Environmental systems and societies

Standard Level

Paper 1 – Mock Examination

Mock Exam 3

Calculator required

Time allowed: **1 hour**

Maximum mark: **35 marks**

Candidate information

Candidate name: .....

Session number: .....

Date: .....

Instructions to candidates

- Write your session number in the box above.
- Do not open this examination paper until you are told to do so.
- Answer **all** questions. Refer to the resource booklet that accompanies this question paper.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[35 marks]**.

Case study: Peru. The resource booklet contains Figures 1–11. Some questions require more than one figure, and the final question requires the booklet as a whole. This is an original practice paper written by IB Demystified for revision purposes. It is not a past paper and is not endorsed by, affiliated with or produced by the International Baccalaureate Organization.

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Using **Figure 2**, identify the ecosystem found along Peru's Pacific coastline. [**1**]

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2. (a) Using **Figure 4**, calculate the difference between the biocapacity per person and the ecological footprint per person in 2000. [**1**]

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(b) **Figure 4** shows that Peru still has an ecological reserve, but that it is becoming smaller. Suggest **two** ways in which Peru could prevent its ecological reserve from disappearing. [**2**]

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3. (a) Using the data in **Figure 5**, calculate the percentage of amphibian species that are endemic to Peru. [**1**]

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(b) Explain why Peru supports a high level of biodiversity. [**3**]

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4. (a) With reference to **Figure 6(a)**, suggest **one** advantage of using the proposed southern route (Route B) compared with the route that was built (Route A). [**1**]

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(b) With reference to **Figure 6(a)**, suggest a possible reason why Route B was rejected in favour of Route A. [**1**]

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(c) With reference to **Figure 6(b)**, identify **one** conflict between the Camisea gas project and sustainability. [**1**]

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(d) With reference to **one** specific event in **Figure 6(b)**, outline a strategy that could be used to reduce future incidents of pollution. [**1**]

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5. With reference to **Figures 7(a)** and **7(b)**, outline **two** reasons for the change in the use of natural gas between 1990 and 2023. [**2**]

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6. Using **Figure 8**, identify which product makes up the greatest proportion of Peru's exports by value. [**1**]

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7. (a) With reference to **Figure 9(a)**, outline the relationship between glacier area and mean dry-season discharge between 1962 and 2022. [**1**]

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(b) Identify **one** storage and **one** transformation in the hydrological cycle shown in **Figures 9(b)** and **9(c)**. [**2**]

Storage: . . . . . .

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Transformation: . . . . . .

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(c) With reference to **Figures 9(b)** and **9(c)**, describe a feedback loop that could be triggered by the loss of glaciers in the Cordillera Blanca. [**2**]

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(d) Outline how the puna grassland may provide a **named** example of natural income. [**1**]

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(e) Describe **two** ways in which climate change could affect the puna ecosystem. [**2**]

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8. (a) Outline **one** impact that a reduction in the vicuña population may have on the food web in **Figure 10(b)**. [**1**]

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(b) With reference to **Figures 10(c)** and **10(d)**, explain how repeated outbreaks of mange could contribute to the evolution of resistance in the vicuña population. [**2**]

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9. With reference to **Figure 11**, evaluate the potential effectiveness of the proposed southern phase of the corridor for wildlife conservation. [**3**]

10. With reference to the information in the resource booklet, discuss to what extent Peru has been effective at meeting its legal obligation to conserve biological diversity and its protected areas. [**6**]

Please **do not** write on this page.

Answers written on this
page will not be marked.

End of examination

Total: **35 marks**

Environmental systems and societies

Standard Level

Paper 1 – resource booklet

Mock Exam 3

Calculator required

Time allowed: **1 hour**

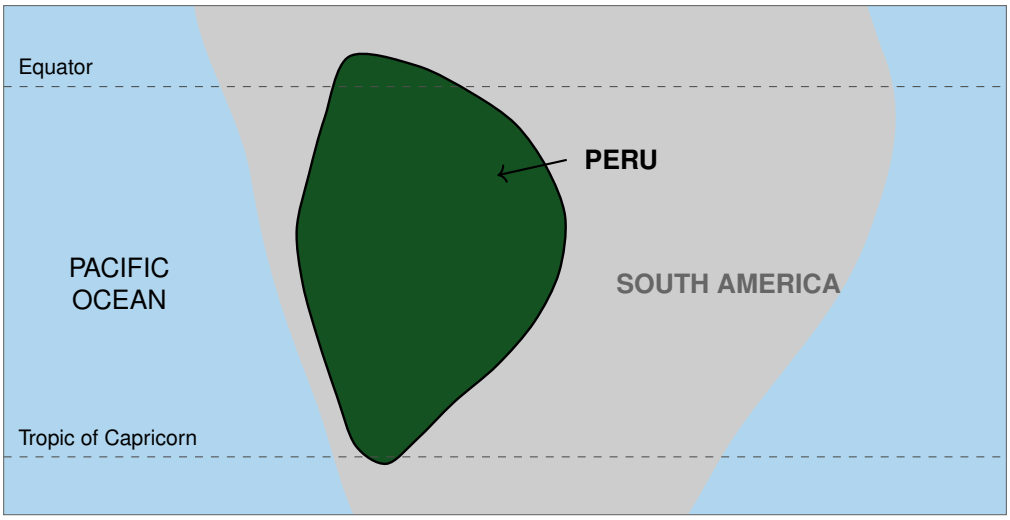
Maximum mark: **35 marks**

Instructions to candidates

- Do not open this booklet until you are told to do so.
- This booklet contains all the resources needed to answer paper 1.
- Case study: **Peru**.

