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# Environmental systems and societies

## Standard level

### Paper 1 – resource booklet

12 November 2025

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: Map showing the location of Ecuador

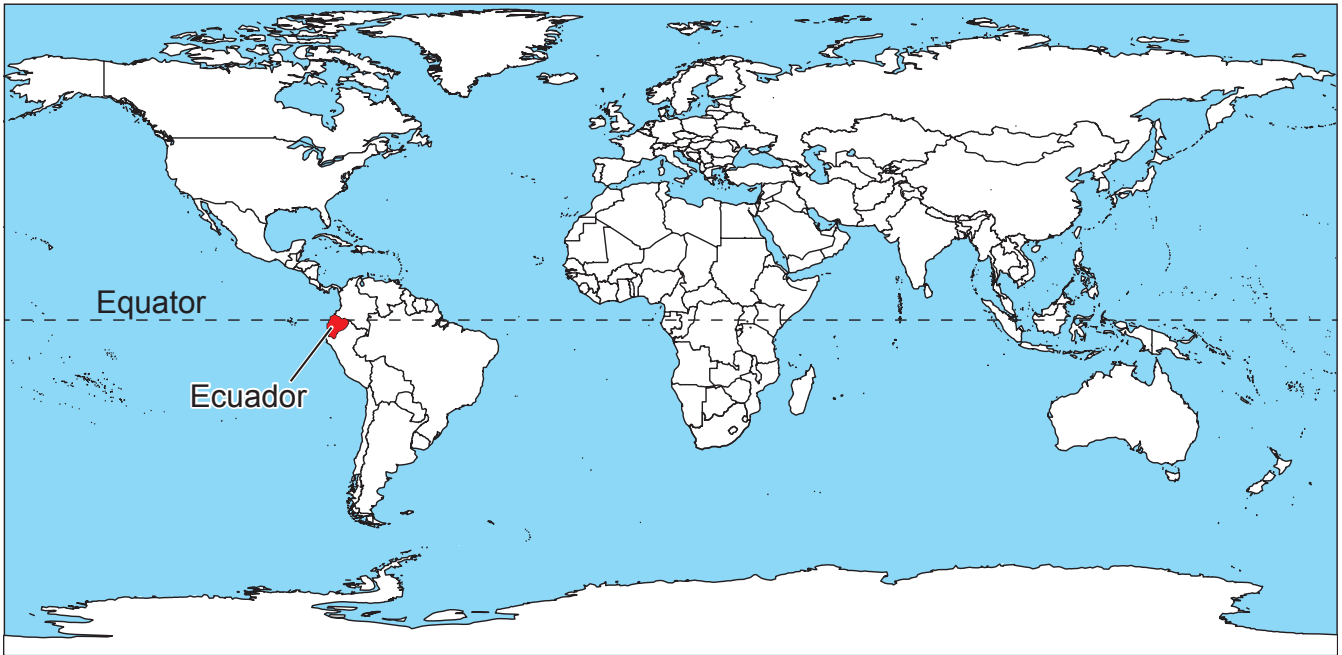
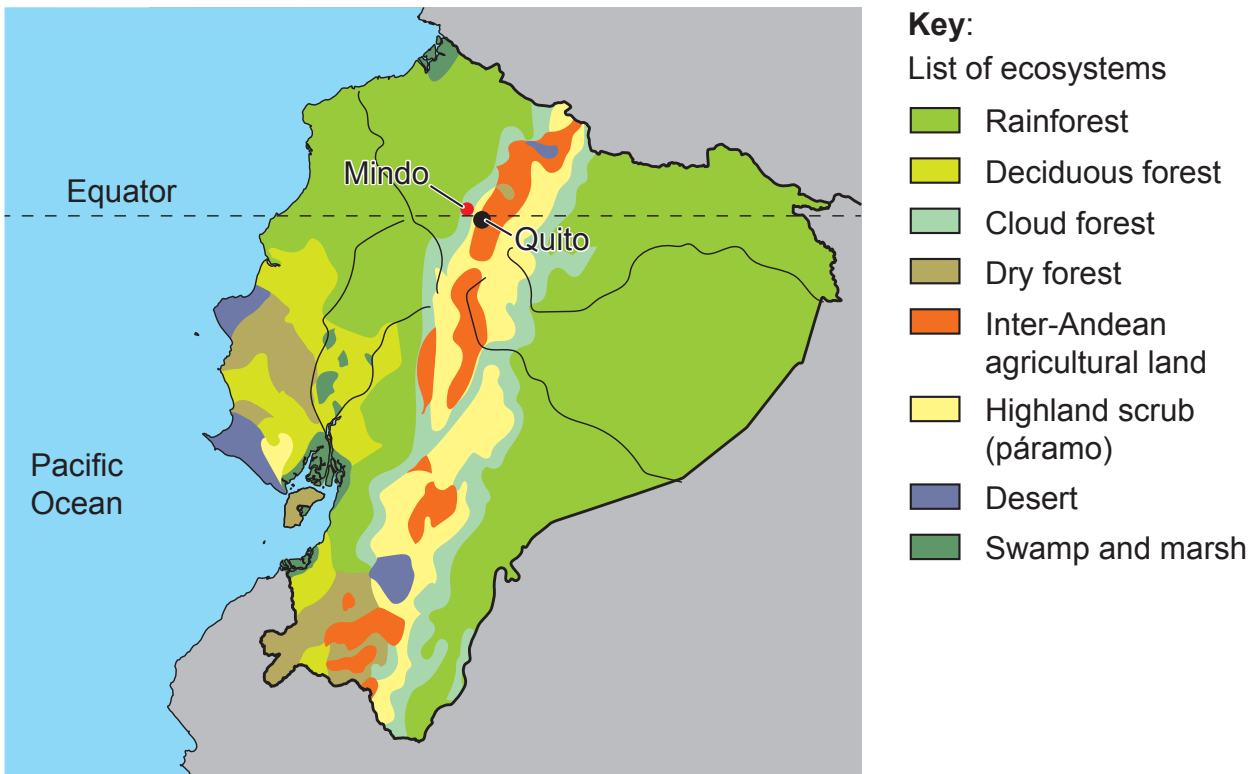


