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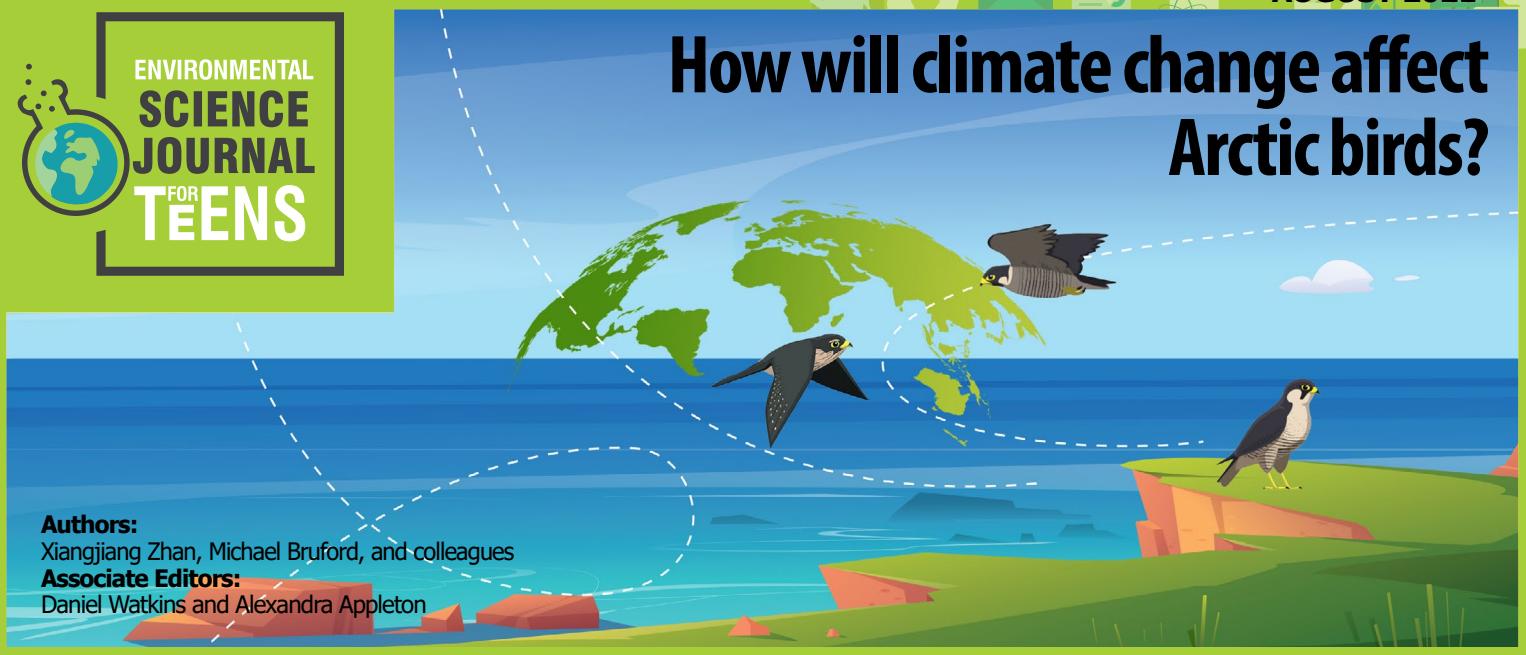
How will climate change affect Arctic birds?



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Abstract

Peregrine falcons are famous for their super-fast diving flights. But that's not the only thing that they're good at. Peregrines are also world travelers! We tracked peregrine falcons migrating from the Arctic to their winter habitat. Some went all the way from northern Russia to the tropics!

We wanted to know how climate change and genetics affect the way peregrines migrate. So we used a computer program to predict how the Arctic would change over the next 50 years. We compared the peregrines' current summer and winter habitats to the computer prediction. We found that summer habitats (where the birds breed) are shrinking, while winter habitats are growing. This is due to climate change.

We tracked migration paths for peregrines from six places in the Eurasian Arctic. We found that some peregrines traveled more than five times as far as other peregrines! When we looked at the peregrines' DNA, we saw that there were differences between the peregrines who had short migrations and those who had long migrations.

Introduction

Do you have a favorite season? Are there places that you like better in one part of the year than another? Many animals migrate from place to place so they can be at their favorite places at their favorite time of year. Summer days in the Arctic *tundra* are long, with huge numbers of smaller birds to eat and feed to their chicks. This makes it a favorite place for migratory birds like peregrine falcons, Arctic terns, and golden eagles.

Climate change is happening faster in the Arctic than in the rest of the world. Animals that rely on the Arctic are thus especially *vulnerable*. Climate change could make birds' favorite migration routes less comfortable. It could change the time of year when the temperature is right at their preferred breeding areas. Or it could shrink the size of their habitats, making it harder for them to find a place to make their nests.

Peregrine falcons migrate to the Arctic during the spring. They breed during the summer and fly south during the fall.

Some falcons journey from as far as Indonesia! Others just travel from northwest Russia to western Europe. We were curious to know more about peregrine falcon *flyways*. Why do some peregrines travel so much further than others? Has a genetic difference developed between peregrines who travel long distances and those that don't? How will climate change affect future populations of peregrines?

Methods

Each summer for 6 years, we visited a different site in the Eurasian Arctic, traveling by boat and camping. We caught peregrine falcons in their nests and outfitted them with backpack-style satellite transmitters (Fig. 1). We took blood and feather samples from 50 peregrines in total. This was to investigate differences in their *genomes.*

To figure out what might happen to their Arctic *habitat* in the future, we used a *climate model*. The model (a computer program) assumed that *greenhouse emissions* will continue to rise throughout the 21st century, with a resulting increase in global temperature.

