Antarctica's Adelie Penguins Cope with Global Climate Change.

Activity Introduction

Adelie Penguins are ideally suited to life in the harsh environment of Antarctica. They spend about 90% of their lives in association with sea ice, but need bare land with a supply of small rocks to build their nest s during breeding season. The adaptations that have helped them survive in this harsh environment are now being tested as these birds must cope with climate change.

Part 1

Look at the map of Antarctica (Fig 1). Find the Antarctic Peninsula and the Ross Sea. These two locations are the focus of our story on Adelie penguins and how they are coping with changes in their environment.

The table below gives the location of three penguin colonies in Antarctica.

COLONY	Location	Longitude	Latitude
Cape Royds	Ross Sea	77° 34' S	166 ° 11' E
Cape Bird	Ross Sea	77 ° 13' S	166 ° 28' E
Anvers Island	Antarctic peninsula	64 ° 34' S	64 ° 15' W

1. What is the difference in latitude between the colony at Cape Royds and Anvers Island?

2. Every degree of latitude = about 60 miles. How much further south (closer to the South Pole) in miles, is Cape Royds?

For centuries the Antarctica Peninsula has provided plenty of seasonal sea ice as well as enough snow free land with a supply of small rocks for the Adelie to build their nest. A perfect environment for Adelie penguins. However in the early 1970's scientist started to notice a decline in the Adelie populations on the northern part of the Antarctic Peninsula. At the same time records were indicating a rise in temperature in that area.

3. Look at **Fig 2** and make a statement about the trend in penguin populations and the temperature. Record your thoughts in your journal.

4. By the beginning of the new century the population of Adelie penguins was 25% of what is was in the early 1970's. But why did the penguins leave? With your group, make a list of possible reasons for this decline in numbers and record them in your journal. Share your ideas with the class.

5. Look at **Fig 3** and make a statement about the changes in sea ice coverage in the Bellingshausen Sea. This Sea is on the west coast of the Antarctica Peninsula and is the home of the Anvers Island Adelie breeding colonies, as well as others, until recently.

The graph in Fig 3 shows a steady decline in the amount of sea ice on the western part of the Antarctic Peninsula. This observation is linked to the increase in temperatures in that area. Adelie Penguins use sea ice to forage. Their main food source, krill and small fish, live under the ice within easy reach of the diving penguins. Without sea ice, the Adelie penguins must swim further and longer to find food, and have no place to rest.

6. With your group discuss the potential link between the decline in sea ice and the decline of the Adelie penguins in these northern colonies.

Part 2

At the same time the northern colonies were decreasing, scientist noticed two colonies in the Ross Sea area that were increasing in size, Cape Royds and Cape Bird. At more southern latitudes than the Antarctica peninsula, these areas were also feeling the change in temperature and sea ice conditions.

7. Look at **Fig 4** and make a statement about the sea ice conditions and the change in penguin population.

Forty years ago, the sea ice in this area kept the population small as it was a long walk to the open ocean, making feeding their chicks a difficult task. With the increase in temperatures, the sea ice began breaking up sooner giving more penguins' easier access to the bare lands and rocks at both Cape Bird and Royds. In these years the populations have increased.

8. Compare the changes in the two latitudes of Antarctica with respect to penguin population, seas ice coverage and change in temperature. Come up with a conclusive statement about what is happening to penguin populations in Antarctica, and what is causing it.

9. Currently there are still a few Adelie groups nesting on the Antarctic Peninsula. Make a prediction about the fate of these penguins if the current temperature changes continue. Record your thoughts in your journal.

Reflection on the Activity.

With an increase in temperature causing changes in sea ice around Antarctica, Adelie penguin populations have both decreased and increased depending on what is happening to the sea ice. To complete their life cycle, Adelies need both high levels of sea ice for foraging, and bare land for nesting sites. This means that suitable habitat is limited in Antarctica and changing. Adelies are having to cope with this change in their environment. As global warming changes the penguins habitat, so it will change other species including the plants and animals that man uses as a food source.

