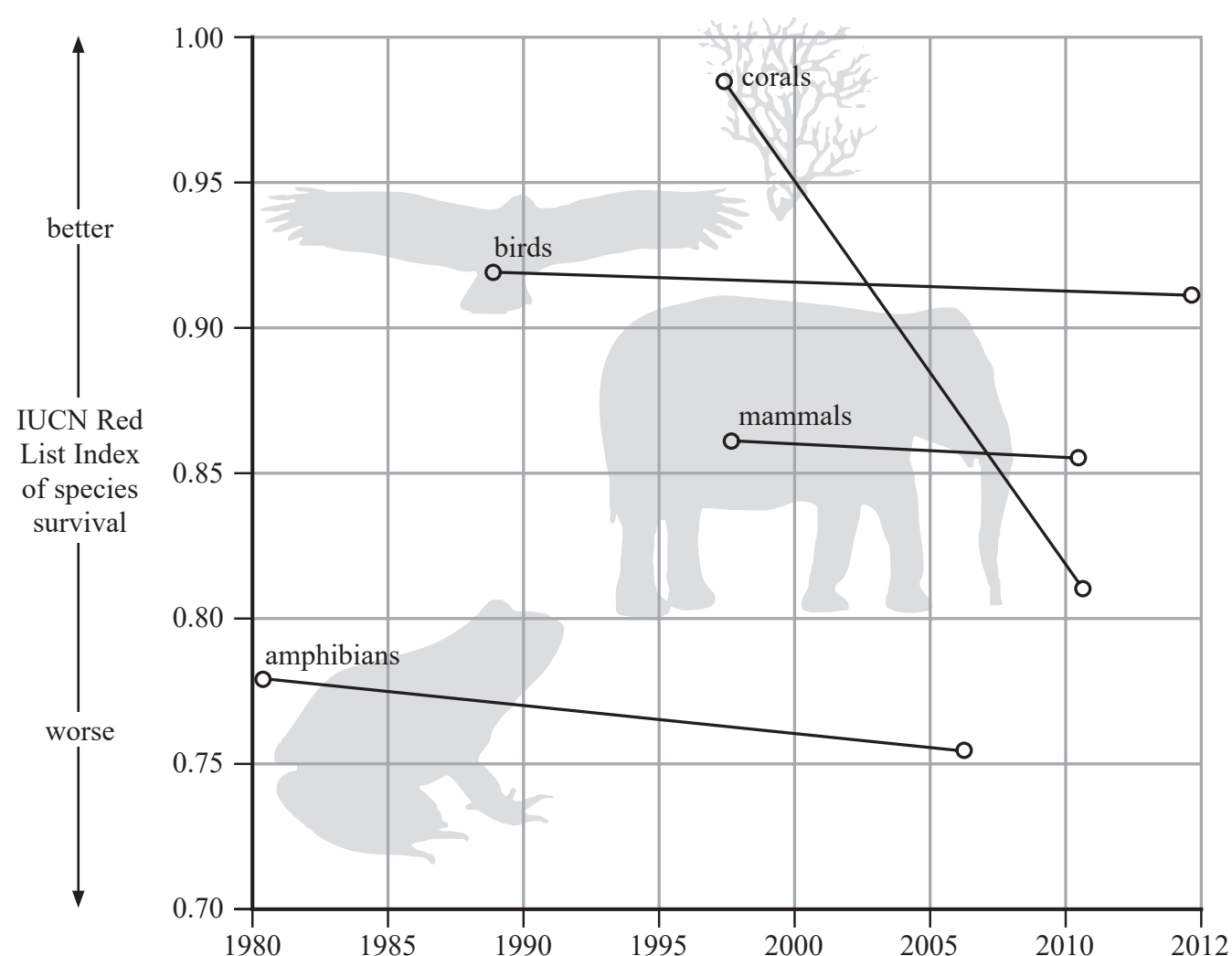
Figure 5: Number of species assessed for the IUCN Red List of Threatened Species™ (2000–2017 (version 2017-3))



By tracking the number of threatened species, the Red List Index (RLI) quantifies overall risk of extinction and how it is changing over time. The RLI is based on IUCN Red List assessments that classify species into one of seven categories (Extinct, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern or Data Deficient). This classification relies on a wide range of criteria including geographical spread, population size and threats. As species can be reassessed over time, the number of species that are threatened with extinction and the severity of that threat can change. Declines in the RLI indicate either that more species are threatened with extinction or some species are increasingly threatened with extinction.

Currently, the RLI is available for four groups only (those in which all species have been assessed at least twice): birds, mammals, amphibians and corals.

Figure 6: RLIs for birds, mammals, amphibians and corals



An RLI value of 1.0 equates to all species within that classification group qualifying as Least Concern (i.e., not expected to become Extinct in the near future). An RLI value of 0 equates to all species having gone Extinct. A constant RLI value over time indicates that the overall extinction risk for the group is constant. If the rate of biodiversity loss were reducing, the RLI would show an upward trend.

