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# Environmental systems and societies

## Standard level

### Paper 1 – resource booklet

2 May 2024

Zone A afternoon | Zone B afternoon | Zone C afternoon

1 hour

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#### Instructions to candidates

- Do not open this booklet until instructed to do so.
- This booklet contains all the resources to answer paper 1.

Figure 1(a): World map showing location of South Africa

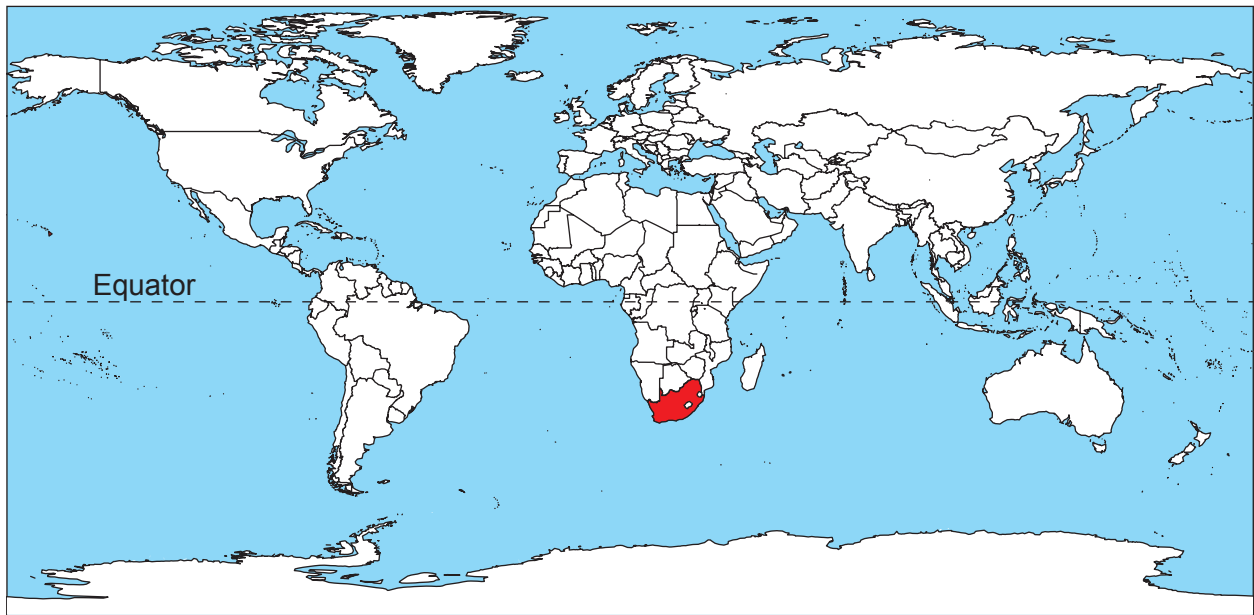
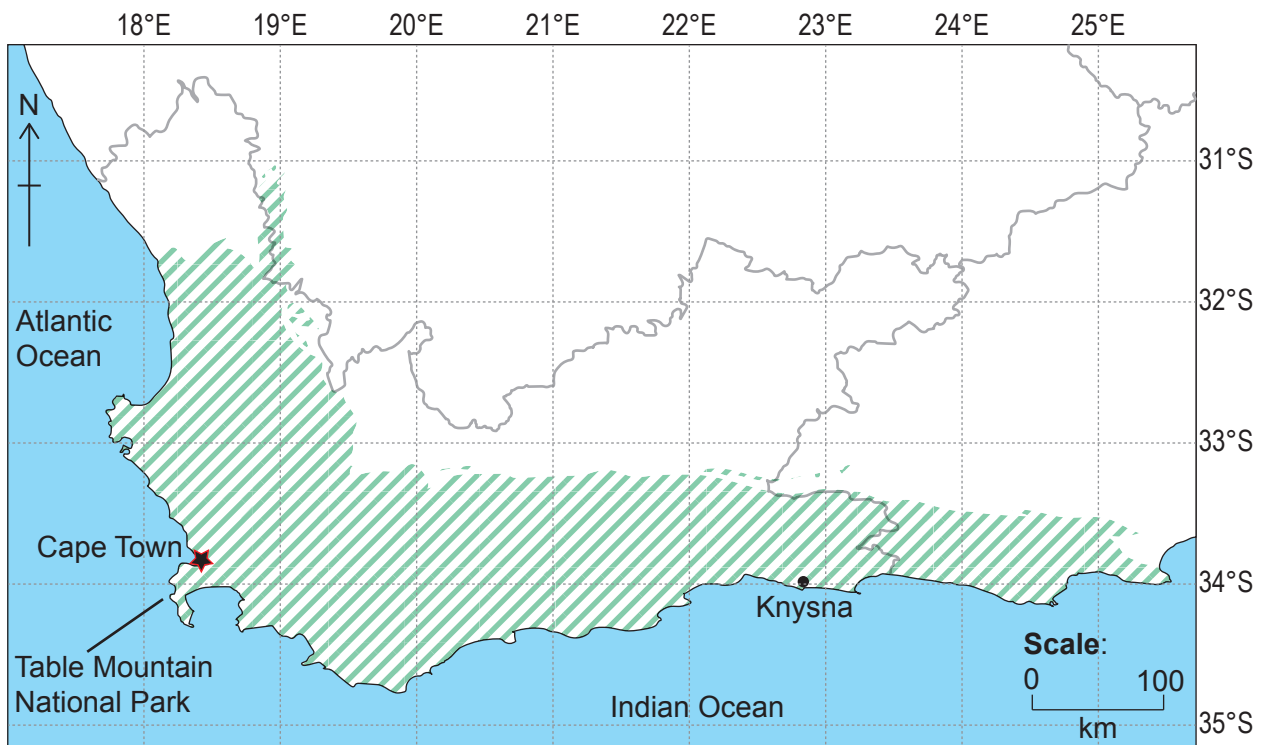


