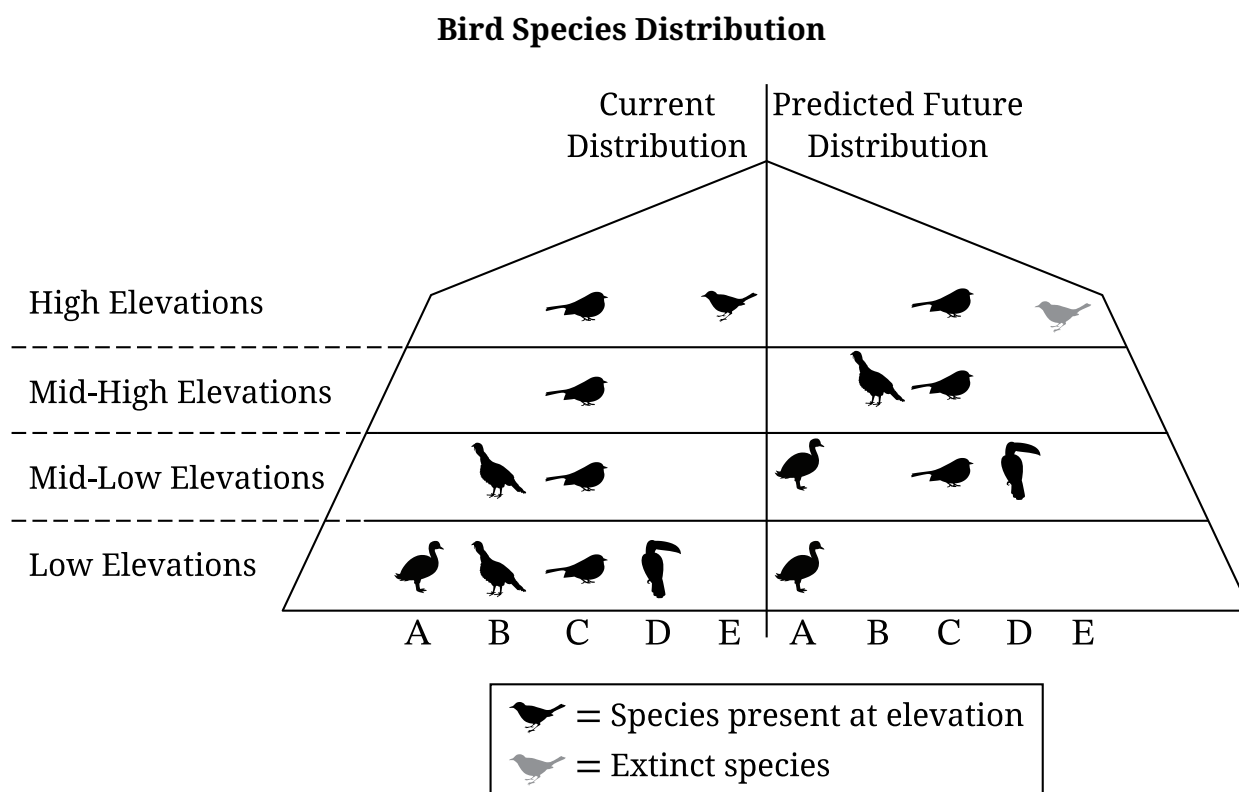


The following information applies to parts A, B, C, D, and E.

Climate change can affect both terrestrial and marine organisms. Researchers studying the effect of climate change on bird distribution mapped elevation zones at which five bird species lived within a tropical mountain range. Birds are distributed in part according to climate-related adaptations. Researchers modeled where the birds would most likely live in the future based on climate change predictions.

The results of this study are shown in the following diagram. Each unique shape in the diagram represents a different bird species, labeled A through E. Current distribution is shown on the left side of the figure, and predicted future distribution is shown on the right.

**The following information applies to parts F, G, and H.**

Some organisms such as birds can move in response to environmental changes, while other organisms such as corals cannot. Researchers studying the effect of climate change on marine organisms conducted two experiments involving photosynthetic algae that have a symbiotic relationship with corals.