Contents

Figure 1: Map showing the location of Peru



Not drawn to scale

Figure 3: Fact file on Peru

- Peru covers approximately 1 285 000 km^2 and has a population of about 34 million. Around one third of the population lives in the capital, Lima.
- Peru has three main regions: a narrow coastal desert, the Andes mountains, and the Amazon lowlands, which cover about 60 % of the country.
- Peru has thirteen UNESCO World Heritage sites, including Machu Picchu, the Manú National Park and the Huascarán National Park.
- Article 2 of the Peruvian Constitution gives every person the right to enjoy a balanced environment. The 2005 General Environmental Law makes the State legally responsible for conserving biological diversity and for maintaining the national system of protected natural areas.
- Peru is one of the world's megadiverse countries. It has more bird species than any country except Colombia, and a very high number of endemic amphibians.
- About 17 % of the land area lies inside protected natural areas, but many are described as "paper parks" because they have very few rangers.
- Peru holds about 70 % of the world's tropical glaciers. Their total area has fallen by more than half since the 1960s, and glacial meltwater supplies rivers used for drinking water, irrigation and hydroelectricity during the dry season.
- Before 2020, about 4.4 million international visitors came to Peru each year, providing income equal to roughly 4 % of gross domestic product (GDP).

Figure 2: Ecosystems of Peru

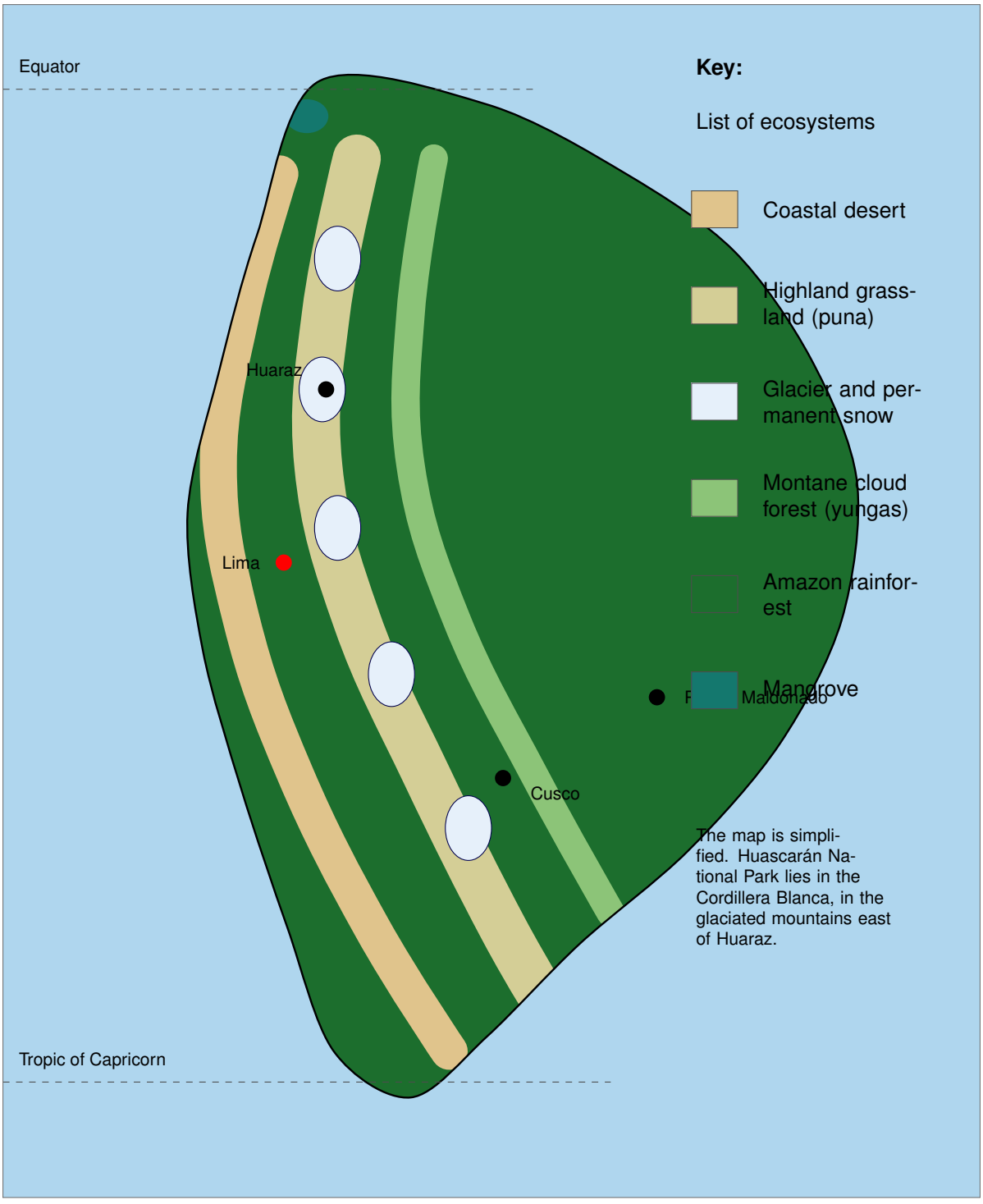
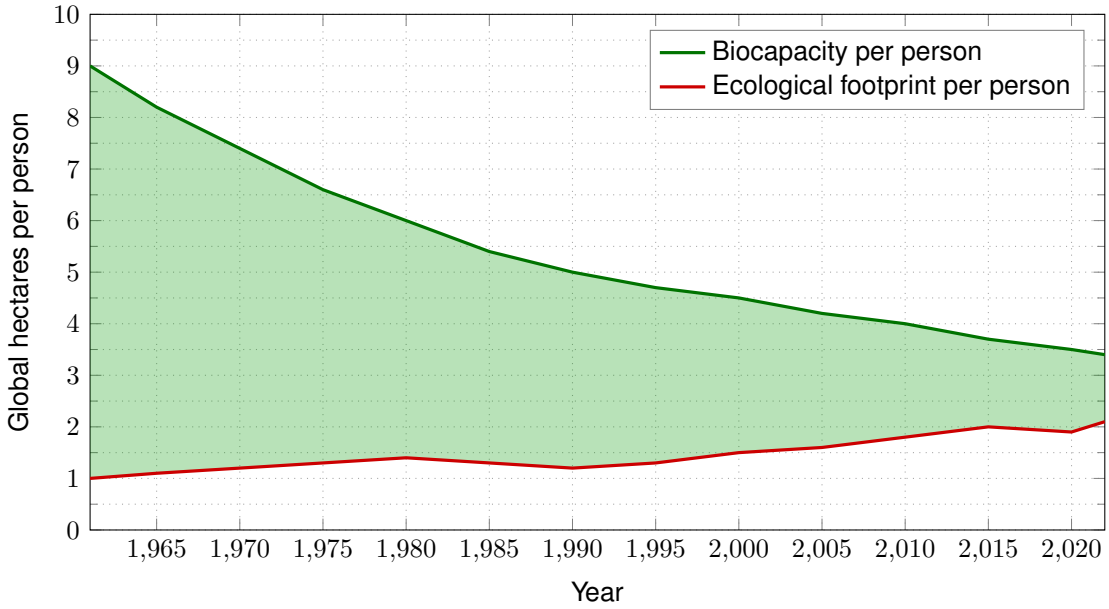