Figure 1(b): Map of The Cape Floristic Region, South Africa



**Key:**

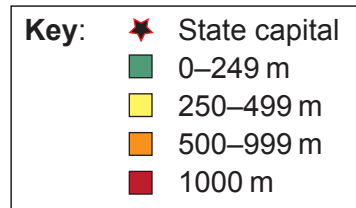
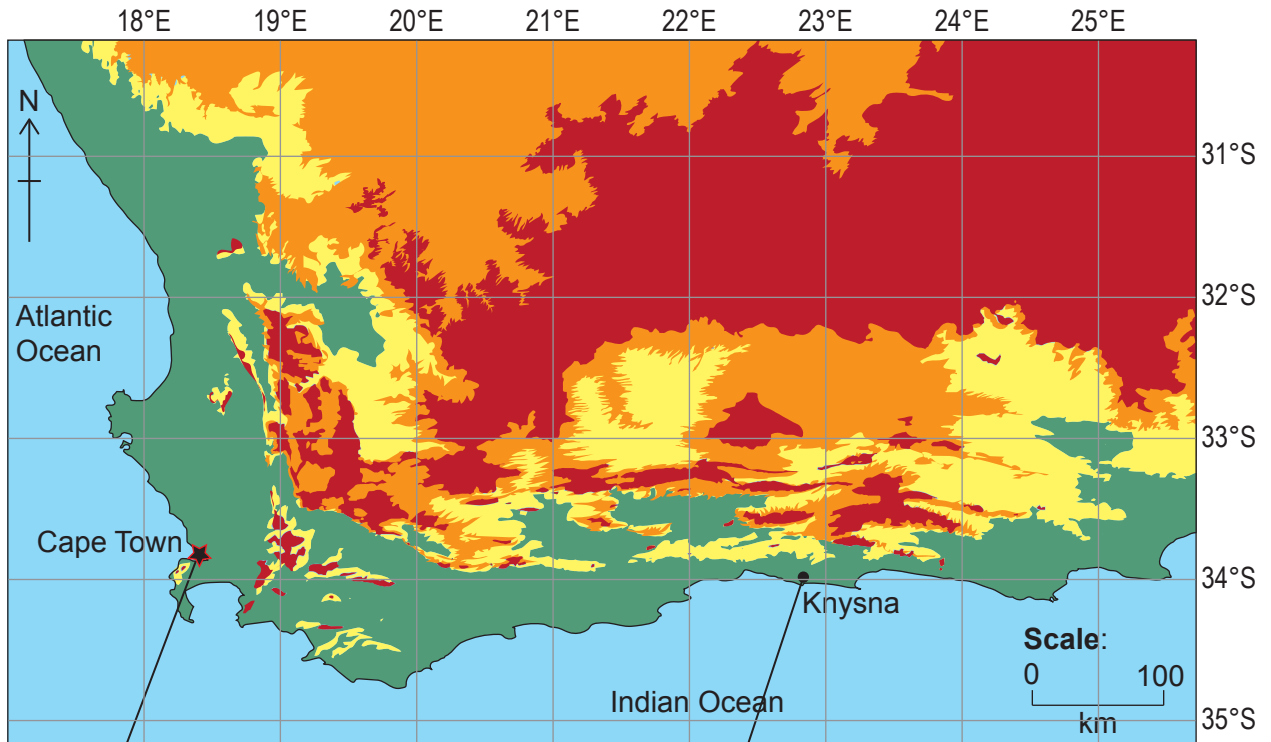
- ★ State capital
- State border
- ▨ Cape Floristic Region

