Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
Level 3 Certificate

Centre Number | | | | | |

Candidate Number | | | | |

Wednesday 13 May 2020

Morning (Time: 1 hour 40 minutes) | Paper Reference **7MC0/01**

Mathematics in Context

Paper 1: Comprehension

You must have: Ruler graduated in centimetres and millimetres, pen, HB pencil, eraser, calculator.
Source booklet.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- **Calculators may be used.**

Information

- The total mark for this paper is 60
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P63297A

1/1/1/1/1/1/

P 6 3 2 9 7 A 0 1 2 0

Pearson

SECTION A

Answer ALL questions. Write your answers in the spaces provided.

SMARTPHONES

Refer to **data source A** in the source booklet for Question 1.

1 (a) Calculate the percentage change in the number of 4G subscriptions from quarter 4 in 2013 to quarter 4 in 2014.
Interpret your answer in context.

(3)

(b) How many mobile subscriptions in total were recorded in 2014?

(2)

The percentage decrease in the number of SMS messages sent in the UK from 2013 to 2014 is approximately 14.7%

Assuming that the number of SMS messages sent in the UK continues to decrease at the same rate, the number of SMS messages sent in the UK can be modelled by

$$S_n = 110 \times 0.853^n$$

where

n is the number of years after 2014
S_n is the number of SMS messages sent in the UK, in billions, in year n

(c) (i) Explain why 110×0.853^n can be used to predict the number of SMS messages sent in the UK, in billions, in future years.

(2)

(ii) Use this model to predict the year in which the number of SMS messages sent in the UK will fall below 25 billion for the first time.

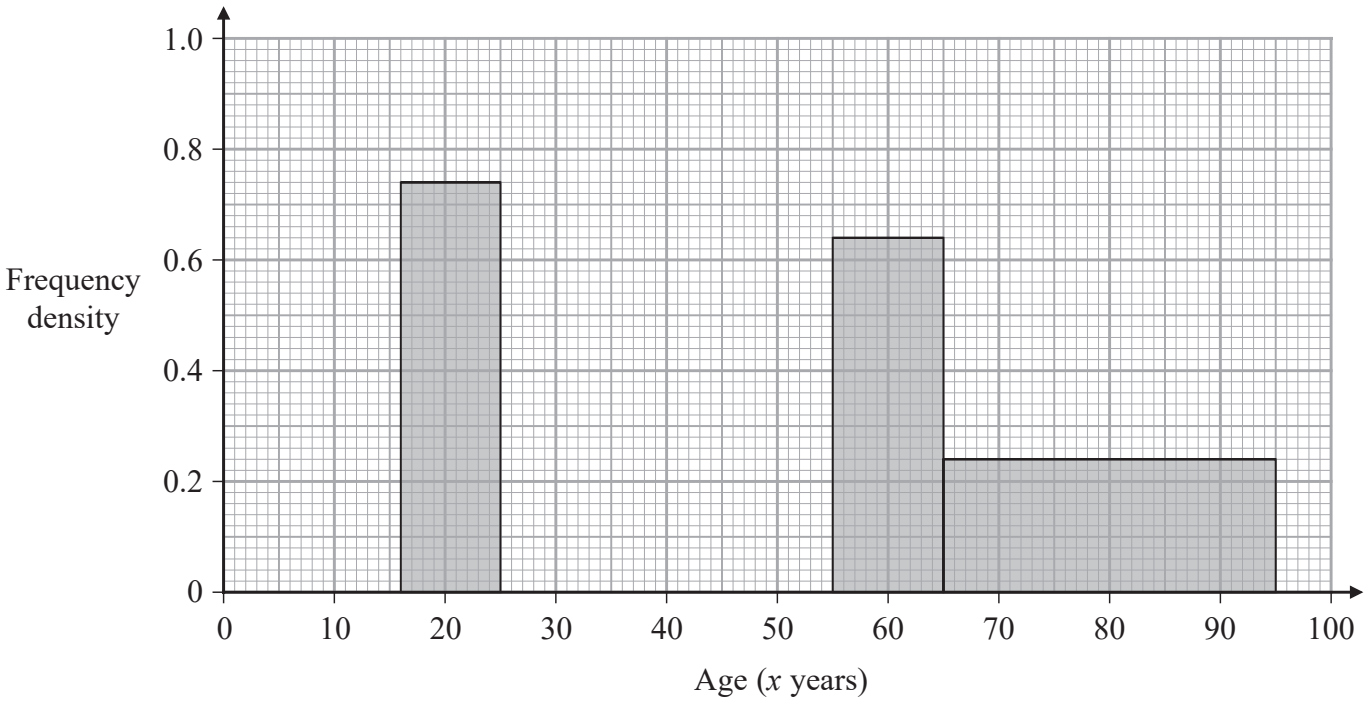
(3)

(Total for Question 1 is 10 marks)

2 The incomplete table and histogram show some information about the ages of the people who had a mobile subscription in 2012.