Figure 4: Ecological footprint (per person) and biocapacity (per person) for Peru, 1961–2022



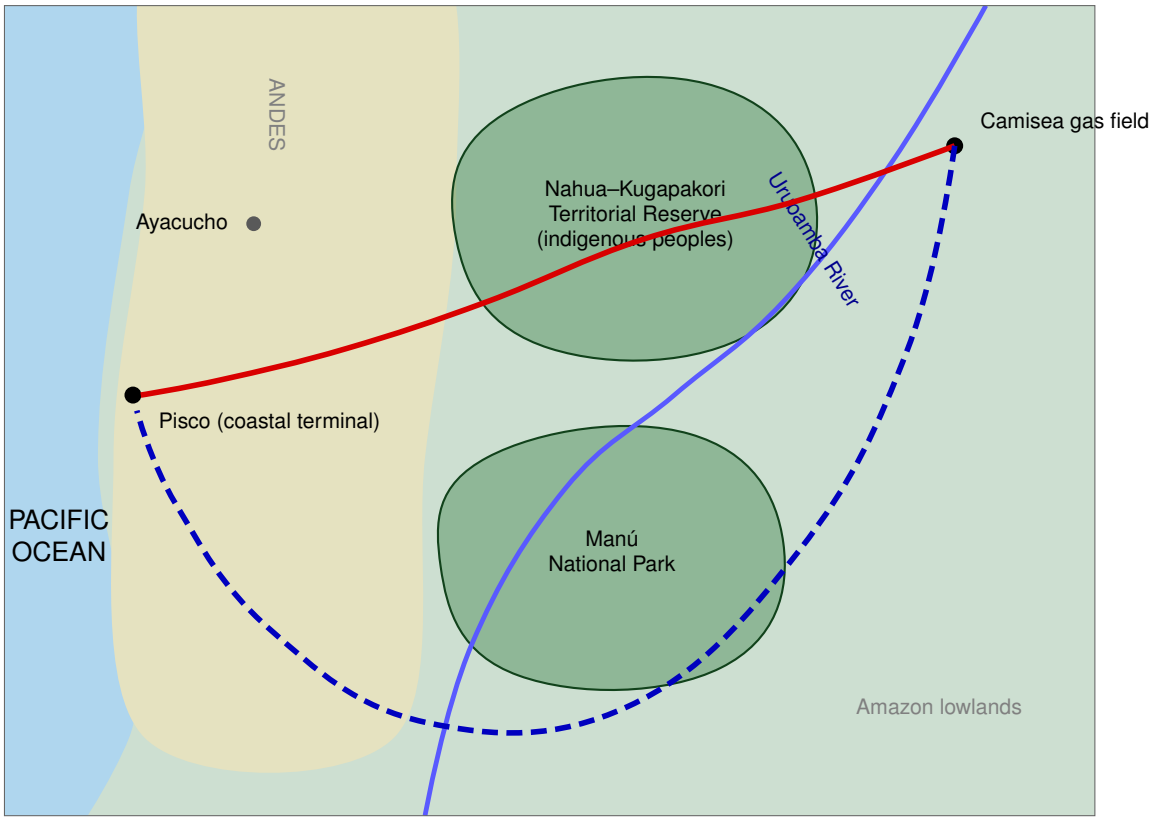
Biocapacity is the amount of biologically productive land and water available, measured in global hectares per person. Where biocapacity is greater than the footprint, a country has an **ecological reserve**.

Figure 5: Species diversity among different taxonomic groups in Peru

Taxonomic group	Total species	Endemic species*
Vascular plants	20 000	5 500
Mammals	569	70
Birds	1 879	139
Reptiles	446	109
Amphibians	649	303
Freshwater fish	1 140	224

* Endemic species refers to those species only found in a given region – here, Peru.

Figure 6(a): Map of the Camisea gas project and the two proposed pipeline routes



Key:

- **Route A**: the 700 km northern route that was built (opened 2004)
- **Route B**: the 950 km southern route that was proposed and then rejected
- Protected or reserved area
- River

The pipeline carries natural gas and natural gas liquids from the Camisea field, in the Amazon lowlands, over the Andes to a terminal on the Pacific coast. Route A crosses the Nahua–Kugapakori Territorial Reserve, which is set aside for indigenous peoples living in voluntary isolation. Route B would cross five major river valleys and a further 60 km of steep terrain.