**Figure 1(c): Cape Town, South Africa**

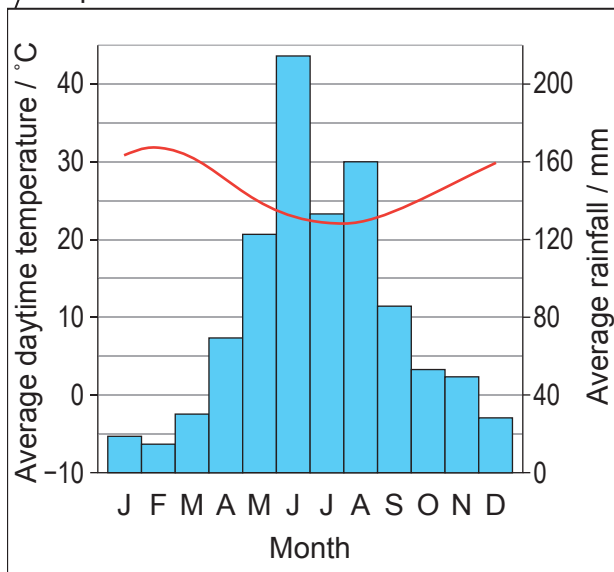
The population of Cape Town was 4.7 million in 2021 and is increasing by 2% annually.



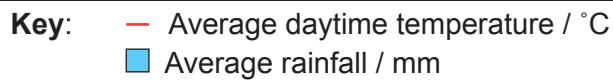
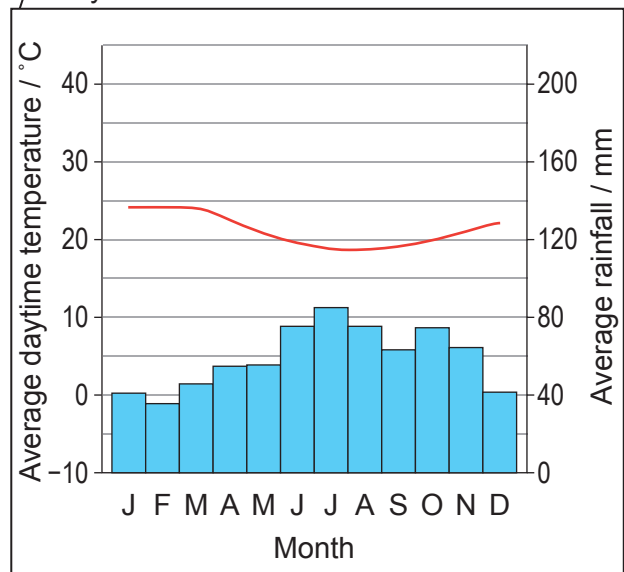
**Figure 1(d): Topographic map of the Cape Floristic Region, with examples of climate in Cape Town and Knysna**



Cape Town climate data



Knysna climate data



### Figure 1(e): Fact file on the Cape Floristic Region

- Covers an area of 78 555 km<sup>2</sup>.
- Contains the highest density of plant species in the world, with over 9000 species of vascular plants of which 6200 are not found anywhere else.
- Includes areas covered by fynbos, succulent karoo, forest and thicket.
- Dominant vegetation is fynbos and accounts for over 7000 plant species.
- Conservation efforts in the Cape Floristic Region have promoted a holistic approach and include working alliances between community groups, NGOs and governmental groups.

