



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2016

LIFE SCIENCES: PAPER II

Time: 2 hours

100 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 14 pages. Please check that your question paper is complete.
 2. All questions must be answered in the Answer Book provided.
 3. This Paper comprises 2 sections. Section A consists of Question 1 and Question 2, which are case studies. Section B consists of Question 3, which is an essay.
 4. Read the questions carefully.
 5. Read the sources provided for the case studies and use the information and your own knowledge to answer Questions 1 and 2.
 6. Source material is also provided for the essay. Use this information and your own knowledge to first plan and then write your response.
 7. Number the answers exactly as the questions are numbered.
 8. Use the total number of marks that can be awarded for each part of the questions in Questions 1 and 2 as an indication of the detail required.
 9. It is in your own interest to write legibly and to present your work neatly.
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SECTION A

QUESTION 1

Read the information on the establishment of a game reserve in KwaZulu-Natal and then answer the questions that follow.

Colchester Zoo is an innovative and world-renowned zoo in England. It focuses on conservation of endangered species and captive breeding programmes. In 2005 it decided to set up its own conservation project and chose South Africa to create a private nature reserve.

Creating the UmPhafa Private Nature Reserve

An area of farmland three hours north of Durban was deemed a suitable location to set up the UmPhafa Private Nature Reserve. This 5,000 hectare area comprised of three farms previously farmed for cattle, with a wide range of habitats from acacia, savannah and bushveld to mountainous terrain. The reserve is situated along the banks of the Tugela River. Owing to previous agricultural practices, many of the natural inhabiting species had been lost and much of the land had been eroded because of overgrazing.

Historically this part of KwaZulu-Natal has been an important agricultural area. There are many farms that are under cultivation with crops such as maize and soya. Many types of livestock are farmed here, e.g. chickens, pigs, beef and dairy farms, which flourish in this part of South Africa.

The aim of Colchester Zoo management was to rehabilitate UmPhafa and re-establish the region's previous natural habitat. UmPhafa is a private nature reserve and is not open to tourists. It serves mainly as a conservation and research facility.

Releasing Impala onto UmPhafa Private Nature Reserve



[Source: <<http://www.wildlifeextra.com>>]

Fencing and animal release

The first step in the management of the reserve was to remove all of the old cattle fencing and equipment and then to start the immense task of fencing the entire reserve. Once the fence around the farm was electrified, an animal release programme started. Many of the released species are increasing naturally, but in order to ensure adequate habitat management, the numbers of grazers will need to be increased. By introducing more individuals, it will prevent over-domination of certain grass species and promote floral diversity. These released species will also eventually serve as a prey base for larger predators.

Mammal species

Some mammal populations remained on UmPhafa and have thrived since the reserve was established. However, since 2006, many more species have been reintroduced. The reserve is now home to a wide range of fauna, including White Rhino and giraffe. Many buck species have also been brought in, such as kudu, Impala, reedbuck, zebra, Blesbok, Red Hartebeest, blue wildebeest, waterbuck, and nyala. Warthog, aardvark and porcupine have also been brought in. Small- to medium-sized carnivores, such as Black-backed Jackal, caracal, serval, genet, and several species of mongoose are also common and recently the staff have been noticing more and more signs of leopard.

Breeding success

Since release, numerous species have bred on the reserve, including all of the antelope species. In addition, nine giraffe and two white rhino calves have been born. Eventually these species will reach carrying capacity on the farm. Signs of leopard are increasing, due to an increase in prey items, but the eventual aim is to release other carnivorous species, such as cheetah, onto the reserve to ensure prey populations are managed sustainably.

Nine giraffe have been born on the reserve since they were reintroduced



[Source: <<http://www.wildlifeextra.com>>]

Goals of UmPhafa

To date, all funding for UmPhafa has been provided by Colchester Zoo and donations from its visitors. The goal, however, is that UmPhafa becomes self-sufficient.

Another priority for UmPhafa is to work with the local community. At present, thirteen members of the local community are employed in positions ranging from game guards to fencing staff. All staff are valued and their skills enhanced. To date, the game guards have been put on game ranger and wildlife management courses to increase their knowledge.

Coupled with employment, UmPhafa staff has also been working with local schools. An education programme has commenced at schools to incorporate wildlife species into their curriculum. Fundraising has also taken place for these schools, with computers purchased for one school and a new kitchen erected at the other; purchased with funds generated by two schools in England. The eventual aim is to raise sufficient funds to construct classroom facilities on UmPhafa so that the children can visit the reserve for environmental lessons. Coupled with the educational programme and recent meetings concerning a recycling centre for the local community on site, UmPhafa is well on its way to becoming a creditable local conservation project.