We used *data* from a previous study to work out where the tundra would have been in the last ice age. We assumed that peregrines prefer the same habitats that they did thousands of years ago. We also assumed that they will still prefer the same habitats in the future.

Figure 1:

(a.) Fitting a falcon with a satellite-tracker backpack

(b.) Falcon wearing a satellite-tracker backpack in flight

Results

Of the 56 peregrines we caught, we were able to track 41 birds through at least one migration flight. We tracked 151 complete migration flights in total. Peregrines from different areas followed different flyways. Individual birds tended to stick close to the same route. Our results showed that the peregrines took between 14 and 46 days to complete their fall migrations. The length of their flyways varied from 2,280 km up to 11,002 km. On average, they traveled 213 km per day.

Based on the migration paths, we separated the birds into a short-distance group and a long-distance group. There were noticeable differences in the peregrines' genes between the two groups. The most significant difference occurred in the *ADCY8* gene. The ADCY8 gene has to do with long-term memory. Genetic changes can happen when groups don't have much interaction with each other. Or they can happen when two groups face different challenges. The challenge of remembering a longer migration route may have caused the difference in genetics between the two groups of peregrines.

The climate model suggests that the winter habitats for peregrines will probably expand northward in the next 50 years – particularly for those wintering in Europe. But the summer habitat in the Arctic tundra will most likely shrink. This may lead to the extinction of some breeding populations.

Discussion

22,000 years ago, during the last ice age, the Earth looked very different. Giant sheets of ice covered North America and parts of Europe and northeast Asia. The ancestors of the peregrines we studied probably bred in the tundra in central and western parts of Asia. They spent winters in southeast Asia.

As the ice age thawed, vegetation better-suited for warm weather replaced the tundra. The birds gradually moved further north to breed, following the tundra. At the same time, the peregrines' winter habitats were expanding. Some birds found a winter habitat much closer to their summer breeding areas, while others had to travel farther than before (Fig. 2). Gradual changes in the locations of their winter and summer habitats may have changed the number of possible flyways.

In the past, when the world got warmer, the tundra moved northward. But the tundra is now on the north coast of Russia and there is no more land further north that could become tundra. Some peregrines may find ways to adapt, such as staying in their winter habitat year-round. Peregrines are not the only migratory birds that rely on the Arctic. Habitat loss due to climate change is a threat to the species that rely on the Arctic tundra.

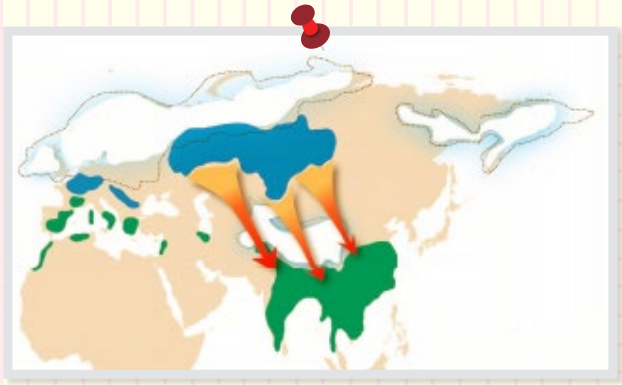
Conclusion

As climate change affects the Arctic more and more, there are fewer places where peregrines can spend the summer. Peregrines and other migratory birds are thus threatened by climate change. It's important that countries work together to protect migratory bird flyways. There are many little things you can do too!

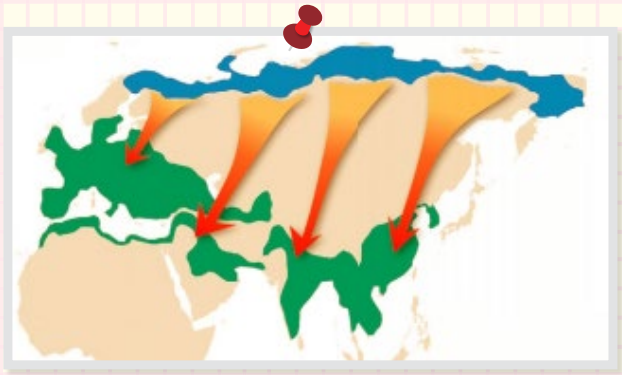
You can:

- Talk to your friends and family about climate change.
- Try to reduce your use of fossil fuel energy.
- Reuse and recycle as much as possible. Do you really need to buy something new?

Figure 2: Changes in falcons' breeding and wintering areas since the last ice age.



(a.) During the last ice age, the tundra was in central Asia, near the southern edge of a giant ice sheet.



(b.) Now, the tundra is spread across the Arctic coast, and peregrines use a variety of flyways.

● Breeding area ● Wintering area

When the Earth warmed after the last ice age, what happened to the peregrines' breeding area? To their wintering area?

Glossary of Key Terms

Climate model – a computer program that uses mathematical equations to simulate the Earth.

Data – facts, numbers, and other pieces of information.

Flyway – the route birds take while migrating.

Genome – an organism's full set of genes. Genes contain the instructions for making an organism.

Greenhouse emissions – gases emitted into the atmosphere as a result of human behavior. These emissions contribute to the greenhouse effect.

Habitat – the place an animal lives.

Tundra – landscapes with cold temperatures, very few trees, and a layer of frozen soil called "permafrost" underground.

Vulnerable – able to be hurt; especially open to negative effects.

Check your understanding

1. Why do birds like to spend summers in the Arctic?

2. Where was the tundra during the last ice age? Where has it moved and why?

3. How did the scientists follow the birds' migrations?

4. What genetic difference did the scientists see in the birds who traveled furthest?

5. Why do countries need to cooperate to help migratory birds?

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