NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

No Bats in the Belfry: The Origin of White-Nose Syndrome in Little Brown Bats

by
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Part I – The Basic Question

Introduction

Imagine going out for a brisk winter snowshoe and suddenly stumbling upon hundreds of bat carcasses littering the forest floor. Unfortunately, this unsettling sight has become all too common in the United States (Figure 1). White-nose syndrome (WNS), first discovered in 2006, has now spread to 20 states and has led to the deaths of over 5.5 million bats (as of January 2012). WNS is a disease caused by the fungus, *Pseudogymnoascus destructans*. Bats infected with WNS develop white fuzz on their noses (Figure 2, next page) and often exhibit unnatural behavior, such as flying outside during the winter when they should be hibernating.

Figure 1. Many bats dead in winter from white-nose syndrome.

WNS affects at least six different bat species in the United States and quickly decimates bat populations (colony mortality is commonly greater than 90%). Scientists have predicted that if deaths continue at the current rate, several bat species will become locally extinct within 20 years. Bats provide natural pest control by eating harmful insects, such as crop pests and disease carrying insect species, and losing bat populations would have devastating consequences for the U.S. economy.

Researchers have sprung into action to study how bats become infected with and transmit *P. destructans*, but a key component of this research is determining where the fungus came from in the first place. Some have suggested that it is an invasive species from a different country while others think it is a North American fungal species that has recently become better able to cause disease. In this case study, we examine the origin of *P. destructans* causing WNS in North America.

Some Other Important Observations

- WNS was first documented at four cave sites in New York State in 2006.
- The fungus can be spread among bats by direct contact or spores can be transferred between caves by humans (on clothing) or other animals.
- European strains of the fungus occur in low levels across Europe but have led to few bat deaths there.
- Bats with WNS frequently awake during hibernation, causing them to use important fat reserves, leading to death.

Questions

1. What is the basic question of this study and why is it interesting?
2. What specific testable hypotheses can you develop to explain the observations and answer the basic question of this study? Write at least two alternative hypotheses.
3. What predictions about the effects of European strains of *P. destructans* on North American bats can you make if your hypotheses are correct? Write at least one prediction for each of your hypotheses.

Figure 2. White fuzz on the muzzle of a little brown bat indicating infection by the disease.

Part II – The Hypothesis

As discussed in Part I, researchers had preliminary data suggesting that the pathogen causing WNS is an invasive fungal species (*P. destructans*) brought to North America from Europe. They had also observed that *P. destructans* occurs on European bats but rarely causes their death.

Preliminary research also suggested that one reason that bats have been dying from WNS is that the disorder arouses them from hibernation, causing the bats to waste fat reserves flying during the winter when food is not readily available.

These observations led researchers to speculate that European *P. destructans* will affect North American bat hibernation at least as severely as does North American *P. destructans* (Warnecke et al. 2012).

Questions

1. Explicitly state the researchers' null (H_0) and alternative hypotheses (H_A) for this study.
2. Describe an experiment you could use to differentiate between these hypotheses (H_0 and H_A).

Part III – Experiments and Observations

In 2010, Lisa Warnecke and colleagues (2012) isolated *P. destructans* fungal spores from Europe and North America. They collected 54 male little brown bats (*Myotis lucifugus*) from the wild and divided these bats equally into three treatment groups.

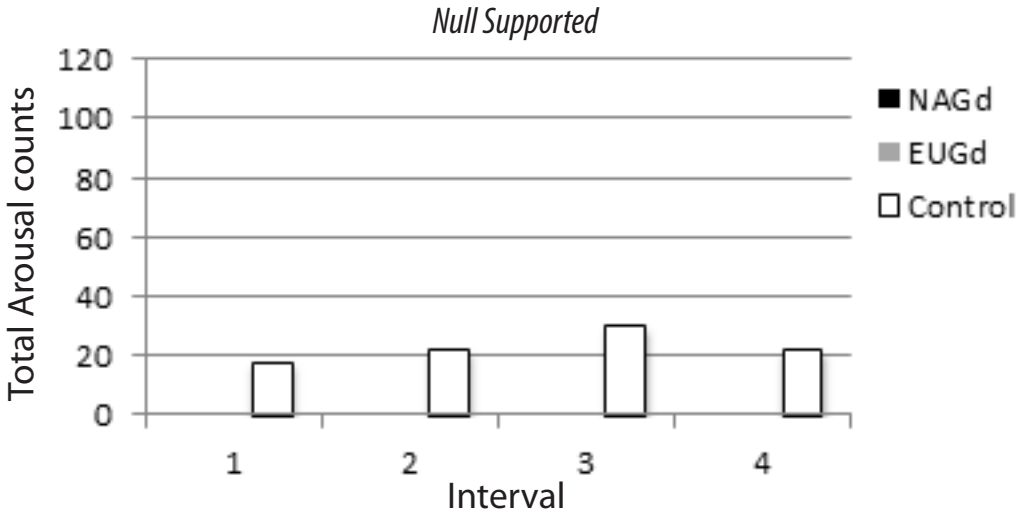
- Group 1 was inoculated with the North American *P. destructans* spores (NAGd treatment).
- Group 2 was inoculated with the European *P. destructans* spores (EUGd treatment).
- Group 3 was inoculated using the inoculation serum with no spores (Control treatment).