10. What do you think would happen if our ability to grow wheat in the Midwest area of America was no longer possible? Wheat is the main ingredient in bread and the Midwest grows a large percent of America's supply.

Taking it Further.

In another part of Antarctica a different Penguin species, the Emperor, spends 100% of its life on the ice. The subject of the popular *March of the Penguins* movie, these birds lay their eggs on the sea ice far enough away from open ocean with the hope that they will be able to completely raise their chicks before the sea ice melts. If the chicks are not ready to be on their own before the open water reaches them, they will not survive. They must complete the molting process and have adult plumage which protects them from the icy waters before they can take to the water and find their own food.

11. At Pt Geologie, the location of the movie, the colony size of Emperor Penguins has been decreasing. The location of Pt Geologie is 66o33'S 139o10'E . How does that compare with the latitude at Cape Royds? How much further north in miles, is this colony?

12. Look at **Fig 5**. which shows the population trend of Emperors at Pt Geologie and the temperature. Make a statement about the future of this colony if the temperature trend continues.

Teachers Notes

Antarctica's Adelie Penguins Cope with Global Climate Change.

Activity Goals:

1. Students will gain experience in working with maps, graphs, data sets and charts.
2. Students will make conclusions about how global climate change alters habitats and species need to adapt, cope or they will die out.

Students should work in small groups to discuss the data charts and write in their journals. Possible responses are below.

1. 13^{o}.

2. 13 x 60 = 780 miles closer to the South Pole

3. As the temperature goes up the population of penguins declines.

4. Possible explanations:
   - Penguins don't' like warm weather
   - The warmer temperatures destroyed the penguin's food source
   - As the temperature increases, the ice melts and since the penguins need ice to survive they move to where there is ice.
   - Warmer weather makes it hard to raise chicks
   - The warmer temperatures melts the ice and snow around the breeding sites and water makes it impossible to build dry nests, the eggs die

5. The Bellingshausen Sea is the area of the northern Adelie penguin colonies around Ansver Island. Since the 1970's the sea ice coverage has declined. It takes longer to form in the winter and disappears earlier in the spring.

6. Adelie penguins need sea ice to complete their life cycle and spend almost 90% of their lives on the frozen floes. Their food source is found underneath the sheets of sea ice which also provide a convenient place to rest between foraging trips. Adelie penguins spend the winter months at the edge of the frozen sea ice where they have aces to open water and the undersides of the floes where they find their food.

7. At the Cape Royds and Bird breeding colonies, as the sea ice is declining the penguin colonies are increasing.

8. Adelie penguin populations are declining in some areas and increasing in others. With the increases in temperatures in the more northern latitudes the habitat of the penguins is decreasing due to the decline in sea ice. In the southern more colonies, sea ice is also changing but becoming more favorable for penguins, therefore those colonies are increasing. Penguins are coping with the climate change by moving their breeding colonies to more southern latitudes as the sea ice changes.

9. If temperature trends continue, the habitat for Adelie penguins in the northern latitude colonies will become less favorable. Those colonies will continue to decline as

the penguins become less successful at raising the next generation or simple immigrate to new areas where the habitat is more favorable.

10. If the climate changes so that wheat can not be grown in Americas Midwest, people, like the penguins will have to move to new areas where they can grow wheat.

11. Pt Geologie is 11^{o} north of Cape Royds, about 660 miles. This partially accounts for the warmer temperatures and the higher rate of sea ice melt.

12. If the temperature trends continue at Pt Geologie, the Emperor penguins will not be able to raise their chicks and the colony will continue to decline.

After students do this activity have them read the document *What is Happening to the Penguins* found on the penguinsceince.com website. They will have a better understanding of how global climate change is a) not a new phenomenon, b) how the current trend is altering the habitat of Adelie penguins, and c) the potential for man to alter his life style

Antarctica's Adelie Penguins Cope with Global Climate Change.

