

Elements of Ecology, 9e (Smith)
Chapter 27 The Ecology of Climate Change

27.1 Short Answer Questions

1) Over the past century, the Earth's climate has _____ by an estimated 0.74°C.

Answer: warmed

Topic: Section 27.1

Bloom's Taxonomy: Knowledge/Comprehension

2) Increases in temperatures have been associated with _____ in the body size of endothermic animals.

Answer: decreases

Topic: Section 27.2

Bloom's Taxonomy: Knowledge/Comprehension

3) The timing of seasonal activities of plants and animals is called _____.

Answer: phenology

Topic: Section 27.3

Bloom's Taxonomy: Knowledge/Comprehension

4) Trees in the Arctic are predicted to move _____ in response to warming trends.

Answer: north

Topic: Section 27.4

Bloom's Taxonomy: Knowledge/Comprehension

5) Differential changes in phenology can result in a _____ of timing between herbivores and their resource.

Answer: mismatch

Topic: Section 27.5

Bloom's Taxonomy: Knowledge/Comprehension

6) Plant species in the Santa Catalina Mountains have moved to higher _____ due to the effects of climate change.

Answer: elevation

Topic: Section 27.6

Bloom's Taxonomy: Knowledge/Comprehension

7) Satellite-based measures of absorbed photosynthetically active radiation (APAR) can be used to estimate terrestrial _____.

Answer: NPP

Topic: Section 27.7

Bloom's Taxonomy: Knowledge/Comprehension

8) CH₄, CFCs, and CO₂ are all considered _____ gasses.

Answer: greenhouse

Topic: Section 27.8

Bloom's Taxonomy: Knowledge/Comprehension

9) Global change predictions are often made using general circulation _____.

Answer: models

Topic: Section 27.9

Bloom's Taxonomy: Knowledge/Comprehension

10) Carbon dioxide that dissolves into the ocean forms _____ acid.

Answer: carbonic

Topic: Section 27.10

Bloom's Taxonomy: Knowledge/Comprehension

27.2 Multiple-Choice Questions

1) The wobble of the Earth is not causing the current warming trend because it takes place on a scale of

A) 410 years.

B) 4100 years.

C) 41,000 years.

D) 410,000 years.

Answer: C

Topic: Introduction to Chapter 27

Bloom's Taxonomy: Knowledge/Comprehension

2) Which part of the Earth is warming the most quickly?

A) the Arctic

B) the tropics

C) the Northern Hemisphere

D) All parts of the Earth are warming equally.

Answer: A

Topic: Section 27.1

Bloom's Taxonomy: Knowledge/Comprehension

3) How far has the global sea level risen over the past 100 years?

A) 0 mm

B) 15 mm

C) 150 mm

D) 15 cm

Answer: C

Topic: Section 27.1

Bloom's Taxonomy: Knowledge/Comprehension

4) What is the main cause of sea level rise?

- A) reduced summer sea ice
- B) warm water expanding
- C) sinking land
- D) reduced snow cover

Answer: B

Topic: Section 27.1

Bloom's Taxonomy: Knowledge/Comprehension

5) Which region has seen the largest increase in ectotherm metabolic rate?

- A) Arctic
- B) north temperate
- C) tropical
- D) south temperate

Answer: C

Topic: Section 27.2

Bloom's Taxonomy: Knowledge/Comprehension

6) In North America, what is the greatest risk of warming to trees?

- A) reduced growing season
- B) reduced water availability
- C) less variable precipitation
- D) Most species live near their thermal maximum.

Answer: B

Topic: Section 27.2

Bloom's Taxonomy: Knowledge/Comprehension

7) What is the great risk of warming to tropical marine species?