### Figure 2(a): Fact file on fynbos

- Fynbos plants have small, fine leaves, e.g. proteas, rooibos, heather and cape reeds.
- Fynbos plants thrive in nutrient-poor soils and seasonally hot and dry conditions.
- Fynbos covers over 80 % of the Cape Floristic Region including mountains, lowland valleys and coastal plains.
- Fynbos is threatened by expansion of agriculture, plantation forestry, urbanization, climate change and invasive species.
- Invasive species in the fynbos include pine trees, eucalyptus, acacia and hakea.
- Pine trees were originally planted for commercial timber plantations.
- These invasive species:
  - can increase fire risk because, when dry, they burn at a higher temperature and for longer than indigenous species
  - use more water than indigenous species
  - alter the nutrient content of the soils
  - can be controlled through physical removal, using herbicides, biological control or through controlled fires.

### Figure 2(b): Examples of fynbos plants



King protea (*Protea cynaroides*) is:

- the national flower of South Africa
- a flagship species
- widely grown commercially for export as a cut flower.



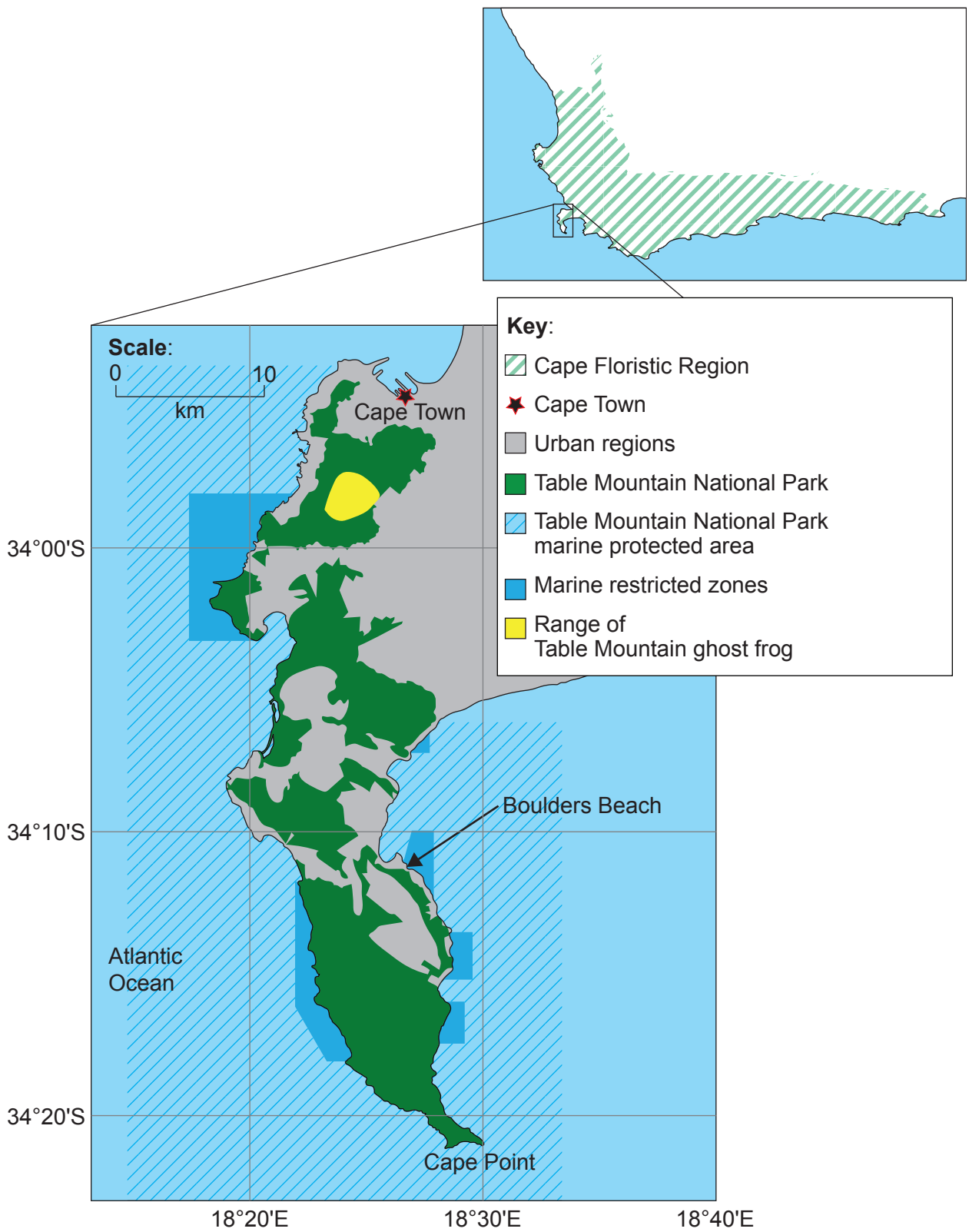
Rooibos (*Aspalathus linearis*) is:

- used to make tea.

**Figure 2(c): The South African government has set up projects to conserve water by removing invasive species**



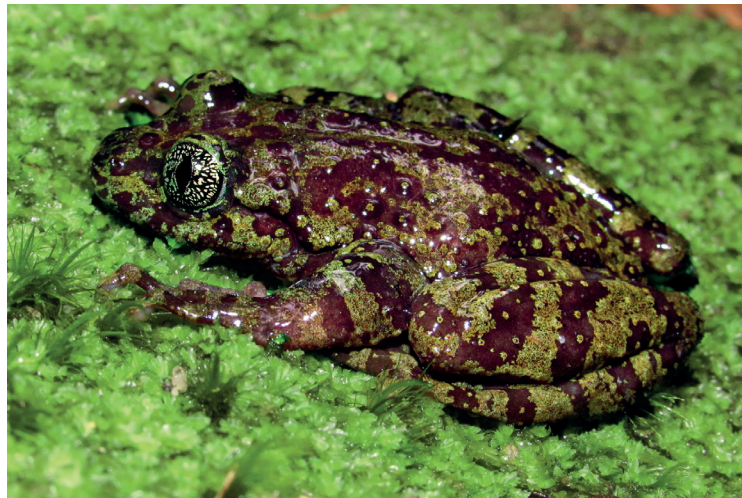
Figure 3(a): Map of the Cape Peninsula, showing Table Mountain National Park



**Figure 3(b): Fact file on Table Mountain National Park**

- It attracts over 4 million tourists per year.
- It lies within the Cape Floristic Region and neighbours Cape Town.
- It covers a land area of 221 km<sup>2</sup>.
- It manages a marine protected area rich in biodiversity:
  - that covers 1000 km<sup>2</sup> of sea and coastline
  - where the cold Benguela and warm Agulhas currents meet at the Cape Peninsula
  - where fishing is managed through permits and quotas
  - where no fishing is allowed within the marine restricted zones (which provide important breeding and nursery grounds).