[Adapted from: <<http://www.wildlifeextra.com>>]

1.1 Give the correct biological terms for the following:

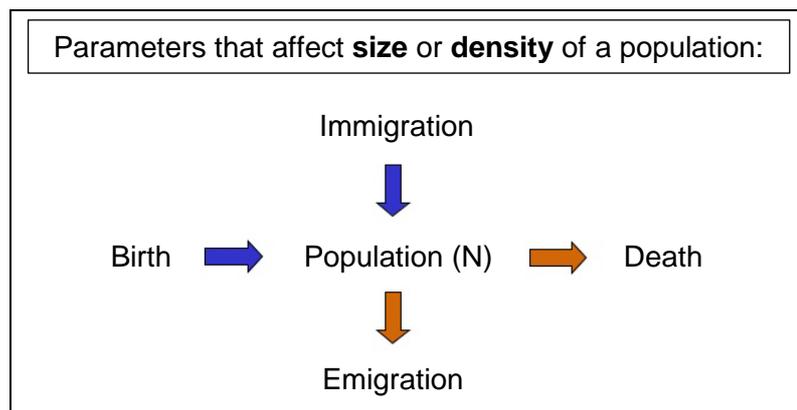
1.1.1 competition between the jackal and the caracal for rodents. (1)

1.1.2 rhino and giraffe feeding on different vegetation in the same area. (1)

1.1.3 natural regrowth of vegetation on overgrazed land. (1)

1.2 1.2.1 Can the UmPhafa Private Nature Reserve be regarded as an open or a closed ecosystem? Explain your answer. (2)

1.2.2 Study the diagram below of the population parameters.



(a) Which population parameter is represented by the release of impala into the reserve? (1)

(b) Draw a simple sketch of a graph that will show the shape of the growth curve of the Impala population from introduction until equilibrium is reached. Provide your graph with a suitable heading. (3)

1.3 To ensure adequate habitat management, the population size of all plants and animals will need to be monitored. The giraffe have already had nine calves born in the few years after they were introduced into the reserve.

1.3.1 What would the rangers observe when the giraffe population exceeds the carrying capacity of the reserve? (2)

1.3.2 Describe ONE option available to the managers of the reserve to return the giraffe numbers back to carrying capacity if it is exceeded. (2)

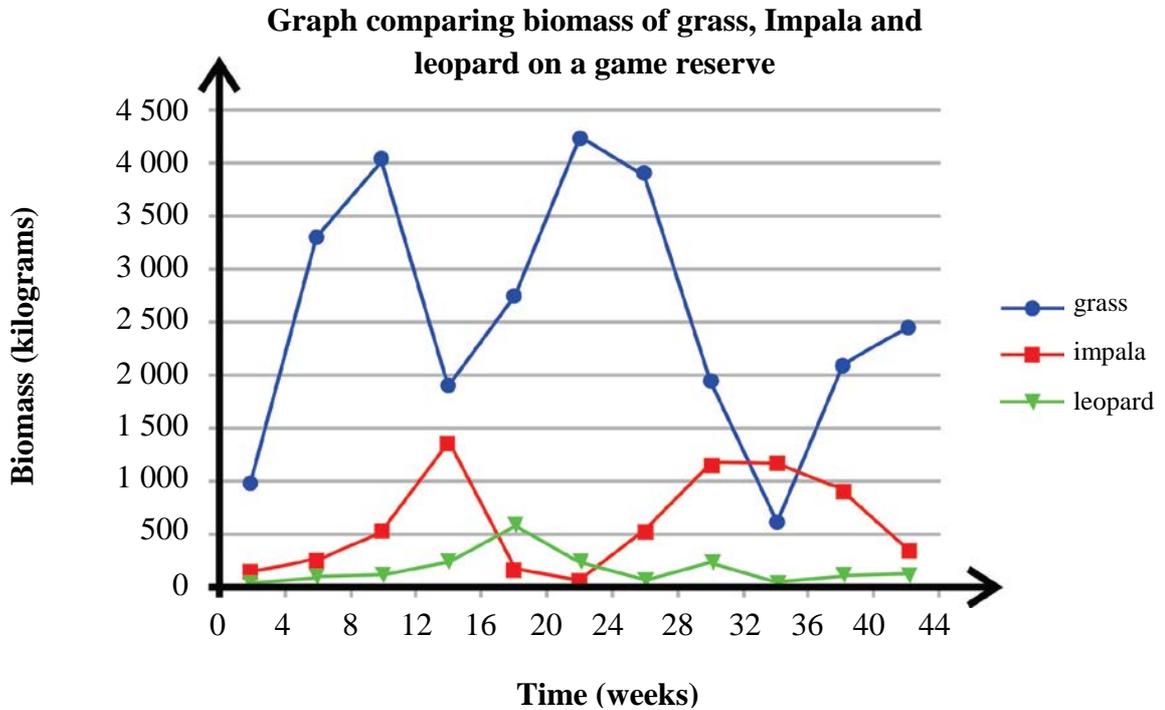
1.3.3 Suggest how the game rangers would count the giraffe in the reserve and explain why the method you have chosen is a suitable method. (2)

1.4 Explain ONE way in which the predators on the UmPhafa game reserve could avoid competing for the same food resource. (2)

1.5 Many believe South Africa does not need more game reserves and would argue that UmPhafa should not have been established. Do you agree with this opinion?