In Experiment 1, the researchers placed photosynthetic algal colonies living in corals in three different saltwater tanks. The temperature of Tank 1 was set to 27°C, the average temperature at which most corals live. Water circulation in each tank mimicked natural ocean currents. After 30 days, the researchers counted the number of bleached corals. The tank setups are shown in the following list.

- Tank 1: 27°C and no sediment
- Tank 2: 32°C and no sediment
- Tank 3: 37°C and no sediment

In Experiment 2, the researchers used the same photosynthetic algae living in corals but modified the conditions of the tanks as shown in the following list. Water circulation kept the sediment in the tanks suspended. After 30 days, the researchers counted the number of bleached corals.

- Tank 1: 27°C and no sediment
- Tank 2: 27°C and moderate sediment
- Tank 3: 27°C and high sediment

1. Respond to parts A, B, C, D, E, F, G, H, I, and J.

Part A

Based on the information in the diagram, **identify** the elevation zone that has the highest species richness for the current distribution.

Part B

Describe a climate condition at high elevations that is different than it is at low elevations.

Part C

A predator at low elevations currently feeds on Species C and D. Based on the information in the diagram, **describe** what could happen to the predator species in the future in response to the predicted changes in the prey community.

Part D

Species C is considered a generalist, while Species E is considered a specialist. **Explain** why Species C and E are predicted to respond differently to climate change.

Part E

Based on the information in the diagram, **explain** why the bird community at low elevations in the future would be less likely to recover from natural disruptions than the current low-elevation bird community.

Part F

Identify the independent variable in Experiment 1.

Part G

Identify a likely scientific question for Experiment 1.

Part H

In Experiment 2 the temperature of the tanks was held constant, while the amount of sediment was varied. **Explain** how this modification could affect the results of this experiment.

Part I

Changes in climate also affect Arctic ecosystems. One impact of climate change is the loss of ice and snow in polar regions. **Describe** a positive feedback loop that results from the loss of ice and snow in polar regions.

Part J

Describe one problem that Arctic species, such as polar bears or ringed seals, face because of warming in polar regions.

The following information applies to parts A, B, C, D, E, and F.

Ocelots are small wildcats that were previously found in 25 counties in Texas where shrubland is prevalent. As a result of land use changes, only 74 ocelots remain in 4 counties in Texas today. Rodents such as pocket mice are the main source of food for ocelots, but ocelots also prey on other small animals such as snakes and lizards.

3. Respond to parts A, B, C, D, E, and F, and all subparts.**Part A**

Identify one environmental consequence that could result from having a smaller population of ocelots.

Part B

Calculate the percent change in the number of Texas counties where ocelots have been found historically as compared to today. **Show** your work.

Part C

Researchers expect the ocelot population to grow at a constant rate of 2.8% per year. **Calculate** the number of years it will take for the ocelot population to double based on a constant rate of growth. **Show** your work.

Part D

Pocket mice eat plants in the shrubland, while snakes are carnivores. **Explain** why the amount of primary production energy available to ocelots would change if ocelots ate only carnivores such as snakes and not pocket mice.

Part E

Ocelots need 720 grams of food per day. Pocket mice weigh an average of 43 grams each. If the ocelot diet consists of 46% pocket mice by weight, **calculate** how many pocket mice an ocelot would need to consume in one day, assuming each mouse weighs the average amount. **Show** your work.