Age (x years)	Frequency (millions)
$16 \leqslant x < 25$	
$25 \leqslant x < 45$	16.0
$45 \leqslant x < 55$	8.2
$55 \leqslant x < 65$	6.4
$65 \leqslant x < 95$	

Source: *Opinions and Lifestyle Survey, Office of National Statistics*



(a) Explain why a histogram is a suitable diagram to represent this data.

(1)

.....

.....

.....

.....

(b) Complete the table and the histogram.

(4)

(c) Estimate the median age of these people.

(2)

A person, of age between 16 and 95 years old, who had a mobile subscription in 2012 is chosen at random.

(d) What is the probability that this person is between the ages of 16 and 45 years old?

(2)

(Total for Question 2 is 9 marks)

Refer to **data source B** in the source booklet for Question 3.

3 Jasmine is using a spreadsheet to calculate Spearman's rank correlation coefficient for the 2017 smartphone models.

This spreadsheet shows the start of her calculations.

1	A	B	C	D
2	**Model**	**Charging time rank**	**Battery life rank**	d^2
3	Motorola Moto Z Play	1	1	0
4	Microsoft Lumia 650	2	14	
5	Huawei Nova	3	9	
6	Google Pixel XL	4	4	
7	HTC 10	5	13	
8	Motorola Moto X Force	6.5	6	
9	LG Leon	6.5	8	
10	Apple iPhone 7	8	11	
11	LG X Screen	9	12	
12	Samsung Galaxy S7 Edge	10	2	
13	Apple iPhone 6S	11	15	
14	Vodaphone Smart Platinum 7	12	10	
15	Apple iPhone SE	13	3	
16	Samsung Galaxy S6 Edge	14	5	
17	Sony Xperia X Compact	15	7	
18				

(a) Explain why the Motorola Moto X Force and LG Leon models both have the same charging time rank.

(1)

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) Write down a suitable formula for cell D4

(2)

The Spearman's rank correlation coefficient for the 2017 smartphone models is –0.0598 correct to 3 significant figures.

Jasmine thinks that this value means the longer the charging time, the longer the battery life.

(c) Is Jasmine correct?
Give a reason for your answer.

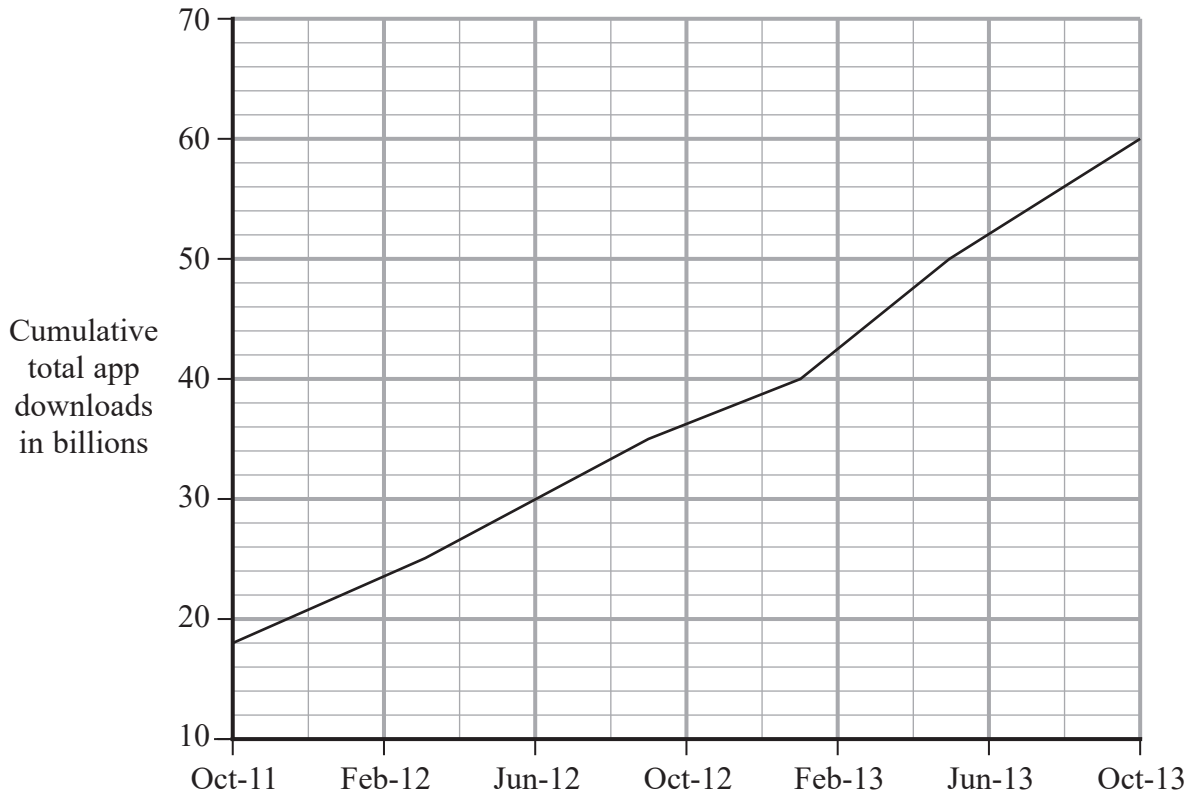
(1)

(Total for Question 3 is 4 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

Refer to **data source C** in the source booklet for Question 4.