Use your own knowledge and information from the text to substantiate your opinion. (4)

1.6 The graph below shows a possible relationship between the biomass of the leopard, the Impala and the grass in a game reserve such as UmPhafa.



1.6.1 What type of relationship exists between the leopard and the Impala? (1)

1.6.2 (a) Give a reason and explain why it is useful to include the biomass of the grass on the graph. (2)

(b) Explain a possible reason from the graph for the drop in the biomass of grass from week 10 to week 14. (2)

1.6.3 Suggest why the units of the y-axis are recorded as the **biomass** of the organisms and not as the **numbers** of the individual organisms. (2)

1.6.4 The average mass of a fully grown leopard is about 45 kilograms. Using information from the graph, calculate the largest number of leopard that existed in one week on the game reserve. Show all working. (2)

[30]

QUESTION 2

Read the information below on bee colonies and the importance of bees and answer the questions that follow.

Albert Einstein is erroneously quoted as saying, "If the bee disappeared off the surface of the globe, then man would only have four years of life left." Although nobody knows who said it first, it does indicate the importance of the black-and-yellow insects.

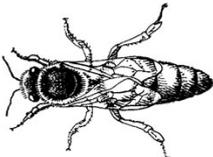
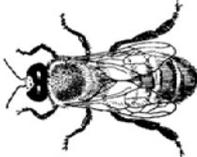
[Adapted: <<http://mg.co.za>>]

A: SOCIAL ORGANISATION OF BEES

Honeybees live in complex societies. The following are characteristics of honeybee colonies:

- Several castes and ages of bees are present in a beehive at the same time.
- Cooperation by some members of the society in caring for offspring that are not their own.
- Division of labour with only queens that reproduce.

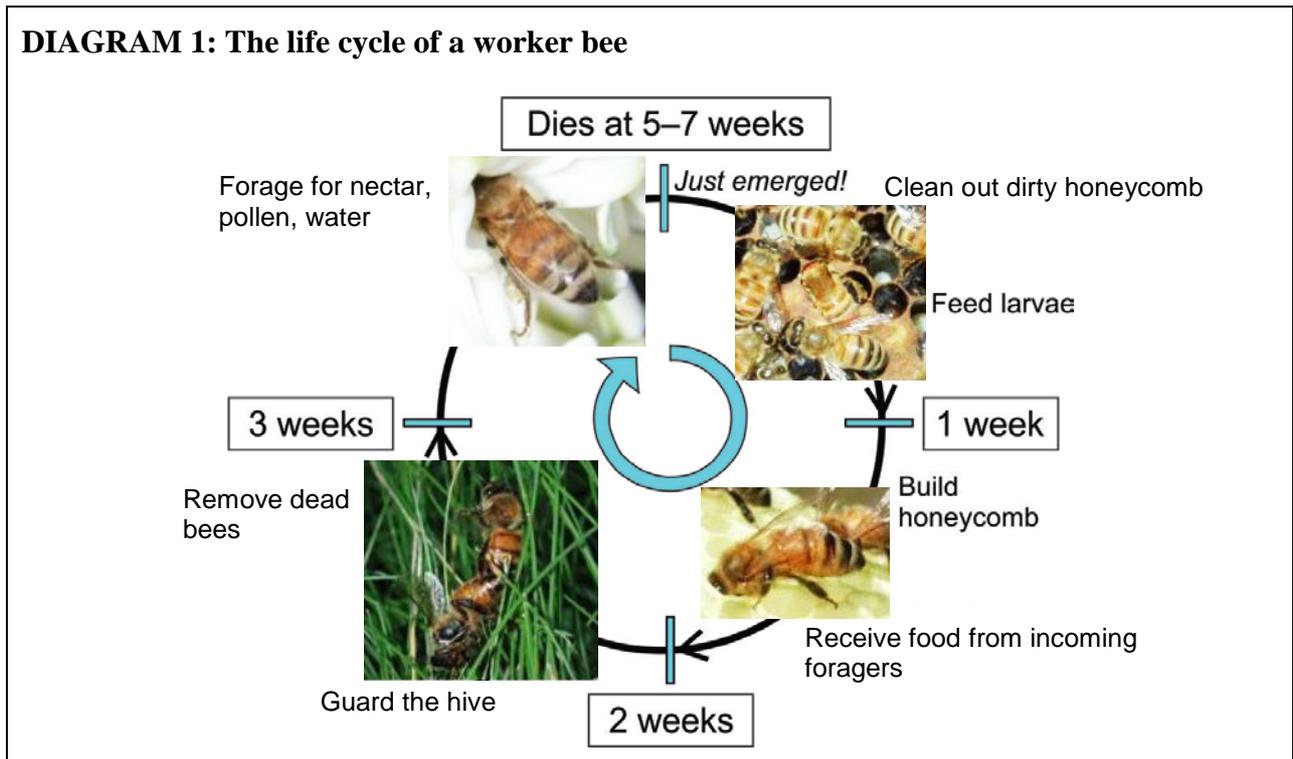
The different castes of bees within a colony

Type of adult bee	What they do	How many in a honeybee colony	What they look like
Queen (female)	Lays eggs.	1	
Worker (female)	Builds and cleans the nest; looks after the larvae; *forages for food.	10 000 to 50 000	
Drone (male)	Hang around the hive and eat. Then they leave the nest to mate and die.	100 to 500	

**forage = look for/gather food*

The role of honeybee workers in the colony

The life of a worker bee is short, but complicated. Worker bees have their own division of labour. The diagram on the next page shows the jobs that an individual honeybee worker might do over the course of her lifetime.