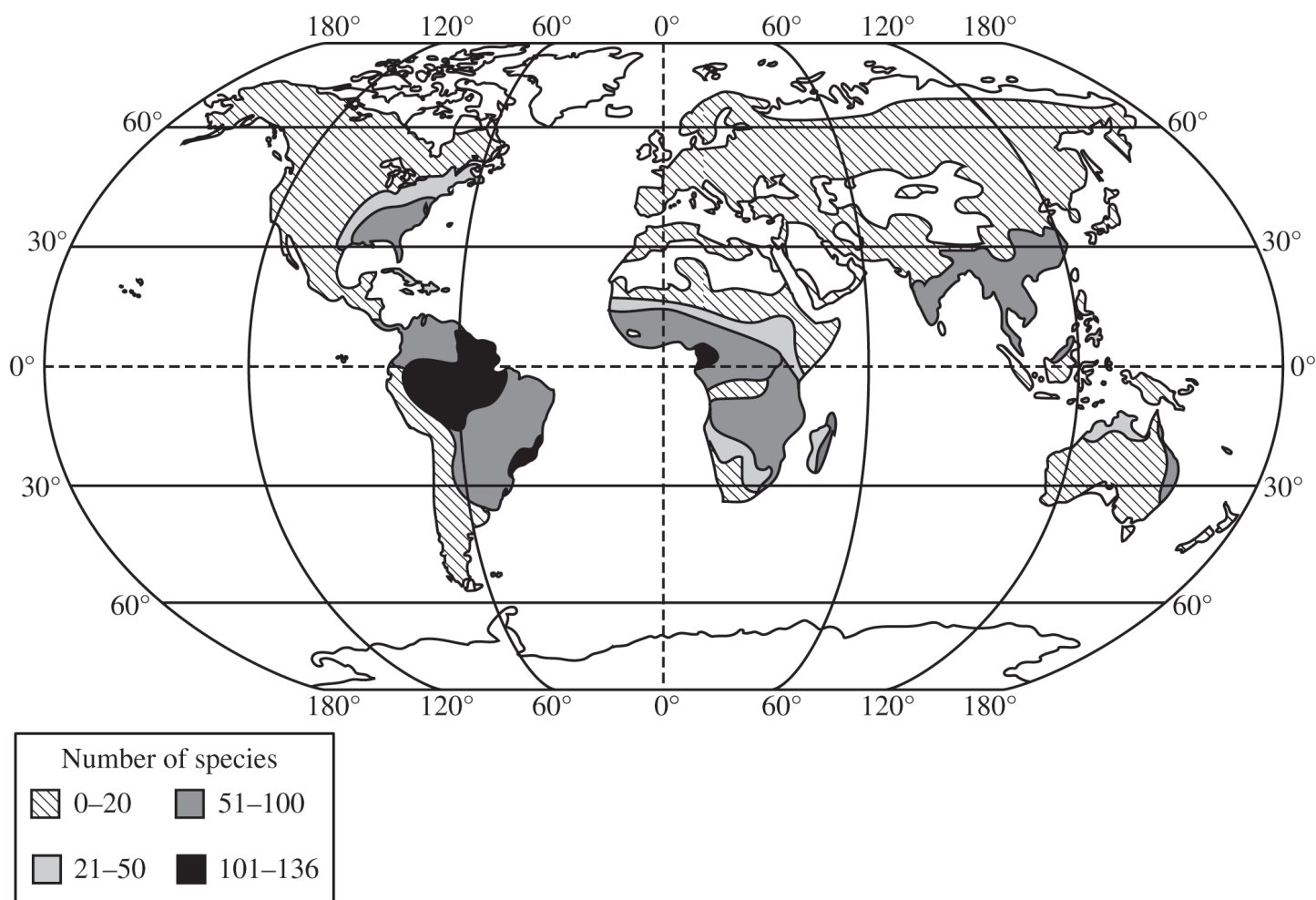
Part F

As urbanization has increased in southern Texas, motor vehicle collisions have become the main cause of death in ocelots, which poses an added threat to the remaining ocelots.

- i. **Propose** a realistic solution to reduce the number of ocelots killed by vehicles.
- ii. **Justify** the solution proposed in part F (i) by explaining an additional advantage, other than reducing the number of ocelots killed by vehicles.

STOP
END OF EXAM

GLOBAL AMPHIBIAN SPECIES RICHNESS



2. Biodiversity around the world is changing as a result of anthropogenic influences.

(a) The map represents species richness of amphibians around the globe. Use the map to answer the following questions.

(i) **Identify** the latitudinal range with the greatest amphibian species richness.

(ii) **Identify** what biome this range most likely represents.

(iii) **Describe** one reason amphibian species richness would tend to be highest in this region.

(b) There are many environmental threats facing amphibians today, such as deforestation. **Describe** one possible anthropogenic reason for deforestation.