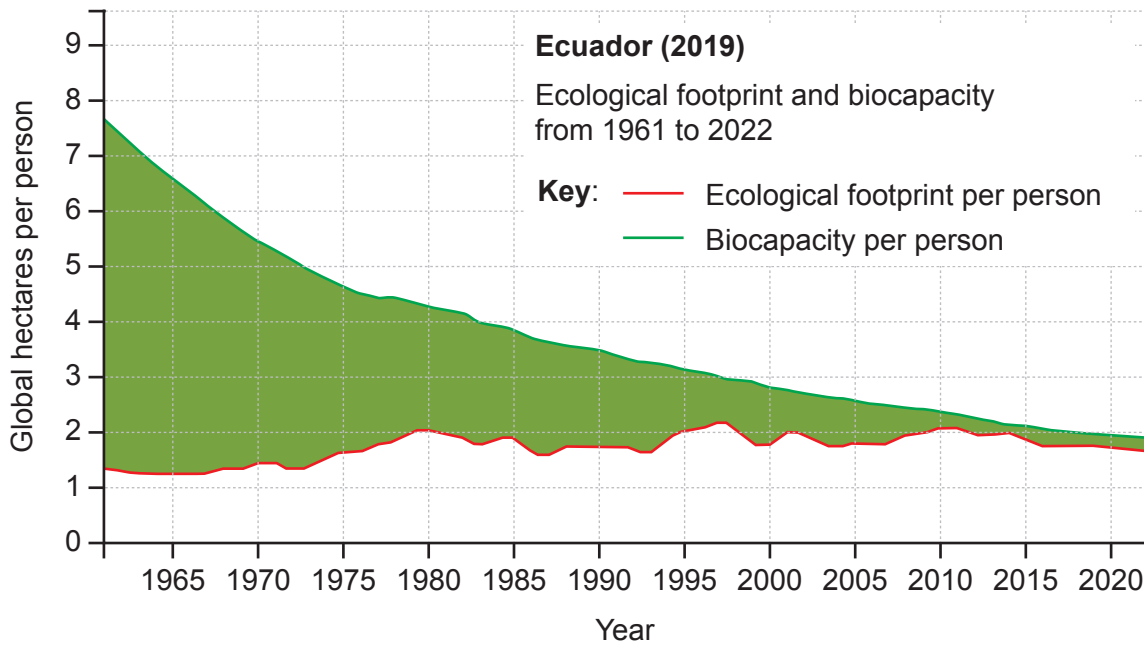
Figure 2: Ecosystems of Ecuador



### Figure 3: Fact file on Ecuador

- Ecuador covers a total area of approximately 284 000 km<sup>2</sup>.
- The human population is approximately 18.3 million.
- Quito is the capital and one of five United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage sites in the country.
- In 2008, Ecuador was the first country in the world to recognize the constitutional legal rights of nature, also referred to as “Pachamama” (Mother Earth).
- Ecuador is one of the richest areas of biodiversity in the world.
- Ecuador has many endemic (found nowhere else in the world) species, and many of these are endangered according to the IUCN Red List.
- There are 1.2 million visitors each year, which provides income that makes up more than 5% of the country’s gross domestic product (GDP). The Ecuadorian Ministry of Tourism’s goal is to reach 2 million visitors by 2025 by attracting travellers who want to interact with nature.

Figure 4: Ecological footprint (per person) and biocapacity (1965–2020)



Biocapacity is the amount of biological productive land, measured in hectares per person.

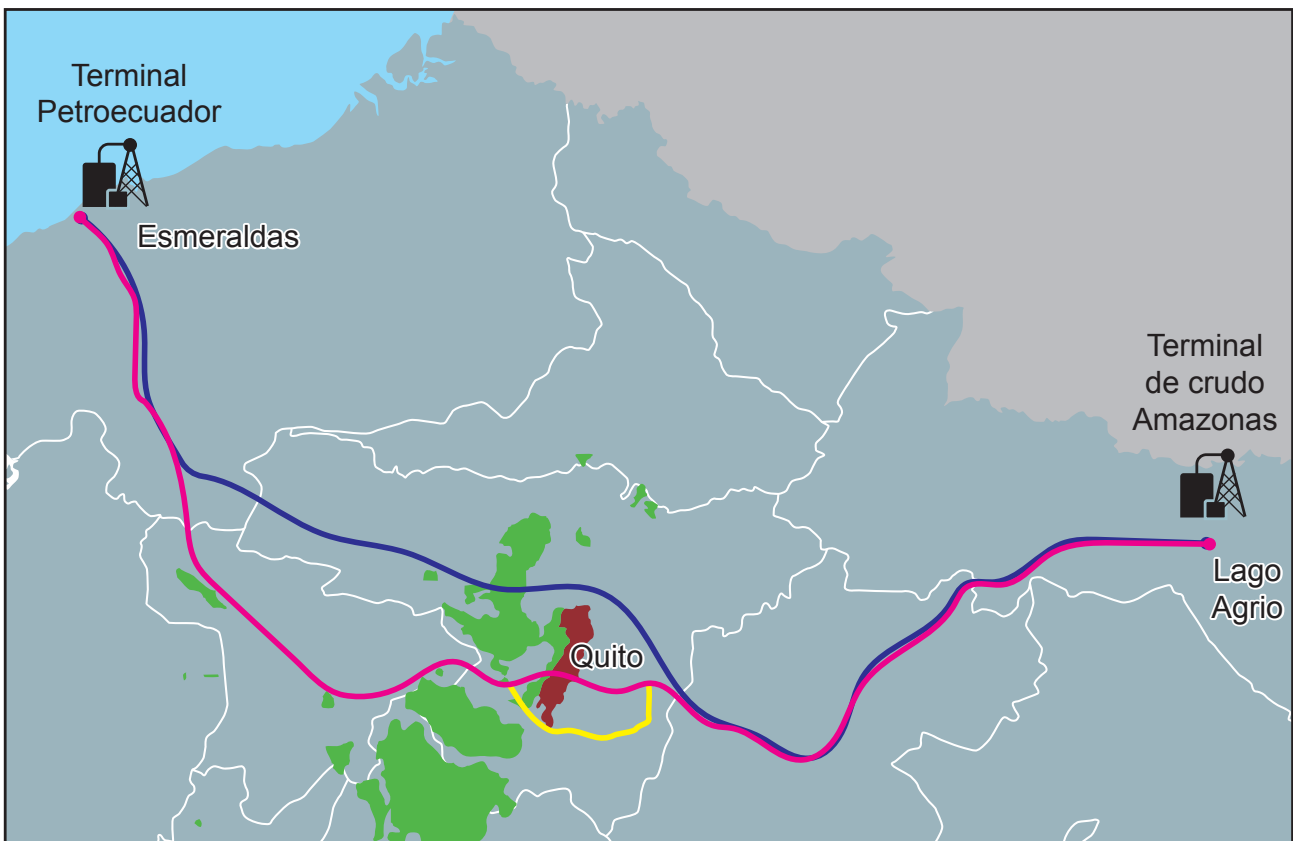
**Figure 5: Species diversity among different taxonomic groups in Ecuador in 2020**