[Adapted from: <<http://www.tandfonline.com>>]

Defence of the nest

African honeybee colonies can be extremely defensive. The workers aggressively patrol and defend their territories well beyond the nest entrance. They have a signalling behaviour to warn off bees from other colonies. If successful, fighting is avoided. One of the most dramatic signalling behaviours employed by the bees to maintain their territory is "head butting".

When there is a shortage of nectar-producing flowers, bees often try to steal nectar from other hives. The bees being robbed also defend their food stores. When robbing is going on, one can see bees fighting with each other at the hive entrance. The ground in front of the hive may be littered with dead honeybees.

Since butting is an easily recognized sign of highly defensive honeybee colonies, anyone observing bees engaged in "butting" should recognise the behaviour as a warning that they have entered the territory of a highly defensive colony and quickly retreat to avoid further harm.

B: THE IMPORTANCE OF BEES IN SOUTH AFRICA

1. Pollination

Throughout South Africa hundreds-of-thousands of hives are needed to pollinate food plants as diverse as avocados and berries, to citrus fruits, pumpkins, marrows and even nuts. Bees are estimated to contribute to 95% of all crops that require pollination.

2. Food security

"Without bees the world would be a vastly different place," says senior researcher, Mike Allsopp, at the South African Agricultural Research Council (SAARC). "Our crops would be drastically reduced and the availability and cost of food would be greatly affected. Remember that meat and dairy industries rely on animals being able to feed on these crops as well."

As human populations grow, so too does the need for more food. In South Africa, where a recent study by the SAARC showed that 45,6% of the population are food insecure, the need for sustainable food crops is ever more apparent. Allsopp says that bees are more important than any other domesticated animal because they are essential to South Africa's food security.

3. Revenue

The honeybee industry is estimated to be worth R20-billion in South Africa. While the primary role of honeybees is for commercial pollination, there are also numerous other byproducts that humans make use of:

- Honey – South Africa consumes about 3 000 tonnes of honey a year, half of which needs to be imported.
- Propolis – a resin produced by bees to protect their hives, is also used for medicinal purposes and for waxing musical instruments.
- Beeswax is used in candles.

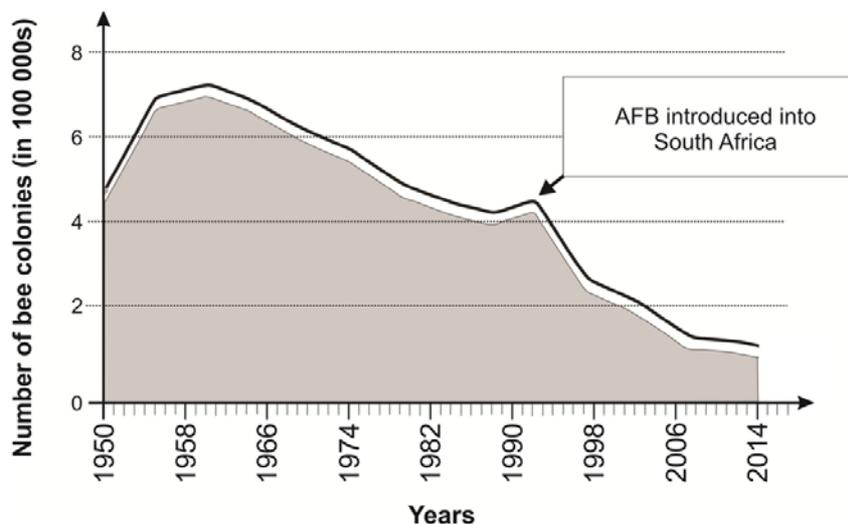
C: THREATS TO SOUTH AFRICAN BEES

Bees have in recent years come under massive threat and face serious factors that are negatively affecting their health, productivity and populations. Collectively these can cause, what has commonly become known as, Colony Collapse Disorder (CCD).

1. Disease

American Foulbrood (AFB) disease is a highly contagious bacterial disease, for which there is no known cure. It destroys entire colonies by infecting and killing the bees' embryos and then spreading millions of spores that infect any nearby colonies. A recent outbreak has killed off 40% of the bees in the Western Cape this year. The spores can survive for half a century.

