

When Hypotheses Are Unsupported: Investigating a Vanishing Fish Population

by

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Part I – Introducing *Roryicus gilmorely**

For decades, Starry Hollows Lake was revered for its incredible biodiversity, and it was most famous for its abundant Gilmore fish (*Roryicus gilmorely*). This fish attracted people from far and wide to take part in an annual 24-hour fishing marathon, an event first introduced 50 years ago. This event continued to attract increasing numbers of tourists and fishing enthusiasts each year, proving to be very profitable for the town.

The Gilmore fish are a freshwater species that grow between 12–16 inches long, making them ideal for fishing. However, in the last decade the number of Gilmore fish has substantially declined, which the townspeople worry will affect annual tourism profits. Additionally, the once beautiful and diverse wildlife of Starry Hollows Lake has also begun to be negatively impacted. The town desperately needs to identify the cause of the decline and has resolved to find a solution as soon as possible to avoid any more environmental and financial damage. To solve this problem, they have hired you to investigate!

Questions

1. You are the head scientist on this project tasked with designing an investigation of the Gilmore fish. Based on the information provided, create a testable hypothesis that identifies a potential cause for the decline of this fish species. Include only an alternate hypothesis (null hypothesis not required). Provide one peer-reviewed journal reference to support your hypothesis (maximum 50 words).
2. Design an experiment that would allow you to test your hypothesis, ensuring it is clear how you would quantify your results. Get creative but be thorough! Be sure to address the key components of sound experimental design (maximum 300 words).

*The location, events, fish species, and data presented in this scenario are fictional.

Part II – Back to the Drawing Board

Your initial investigation of Starry Hollows Lake pointed to the idea that overfishing was the cause of the decline in *R. gilmorely* fish. However, when you ran your experiment and collected your data, you found no difference between your experimental and control groups.

You learn from some local townspeople that the fishing marathon was actually banned over 15 years ago and hasn't taken place since; how did everyone fail to mention this?! This action was taken in the hopes that the population of *R. gilmorely* fish would begin to rise again, but this unfortunately wasn't the case: the fish population continued to steadily decline. Back to the drawing board for you.

You conduct further research on the surrounding habitat by testing the water and discover the presence of a chemical called kryptonite. Upon further investigation, you learn that this chemical was used at Starry Hollows Farm located not too far away from Starry Hollows Lake. It somehow ended up in the lake nearly two decades ago. Upon further research, you find out that this chemical is used as an insecticide.

Questions

1. Your first experiment did not find any significant differences between your experimental and control group. You now need to investigate a whole new line of inquiry. Was your first experiment a “failure”? Justify your answer (maximum 50 words).
2. Based on the information provided, construct a new hypothesis to explain the decline in *R. gilmorely* fish populations. Include only an alternate hypothesis (null hypothesis not required). Provide one peer-reviewed journal reference to support your hypothesis (maximum 50 words).
3. Design an experiment that would test your hypothesis and explain how you would obtain your results. Be sure to address the key components of sound experimental design (maximum 300 words).
4. Identify two limitations from the experiment you designed above (maximum 125 words).

Part III – One More Time

After executing your last experiment, you conclusively determine that the chemical kryptonite was not the cause of a sudden decline of the Gilmore fish. Returning to the lake, you note an overabundance of another fish species, the Sookie (*Chefie mccarthyicus*). This species is not native to the area but instead originates from Europe. It is thought that the Sookie fish was brought here many years ago with some of the tourists who attended the fishing marathon, and over the years the Sookie population in Starry Hollows Lake grew. At the time of your investigation, the number of Sookie fish within the lake seemed to be nearly equal to the population of the Gilmore fish. Existing research found that the Sookie has some overlap in resource usage to the Gilmore. While the Gilmore fish consumes smaller fish and insects, the Sookie feeds on smaller insects and tadpoles. You are concerned that this newly introduced species could be the cause of the problem as an ecosystem invader.

Invasive species are organisms that have been introduced to an area outside their historical range where they spread rapidly and cause harm to native species and ecosystems. Invasive species often lack the natural predators or competitors that kept their populations in check in their native range, allowing them to outcompete native organisms for resources, alter habitats, and reduce biodiversity.

Questions

1. Based on the information provided, construct a new hypothesis to explain the decline in Gilmore fish populations. Ensure your hypothesis is clear, testable, and justified. Include only an alternate hypothesis (null hypothesis not required). Provide one peer-reviewed journal reference to support your hypothesis (maximum 50 words).
2. You conduct an experiment to determine whether the presence of the Sookie fish was the cause of the decline in the Gilmore fish population. Two large tanks were used: one contained 20 Gilmore fish (the control) while the other contained 10 Gilmore fish and 10 Sookie fish (the treatment) to maintain equal densities of fish in each tank. Both tanks were kept at 20° C and provided equal daily amounts of insects, small fish, and tadpoles. Note that food availability was consistently provided but not unlimited. The tanks were monitored for two months. The results of your experiment are shown in Figures 1 and 2 (see next page).

Summarize the main findings from this experiment. Do these findings support your hypothesis? Explain (maximum 150 words).

3. Based on the information provided, provide one argument in favor of the conclusion that Sookie is an invasive species. Provide one argument for why you cannot conclude that Sookie is an invasive species (maximum 200 words).