(c) Many factors influence biodiversity.

(i) **Explain** how the species richness of an ecosystem influences its response to environmental stressors.

(ii) **Explain** why amphibian biodiversity is declining globally, other than from deforestation.

(d) Currently, wildlife species are going extinct at an alarming rate. To combat this threat, governments around the world have enacted legislation and signed treaties to protect species threatened by extinction.

- (i) **Identify** one specific piece of legislation that has been designed to protect species threatened by extinction.
- (ii) **Explain** how the requirements of the legislation identified in part (d)(i) specifically protect species threatened by extinction.
- (e) A town is considering selling an undeveloped parcel of land along its border for residential developments. The square parcel of land consists of approximately 30% wetland and 70% pasture. The wetland runs through the middle of the property for its entire width and is home to three native frog species.
- (i) **Propose** a viable solution that will result in the protection of the native frog species while still allowing for maximum profit of the property development.
- (ii) **Justify** the solution proposed in (e)(i) by describing a potential advantage of the plan, other than frog protection.

Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

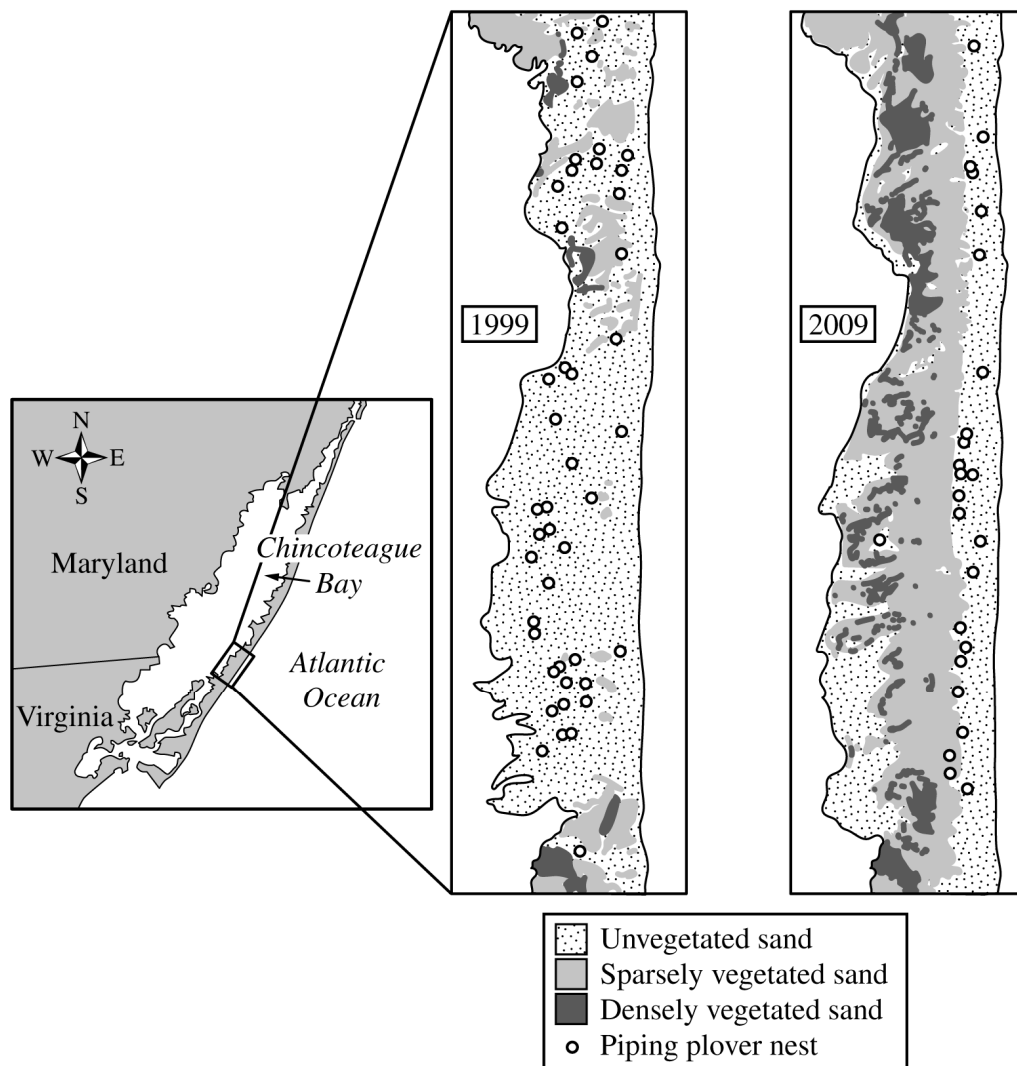
ENVIRONMENTAL SCIENCE**SECTION II****Time—1 hour and 30 minutes****4 Questions**