Fig 1. Map of Antarctica

Courtesy of Glacier.edu

Fig 2. Changes in Adelie penguin populations at Northern colonies near Ansver Island since 1974.

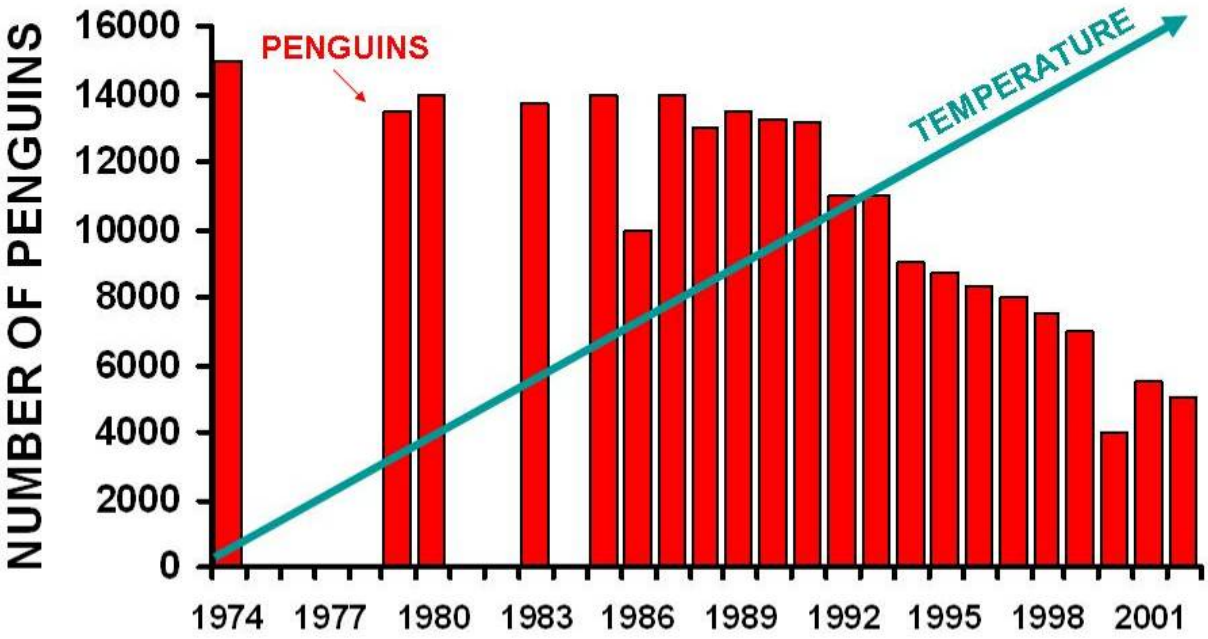

Fig 3. Changes in sea ice coverage around the Antarctica Peninsula.

Figure 9.4 Changes in annual extent of sea ice in the Ross Sea and Bellingshausen Sea (west coast of Antarctic Peninsula). *Data from Stammerjohn and Smith.*[46]