4 The diagram below shows an enlarged part of Figure 3.



(a) Use the graph above to find an estimate for the average number of app downloads per month from January 2012 to January 2013.
Make your method clear.

(3)

Kawsar suggests that the total number of app downloads per year, A_n, can be modelled using

$$A_n = 1.49 \times 1.52^{n-2008}$$

where

n is the year
A_n is the number of app downloads, in billions, in year n

(b) (i) Use Kawsar's model to calculate the **total** number of app downloads for the years 2008 to 2017 inclusive.

(3)

Stuart suggests that the total number of app downloads per year, D_n, can be modelled using

$$D_n = 0.03 \times 2.58^{n-2008}$$

where

n is the year
D_n is the number of app downloads, in billions, in year n

Using Stuart's model, the **total** number of app downloads for the years 2008 to 2017 inclusive is 248 billion, correct to the nearest billion.

(ii) Whose model provides a more accurate representation of the actual total number of app downloads for the years 2008 to 2017 inclusive?
Give a reason for your answer.

(1)

.....

.....

.....

.....

.....

.....

(Total for Question 4 is 7 marks)
(Total for SMARTPHONES is 30 marks)

TOTAL FOR SECTION A IS 30 MARKS

SECTION B

Answer ALL questions. Write your answers in the spaces provided.

LIVING PLANET

Refer to **data source D** in the source booklet for Question 5.

5 (a) 1971 was described as

'*an ecological overshoot situation*'

How does Figure 4 show that an ecological overshoot took place in 1971?

(1)

Linear models for the historical trends of the Ecological Footprint and the Earth's biocapacity can be written as

$$E = 0.2x + 7.1$$
$$b = 0.05x + 9.4$$

where

x is the number of years after 1961
E is the Ecological Footprint in billions of gha
b is the Earth's biocapacity in billions of gha

(b) Use the models to calculate the year in which the Ecological Footprint will be twice the Earth's biocapacity.

(4)

(Total for Question 5 is 5 marks)

Refer to **data source E** in the source booklet for Question 6.

6 Not all species in some groups have been evaluated. Therefore, a sample of the species within a group has been taken and evaluated.

(a) (i) Write down **one** advantage of taking a sample.

(1)

(ii) Write down **one** disadvantage of taking a sample.

(1)

Joan suggests that the number of species assessed in 2017 for the IUCN Red List provides a more accurate representation of the number of species threatened than the IUCN Red List produced in 2000.

(b) Does Figure 5 in the source booklet support Joan's suggestion?
You must explain your answer.

(1)

(c) Which of birds, mammals, amphibians, or corals is showing the greatest risk of extinction?
Use Figure 6 to explain your answer.

(2)

(Total for Question 6 is 5 marks)

Refer to **data source F** in the source booklet for Questions 7 and 8.

7 The table below shows the changes in the number of threatened species, every two years between 1998 and 2016, for the five groups of vertebrates.

	Year								
Vertebrate group	**2000**	**2002**	**2004**	**2006**	**2008**	**2010**	**2012**	**2014**	**2016**
Mammals	34	7	.....	–8	48	–10	8	60	–5
Birds	76	9	21	–7	16	18	73	60	87
Reptiles	43	–3	11	37	82	171	213	120	152
Amphibians	22	11	1613	41	94	–7	35	24	111
Fishes	18	–10	58	371	104	576	207	164	137

(a) Complete the table by finding the missing value.

(1)

.....

.....

.....

(b) Explain, in context, what the value you found in part (a) represents.

(1)

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

The table below shows the mean and standard deviation for the changes in the number of threatened species, every two years between 1998 and 2016, for the five groups of vertebrates.

Vertebrate group	Mean (correct to 1 decimal place)	Standard deviation (correct to 2 decimal places)
Mammals	10.9	29.04
Birds	39.2	32.63
Reptiles	91.8	71.78
Amphibians	216.0	495.22
Fishes	180.6	.....

Given that

$$\sum x = 1625 \qquad \sum x^2 = 572\,535$$

where x is the change in the number of threatened species for the Fishes group,

(c) calculate the standard deviation for the Fishes group.