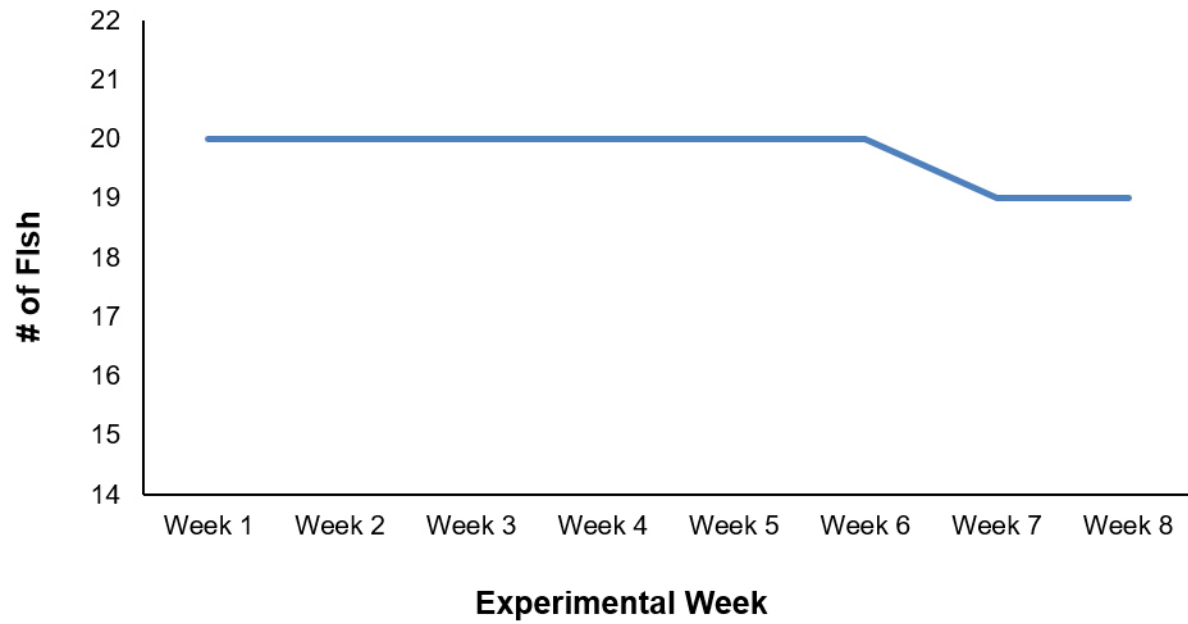


Figure 1. Population size of *Roryicus gilmorely* fish after 8-week experiment ($n = 20$).

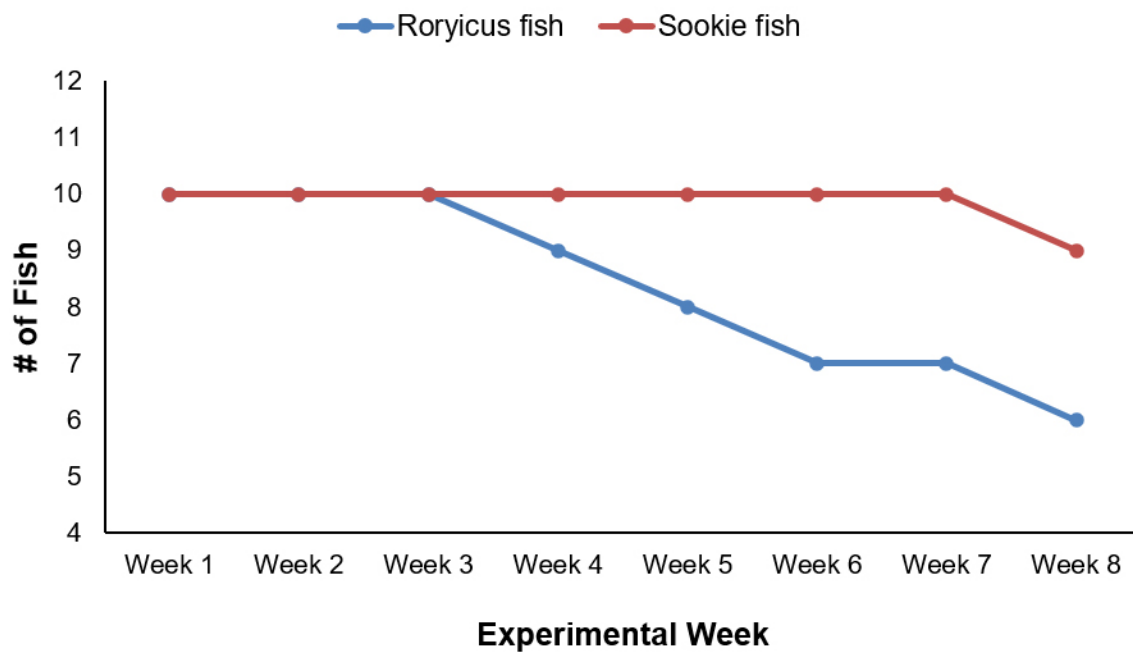


Figure 2. Population size of both *Roryicus* and *Sookie* fish after eight-week experiment when placed together in the same experimental tank ($n = 10$ for each species).