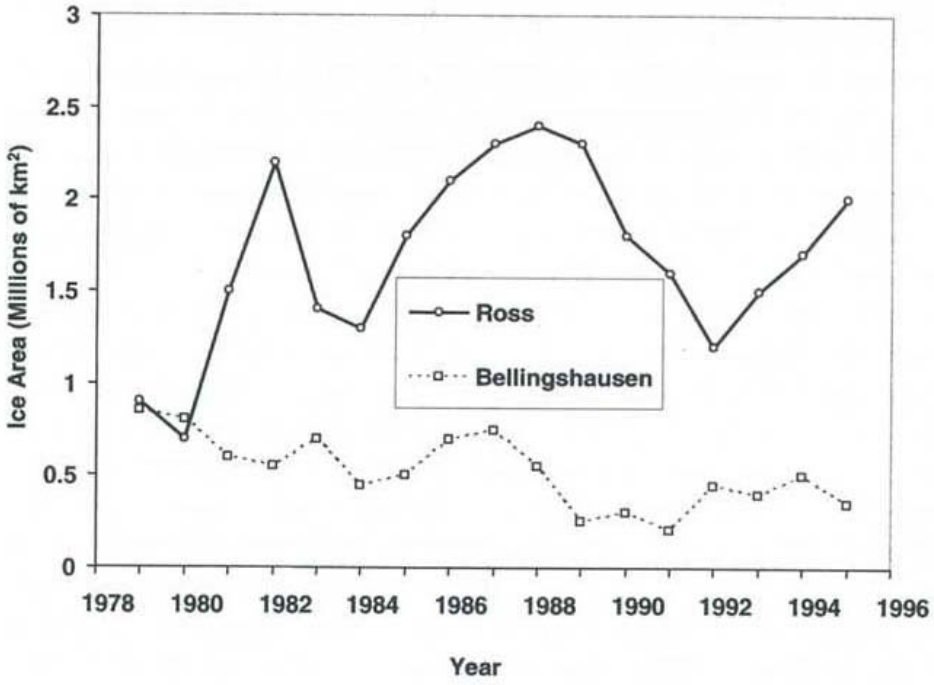

Fig 4. The change in sea ice concentration and the population of Adelie Penguins in the Ross Sea area.

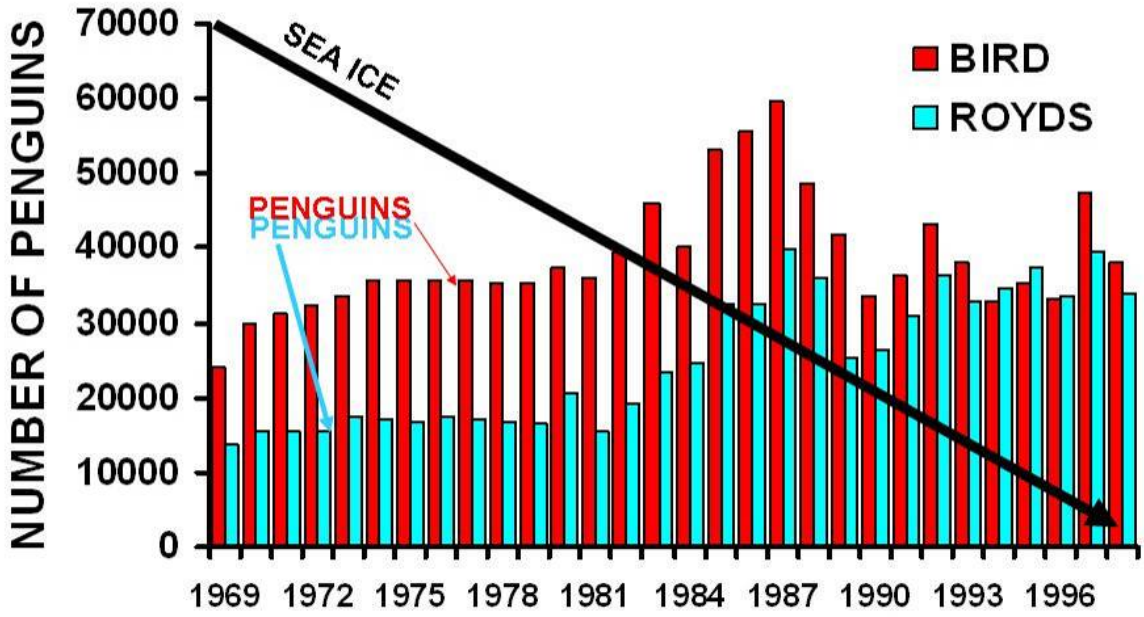

Fig 5. The Emperor Colony at Pt Geologie (66o33'S 139o10'E)