**Figure 3(c): Table Mountain ghost frog (*Heleophryne rosei*)**



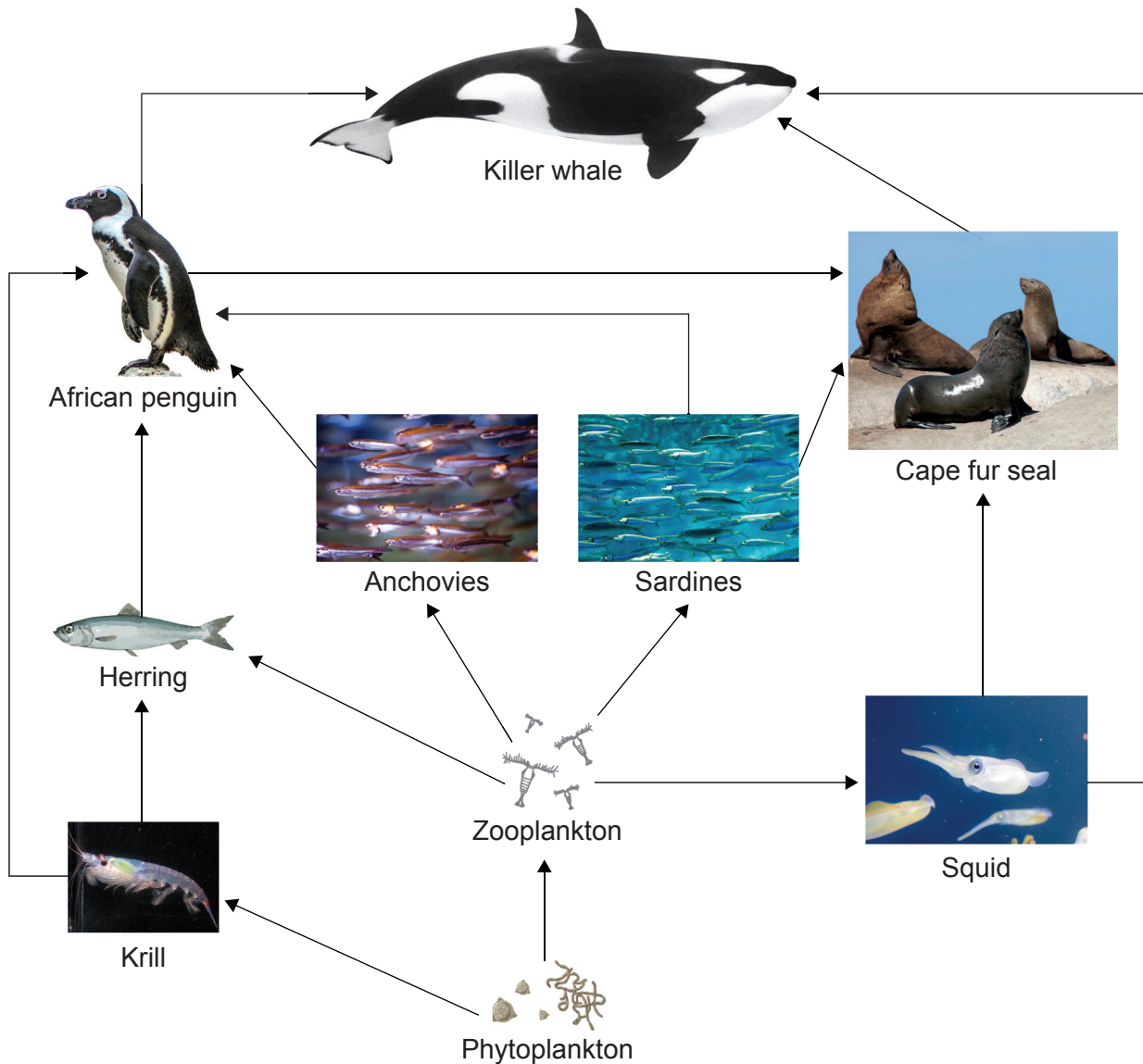
**Figure 3(d): Fact file on the Table Mountain ghost frog**

- Its IUCN “Red List of Threatened Species” classification changed from ‘endangered’ in 1994 to ‘critically endangered’ in 2004.
- Its area of distribution is about 4 km<sup>2</sup>.
- Historically, it has been recorded in eight rivers, but now is only found in five rivers on Table Mountain.
- Their tadpoles live in streams that are in danger of drying up due to:
  - invasive vegetation species
  - fires
  - reservoir construction.
- In 2019 a programme was set up to:
  - monitor conditions of the streams on Table Mountain
  - undertake conservation action such as removal of alien vegetation.

**Figure 4(a): Fact file on African penguins (*Spheniscus demersus*)**

- African penguins are classified by the IUCN as 'endangered'.
- A colony is located at Boulders Beach, within Table Mountain National Park.
- Two pairs of African penguins arrived at Boulders Beach in 1982 and the population has grown to about 1000 pairs.
- Globally, African penguin numbers have declined from about 87 000 pairs in 1978 to about 25 000 pairs in 2015.
- The penguin colony—and whale watching—attracts tourism to the area.