Number of honeybee colonies in South Africa from 1950 to 2014



[Adapted from: <<http://www.enca.com>>]

2. Access to food

The biggest threat to local bees and their keepers lies in the bees' access to food. The expansion of urban areas into viable forage land is greatly affecting access to food and availability of nesting sites for bee colonies.

- 2.1 2.1.1 Give ONE reason why bees are classified as social animals. (1)
- 2.1.2 What do you understand by Allsopp's comment that bees are more important than any other domesticated animal? (2)

2.2 Match the term from the text with the correct description in the first column in the table below.

Write only the numbers 2.2.1 to 2.2.4 in your Answer Book and the correct term next to each number.

	Descriptions	Terms from text
2.2.1	Male bees whose sole purpose is to mate.	Propolis
2.2.2	A resin produced by bees to protect their hives.	CCD
2.2.3	Transferring pollen from the anther of a flower to the stigma.	Queen
2.2.4	All the factors that cause distress to the bees' health and immune systems.	Drones
		Pollination

(4)

- 2.3 Study the graph on page 8 of the effects of American Foulbrood (AFB) on beehives.
 - 2.3.1 Describe clearly the trend shown by the graph before the introduction of AFB into South Africa. Mention important relevant dates. (2)
 - 2.3.2 Between which years was the decrease in honeybee colonies the greatest? (1)
 - 2.3.3 If nothing is done to protect bees in South Africa, predict when they will die out. (1)
 - 2.3.4 Can the effect of AFB on local beehives be described as a density-dependent or density-independent factor? Explain your answer. (2)
- 2.4 2.4.1 Draw a table of the data provided in Diagram 1 on page 7 to best summarise the information on the life cycle of worker bees. Provide your table with a suitable heading. (5)
- 2.4.2 Discuss how and why bees protect their colonies. (4)
- 2.5 Which threat to bees do you think is the most serious to South Africa? Justify your answer with information from the text. (3)
- 2.6 South Africa's large endangered mammals such as the rhino and the elephant receive much publicity and support from interested parties. However, the plight of the honeybee is rarely brought to the attention of the public.
 - 2.6.1 Suggest why this is so. (1)
 - 2.6.2 Evaluate the importance of saving these endangered mammals compared to conserving the honeybee in South Africa. (4)

[30]

60 marks

SECTION B

QUESTION 3

More than two planets needed by 2030 – World Wildlife Foundation (WWF) *Living Planet Report* finds

An ever-growing demand for resources by a growing population is putting tremendous pressure on our planet's biodiversity and is threatening South Africa's future security, health and wellbeing. That's according to the WWF Living Planet Report – the leading survey of the Earth's health.

[Source: <www.wwf.org.za>]

South Africa should implement policies to limit the birth rate of its population.

Using the source material provided as well as your own knowledge, discuss your opinion on the above statement in the form of a 2½–3 page essay.

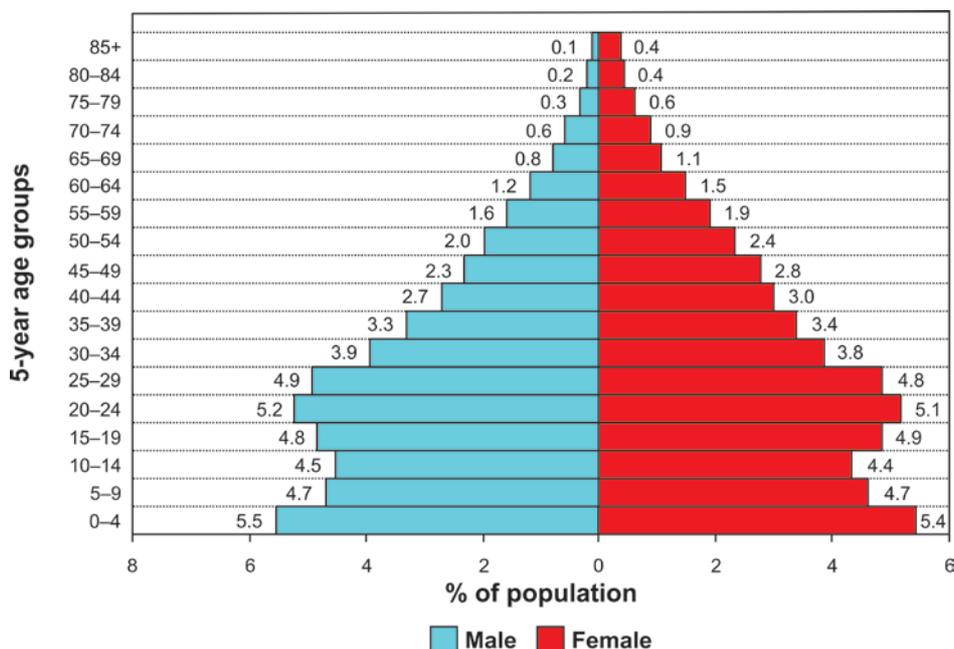
40 marks

To answer this question you are expected to:

- Read the source material carefully and present a debated argument to illustrate your point of view.
- Select relevant information from sources A to H below.
- It is important to integrate your own relevant biological knowledge.
- Take a definite stand on the question and arrange the information to best develop your argument.
- Write in a way that is scientifically appropriate and communicates your point of view clearly.
- **Provide** a clear **plan** of your essay before you start writing. Note that the plan will be marked as part of the assessment of this question.