<b>Taxonomic group</b>	<b>Total species</b>	<b>Endemic species*</b>
Plants	25 560	5348
Vertebrates	2794	436
Mammals	362	30
Birds	1616	52
Reptiles	394	114
Amphibians	422	240

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\* Endemic species refers to those species only found in a given region

Figure 6(a): Map of the SOTE pipeline and proposed OCP pipeline routes

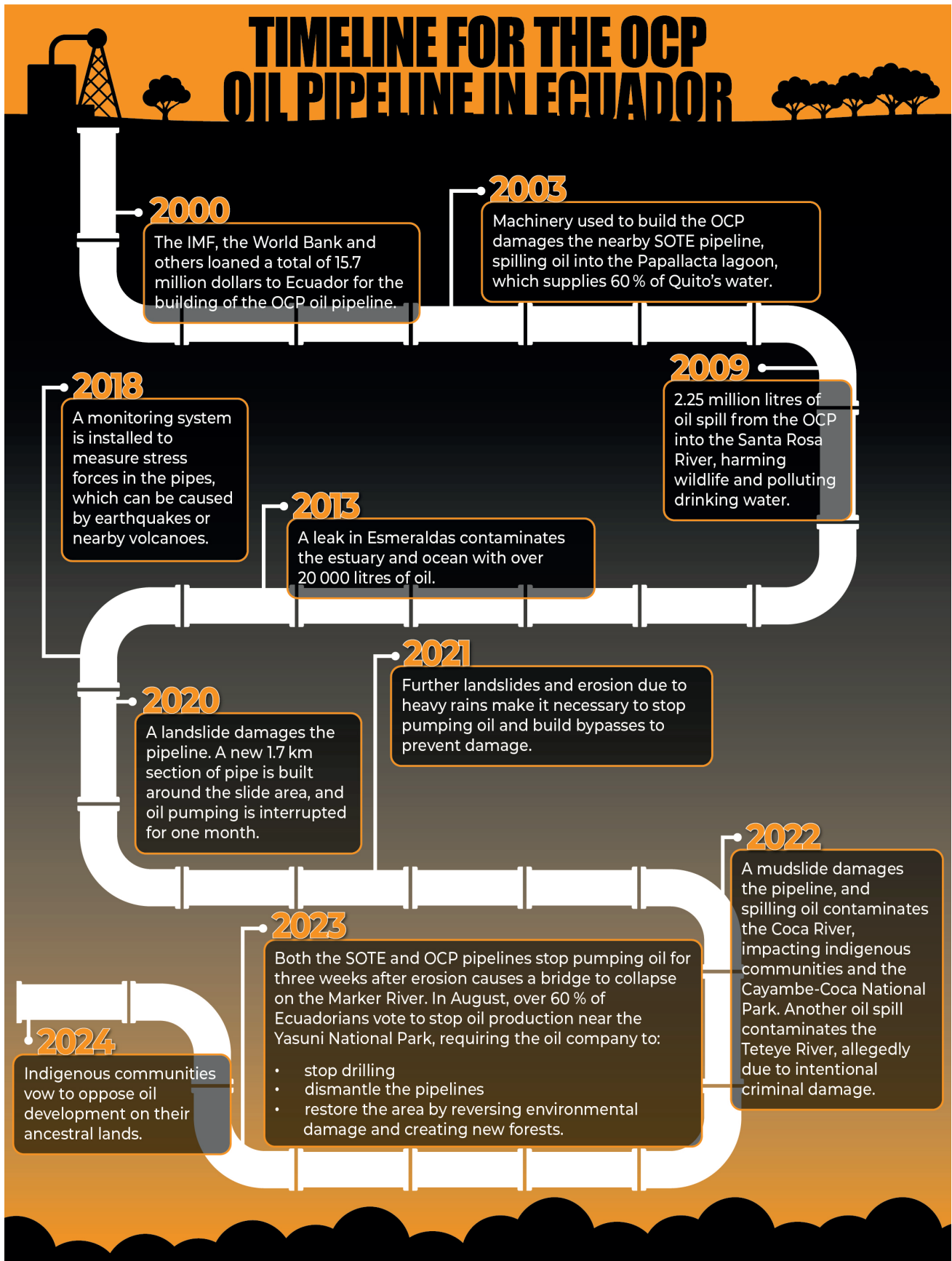


**Key:**

- The existing OCP pipeline northern route that was completed in 2003 (OCP = Oleoducto de Crudos Pesados)
- The proposed OCP southern route that was rejected in favour of the northern route
- The SOTE pipeline that was completed in 1972 (SOTE = Sistema del Oleoducto Transecuatoriano)
- Protected nature area

SOTE is operated by the government and OCP is run privately. Both coexist today and are fully functional.