**Figure 4(b): Simplified food web for Boulders Beach**



**Figure 5: Dam storage, urban and agricultural water use, and rainfall in the Western Cape, South Africa, 2014-2018**

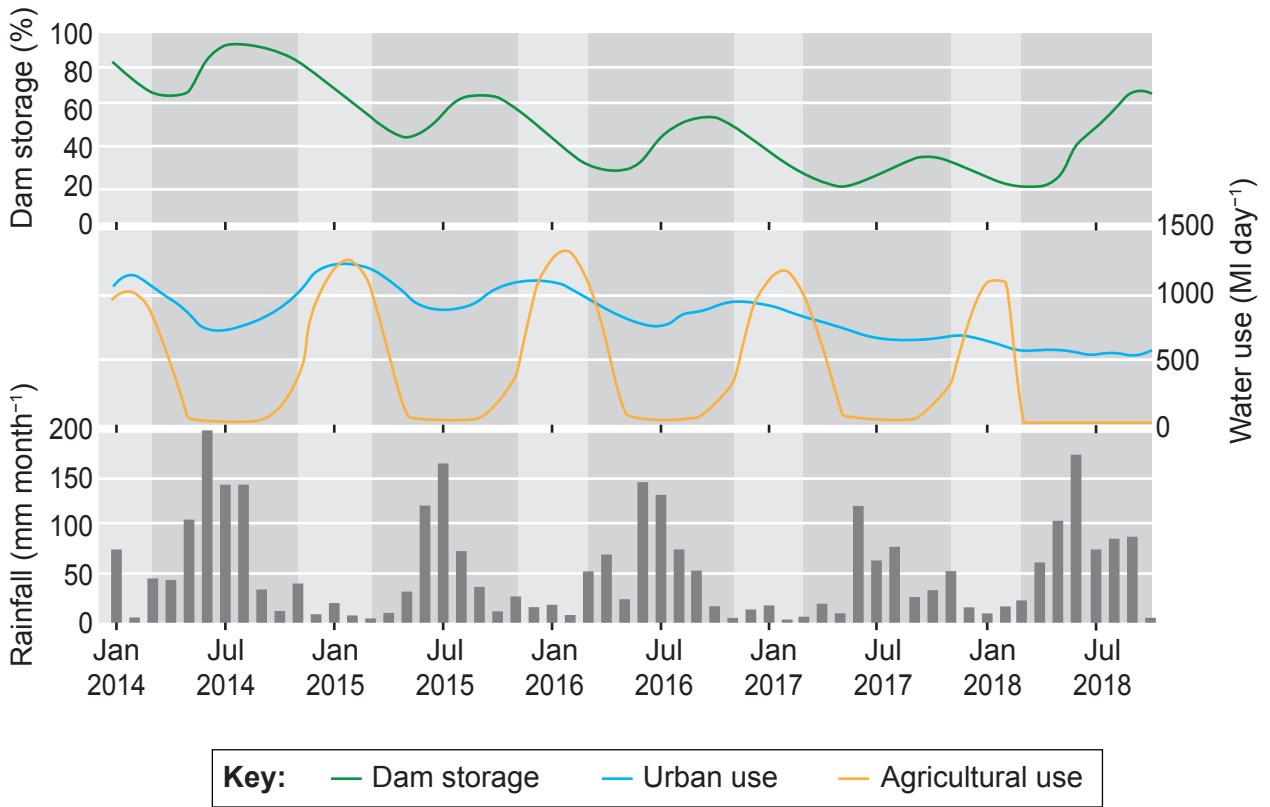
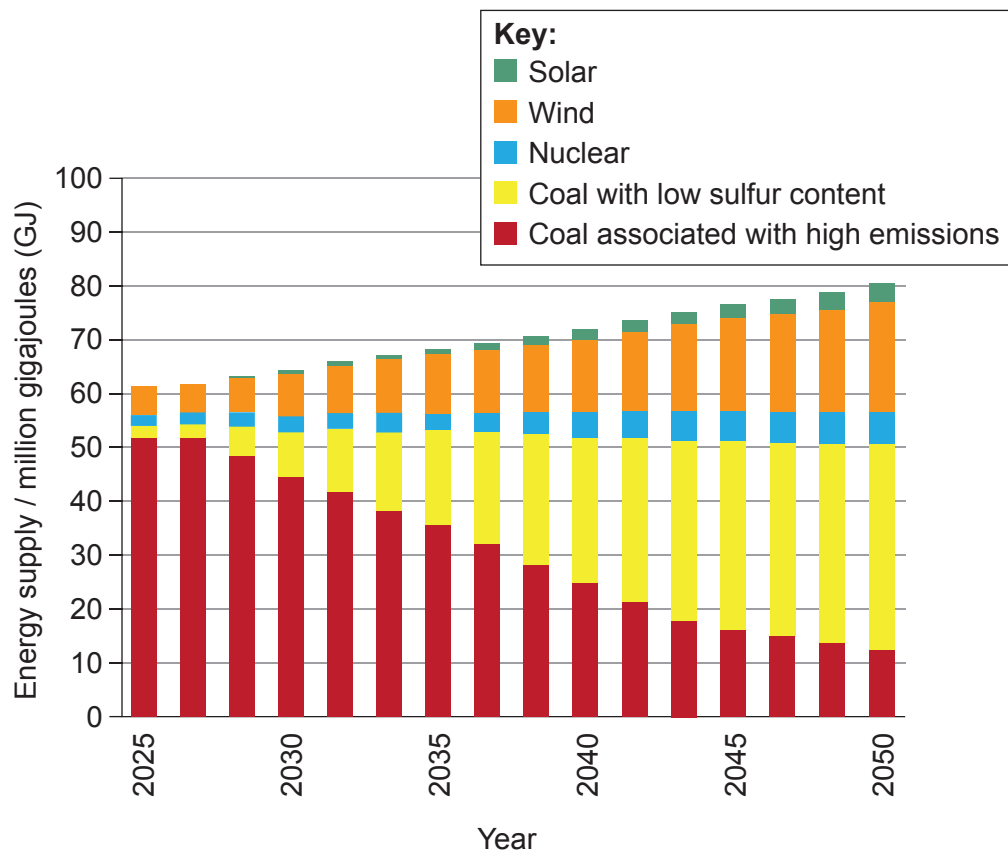