Figure 6(b): Timeline for the Camisea gas project

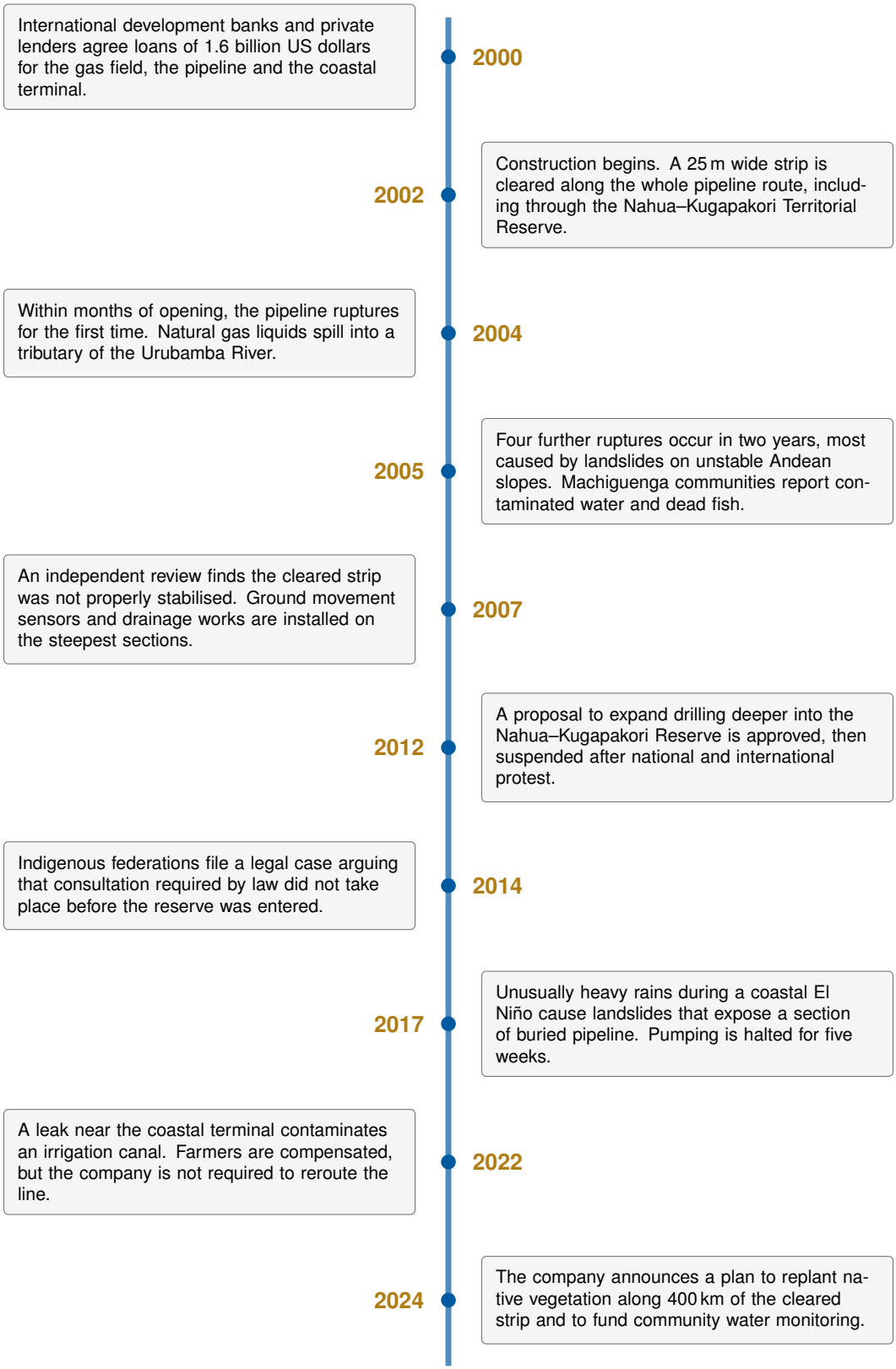
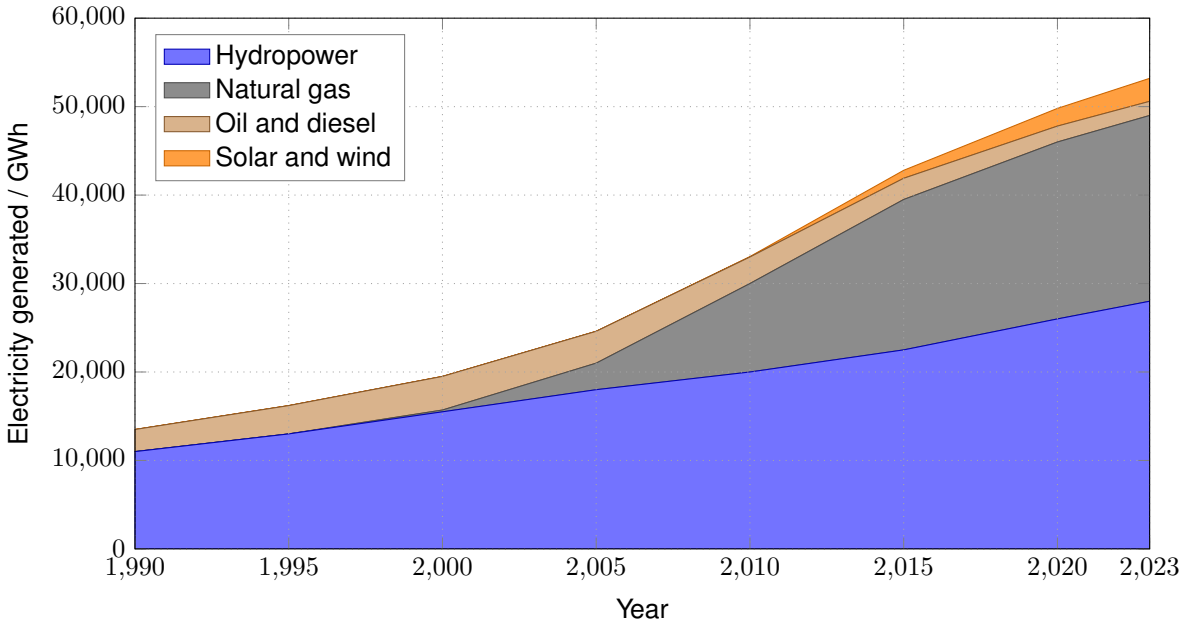