Figure 6(b): Timeline for the OCP oil pipeline



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

- Ecuador's mountainous terrain and rivers allow for hydropower generation, however this does not work in dry weather conditions.
- During dry weather conditions, Ecuador relies on oil-fired plants for power generation.
- Liquid petroleum gas (LPG) is subsidized by the government and is commonly used in household cooking and heating water.
- A new programme seeks to change the energy source for residential kitchens from LPG to more efficient electric induction cookers.

**Figure 7(b): Ecuador's energy consumption by source (1965-2023)**

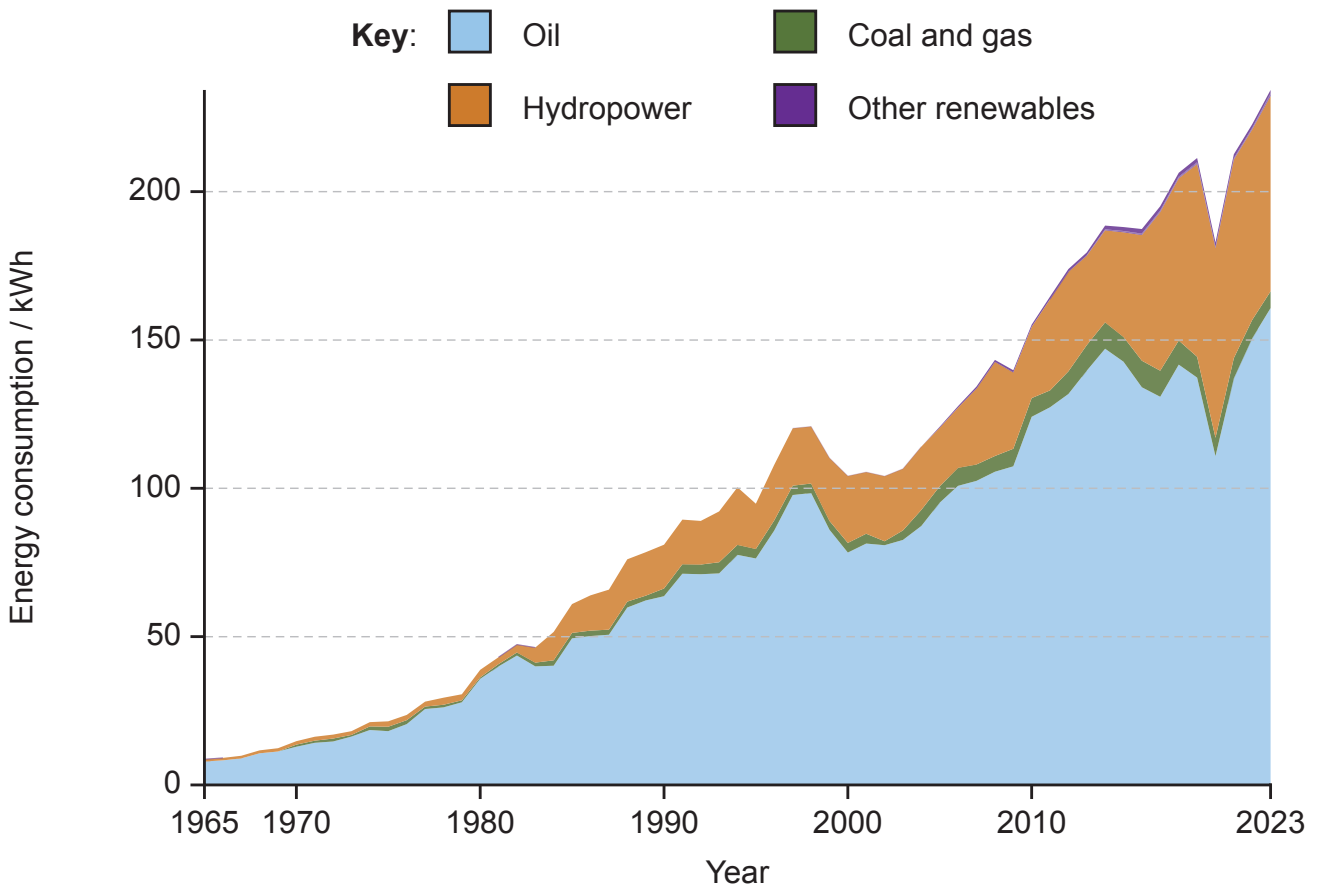
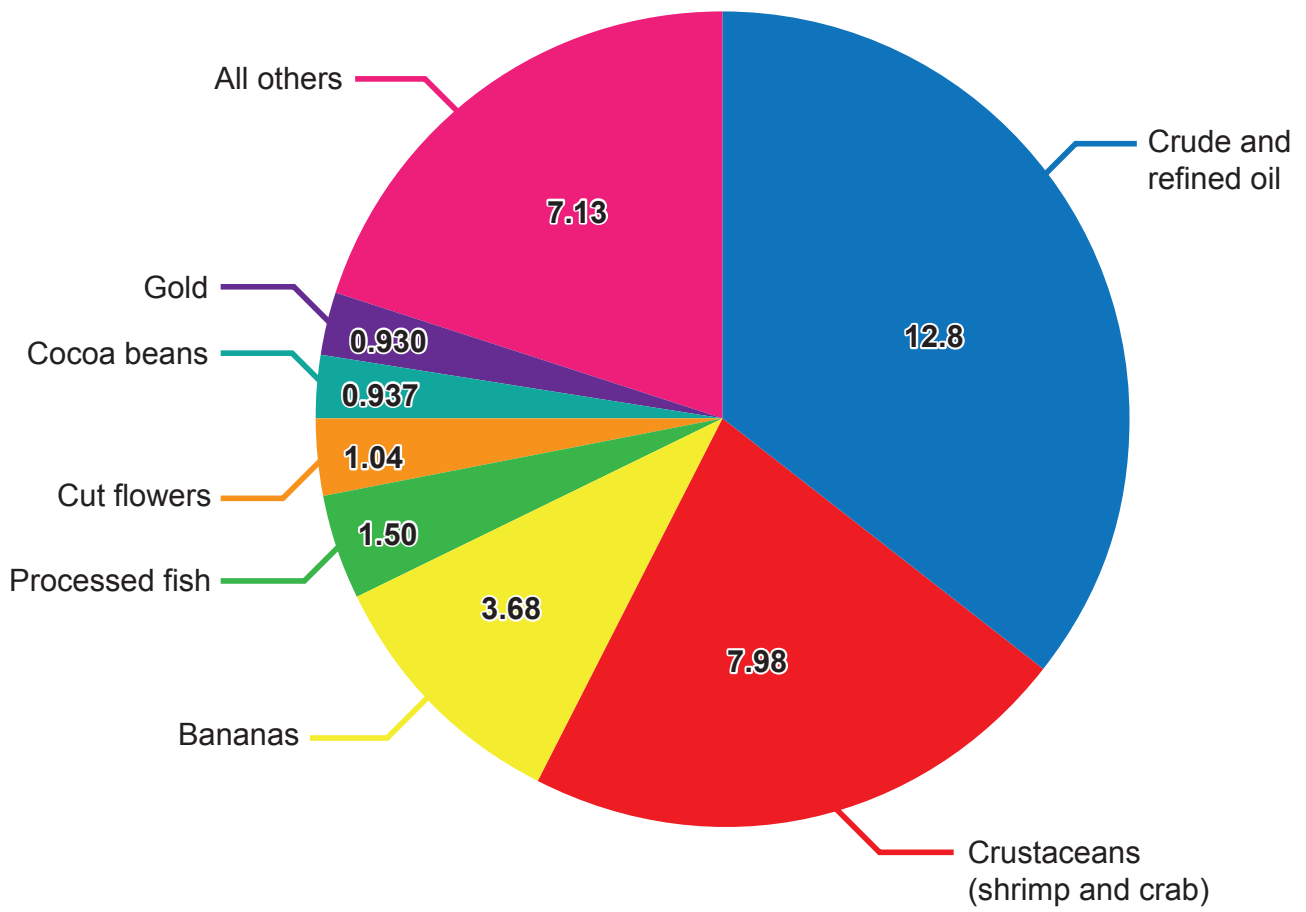