SOURCE A Population Statistics 2015

Percentage distribution of the total population of South Africa by age group and sex



[Adapted from: <www.statssa.gov.za>]

SOURCE B World Population Prospects – Global Demographic Estimates and Projections by the United Nations

The last national census of the South African population was carried out in 2011.

South Africa Population History

At the 2001 Census, the final declared total for resident citizens in South Africa was 44,896,856. In terms of population density that equated to 37 people living in every square kilometre of land and the country's sparseness was highlighted by the fact that it was only the 169th biggest in the world for density alone.

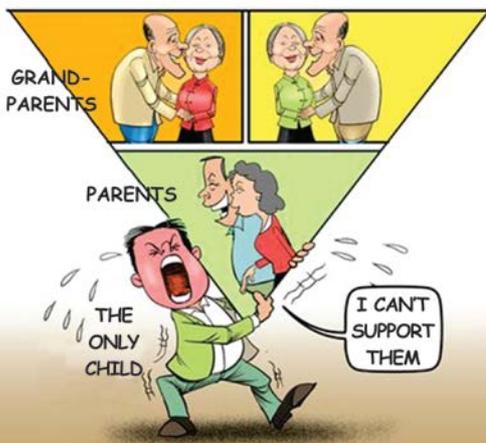
The findings in 2011 suggest that there had been a significant rise in numbers over the course of the previous ten years and that the South African population had finally hit the 50 million mark, making it the 24th largest country in the world.

Table showing population statistics from 1955 to 2015

Year	Population	Density (per sq. km)	Growth rate
2015	54,490,405	44	0,8925%
2005	48,352,950	39	1,386%
1995	41,426,810	34	1,8734%
1985	32,983,013	27	2,25%
1975	25,698,856	21	2,5179%
1965	19,813,947	16	2,5477%
1955	15,384,556	12	2,4099%

[Adapted from: <<http://worldpopulationreview.com>>]

SOURCE C Labour Force



Age dependency ratio

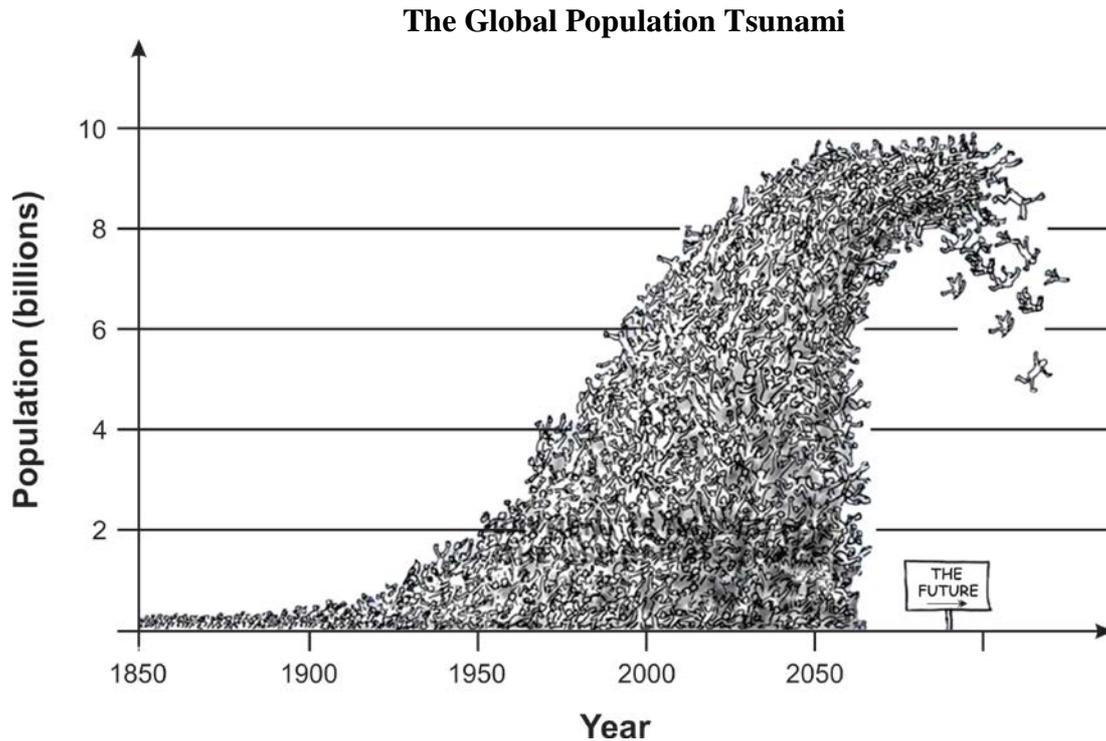
The dependency ratio of a population is a ratio of people who are generally not in the labour force (the dependents) to the workforce of a country (the working part of population). The dependent part includes the population under 15 years old and people aged 65 and over. The productive part of population therefore consists of those between 15 and 64 years who are in the workforce.

