Abstract
Evaluating the issues and solutions in sustainable fishing requires an in-depth and multidisciplinary analysis. Our project is divided into three distinct tasks: researching the problem at hand, examining math models on population data and developing an application to analyze the results and raise awareness for a potential solution.

Ultimately, fishing quotas are most commonly used to reduce the impact of overfishing; however, few other options and exist, and fishing quotas are not reliable solutions. Math modeling can be used to show the changes in population and species distribution. Our project examined the Lotka Volterra model, the Nicholson Bailey model, Maximum Entropy models, and their applications in sustainable fishing.

Based on these models and the known issues in sustainable fishing, we built a few small applications to examine solutions to the overfishing problem. These applications are meant both to raise awareness about sustainable fishing and to help policy-makers analyze the risks and benefits that their policies will have on the fish populations.

Current Issues in Sustainable Fishing
Overfishing is one of the biggest threats to the marine ecosystem. Problems have multiplied on account of human demand and improved technology. Overfishing is one of the biggest threats to the marine ecosystem. Problems have multiplied on account of human demand and improved technology. Widespread impact due to human demand and negligence.

Many species depleted or extinct.

Predator/prey relationships are damaged by depletion.

Fishery employees are jobless after population collapse.

In 1992, the cod fishery in Newfoundland, Canada collapsed causing over 40,000 people to lose their jobs.

Application Design
Fish Food: The fun way to learn about sustainability!

• An important and difficult task of sustainability research is raising awareness on the issues.
• Fish Food teaches children about at-risk species.
• Players must guess which fish are good to eat.
• This knowledge can be applied at home.
• The data is based off research from the Monterey Bay Aquarium.

Policy-makers and scientists who are researching overfishing issues will want an application that shows the mathematical analysis of the fish populations and changes due to overfishing; however, such an application would not appeal to a broader audience. Consequently, we created a few different designs to examine interfaces for different audiences.

Math Models
Lotka-Volterra Model

\[
dx/dt = x(r - axy)
\]
\[
dy/dt = -kxy
\]

where

- \(t\) = time
- \(x\) = prey
- \(y\) = predator
- \(r\) = growth rate of prey population (> 0)
- \(b\) = growth rate of predator population (> 0)
- \(a\) = rate at which predators meet prey (> 0)
- \(k\) = (natural) death rate of predators (> 0)

Conclusion
Spreading awareness is vital to controlling overfishing. Our research and analysis show that the marine ecosystem could still be restored if the correct measures are taken. By creating the four layouts we were able to cover a large group of people ranging from children to policy makers. The game is also a fun and effective tool to teach people of all ages. We hope by effectively spreading awareness and following policies and protocols will benefit the fish populations, marine ecosystem, as well as fishing industries.

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References