Figure 8: Ecuador's main exports by value (billions of USD) for 2022



\*Each wedge represents billions in USD

Figure 9(a): Topographic map and percentage cloud frequency map of Ecuador

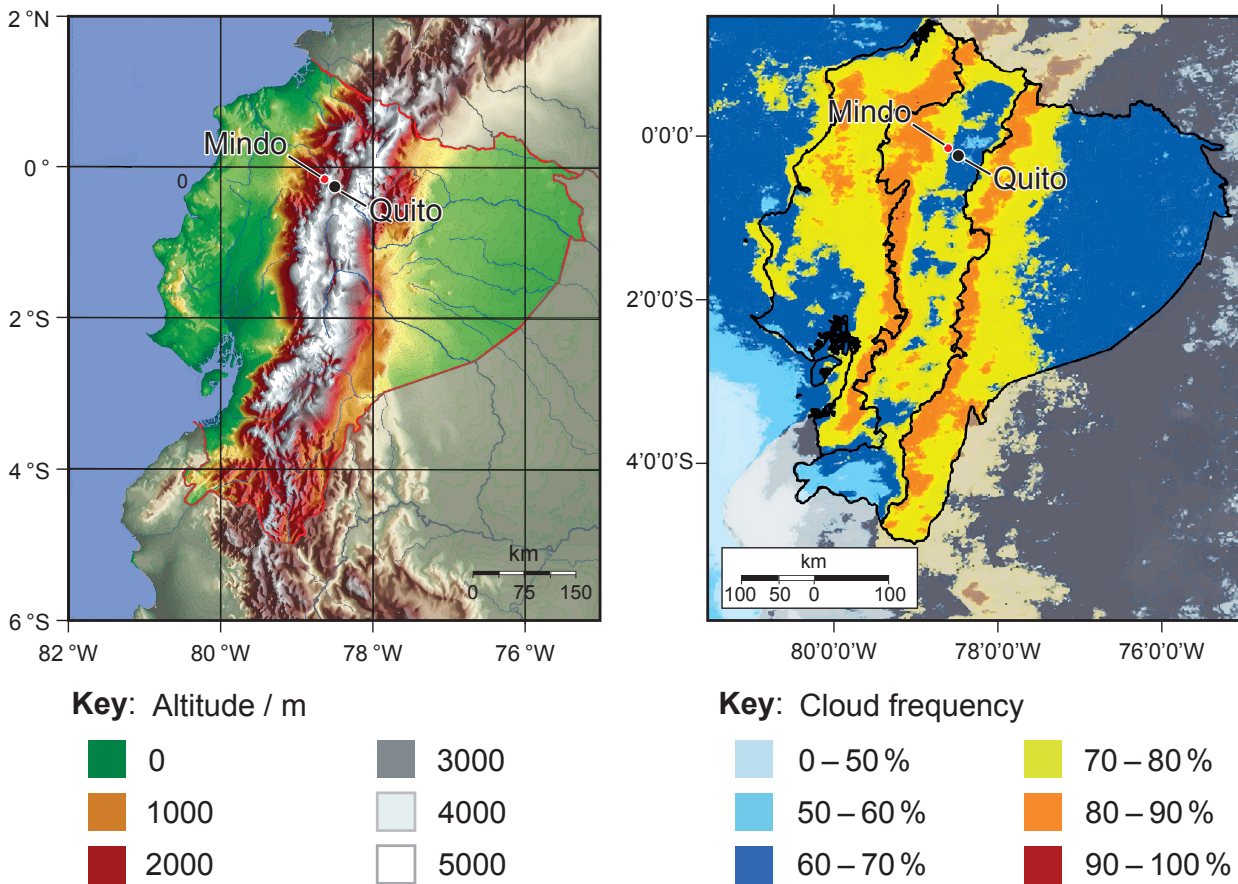
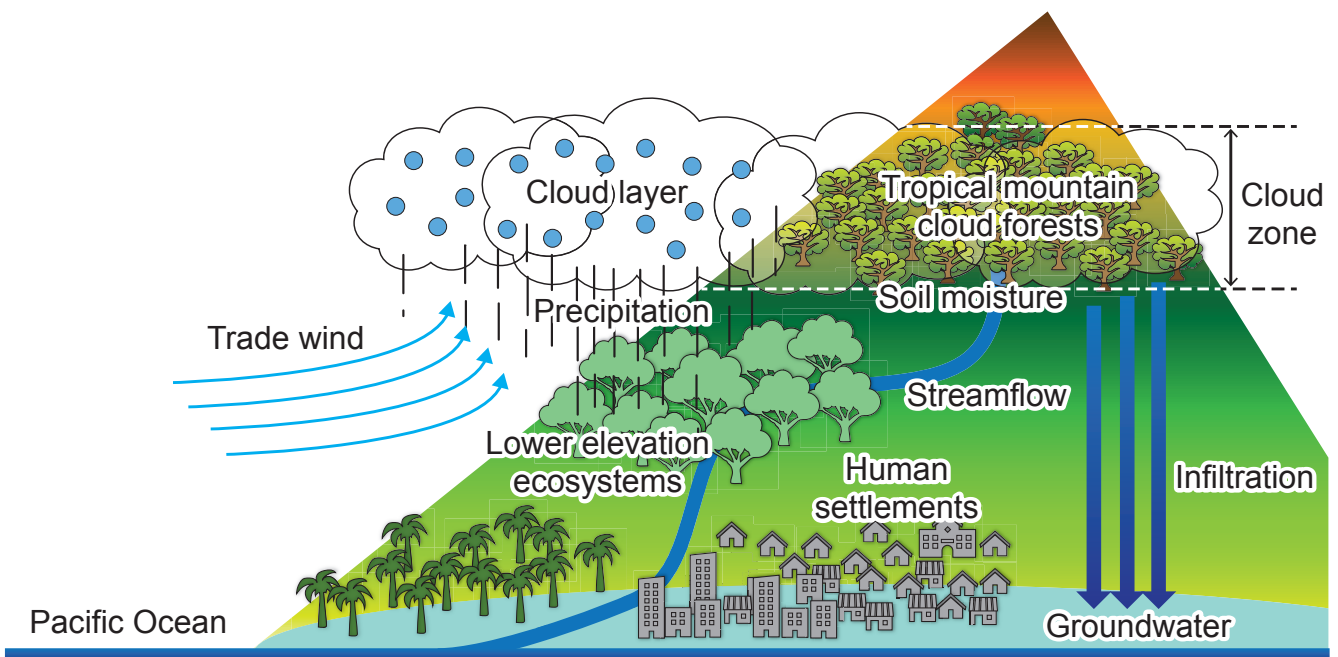