Figure 7(a): Fact file on Peru's energy choices

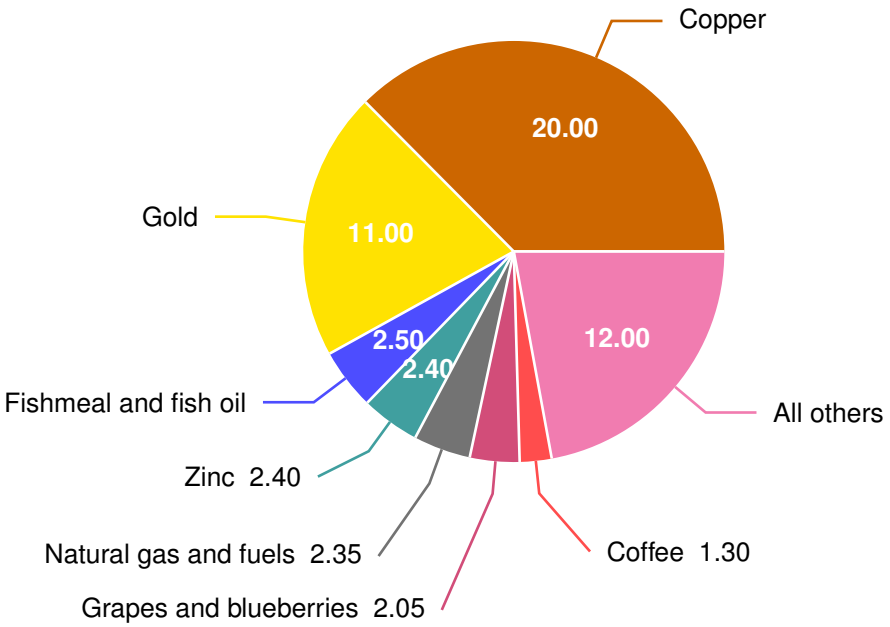
- Peru's mountainous terrain and glacier-fed rivers allow large-scale hydropower generation, but output falls during the dry season and is threatened in the long term by glacier retreat.
- Natural gas from the Camisea field has been available since 2004. It is cheaper than imported oil and is now burned in power stations near Lima.
- Diesel generators are still used in isolated Amazon towns that are not connected to the national grid; the fuel has to be brought in by river.
- The southern highlands and the coastal desert receive some of the highest levels of solar radiation in the world, and the first large solar plants were built after 2012.
- Around 95 % of the population now has access to mains electricity, compared with about 45 % in 1990.
- Peru has signed international climate agreements and has committed to increasing the share of renewable energy in its electricity supply.

Figure 7(b): Peru's electricity generation by source (1990–2023)



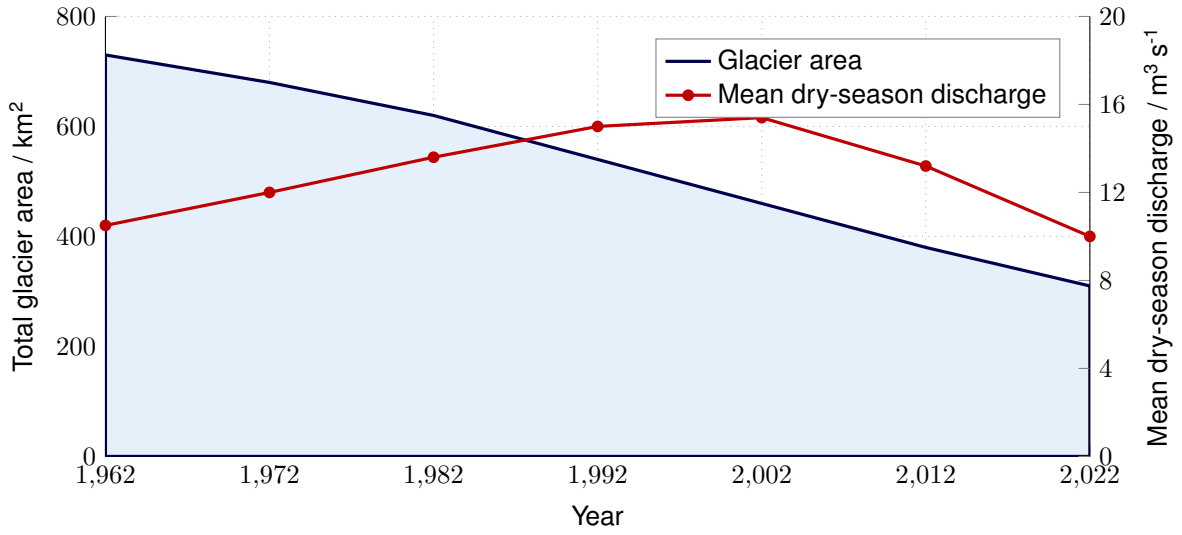
The graph is stacked: the thickness of each band shows the contribution of that source, and the top of the shaded area shows total generation.

Figure 8: Peru's main exports by value (billions of USD) for 2022



*Each wedge represents billions of US dollars. Total exports in 2022 were 53.40 billion US dollars.

Figure 9(a): Glacier area in the Cordillera Blanca and dry-season discharge of a glacier-fed river, 1962–2022



Dry-season discharge is measured in the months of June to September, when almost no rain falls in the Andes and river flow depends on stored water.

