Abstract

Did you know that there are more than 1,000 species of bats? They’re also the only mammals that can fly! These amazing animals are well adapted to life in the forest, but what happens when wildfires hit their homes?

We wanted to find out how wildfires in the Sierra Nevada Mountains of California affect bats. We looked at three different areas where there have been large fires and counted how many species of bat we found in those areas. We also looked at how different levels of fire severity affected bats.

Our results showed that wildfires are beneficial to bats. This is mainly because fires make forests less cluttered, which makes it easier for bats to find food and roosting spots. Instead of preventing all fires, we should manage some fires burning far from people so that there is a mix of severities and bat habitats. This would help bats and also reduce the risk of out-of-control megafires happening in the future!

Introduction

You might have seen stories on the news about the devastation that wildfire can cause. But did you know that wildfire can play an important role in nature? In nature, wildfires help to create a mix of habitat types for wildlife. This is called pyrodiversity. But in the last 100 years, humans have suppressed wildfires to keep them from getting out of control and burning homes and property. This has led to forests becoming very dense, which changes habitat for animals and even changes how future fires will burn.

Bats use forests for foraging (finding food) as well as roosting habitat, both of which are affected by fire. Each bat species has different needs, which determines the habitat they choose within the forest. For example, small bats with high-frequency echolocation calls often like to live in denser forests with lots of trees and vegetation. From a bat’s point of view, these are “cluttered” environments. Larger, fast-flying species prefer more open areas, which are less cluttered.
The number and severity of fires in the Sierra Nevada Mountains are increasing as the climate warms and because when we stop all fires for a time, we build up fuel for a future fire. The severity of fire determines what the forest will look like afterward, and therefore which bat species will live there. We think that areas that have had a mix of fire severity levels will attract the most bat species. It’s important that we understand exactly how fire affects bats so that we can manage the fires in the best way for wildlife.

**Methods**

We conducted bat surveys during spring and summer from 2014 to 2017. We used *acoustic detectors* to record bat echolocation calls (Fig. 1).

We deployed the detectors overnight (when bats are active) from 30 minutes before sunset, to 30 minutes after sunrise for a total of 1274 nights. We also collected data about the environment, including:

- Level of background noise
- Temperature for each night
- Amount of *tree canopy* cover

We carried out the surveys in three areas that had been burned by large wildfires. Within these areas, we used satellite images to determine how severe the fire had been. We could then give each survey location a severity level, which ranged from “unburned” (no trees destroyed by fire) to “high-severity” (up to 100% of tree area destroyed).

We then used a computer program called SonoBat to identify which bat species we recorded. Each species has unique echolocation calls, so we were able to work out how common each bat species was and how many species we could hear in each survey.

**Results**

Our results varied a lot among the 17 bat species that live in the Sierra Nevada Mountains. Overall, we found that bats respond positively to wildfire! The number of bat species was highest when there was a mix of fire severity levels. It was lowest in unburned areas.
DO BATS BENEFIT FROM WILDFIRES?

Conclusion

Bats face lots of threats, including climate change, habitat loss, wind energy development, and new diseases. It’s really important that we continue to study bats and their habitat so that we can protect them. They add to the biodiversity in an ecosystem and consume insects that can be harmful to forests and farms. What can you do to help?

1. Become a bat ambassador! Bats have an undeserved bad reputation. By sharing knowledge about these amazing animals and the benefits they provide, you can help inspire others to protect bats.

2. Help their habitat. Build a bat house in your backyard!

3. Do some science! Many areas have citizen science projects where you can help to monitor bats. What’s happening near you?

Discussion

In recent years we have practiced fire suppression in the Sierra Nevada forests to reduce the number and area burned by fires. This has led to lots of areas that don’t have enough fire and thus, forests which are too dense and cluttered. This is a problem for bats that are adapted to natural wildfires and the less dense habitats these fires produce.

Wildfires naturally create diverse habitats. It would be best for bats if we could change our fire management to create a mix of habitat types. These fires can be controlled burns when they are near where people live, or natural fires (started by lightning) which are allowed to burn in wilderness areas away from people.

An added bonus is that these fires also thin the forest naturally, which reduces the risk of the devastating ‘megafires’ you see on the news. This is especially important as the climate warms. As our planet becomes hotter and drier, megafires become much more likely. We can prevent big fires by allowing little ones to burn up the forest fuel!

We also found that:

- Most species were more common when fire severity was higher. However, one species, the small-footed bat, was more common in unburned forests (Fig. 2).
- The most common species was the Mexican free-tailed bat (we detected it in 97% of surveys!).
- In general, we detected fewer echolocation calls during noisy nights - when there was some background noise.
- We detected more calls during warmer nights.
- The amount of tree canopy cover also affected how often we detected some species.

In Figure 2 we show the frequency of bat occurrence (the percentage of survey periods we detected the bat species) compared to fire severity.

![Figure 2: Frequency of bat occurrence (the percentage of survey periods we detected the bat species) compared to fire severity.](image)

Which species were more common in areas with high fire severity?

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Glossary of Key Terms

**Acoustic detectors** – equipment that can detect and record bat echolocation calls, most of which are too high-frequency to be heard by humans. Acoustic detectors can also be used for other things, like recording birds, frogs, whales and dolphins.

**Clutter** – in this case, how crowded an area is with vegetation (trees, shrubs, vines, etc.). A path which you may walk along in the forest has been cleared and so is less cluttered. If you leave the path you may find it more difficult to walk as there are lots of branches and trees in your way. This is a more cluttered environment.

**Echolocation** – using reflected sound waves to locate objects. Bats make sounds that bounce back to them to locate and identify their prey (for example, insects). Whales and dolphins also use echolocation in the marine environment.

**Fire severity** – a measure of the change to an area caused by fire (sometimes measured as percentage of vegetation that died). High severity means the fire caused a lot of change (for example 100% of vegetation died) in the area.

**Pyrodiversity** – the range of effects of fire on an environment. For example, a fire that contains both low- and high-severity areas would provide both forest and shrubland habitats.

**Suppression** – in this case, fire suppression, which are methods to stop, control the size, or prevent the spread of wildfires.

**Tree canopy** – the layer of leaves and branches that cover the ground from above.

Check your understanding

1. Why does having a mix of habitat types in the forest attract more bat species?
2. What has been the effect of a policy of fire suppression on forests in the United States?
3. Why and how do we use acoustic detectors to survey bats?
4. Why might more background noise mean we are less likely to detect bats?
5. How can you get involved in helping bats?

REFERENCES


Bat Conservation International: Bat Houses https://www.bats.org.uk/about-bats

Bat Conservation International - Bat houses http://www.batcon.org/resources/getting-involved/bat-houses


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