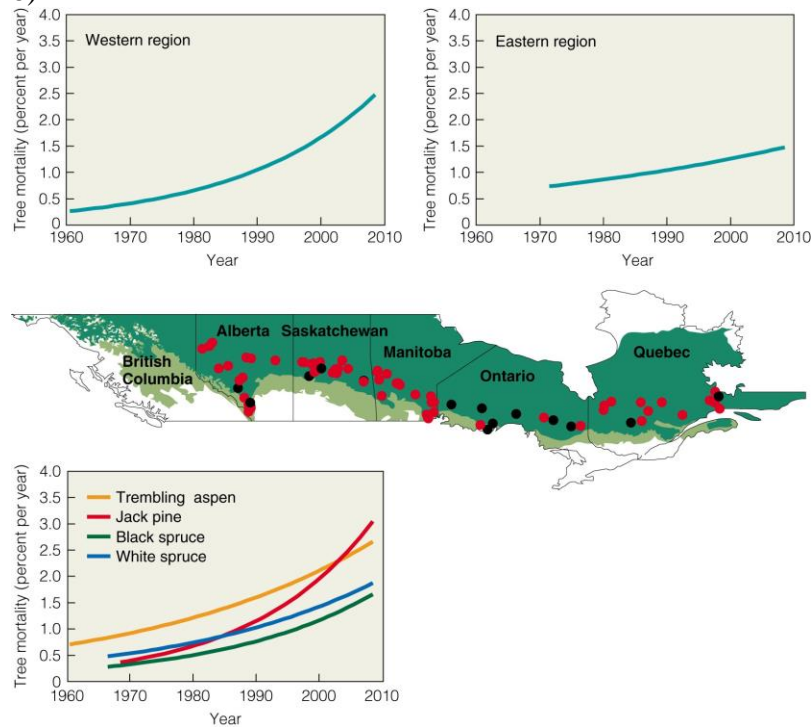
- A) reduced growing season
- B) reduced water availability
- C) less variable precipitation
- D) Most species live near their thermal maximum.

Answer: B

Topic: Sections 27.2

Bloom's Taxonomy: Knowledge/Comprehension

8)



Which tree species is suffering the largest current tree mortality?

- A) trembling aspen
- B) jack pine
- C) black spruce
- D) white spruce

Answer: B

Topic: Section 27.2

Bloom's Taxonomy: Application/Analysis

9) In great tits, increased warming has resulted in

- A) earlier egg laying.
- B) earlier migration schedules.
- C) greater mortality.
- D) larger body size.

Answer: A

Topic: Section 27.3

Bloom's Taxonomy: Knowledge/Comprehension

10) What effect is warming predicted to have on migration behavior?

- A) Birds will depart for migration earlier and return later.
- B) Birds will depart for migration later and return later.
- C) Birds will depart for migration earlier and return earlier.
- D) Birds will depart for migration later and return earlier.

Answer: C

Topic: Section 27.3

Bloom's Taxonomy: Application/Analysis

11) In which group of organisms has the timing of spring events changed the most in response to climate change?

- A) birds
- B) butterflies
- C) amphibians
- D) trees

Answer: C

Topic: Section 27.3

Bloom's Taxonomy: Knowledge/Comprehension

12) In some regions, butterflies are emerging earlier than the flowering of herbaceous plants. This is an issue because