Directions: Answer all four questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers on the pages following the questions in this book. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples.

1. The piping plover is a globally threatened species, with perhaps as few as 2,000 nesting pairs remaining in the Atlantic population of these migratory shorebirds. Plovers were nearly hunted to extinction in the nineteenth century.

Plovers prefer to nest and search for food on open sandy beaches between sparsely vegetated sand dunes. Washovers, where sand is washed up from the beach and buries vegetated areas during big storms, are also important to plovers because they provide moist and undisturbed habitat for plover adults and their chicks. Ecologists with the Elliott Oceanographic Institute mapped the distribution of plover nests during two seasonal surveys of nesting sites over a ten-year period on Assateague Island. This is a barrier island, a long, narrow island running parallel to the Atlantic coast of Virginia.

**SPRING PIPING PLOVER NESTING SITES
ON ASSATEAGUE ISLAND, VIRGINIA**



(a) Use the maps provided to answer the following questions.

- (i) **Identify** the preferred nesting habitat for piping plovers.
- (ii) **Describe** the change in the number of piping plover nests on Assateague Island between 1999 and 2009.
- (iii) **Describe** one likely reason for the change in the number of piping plover nests between 1999 and 2009.

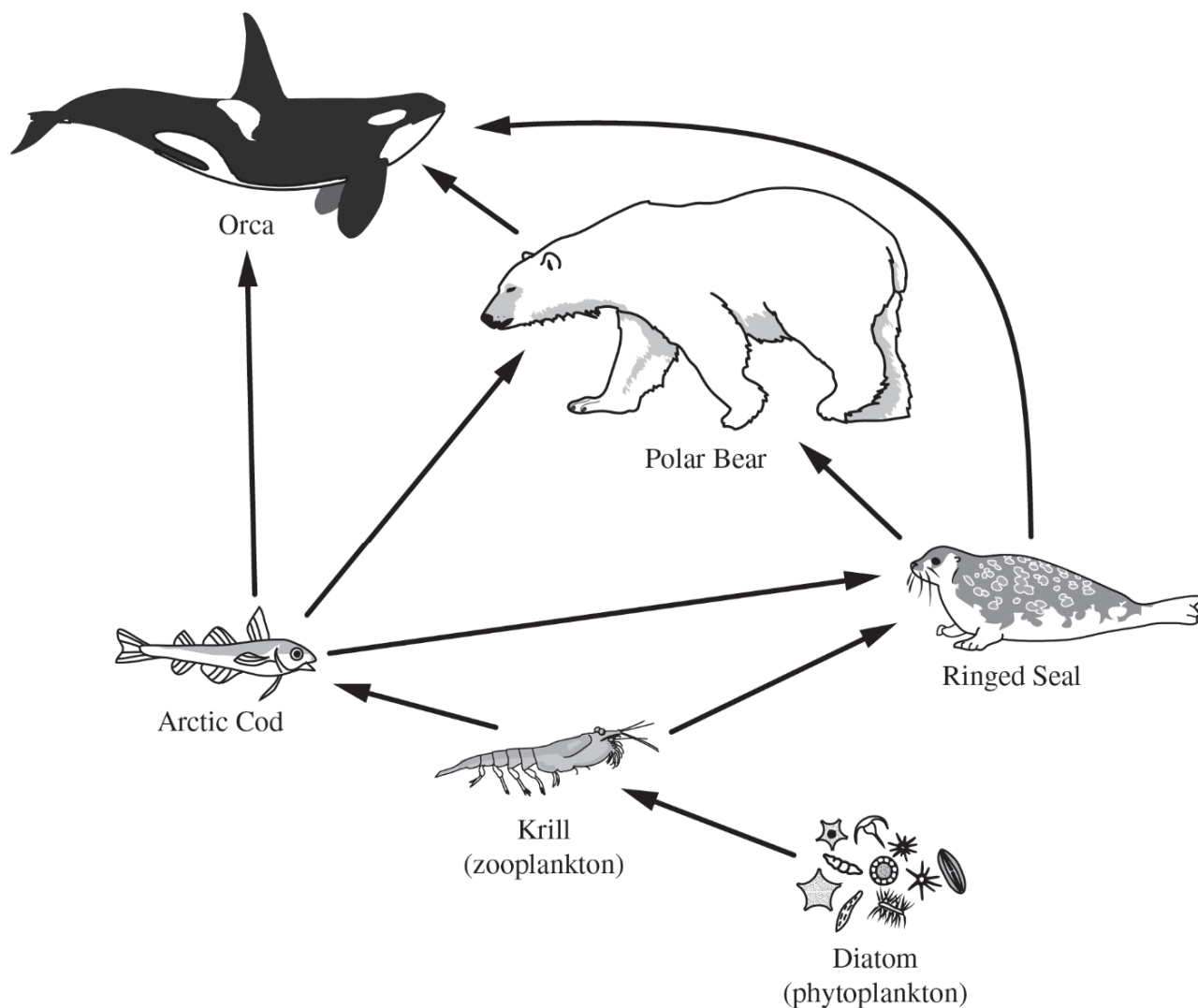
(b) Coastal species are affected by more than just natural events.