Figure 9(b): Relationship of the high Andes with the hydrological cycle

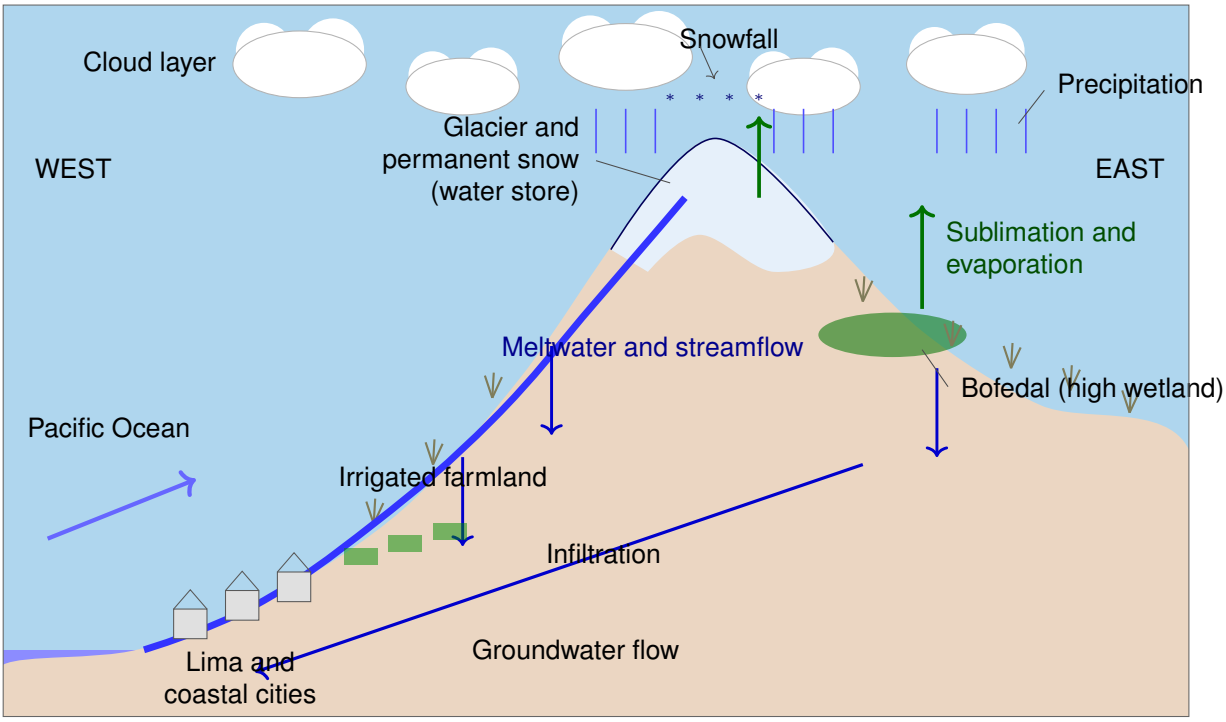


Figure 9(c): Adaptations of high-Andean plants

Plants growing above 4000 m in the puna face intense sunlight, freezing nights, strong drying winds and a long dry season. Their adaptations include:

- **Cushion growth form**: many species grow as dense, low domes only a few centimetres high. This traps still air, keeps the plant warmer than the surrounding air at night, and reduces water loss to the wind.
- **Small, thick leaves with a waxy cuticle**: reduce the surface area from which water can evaporate and reflect some of the intense ultraviolet radiation.
- **Deep and dense root systems**: reach water stored in the soil and hold soil particles together on steep slopes, reducing erosion during the wet season.
- **Peat-forming cushion plants in the *bofedales***: these permanently wet cushion bogs build up thick, waterlogged peat that absorbs meltwater during the wet season and releases it slowly through the dry season, keeping streams flowing.
- **Polylepis woodland**: these trees, the highest-growing in the world, have papery, peeling bark that insulates the trunk against night frost, and their canopy intercepts fog and reduces evaporation from the soil below.

Figure 10(a): Fact file on Huascarán National Park

- Huascarán National Park was established in 1975 and covers 3400 km^2 of the Cordillera Blanca. It became a UNESCO Biosphere Reserve in 1977 and a World Heritage site in 1985.
- The park contains more than 600 glaciers, about 300 glacial lakes, and the highest-growing trees in the world, the *Polylepis* or queñua woodlands.
- Its wildlife includes the vicuña, the spectacled bear, the Andean condor, the puma and the mountain viscacha.
- Around 250 000 people live in communities around the park. Many hold long-standing rights to graze cattle and sheep on puna grassland inside the park boundary.
- About 200 000 visitors come each year for trekking and climbing. Entrance fees are the park's main source of income, but the park employs fewer than 40 rangers for the whole area.
- As glaciers retreat, meltwater collects in lakes behind unstable moraines. If a moraine fails, the resulting outburst flood can reach the valleys below within minutes. Several lakes have been drained or dammed to reduce this risk.

Figure 10(b): Simplified food web for the puna grassland of the Cordillera Blanca

Arrows show the direction of energy flow. Dashed arrows show scavenging: the Andean condor feeds on animals that have already died. The width of the shaded triangle represents the decrease in biomass at each trophic level.