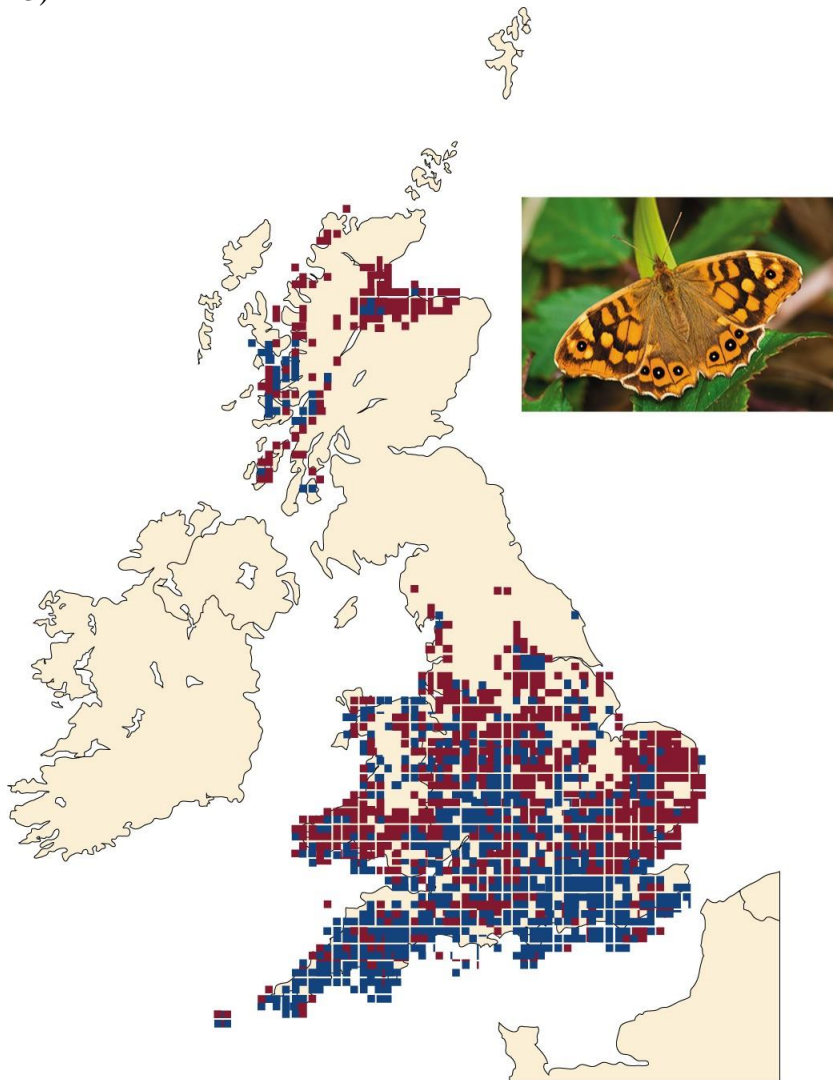
- A) butterflies rely on the flowers for food.
- B) butterflies rely on the flowers for shelter.
- C) butterflies rely on the flowers to deposit eggs.
- D) herbaceous plants rely on butterflies for food.

Answer: A

Topic: Section 27.3

Bloom's Taxonomy: Application/Analysis

13)



Data in this figure suggest

- A) butterfly populations are declining.
- B) butterfly habitat is degrading over time.
- C) butterflies are moving north over time.
- D) two species of butterflies are evolving over time.

Answer: C

Topic: Section 27.4

Bloom's Taxonomy: Application/Analysis

14) Plant species in California's Santa Rosa Mountains are seen to be

- A) moving southward.
- B) growing larger in size.
- C) moving to higher elevation.
- D) unaffected by climate change.

Answer: C

Topic: Section 27.4

Bloom's Taxonomy: Knowledge/Comprehension

15) How are the majority tree species responding to climate change in terms of distribution?

- A) moving north
- B) moving south
- C) contracting in range
- D) no change in distribution

Answer: C

Topic: Section 27.4

Bloom's Taxonomy: Knowledge/Comprehension

16) Why is the Arctic fox declining in numbers?

- A) Red fox are outcompeting them as they expand north.
- B) Resource availability is lacking.
- C) They are up against their thermal maximum with increased global temperatures.
- D) Melting ice reduces suitable habitat.

Answer: A

Topic: Section 27.5

Bloom's Taxonomy: Knowledge/Comprehension

17) How has climate change altered the mountain pine beetle?

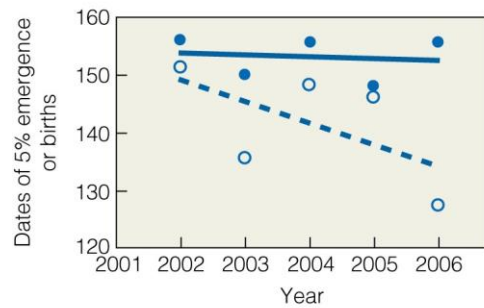
- A) They are being outcompeted by the prairie pine beetle.
- B) They now have two generations per year.
- C) They have decreased the average elevation of their distribution.
- D) Their abundance has increased through lack of predators due to mismatched phenology.