All three groups were put into separate dark chambers that simulated the environmental conditions of a cave. All bats began hibernating within the first week of the study.

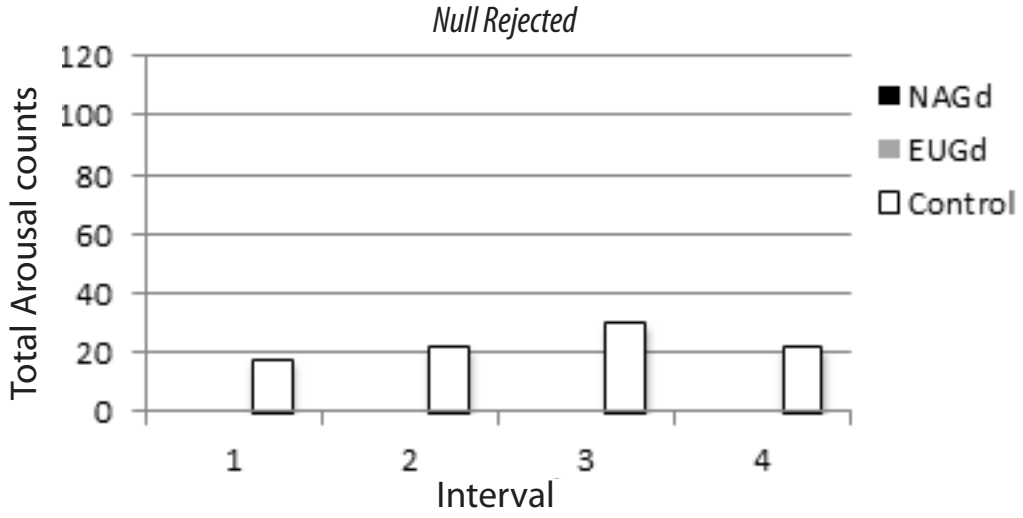
The researchers used infrared cameras to examine the bats' hibernation over four consecutive intervals of 26 days each. They then used the cameras to determine the total number of times a bat was aroused from hibernation during each interval.

Questions

1. Use the graph below to predict what the results will look like if *the null hypothesis is supported*. The total arousal counts in the control treatment at each interval is graphed for you (open bars). Justifiy your predictions.



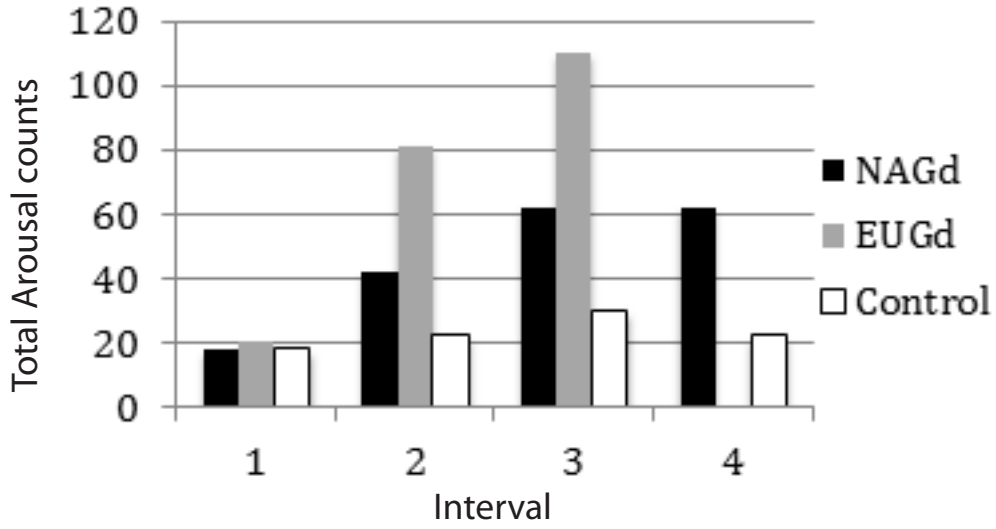
2. Use the graph below to predict what the results will look like if *the null hypothesis is rejected*. The total arousal counts in the control treatment at each interval is graphed for you (open bars). Justify your predictions.



Part IV – Results

Figure 3 (below) shows the real data from the study. There is no data for interval 4 bats that were exposed to the European *P. destructans* (gray bar) because all of the bats in that group died.

Figure 3. Changes in hibernation patterns in M. lucifugus *following inoculation with North American* P. destructans *(NAGd), European* P. destructans *(EUGd), or the control serum.*



Questions

1. How do your predictions compare with the experimental results? Be specific.
2. Do the results support or reject the null hypothesis?
3. If the European *P. destructans* is causing WNS in North America, how come European bats aren't dying from the same disease?

References

U.S. Fish and Wildlife Service. 2012. White-Nose Syndrome. Available at: http://whitenosesyndrome.org/. Last accessed December 20, 2013.

Warnecke, L., et al. 2012. Inoculation of bats with European *Geomyces destructans* supports the novel pathogen hypothesis for the origin of white-nose syndrome. *PNAS Online Early Edition: http://*www.pnas.org/cgi/doi/10.1073/pnas.1200374109. Last accessed December 20, 2013.