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How will dragonflies adapt to a warmer Earth?

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Abstract

The Earth is getting warmer, and we can already see problems from it. Floods, storms, and deserts are all getting worse. People, animals, and plants all have to make changes if we want to survive.

Male dragonflies use dark coloring on their wings to attract females. It also helps them scare off other males. We wanted to know if this dark coloring might change as the climate gets warmer. We created a database to compare dragonflies living in warm climates to dragonflies living in cooler climates.

We found that male dragonflies living in warmer climates have smaller and lighter areas of dark color on their wings. This is because the darker coloring can make the dragonfly too hot. (It's hard to be active when you're in a hot place with warm clothes on, right?) Less or lighter coloring is more helpful for the dragonflies in warmer climates.

Introduction

With the world getting warmer, it's important to know how animals deal with this change. Even humans can't survive if it gets too cold or too hot! As temperatures go up, some species **migrate** to new locations with lower temperatures. Other species are able to **adapt** to the warmer temperatures in their **environment** by changing what traits they have.

Many animals have **ornamental coloration**. That's a scientific way of saying they use different colors and designs to attract **mates**. It can also scare off any other animals who might want to take their mate. We decided to look at dragonflies because the males have dark ornamental coloration on their wings.

The darker the male's coloring, the more successful he is at attracting a mate. But this same dark coloring also changes his body temperature: it takes in more energy from the sun, making his body temperature go up. Females also have ornamental coloration, but they spend more time in the shade looking for food, so they don't have a chance to heat up as much.

We **hypothesized** that only males would have less or lighter ornamental coloration in warmer temperatures. We tested this **hypothesis** by looking at how dragonfly species have changed over time and by location.

A dragonfly with dark wing ornamentation.

Photo: Allison Gamzon

Methods

We created a **database** with information about 319 different dragonfly species. They came from as far north as Alaska and Canada, and as far south as northern Mexico. To help us, we used the community-science website iNaturalist. Images on the site showed us which species have ornamental coloration on their wings. For those species, we wrote down if the coloration was dark (black or dark brown) or light (lighter brown or yellow). We did that for both male and female dragonflies. Then we checked if species with dark ornamental coloration usually showed up in cooler locations.

We also focused on 10 species. We used iNaturalist images to measure the size of the dark coloring on over 200 dragonflies in each species. We then compared the size of the dark area to the total wing area to make a **ratio**.

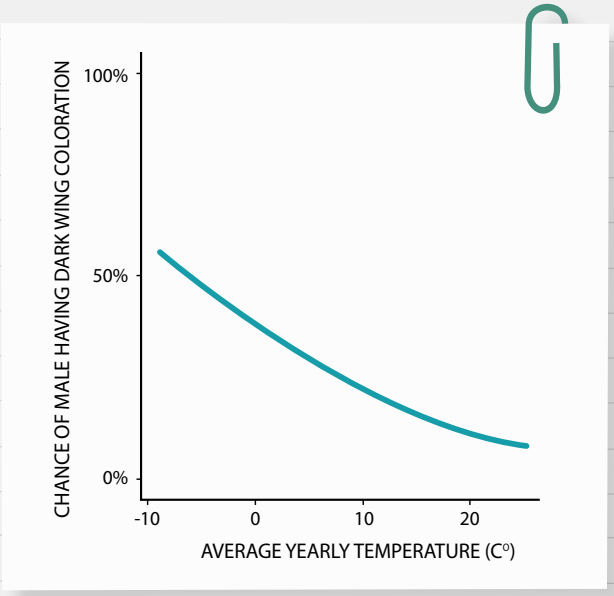
We compared this ratio to the average yearly temperature in each location. This helped us see if dragonflies that live in warmer places had smaller areas of dark color on their wings. We also tracked these species between 2005 and 2019 to see if dark ornamental coloration was less common in warmer years.

Results

First, we looked at the results from dragonflies from different species. We found that species that live in warmer climates were less likely to have ornamental coloration on their wings. Plus, when they did, the male wing coloring was usually lighter (Figure 1). Then we looked at the results from dragonflies from the same species. We saw that the warmer the habitat was, the smaller the area of ornamental coloration was on the male dragonflies' wings.

We then looked at the results between 2005 and 2019 for male dragonflies. Our work showed that the warmer the year, the smaller the area of ornamental coloration.

But what about female dragonflies? The ornamental coloration on female dragonflies' wings did not show any relationship to climate in any of these results. (So, it didn't change in a way we could connect to temperature.)



As average yearly temperatures go up, what happens to the chance that male dragonflies will have dark wing coloration?

Figure 1:
The chance that a male dragonfly will have areas of dark ornamental coloration on their wings based on temperature. 0% chance means it definitely won't have dark wing coloration at that temperature. 100% chance means it definitely will.

Discussion

Male and female dragonflies did not change in the same way when the temperatures got warmer. This is because they have different roles. (Remember, female dragonflies spend more time in the shade looking for food.) We cannot assume that the males and females of any species will adapt in exactly the same way when they face new environments.

The ornamental coloration on male dragonflies' wings is less and lighter in warmer climates. Scientists expect the climate to become warmer over the next 70 years. So, the ornamental coloration on male dragonflies' wings will most likely need to become even less/lighter. If that continues, the way they attract mates might change over time, too.

Other animals also use dark ornamental coloration to attract mates. So, we expect similar changes as they adapt to warmer temperatures.

Conclusion

The Earth's climate is changing. Some species will change to adapt to a warmer world. Why do we care? As plants and animals change, the other plants and animals they are connected to also have to change. That means we will have to change the way we live our lives, too.

To protect the environment from climate change, we need to try to stop the Earth from warming up too much. You can help by being careful about how much energy and water you use. Take shorter showers, use public transportation or a bicycle instead of a car, and buy less stuff. Small changes can make a big difference if everyone helps!

Glossary of Key Terms

Adapt - to change to fit the environment better. These changes are called adaptations.

Database - a way of storing information in an organized way. Your school probably has a database of its students with information like your names, teachers, grades, address, and so on. That makes it easy for them to find the information when they need to send your parents a letter or print out your report card!

Environment - all of the conditions that are part of the place where something lives. Your environment includes the air, land, water, and all the plants and animals around you as well as conditions like light and heat.

Hypothesize - to make a guess about what will happen based on the information you have available. This kind of informed guess is called a **hypothesis**.

Mate - the partner of an animal; another animal to make babies or eggs with.

Migrate - when an entire population of animals travels from one place to another.

Ornamental coloration - decorative color used to attract mates and scare off any others who might want to steal their mate. (To help you remember, think about how you might hang ornaments on trees or windows to decorate for a holiday.)

Ratio - a measure for comparing two numbers or measurements. You divide one number by the other. A ratio of 1 means that the two numbers you are comparing are the same. In our case, a ratio of 1 would mean the entire dragonfly wing was covered in ornamental coloration.

Check your understanding

1. What are two ways that animals deal with a changing environment?
2. Why do some animals have ornamental coloration?
3. Why did we choose to look at dragonflies?
4. Based on the results of this study, how should we expect the coloring on the wings of male and female dragonflies to change in the near future?
5. We suggested some small changes you can make to your life to slow down climate change. Can you think of three more ways you can prevent more warming? Out of the three, which change do you think you are most ready to make and why?

REFERENCES

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