Answer: B

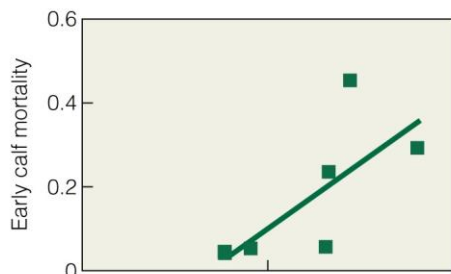
Topic: Section 27.5

Bloom's Taxonomy: Knowledge/Comprehension

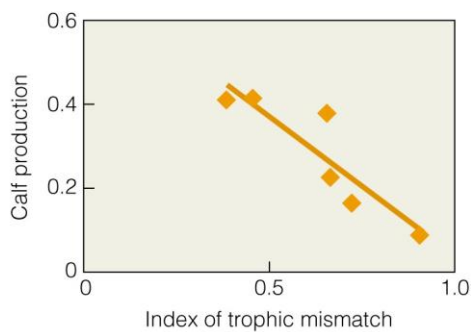
18)



(a)



(b)



(c)

What does the figure show regarding the emergence of caribou calves and their forage?

- A) Calves and forage are emerging earlier.
- B) Calves are emerging earlier but forage is not.
- C) Forage is emerging earlier but calves are not.
- D) Forage and calves are emerging later.

Answer: C

Topic: Section 27.5

Bloom's Taxonomy: Application/Analysis

19) During the last 40 years, warmer-water plankton have moved

- A) 1° in latitude north.
- B) 10° in latitude north.
- C) 1° in latitude south.
- D) 10° in latitude south.

Answer: B

Topic: Section 27.6

Bloom's Taxonomy: Knowledge/Comprehension

20) Due to global warming what occurred in fish in the North and Celtic seas?

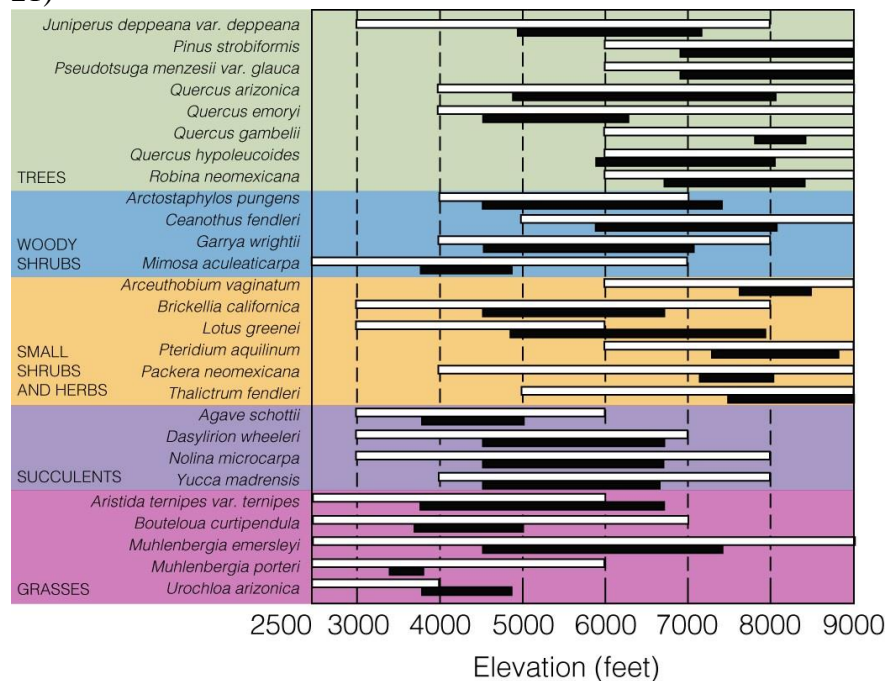
- A) Species richness increased.
- B) Species richness declined.
- C) Fewer deep-water species were present.
- D) Fewer shallow-water species were present.

Answer: A

Topic: Section 27.6

Bloom's Taxonomy: Knowledge/Comprehension

21)



What does this figure indicate?