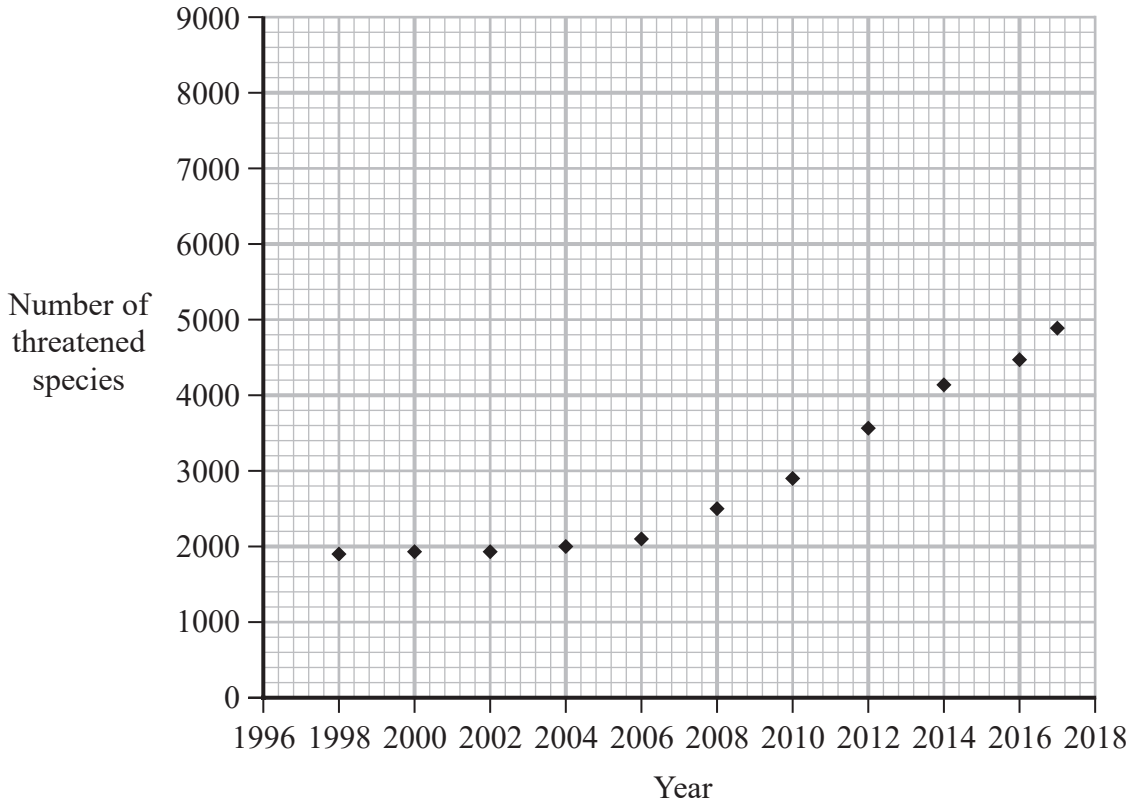
(2)

(d) Explain why the mean does not provide an appropriate value for the average of the changes in the number of threatened species for the Amphibians group.

(1)

(Total for Question 7 is 5 marks)

8 The diagram below shows the number of threatened species recorded for the **invertebrates** group.



(a) Explain why **year** is the explanatory (independent) variable.

(1)

.....

.....

.....

The table below shows some of the data for **vertebrates** from Table 2 (correct to 2 significant figures).

Year	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2017
Number of threatened species	3300	3500	3500	5200	5600	6000	6700	7300	7700	8200	8400

(b) Plot the data for vertebrates on the grid above.

(2)

The equation of the regression line of y on x for vertebrates is in the form $y = a + bx$ where x is the year and y is the number of threatened species.

Given that, for vertebrates,

$S_{xy} = 121\,945.45$

$S_{xx} = 420.91$

$S_{yy} = 36\,227\,272.73$

$\Sigma x = 22\,087$

$\Sigma y = 65\,400$

(c) show that, correct to 3 significant figures,

$a = -576\,000$
$b = 290$

(4)

The equation of the regression line of y on x for vertebrates is $y = 290x - 576\,000$

(d) Use the equation of the regression line of y on x for vertebrates to predict the number of vertebrate species that are expected to be identified as threatened in the year 2025.

(2)

(e) In which year will $\frac{1}{3}$ of the total number of known vertebrate species in 2017 be expected to be identified as threatened?
Comment on the reliability of your answer.

(4)

The equation of the regression line of y on x for vertebrates is $y = 290x - 576\,000$
The equation of the regression line of y on x for invertebrates is $y = 165x - 329\,000$

(f) Compare and interpret, in context, the gradients of the regression lines.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 8 is 15 marks)
(Total for LIVING PLANET is 30 marks)

TOTAL FOR SECTION B IS 30 MARKS
TOTAL FOR PAPER IS 60 MARKS

BLANK PAGE

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

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

Do not return this source booklet with the question paper.

Turn over ▶

P63297A

1/1/1/1/1/1/

P 6 3 2 9 7 A 0 1 1 2

Pearson

Formulae sheet

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

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

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

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

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

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

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

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

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

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

The product moment correlation coefficient is

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

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

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

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

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

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.

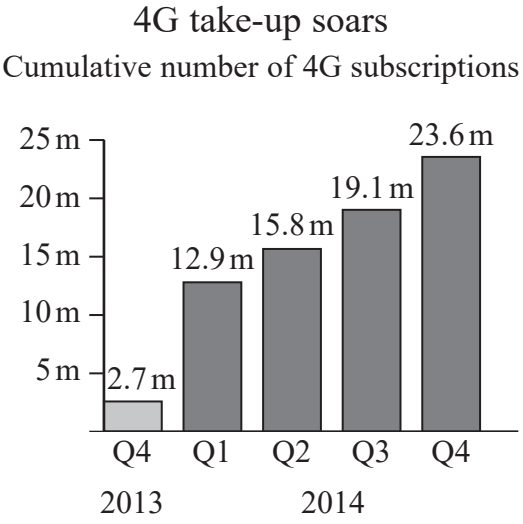
2014 statistics show that

- 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
Vodaphone 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