- (i) Special beach restrictions can help piping plovers during nesting season. **Describe** one restriction that could reasonably be implemented to help prevent the destruction of plover nests by human actions.
- (ii) In addition to providing habitat for piping plovers, barrier islands (and closely related landforms) are important for other reasons. **Explain** one way that these features help to preserve and protect the environment in coastal regions.
- (iii) **Identify** one human action that directly threatens coastal habitats and **describe** one impact on species, other than the piping plover, that use the habitat.

Approximately 40% of the United States population resides in coastal areas, such as areas near Assateague Island, where sea level rise and shoreline erosion is occurring.

- (c) **Identify** one economic impact on coastal communities that has resulted from rising sea levels.
- (d) **Describe** TWO methods that may be used locally to protect coastal communities from rising sea levels.

3. An Arctic food web includes the following organisms.



Note: Figures not drawn to scale.

(a) Refer to the food web above to complete the following table.

	Organism from Arctic food web
(i) Identify a primary producer	
(ii) Identify a primary consumer	
(iii) Identify a secondary consumer	

(b) Other than showing which organisms are consumed by other organisms, **describe** what is indicated by the direction of the arrows in the diagram.

As the amount of sea ice has decreased, larger expanses of the Arctic Ocean are now completely free of sea ice for several weeks each summer. Ringed seals, the preferred prey of polar bears, come to holes in the sea ice to breathe.