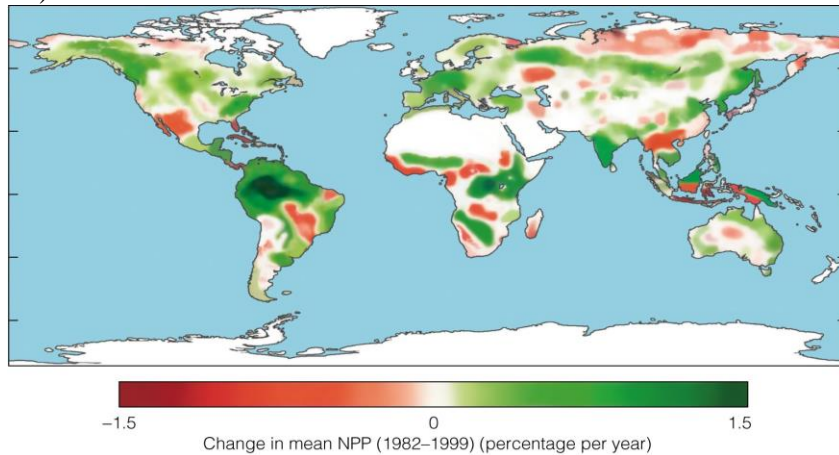
- A) Species abundances have dramatically declined.
- B) Species richness has dramatically declined.
- C) Species have moved higher in elevation over time.
- D) Species have moved lower in elevation over time.

Answer: C

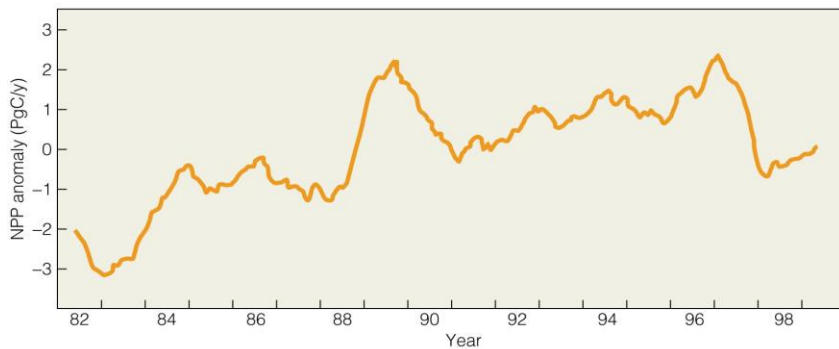
Topic: Section 27.6

Bloom's Taxonomy: Application/Analysis

22)



(a)



(b)

According to the figure, which area is seen as exhibiting only increases in NPP due to climate change?

- A) South America
- B) Africa
- C) Australia
- D) Western Europe

Answer: D

Topic: Section 27.7

Bloom's Taxonomy: Knowledge/Comprehension

23) Overall, what is the net trend of NPP due to climate change?

- A) It is increasing.
- B) It is decreasing.
- C) It is not affected.
- D) It is decreasing currently, but will soon begin to increase.

Answer: B

Topic: Section 27.7

Bloom's Taxonomy: Knowledge/Comprehension

24) Which part of the globe is responsible for the largest increase in NPP?

- A) the Arctic
- B) the United States
- C) the Amazon rain forest
- D) North Africa

Answer: C

Topic: Section 27.7

Bloom's Taxonomy: Knowledge/Comprehension

25) Which of the following is not a greenhouse gas?

- A) N₂O
- B) CO₂
- C) CH₄
- D) N₂

Answer: D

Topic: Section 27.8

Bloom's Taxonomy: Knowledge/Comprehension

26) Warming is predicted to be greatest

- A) during winter months.
- B) during summer months.
- C) in the Southern Hemisphere.
- D) in the Pacific Ocean.

Answer: A

Topic: Section 27.8

Bloom's Taxonomy: Knowledge/Comprehension

27) What is a GCM?

- A) general climate model
- B) geographic climate model
- C) general circulation model
- D) geothermal climate model

Answer: C

Topic: Section 27.8

Bloom's Taxonomy: Knowledge/Comprehension

28) The International Tundra Experiment provides evidence that

- A) the Arctic has risen in temperature by 1-3°C.
- B) species diversity will increase in the Arctic due to climate change.
- C) shrubs in the Arctic will have decreased height due to climate change.
- D) there will be less cover by lichens and mosses due to climate change.