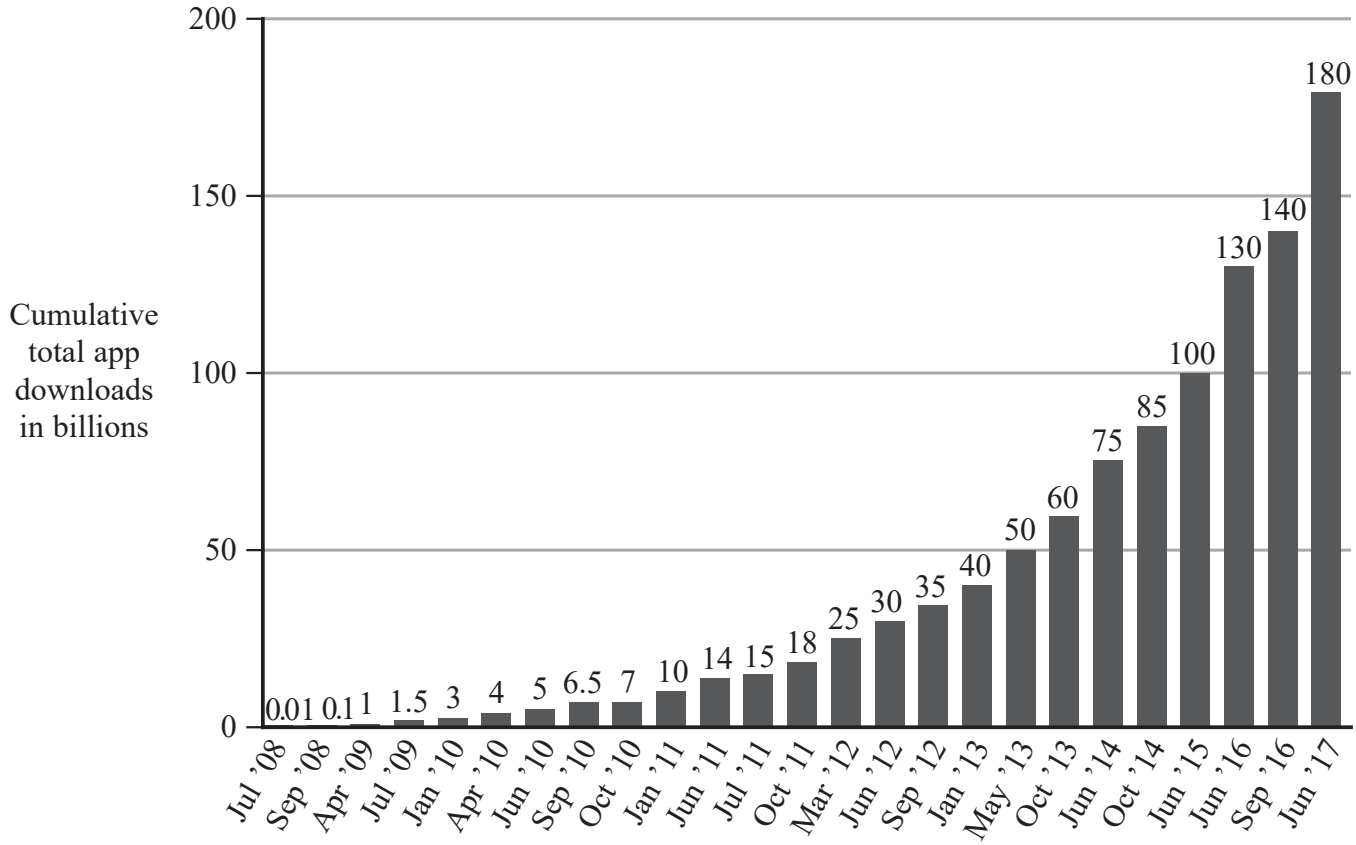
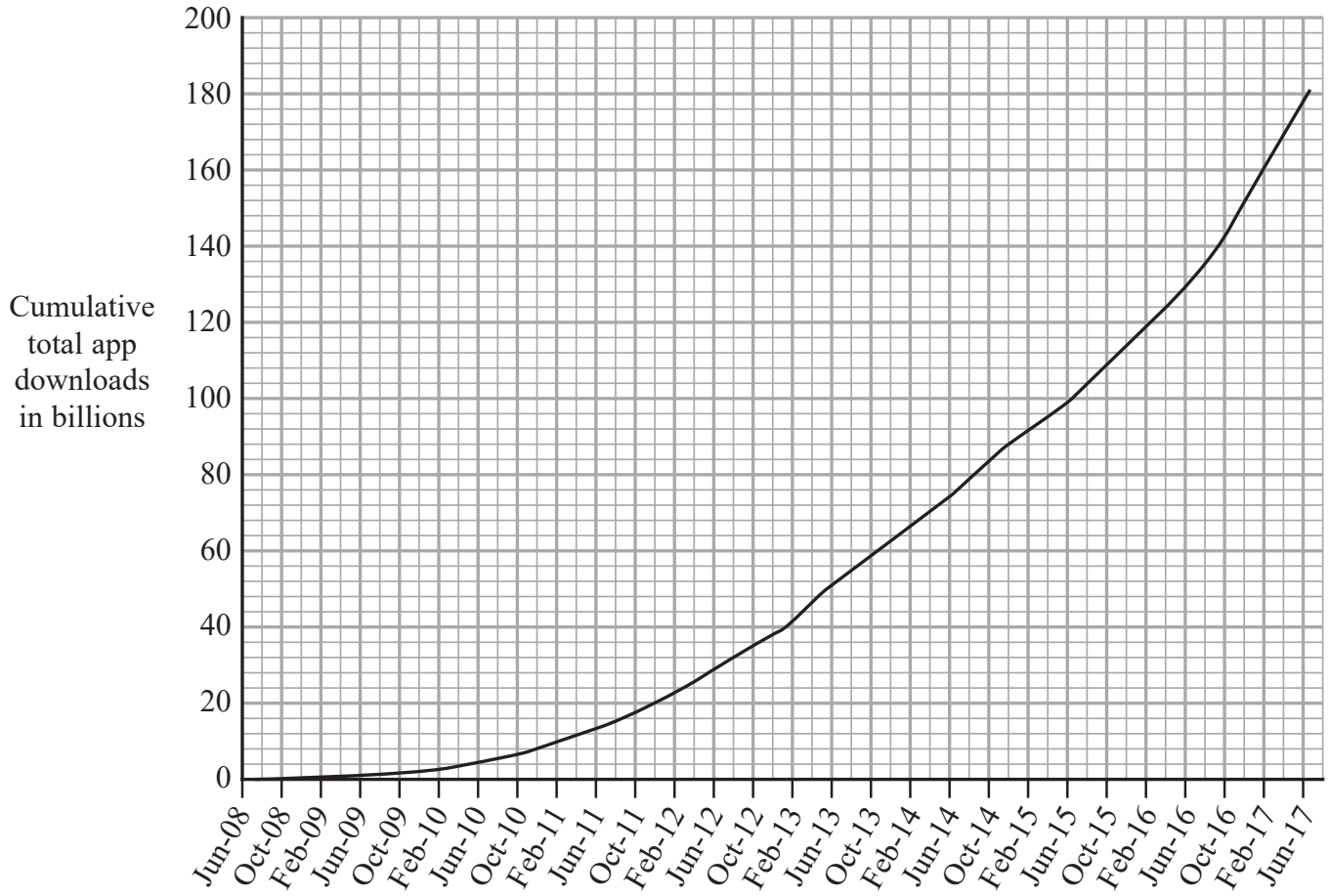