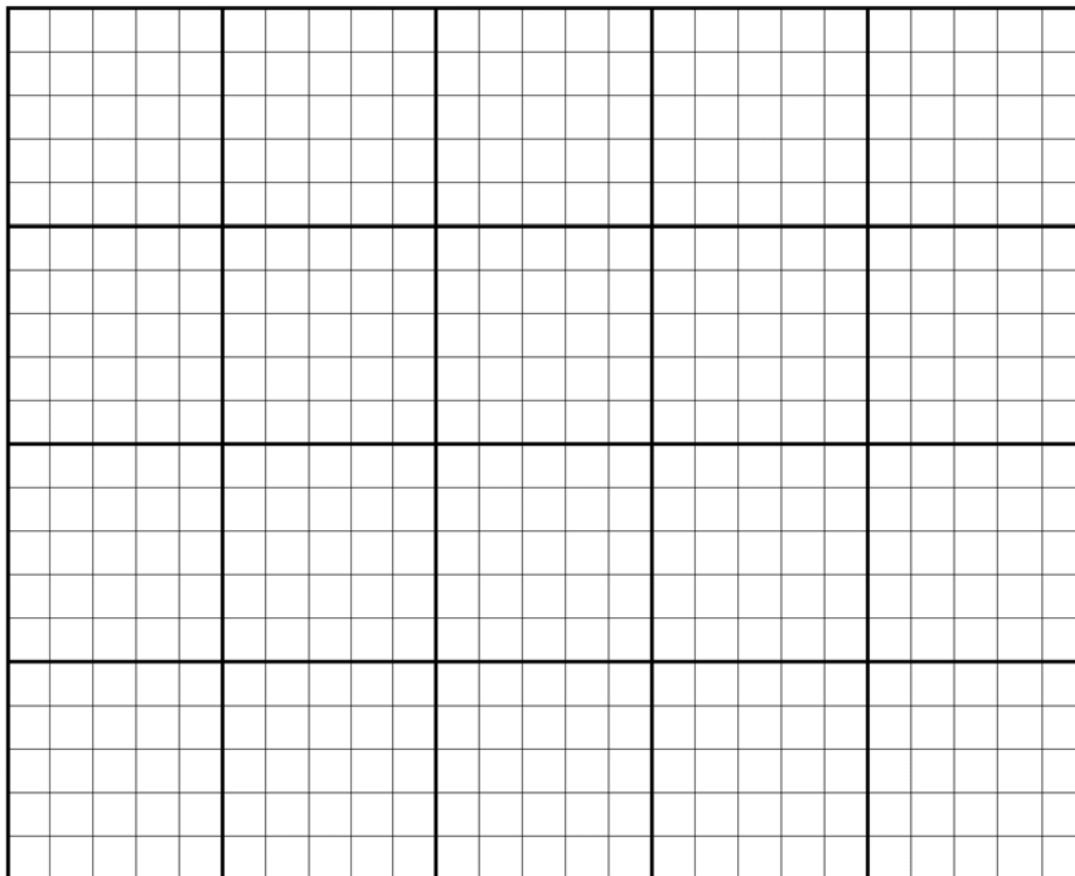
- (c) **Describe** how the change in sea ice habitat is affecting polar bears' ability to hunt and feed.
- (d) **Explain** how melting sea ice leads to a feedback loop that increases Arctic warming.
- (e) Many species, including some whales and birds, will travel thousands of kilometers during annual migrations.
 - (i) **Provide** one reason a species may migrate a long distance.
 - (ii) The North Atlantic right whale migrates between subtropical and polar waters annually. Nearly 50 percent of right whale deaths are due to human activities. **Describe** one commercial activity, other than whaling, that may result in the death of right whales.
 - (iii) **Describe** one strategy that could reasonably be implemented to decrease right whale deaths caused by the commercial activity you described in part (ii).

2. Populations of large terrestrial animals, such as African elephants and snow leopards, are in decline around the world. Many of these large animals are now on the verge of extinction.

ESTIMATED AFRICAN
ELEPHANT POPULATION
ON THE AFRICAN
CONTINENT

Year	Population
1970	2,000,000
1980	1,300,000
1990	600,000
1995	550,000
2000	400,000
2005	550,000
2010	650,000
2015	600,000

- (a) Using the data provided in the table above, **plot** the elephant population data as points on the grid below, placing the independent variable on the x -axis. Clearly **label** the axes.



- (b) **Calculate** the percent loss of elephants in Africa from 1970 to 2000. Show all work.
- (c) The International Union for Conservation of Nature (IUCN) estimates that the elephant population will decline by 20 percent between 2015 and 2022. Use this estimate to **calculate** how many elephants will be left in Africa in 2022. Show all work.
- (d) Most large terrestrial mammals are K-strategists. **Identify** one characteristic of a K-strategist and **explain** how the characteristic you identified can make these mammals prone to extinction.
- (e) **Identify** and **discuss** TWO conservation strategies that could be implemented to prevent the extinction of large terrestrial mammals, such as the African elephant or snow leopard.