Answer: D

Topic: Section 27.9

Bloom's Taxonomy: Knowledge/Comprehension

29) The Network of Ecosystem Warming Studies provides evidence that as a result of climate change

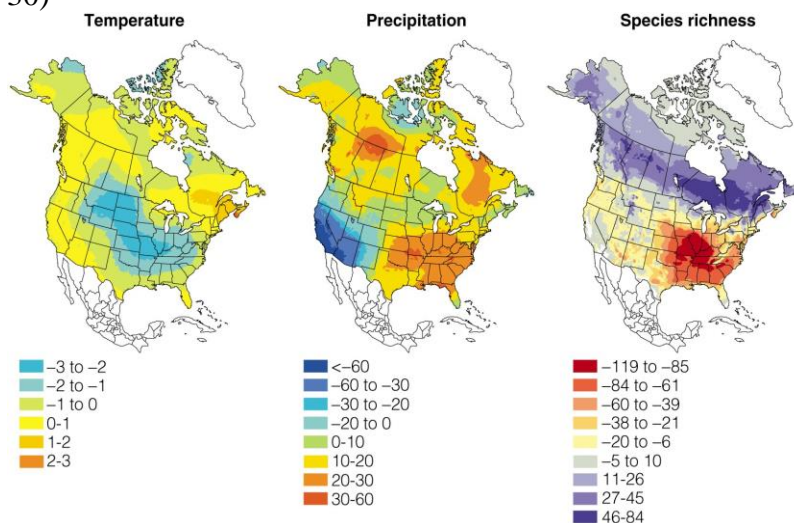
- A) net nitrogen mineralization has increased.
- B) soil respiration has decreased.
- C) plant productivity has decreased.
- D) their sites have warmed by at least 7°C.

Answer: A

Topic: Section 27.9

Bloom's Taxonomy: Knowledge/Comprehension

30)



According to the figure, California is predicted to have

- A) reduced temperatures.
- B) reduced precipitation.
- C) massive increases in species richness.
- D) massive decreases in species richness.

Answer: B

Topic: Section 27.9

Bloom's Taxonomy: Application/Analysis

31) What is the bioclimatic envelope model approach also known as?

- A) forest inventory and analysis
- B) general circulation model
- C) ecological niche model
- D) net ecosystem productivity model

Answer: C

Topic: Section 27.9

Bloom's Taxonomy: Knowledge/Comprehension

32) What percentage of carbon emissions remain in the atmosphere?

- A) 5 percent
- B) 15 percent
- C) 50 percent
- D) 90 percent

Answer: C

Topic: Section 27.10

Bloom's Taxonomy: Knowledge/Comprehension

33) The formation of carbonic acid in the oceans directly results in

- A) increased sea surface temperatures.
- B) inhibition of shell growth in marine animals.
- C) increased marine biodiversity.
- D) increased pH.

Answer: B

Topic: Section 27.10

Bloom's Taxonomy: Knowledge/Comprehension

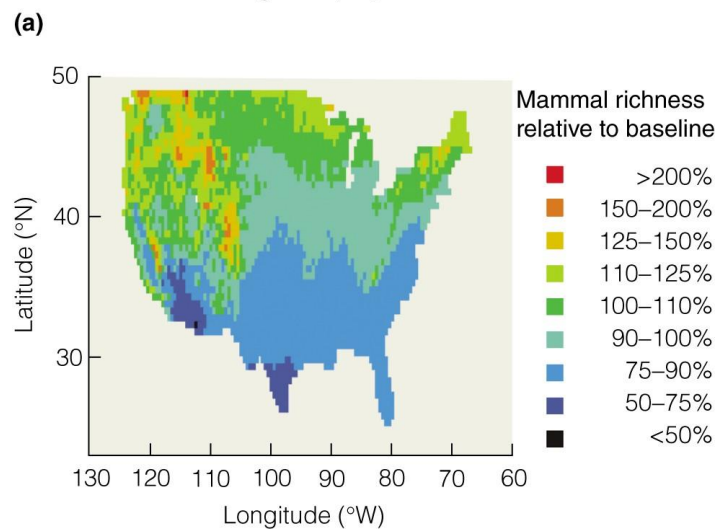
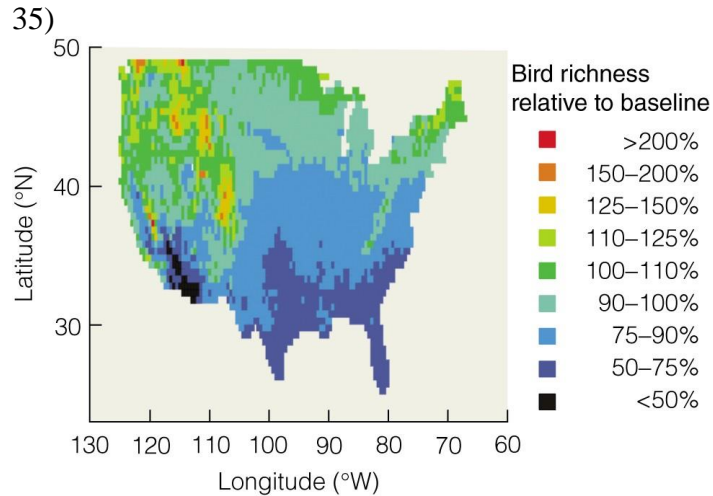
34) Which of the following would contribute to a negative feedback loop that would reduce atmospheric CO₂?