Figure 3: Curve fitted to Figure 2 showing cumulative total app downloads from Apple's App Store from the end of July 2008 to the end of June 2017



SECTION B: LIVING PLANET

Data source D

STATE OF THE NATURAL PLANET

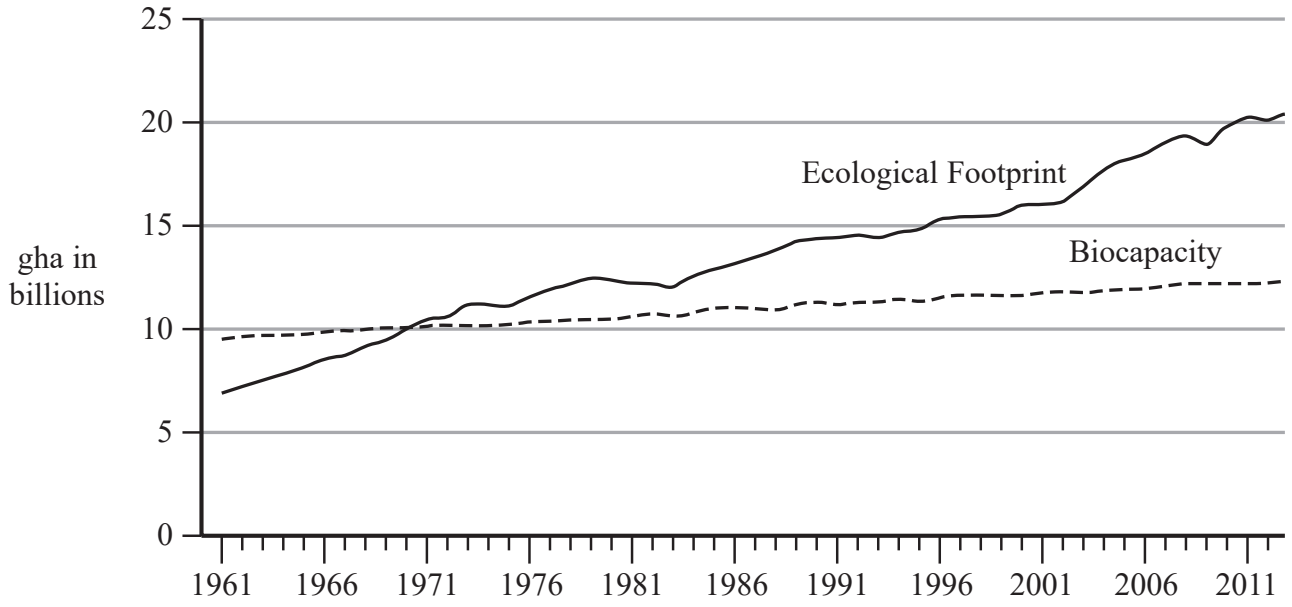
Increased human pressure threatens the natural resources that humanity depends on, increasing the risk of water and food insecurity and competition over natural resources. One way to track human demand for renewable resources and ecological services is to use footprint indicators. The general intent 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