This ratio shows the pressure on the working population produced by the dependent part of population.

The **total dependency ratio** of the population in South Africa is 51.9%. What does this value mean. It means that the working population (labour force) in South Africa must provide goods for itself and cover expenditure on children and aged persons. The value of more than 50% shows that less than half the population supports the rest.

[Adapted from: <<https://xchmhlx.wordpress.com>>]

SOURCE D



[Adapted from: <<http://www.chrismadden.co.uk>>]

SOURCE E

Life expectancy continues to rise as South Africa's population breaks 54 million

South Africa's population now stands at just over 54 million. This is the main finding of Stats SA's latest Mid-year Population Estimates report, which was released in January 2016.



The South Africa I know, the home I understand

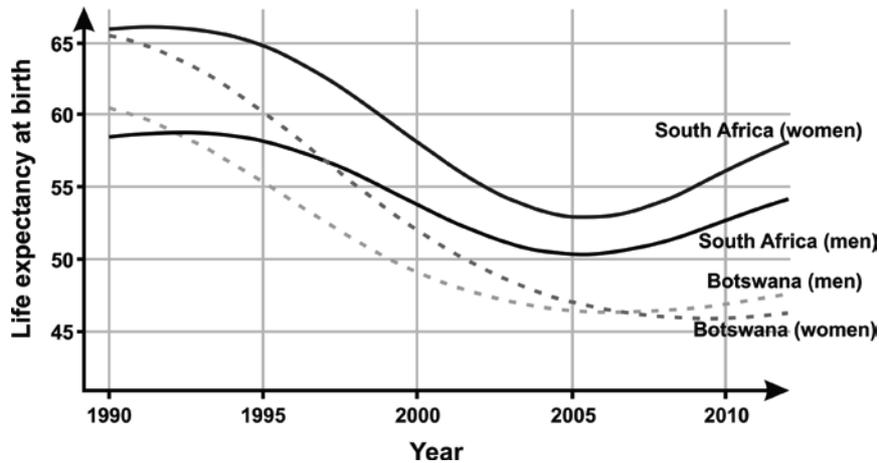
According to the report, life expectancy stands at 61 years, having increased from an estimated 52 years in 2005.

The rise in life expectancy can be attributed to two important trends:

- First, the number of AIDS-related deaths is estimated to have decreased from 363 910 deaths in 2005 (51% of all deaths) to 171 733 deaths in 2014 (31% of all deaths). This can be associated with the increased rollout of antiretroviral therapy.
- Second, the infant mortality rate has fallen from an estimated 58 infant deaths per 1 000 live births in 2002 to 34 infant deaths per 1 000 live births in 2014. The decline in the infant mortality rate points to an improvement in the general health and living standards of the population.

[Adapted from: <<http://www.statssa.gov.za>>]

Life expectancy in South Africa and Botswana with high HIV/AIDS prevalence, 1990–2012



[Adapted from: <rpubs.com>]

SOURCE F Sweden's Forced Sterilization Programme

For over 40 years, young socially marginalised working class women in Sweden faced the danger of forced sterilisation. This was carried out under laws intended to purify the Swedish race, prevent the mentally ill from reproducing and stamp out social activities classed as deviant. The last sterilisation took place in 1975.

Until the Sterilisation Act was finally repealed in 1975, 62,000 people, 90% of them women, were sterilised. Orphans were sterilised as a condition of their release from children's homes. Others were pinpointed on the basis of local neighbourhood gossip and personal grudges. Some were targeted because of their 'low intelligence', being of mixed race, or for physical defects.

The issue has become a national scandal, although similar revelations have emerged in other countries including Norway, Austria, Denmark, Finland, Belgium and the United States. Only Nazi Germany sterilised more people than Sweden.

[Adapted from: <https://www.wsws.org>]

SOURCE G Human Overpopulation

This information has been edited and peer-reviewed by contributors to the Natural Standard Research Collaboration.



- Experts define overpopulation as the presence of excessive numbers of a species, which are then unable to be sustained by the space and resources available.
- The carrying capacity refers to the maximum number of organisms of a given species that an ecosystem can support.
- Environmental degradation, natural disasters, civil war, and forced resettlement may cause population increases in other locations.
- Internal displacement of large numbers of people, as well as undocumented migration across borders, may turn a region able to carry its original inhabitants into an overpopulated one.
- The World Wildlife Fund has calculated that South Africans have an average ecological footprint of **2,8 hectares**. That is how much of our natural resources such as food, timber, land and energy we use to live our lives each year. But nature is only able to renew the supply of **1,8 hectares** per person, which means that we are running on overdraft.