Data source F

Table 2 shows different groups of living organisms and the number of threatened species that are listed in each version of the IUCN Red List, produced every two years, since 1998.

Table 2: Number of threatened species by major groups of organisms (1998 – 2017)

			Number of threatened species (Critically Endangered, Endangered, or Vulnerable)											
Group	Number of known species in 2017	Number of species evaluated in 2017	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2017	
Vertebrates	Mammals	5 674	1 096	1 130	1 137	1 101	1 093	1 141	1 131	1 139	1 199	1 194	1 204	
	Birds	11 122	1 107	1 183	1 192	1 213	1 206	1 222	1 240	1 313	1 373	1 460	1 469	
	Reptiles	10 450	253	296	293	304	341	423	594	807	927	1 079	1 215	
	Amphibians	7 728	124	146	157	1 770	1 811	1 905	1 898	1 933	1 957	2 068	2 100	
	Fishes	33 600	734	752	742	800	1 171	1 275	1 851	2 058	2 222	2 359	2 386	
	Subtotal	68 574	46 092	3 314	3 507	3 521	5 188	5 622	5 966	6 714	7 250	7 678	8 160	8 374
Invertebrates	Insects	1 000 000	537	555	557	559	623	626	733	829	993	1 268	1 414	
	Molluscs	85 000	920	938	939	974	975	978	1 288	1 857	1 950	1 984	2 187	
	Crustaceans	47 000	407	408	409	429	459	606	596	596	725	732	732	
	Corals	2 175	864	1	1	1	1	235	235	236	235	237	237	
	Arachnids	102 248	249	11	11	11	11	18	19	20	163	166	170	
	Velvet worms	165	11	6	6	9	9	9	9	9	9	9	9	
	Horseshoe crabs	4	4	0	0	0	0	0	0	0	0	1	1	
	Others	68 658	773	9	9	9	9	24	24	24	65	73	143	
	Subtotal	1 305 250	21 130	1 891	1 928	1 932	1 992	2 102	2 496	2 904	3 570	4 140	4 470	4 893
	Mosses	16 236	102	---	80	80	80	80	82	80	76	76	76	76
Plants	Ferns and Allies	12 000	479	---	---	140	139	139	148	167	194	217	246	
	Gymnosperms	1 052	1 012	141	142	305	306	323	371	374	400	400	401	
	Flowering plants	268 000	22 566	5 186	5 492	7 796	7 865	7 904	8 116	8 764	9 905	10 941	11 773	
	Green algae	6 050	13	---	---	---	---	0	0	0	0	0	0	
	Red algae	7 104	58	---	---	---	---	9	9	9	9	9	9	
	Subtotal	310 442	24 230	5 328	5 611	5 714	8 321	8 390	8 457	8 724	9 390	10 584	11 643	12 505
Fungi and Protists	Lichens	17 000	13	---	---	2	2	2	2	2	4	7	10	
	Mushrooms	31 496	43	---	---	---	1	1	1	1	1	21	33	
	Brown algae	3 784	15	---	---	---	---	6	6	6	6	6	6	
	Subtotal	52 280	71	---	---	2	3	9	9	9	11	34	49	
TOTAL	1 736 546	91 523	10 533	11 046	11 167	15 503	16 117	16 928	18 351	20 219	22 413	24 307	25 821	

Source information (Data was available when referenced in February 2018)

Data source A adapted from:

<https://www.ofcom.org.uk/about-ofcom/latest/features-and-news/uk-now-a-smartphone-society>
<http://webarchive.nationalarchives.gov.uk/20160115211048/http://www.ons.gov.uk/ons/about-ons/business-transparency/freedom-of-information/what-can-i-request/previous-foi-requests/people-and-places/mobile-and-smartphone-usage/mobile-phone-users-by-age-group--gb--2012.xls>

Data source B adapted from:

<https://www.anandtech.com/show/8554/the-iphone-6-review/7>
<http://www.expertreviews.co.uk/mobile-phones/1402071/best-phone-battery-life-2017-the-best-smartphones-tested>

Data source C adapted from:

<https://www.statista.com/statistics/263794/number-of-downloads-from-the-apple-app-store/>

Data source D adapted from:

https://c402277.ssl.cf1.rackcdn.com/publications/964/files/original/lpr_living_planet_report_2016.pdf?1477582118&_ga=1.148678772.2122160181.1464121326

Data source E adapted from:

<http://www.iucnredlist.org/about/summary-statistics>

Data source F adapted from:

http://cmsdocs.s3.amazonaws.com/summarystats/2017-3_Summary_Stats_Page_Documents/2017_3_RL_Stats_Table_1.pdf

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