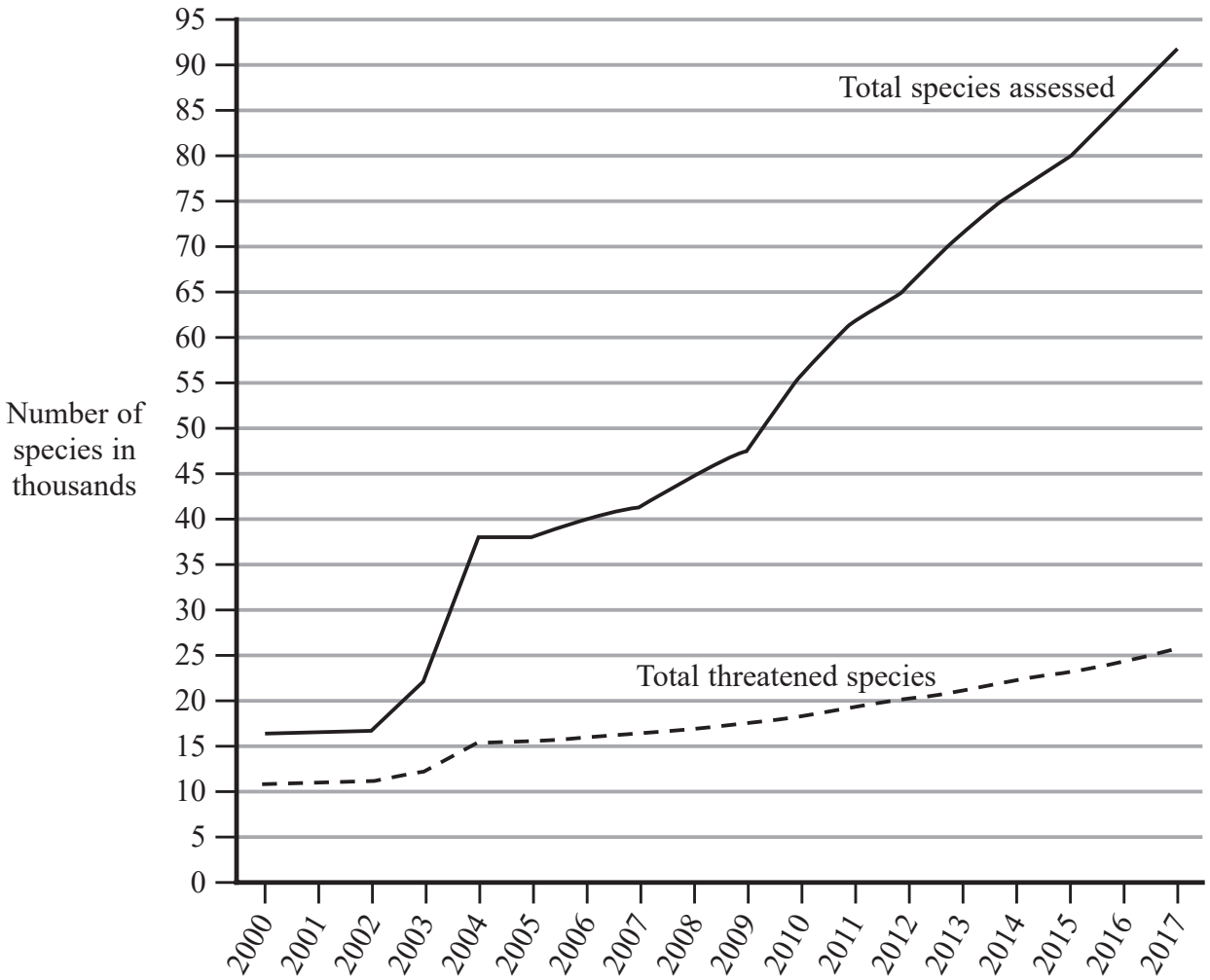
The International Union for the Conservation of Nature (IUCN) has been assessing the conservation status of living things on a global scale for the past 50 years in order to highlight populations of species threatened with extinction, and thereby promote their conservation. Plants and animals identified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