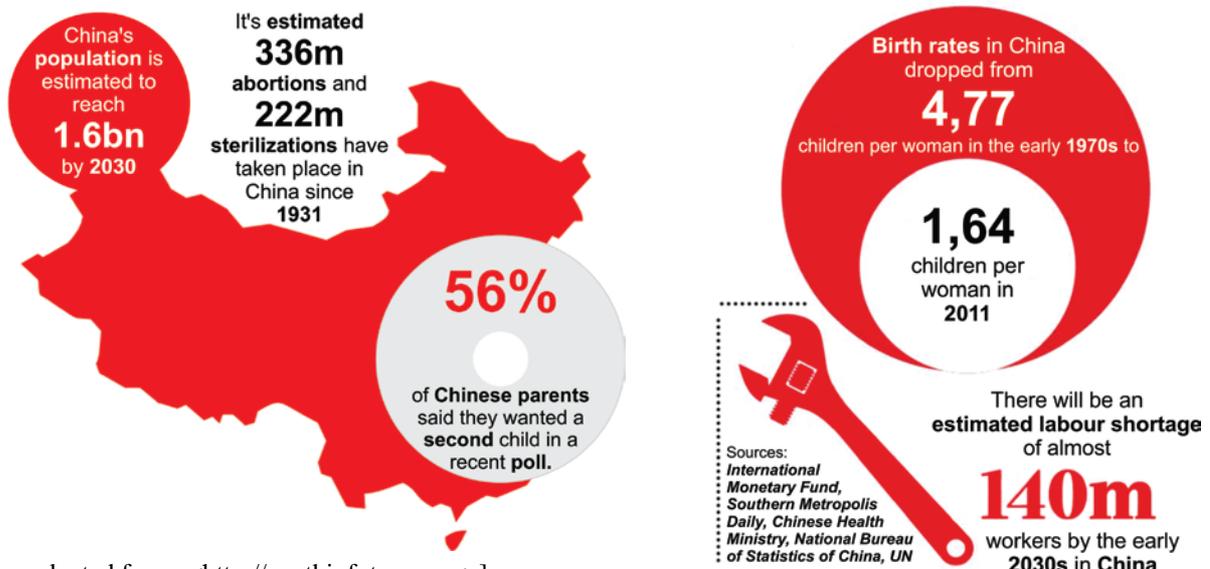
[Adapted from: <www.naturalstandard.com>]

SOURCE H

China Ends One-Child Policy, Allowing Families Two Children – October 2015

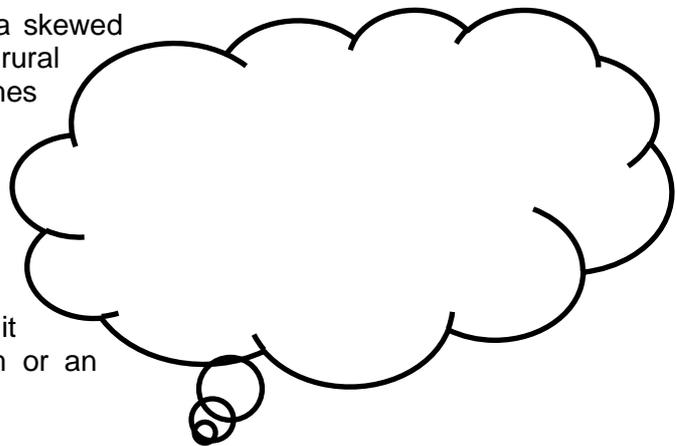
BEIJING – Driven by fears that an aging population could jeopardize China's economic growth, the Communist Party leadership ended its decades-old "one child" policy announcing that all married couples would be allowed to have two children.

The decision was a dramatic step away from a core Communist Party policy that was imposed in the late 1970s. This bred intense resentment over the brutal intrusions involved, including forced abortions and crippling fines, especially in the countryside.



[Image adapted from: <<http://nextbigfuture.com>>]

The efforts to limit family size also led to a skewed sex ratio of males to females. As traditional rural families favour boys over girls, they sometimes resorted to infanticide to ensure they had a son. Many young men now face the prospect of never finding a partner or starting a family of their own.



Yet while the decision surprised many experts and ordinary Chinese, some said it was unlikely to ignite either a baby boom or an economic one.

The initial public reaction to the party leaders' decision was restrained, and many citizens in Beijing who were asked whether they would grasp the chance to have two children expressed reluctance or outright indifference.

Some, however, were pleased.

Yang Qing, a clothing designer in Hangzhou, in eastern China, said that she wanted a second child, in addition to her 4-year-old son. "I always heard that people got fined for having more than one child, and they had to hide out and they will get caught," she said. "Everyone was scared."

"Really? Can you show me the news on your phone?" said Sun Bing, 34, the owner of a small technology store in Beijing, who had his 2-year-old son by his side. "This is a good thing, and I'm very supportive," he said. "I want to have a second kid in two years. But, of course, it's not cheap to raise children."

[Adapted from: <<http://www.nytimes.com>>]

Total: 100 marks