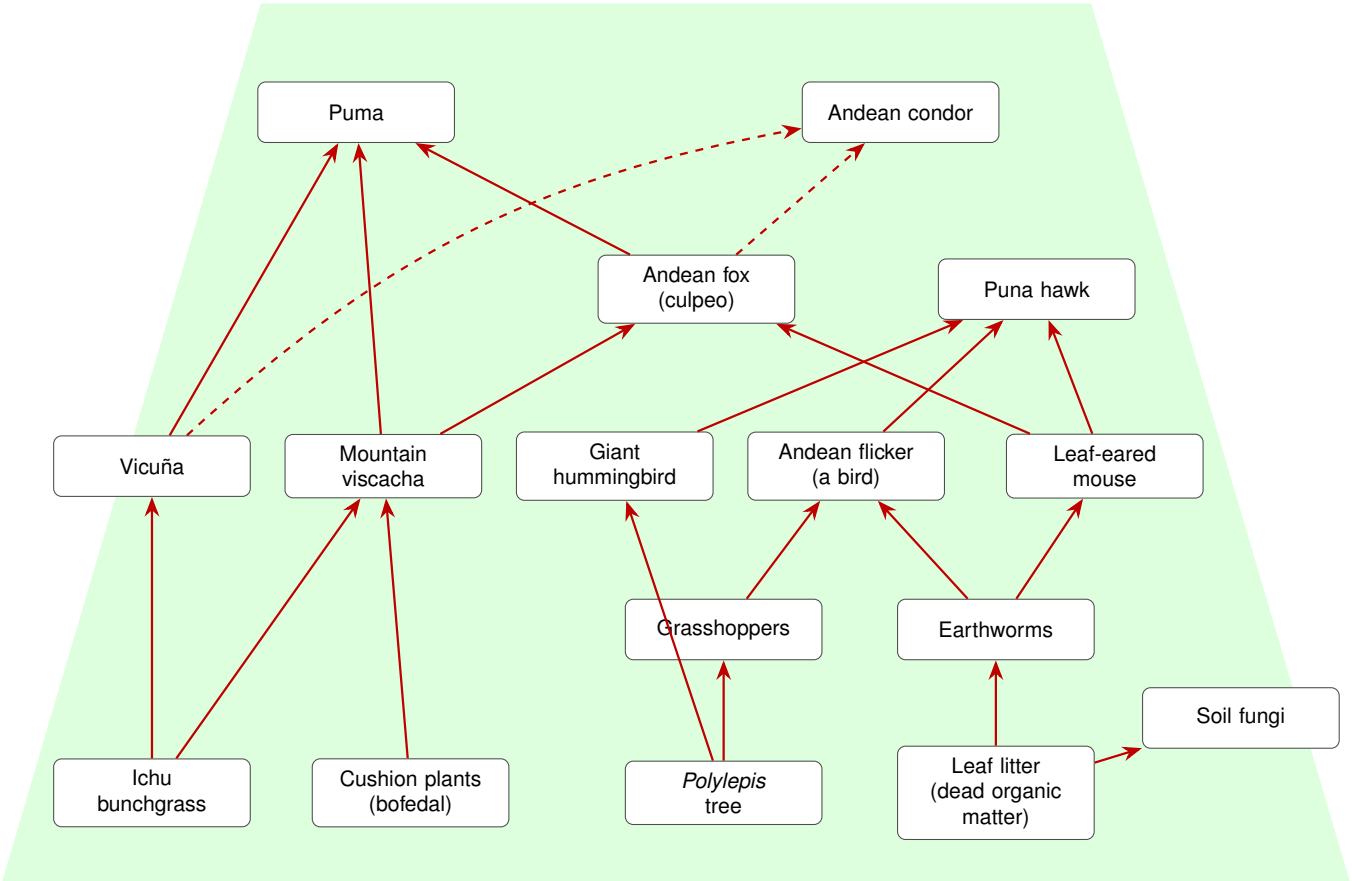
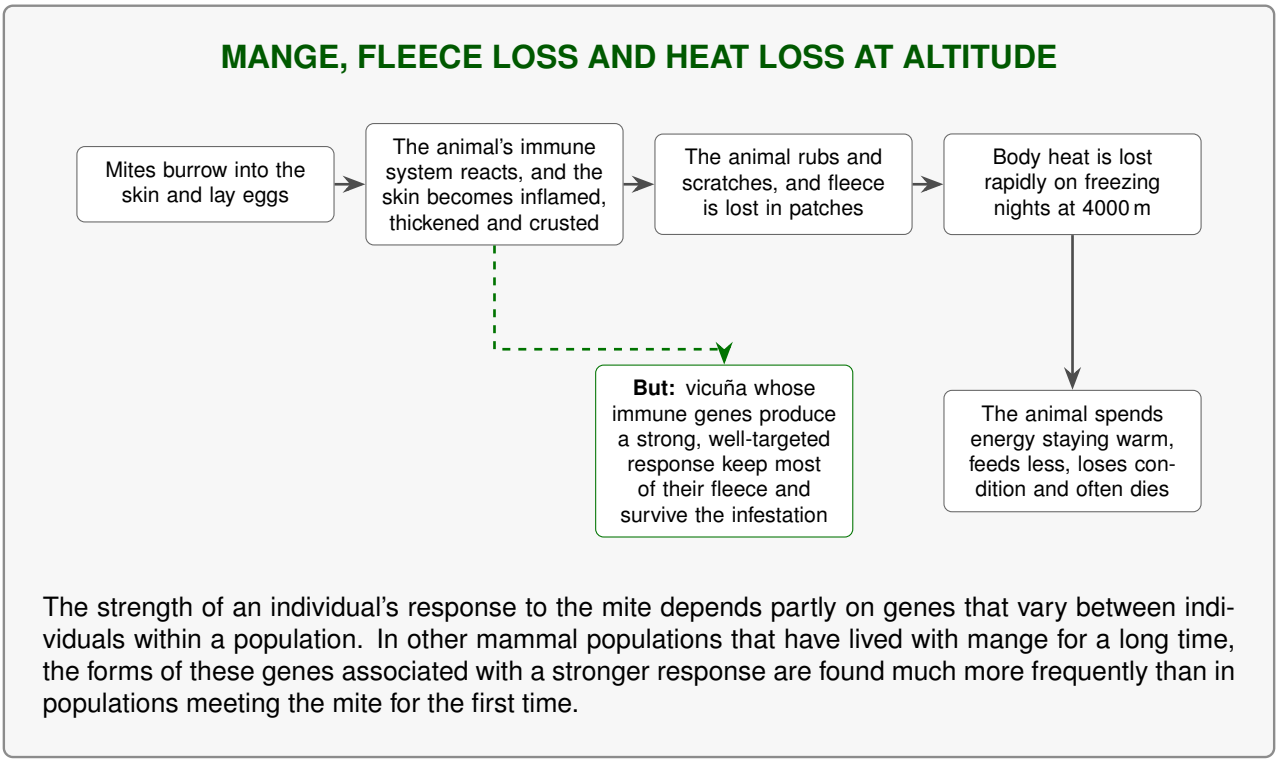