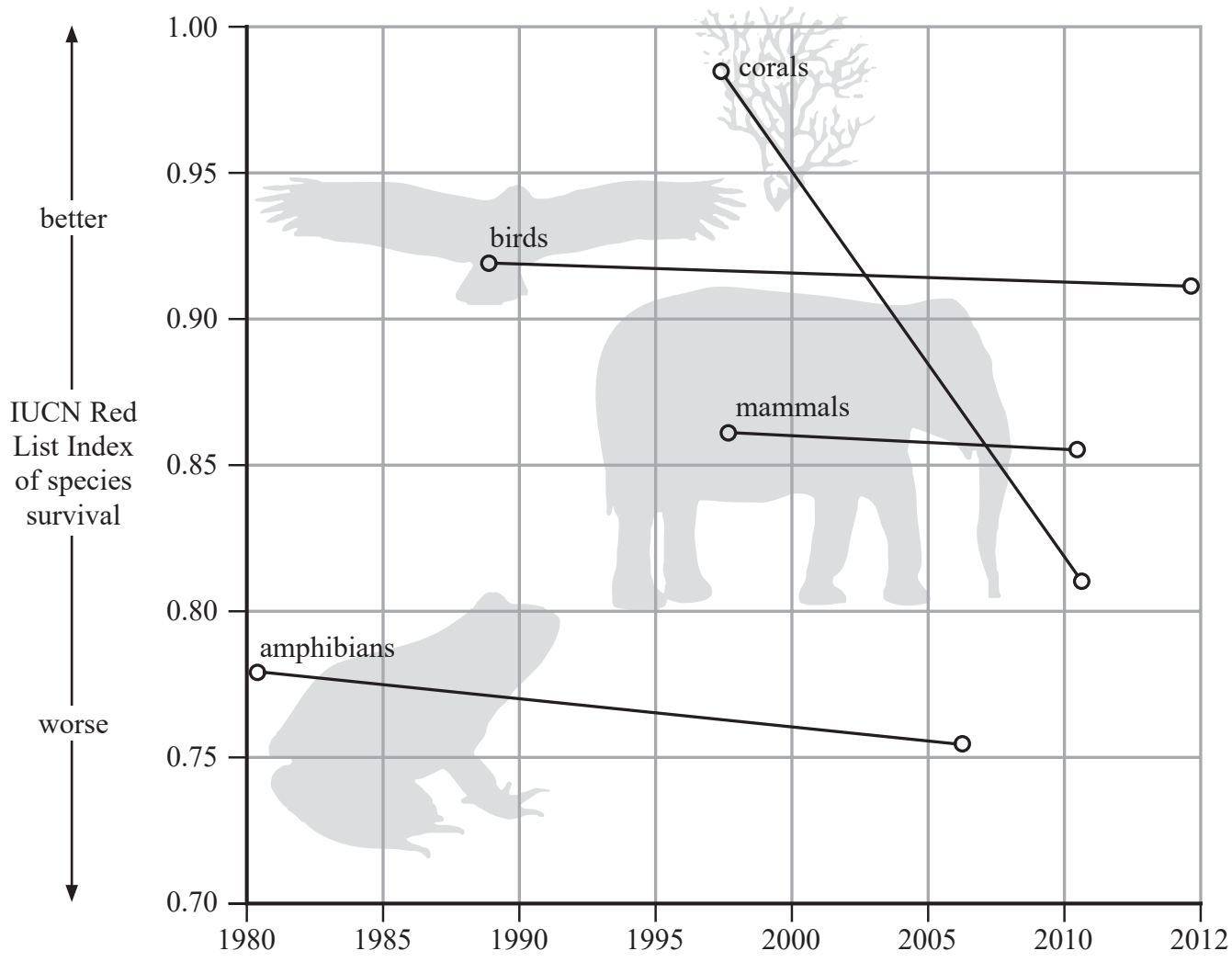
Figure 5: Number of species assessed for the IUCN Red List of Threatened Species™ (2000–2017 (version 2017-3))



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)

	Group	Number of known species in 2017	Number of species evaluated in 2017	Number of threatened species (Critically Endangered, Endangered, or Vulnerable)										
				1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2017
Vertebrates	Mammals	5 674	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	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	6 278	253	296	293	304	341	423	594	807	927	1 079	1 215
	Amphibians	7 728	6 609	124	146	157	1 770	1 811	1 905	1 898	1 933	1 957	2 068	2 100
	Fishes	33 600	16 409	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	7 639	537	555	557	559	623	626	733	829	993	1 268	1 414
	Molluscs	85 000	8 413	920	938	939	974	975	978	1 288	1 857	1 950	1 984	2 187
	Crustaceans	47 000	3 177	407	408	409	429	459	606	596	596	725	732	732
	Corals	2 175	864	1	1	1	1	1	235	235	236	235	237	237
	Arachnids	102 248	249	11	11	11	11	11	18	19	20	163	166	170
	Velvet worms	165	11	6	6	6	9	9	9	9	9	9	9	9
	Horseshoe crabs	4	4	0	0	0	0	0	0	0	0	0	1	1
	Others	68 658	773	9	9	9	9	24	24	24	23	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**
Plants	Mosses	16 236	102	---	80	80	80	80	82	80	76	76	76	76
	Ferns and Allies	12 000	479	---	---	---	140	139	139	148	167	194	217	246
	Gymnosperms	1 052	1 012	142	141	142	305	306	323	371	374	400	400	401
	Flowering plants	268 000	22 566	5 186	5 390	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