Figure 6: Planned changes in energy supply in Cape Town, 2025–2050



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**References:**

**Figure 1(c)** sharonang / Pixabay.

**Figure 1(d)** Topographic-map.com. Available at: <https://en-gb.topographic-map.com/map-t2n3q/Cape-Town/center=-34.20414%2C17.75966&zoom=13>. OpenStreetMap under copyright and licensed under the Creative Commons Attribution-ShareAlike 2.0 license (CC BY-SA 2.0). <https://creativecommons.org/licenses/by-sa/2.0/>. Source adapted. TessaDEM is licensed under the Open Database License (ODbL) v1.0. <https://opendatacommons.org/licenses/odbl/summary/>. Source adapted.

**Figure 2(b)** Stan Shebs. [https://commons.wikimedia.org/wiki/File:Protea\\_cynaroides\\_5.jpg](https://commons.wikimedia.org/wiki/File:Protea_cynaroides_5.jpg). Licensed under CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0/deed.en>.

Winfried Bruenken (Amrum). [https://en.wikipedia.org/wiki/File:Rooibos\\_\(Aspalathus\\_linearis\).jpg](https://en.wikipedia.org/wiki/File:Rooibos_(Aspalathus_linearis).jpg). Licensed under CC BY 2.5 <https://creativecommons.org/licenses/by-sa/2.5/deed.en>.

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**Figure 3(c)** Oliver Angus. *Heleophryne\_rosei\_103117497.jpg*. [https://commons.wikimedia.org/wiki/File:Heleophryne\\_rosei\\_103117497.jpg](https://commons.wikimedia.org/wiki/File:Heleophryne_rosei_103117497.jpg). Public domain.

**Figure 4(b)** Gnos, I., 2021. *Killer Whale in Shanghai*. [photograph] Unsplash. Available at: <https://unsplash.com/photos/dyu466BfWj8> [Accessed 13 December 2022]. Source adapted.

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PAL LTER. *Krill*. <https://www.flickr.com/photos/106398176@N07/10544278996/>. Licensed under CC BY-SA 2.0 DEED <https://creativecommons.org/licenses/by-sa/2.0/>.

**Figure 5** Ziervogel, G., 2019. UNPACKING THE CAPE TOWN DROUGHT: LESSONS LEARNED. [pdf] African Centre for Cities. Available at: [https://www.africancentreforcities.net/wp-content/uploads/2019/02/Ziervogel-2019-Lessons-from-Cape-Town-Drought\\_A.pdf](https://www.africancentreforcities.net/wp-content/uploads/2019/02/Ziervogel-2019-Lessons-from-Cape-Town-Drought_A.pdf) [Accessed 13 December 2022]. Source adapted.

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