Figure 9(b): Relationship of cloud forest with hydrological cycle



**Figure 9(c): Cloud forest tree adaptation for water condensation and absorption**

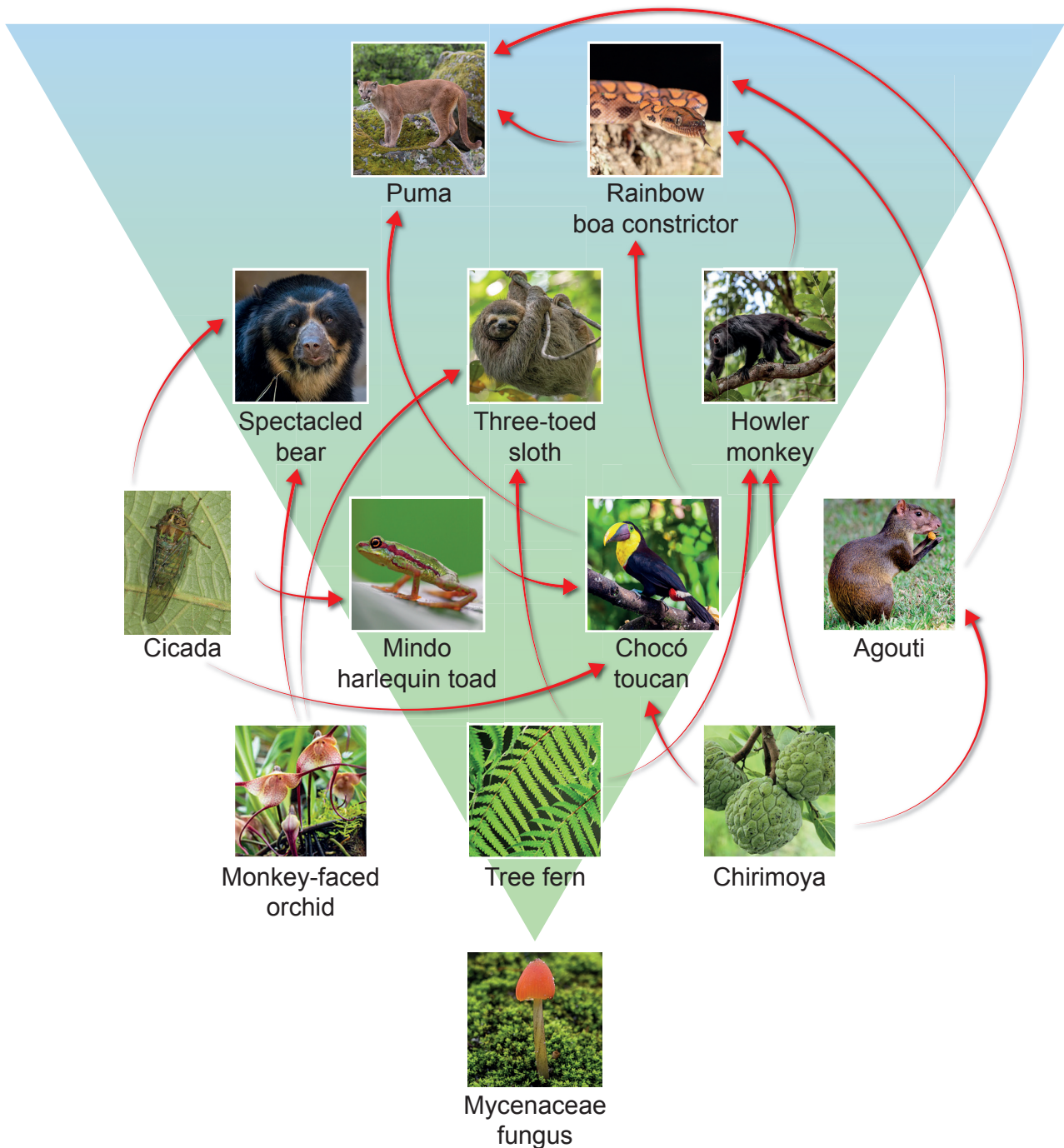
Trees in the Mindo cloud forest have several adaptations that are crucial for their survival. These adaptations include:

- Fog drip utilization: this is when water droplets in fog condense on the leaves and drip to the forest floor. This increases the water content in the soil at the base of the tree.
- Leaf structure: leaves are often smaller and thicker, reducing water loss from transpiration. The leaves are also able to absorb water directly via a process called foliar uptake, more efficiently than trees outside of the cloud forest.
- Tree crowns: the crown or top of the tree disrupts wind driven cloud moisture forming fog drip.

**Figure 10(a): Fact file on Mindo cloud forest**

- Only one third of Ecuador’s identified cloud forest sites are protected.
- The Mindo-Nambillo cloud forest reserve forms part of several protected areas across Ecuador.
- The Mindo cloud forest covers an area of 268 km<sup>2</sup>.
- This forest is home to several indigenous subgroups of the Quichua people.
- The village of Mindo is located due west of the reserve and is known for its chocolate, which is made from locally grown cacao.
- Various organizations are working in Mindo with local farmers to find alternatives to cattle ranching, and with indigenous groups to develop more sustainable agricultural practices, which will reduce habitat destruction.

**Figure 10(b): Simplified food web for Mindo cloud forest**



**Figure 10(c): Fact file on Mindo harlequin toad**

- Endemic (not found elsewhere) to the Mindo cloud forest.
- This toad was considered extinct until five specimens were found in 2019. It is currently classified as critically endangered by the IUCN Red List.
- This toad and other amphibians are threatened by chytrid fungal disease, habitat degradation, pesticide pollution and invasive species.
- North American rainbow trout were introduced to Ecuadorian rivers in the 1920s for sport fishing and aquaculture. This invasive species feeds on the tadpoles of the Mindo harlequin toad and other amphibians.
- The chytrid fungal disease is thought to have originated in East Asia and spread because of the exotic pet trade.

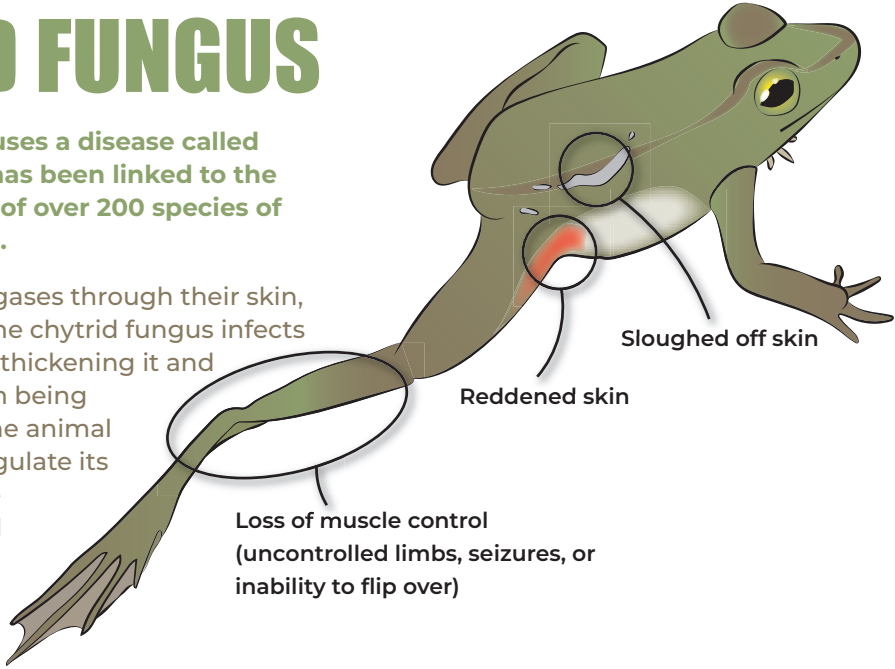
**Figure 10(d): Mechanism of chytrid fungus infection in Mindo amphibians**

# CHYTRID FUNGUS

The Chytrid fungus causes a disease called chytridiomycosis and has been linked to the decline and extinction of over 200 species of amphibians worldwide.