- A) increased terrestrial NPP
- B) decreased terrestrial NPP
- C) increased CO₂ emissions
- D) decreased oceanic NPP

Answer: A

Topic: Section 27.10

Bloom's Taxonomy: Application/Analysis



(b)

According to the figure most of the South in the United States is predicted to have

- A) large increases in bird and mammal richness.
- B) large decreases in bird and mammal richness.
- C) no effect in bird and mammal richness.
- D) no effect in bird but large decreases in mammal richness.

Answer: B

Topic: Section 27.10

Bloom's Taxonomy: Knowledge/Comprehension

27.3 True/False Questions

1) The "wobble" of the Earth's tilt is responsible for previous ice ages.

Answer: TRUE

Topic: Introduction to Chapter 27

Bloom's Taxonomy: Knowledge/Comprehension

2) The current warming trend on the Earth is due solely to natural fluctuations.

Answer: FALSE

Topic: Section 27.1

Bloom's Taxonomy: Knowledge/Comprehension

3) Change in temperature has been the greatest in the tropics.

Answer: FALSE

Topic: Section 27.2

Bloom's Taxonomy: Knowledge/Comprehension

4) Changes in climate have mostly delayed the spring behaviors of plants and animals.

Answer: FALSE

Topic: Section 27.3

Bloom's Taxonomy: Knowledge/Comprehension

5) Changes in climate have shifted the distribution of most species farther north.

Answer: FALSE

Topic: Section 27.4

Bloom's Taxonomy: Knowledge/Comprehension

6) Herbivores are tracking phenological changes in their resource in response to climate change.

Answer: FALSE

Topic: Section 27.5

Bloom's Taxonomy: Knowledge/Comprehension

7) There are no long-term data to support the idea that the community structure of aquatic species has changed due to climate change.

Answer: FALSE

Topic: Section 27.6

Bloom's Taxonomy: Knowledge/Comprehension

8) There is currently a drying trend due to global warming in the Southern Hemisphere.

Answer: TRUE

Topic: Section 27.7

Bloom's Taxonomy: Knowledge/Comprehension

9) By the end of this century, it is estimated that the emission of CO₂ will be double that of preindustrial levels.

Answer: TRUE

Topic: Section 27.8

Bloom's Taxonomy: Knowledge/Comprehension

10) Current methodologies and understanding allow us to make precise predictions regarding the impacts of climate change on the current abundance and distribution of species.

Answer: FALSE

Topic: Section 27.9

Bloom's Taxonomy: Knowledge/Comprehension

27.4 Essay Questions

1) Provide an argument, including three lines of evidence from Northern Hemisphere data, to support the argument that global climate change is occurring.

Topic: Section 27.1

Bloom's Taxonomy: Synthesis/Evaluation

2) Outline the differences between ectotherm and endotherm responses to climate change.

Topic: Sections 27.2

Bloom's Taxonomy: Synthesis/Evaluation

3) Explain how changes in climate might alter the phenology of three different organisms in a forest ecosystem.

Topic: Section 27.3

Bloom's Taxonomy: Synthesis/Evaluation

4) Provide an example of consumers not tracking a change in their resource phenology, and explain how different cues for each organism are responsible for this mismatch.

Topic: Section 27.5

Bloom's Taxonomy: Application/Analysis

5) Explain why net primary productivity is increasing in some areas while decreasing in others. Provide examples of each.

Topic: Section 27.7

Bloom's Taxonomy: Application/Analysis

6) Provide evidence that humans are the cause of increased CO₂ emissions.

Topic: Sections 27.8-27.10

Bloom's Taxonomy: Application/Analysis