Figure 10(c): Fact file on mange in Peru's vicuña

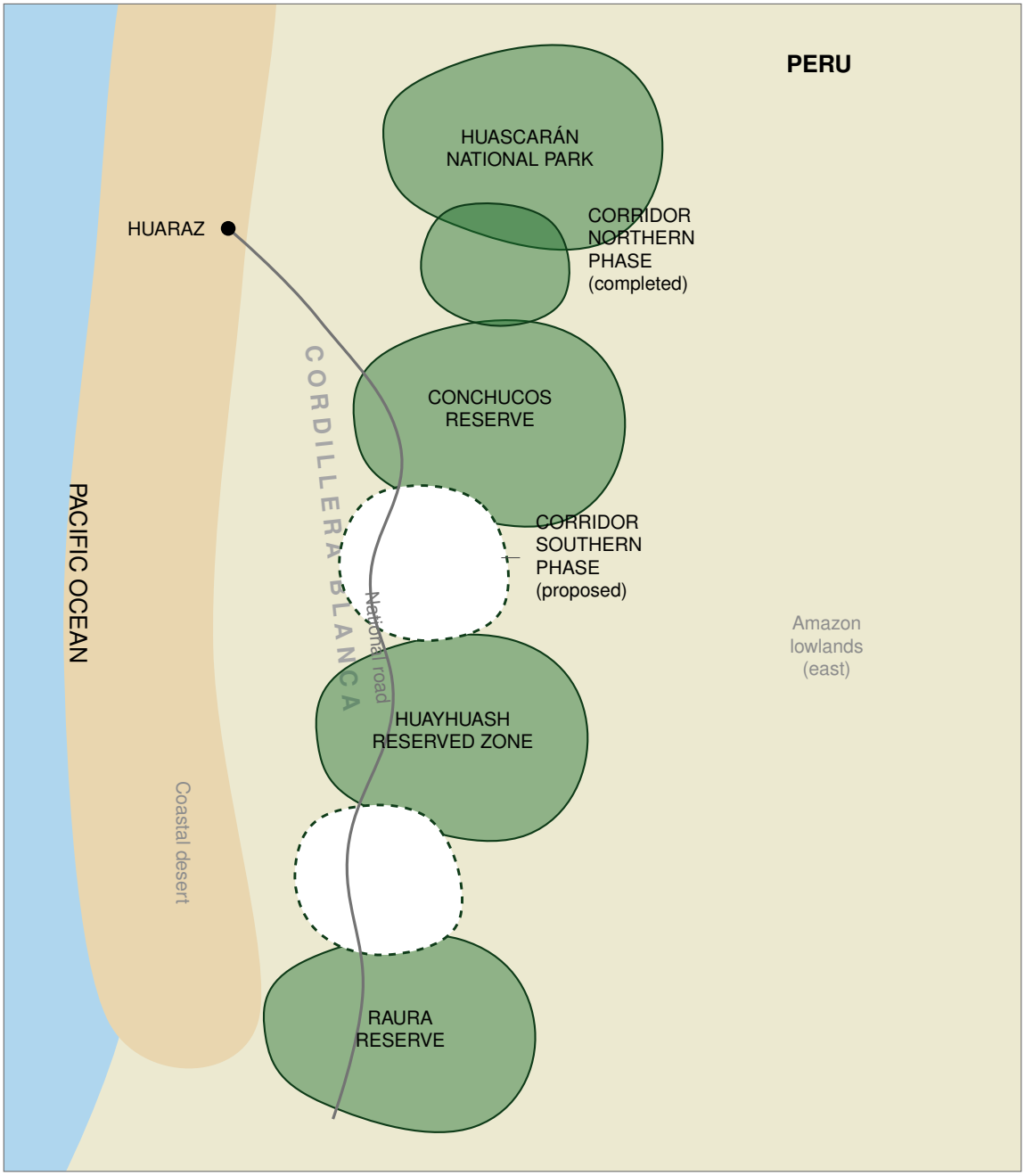
- The vicuña is a wild relative of the llama and alpaca. Hunting for its extremely fine wool reduced the Peruvian population to about 5000 animals by 1965. Since then it has been legally protected and the population has recovered to over 200 000.
- Local communities are allowed to round up wild vicuña once a year in a traditional *chaccu*, shear the fleece and release the animals. The wool is one of the most valuable natural fibres in the world.
- Since around 2010, outbreaks of mange have been recorded in several Peruvian vicuña populations. Mange is caused by a mite that burrows into the skin. It is thought to have spread from domestic sheep and alpaca grazing on the same pasture.
- Infected animals lose their fleece in patches. At 4000 m, where night temperatures fall below freezing, an animal without its fleece loses heat rapidly, feeds less and often dies. In some outbreaks more than half the animals in a herd have died.
- Handling large numbers of animals together during a *chaccu* can spread mites between individuals.
- There is no practical way to treat a wild population across such a large area. Management currently focuses on separating livestock from wild herds, monitoring outbreaks, and postponing round-ups where mange is present.

Figure 10(d): Mechanism by which mange kills a vicuña



The strength of an individual's response to the mite depends partly on genes that vary between individuals within a population. In other mammal populations that have lived with mange for a long time, the forms of these genes associated with a stronger response are found much more frequently than in populations meeting the mite for the first time.

Figure 11: Proposal for a high-Andean corridor connecting Huascarán National Park with other reserves



The land still required for the southern phase is communal grazing land held by highland villages, who have used it for cattle, sheep and alpaca for generations.

Note on sources

This resource booklet was written and drawn by IB Demystified as original practice material. It is not a past paper, and it is not endorsed by, affiliated with or produced by the International Baccalaureate Organization.

The Peru case study is realistic but deliberately simplified for teaching. All figures have been drawn for this paper. Values have been rounded so that they can be read quickly under exam conditions, and some events in the timeline in Figure 6(b) have been simplified or combined. The species shown in the food web in Figure 10(b) do occur in the Peruvian puna, but the feeding relationships shown are a simplified selection rather than a complete web. The pipeline routes in Figure 6(a) and the reserves in Figure 11 are illustrative. None of the values in this booklet should be quoted as a research source.

End of resource booklet