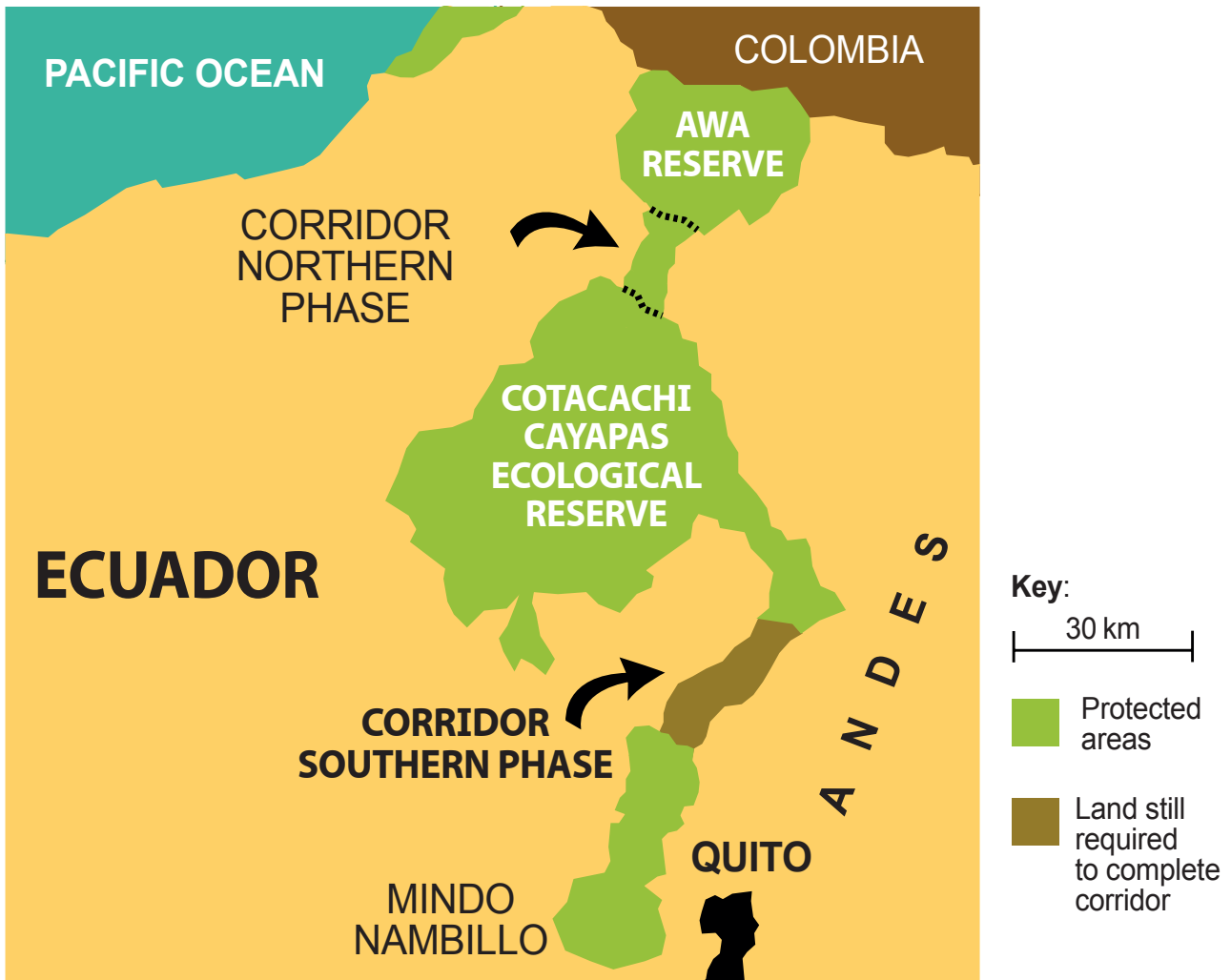
Amphibians exchange gases through their skin, as well as their lungs. The chytrid fungus infects the outer layers of skin, thickening it and preventing oxygen from being absorbed. As a result, the animal cannot breathe well, regulate its temperature or balance important minerals and nutrients in its cells. They lose muscle control and the infected skin turns red and falls off.

There is no cure and those infected experience 85-100% mortality.



The diagram illustrates a frog with several symptoms of chytrid fungus infection. A circular inset shows a magnified view of the frog's skin, revealing a thick, irregular layer of sloughed-off skin. Another inset shows a patch of skin that has turned bright red, labeled 'Reddened skin'. A third inset shows the frog's hind legs, which are splayed out and uncontrolled, labeled 'Loss of muscle control (uncontrolled limbs, seizures, or inability to flip over)'. The frog is shown in a crouching position, with its body and limbs appearing somewhat rigid and uncoordinated.

Figure 11: Protected corridor proposal to connect Mindo cloud forest with other Ecuadorian reserves



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- Figure 6(b)** Text adapted from Global Energy Monitor. [www.gem.wiki/Crudos\\_Pesados\\_Oil\\_Pipeline](http://www.gem.wiki/Crudos_Pesados_Oil_Pipeline).
- Figure 7(b)** Our World in Data. *Energy consumption by source, Ecuador* <https://ourworldindata.org/profile/energy/ecuador#what-sources-does-the-country-get-its-energy-from>. OurWorldinData.org/energy. Licensed under CC BY 4.0 <https://creativecommons.org/licenses/by/4.0/>. Source adapted.
- Figure 8** The Observatory of Economic Complexity (OEC). <https://oec.world/en/profile/country/ecu?selector2652id=2022&selector2427id=valueOption>. Creative Commons - CC0 public domain license <https://creativecommons.org/public-domain/cc0/>. Source adapted.
- Figure 9(a)** Left: Sadalmelik. [https://commons.wikimedia.org/wiki/File:Ecuador\\_Topography.png](https://commons.wikimedia.org/wiki/File:Ecuador_Topography.png). Public domain. Source adapted.
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**Figure 10(d)** Alithographica. [https://commons.wikimedia.org/wiki/File:Science\\_fact\\_friday\\_chytrid\\_fungus\\_in\\_amphibians\\_by\\_alithographica\\_dc20ae6-fullview.jpg](https://commons.wikimedia.org/wiki/File:Science_fact_friday_chytrid_fungus_in_amphibians_by_alithographica_dc20ae6-fullview.jpg). Licensed under CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0/deed.en>. Source adapted.

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