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PHY 203
Project: Write-up

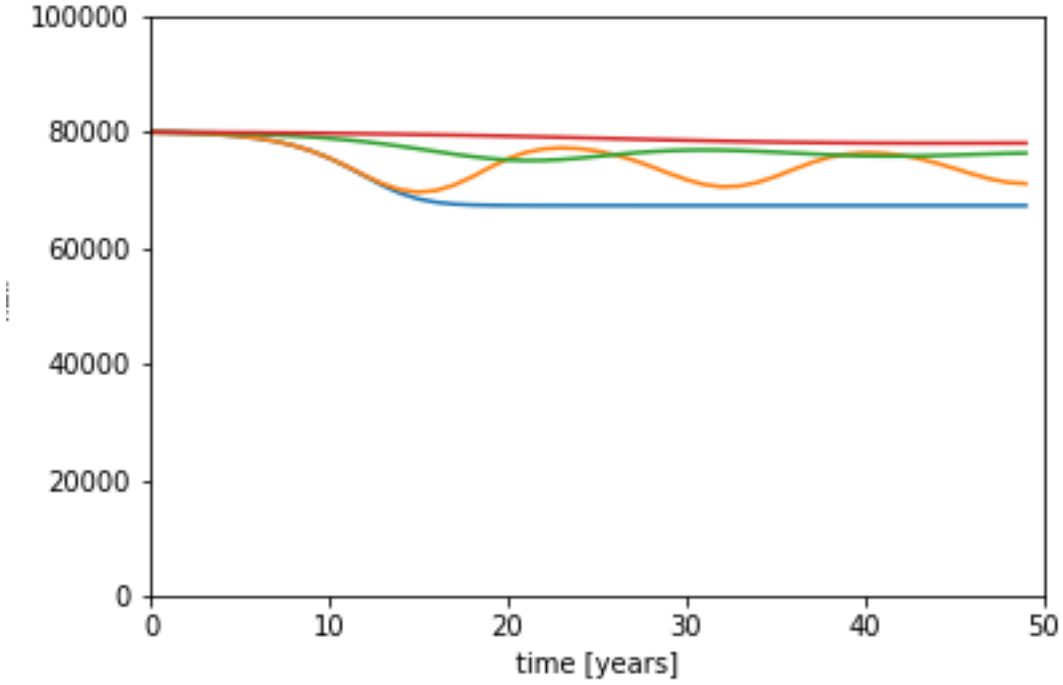
1) The question being addressed for the project is this: What impact would removing the Grey Wolf from the list of Endangered Species have on the Grey Wolf population as a whole? From this guiding question, we explore the potential impacts of increased hunting, as well as man-wolf conflicts that could arise from an increased wolf population, particularly between farmers and wolves (poaching).

2) The main control parameter in the model is hunting. Here we consider the effects hunting would have on the Grey Wolf population. We explore four different scenarios:
    a. No hunting, no poaching (blue)
    b. No hunting, poaching (orange)
    c. Moderate hunting and poaching (green)
    d. Heavy hunting and poaching (red)

    The idea here is that a) and b) would represent two different scenarios given that we preserve the status quo, i.e. keep Grey Wolves on the List of Endangered Species, whereas c) and d) represent two different models of what would happen if we remove Grey Wolves for the endangered species list.

3) The variables in the system are as follows:
    - *Tau* - Tau represents the combined birth rate and death rate of wolves. While the birth rate is essentially constant (approximately 4 pups per year per female wolf), the death rate will vary due to levels of hunting/poaching.
    - *Wolf population* – The overall wolf population is affected by Tau, which is in turn effected by the death rate from natural causes, hunting, poaching, and inter-wolf competition for habitat and resources. The idea with inter-wolf competition is that there's only so much habitable land available for wolves, and once the wolf population reaches a certain point, their population will "max out" so to speak for a given area.
    - *Time* – All variables described above are modelled to see how they change over a time period of 50 years.

4) Here's a brief description of the graphs:
    - In the first graph, we model the change in Grey Wolf population as a function of time. In laymens terms, we see how the Grey Wolf population could change over a span of 50 years under the four scenarios outlined in 2).
    - In the second graph, tau represents the birth/death rate of wolves. Here we leave the birth rate essentially constant but change the death rate as outlined in 2).
    - Finally, in the third graph, we model the (estimated) maximum wolf population under the four different scenarios.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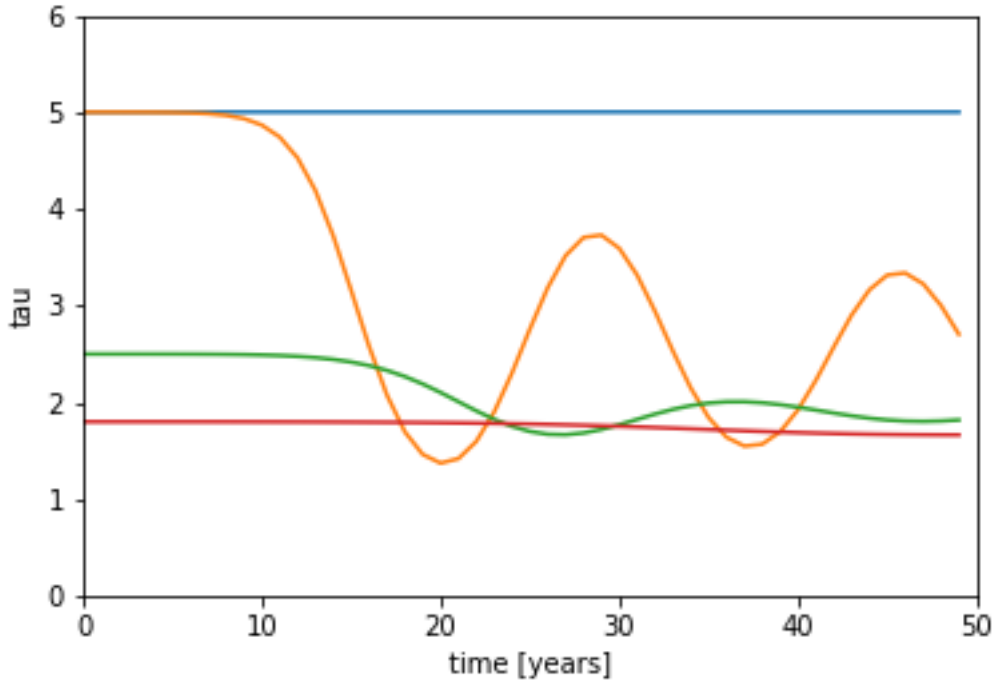
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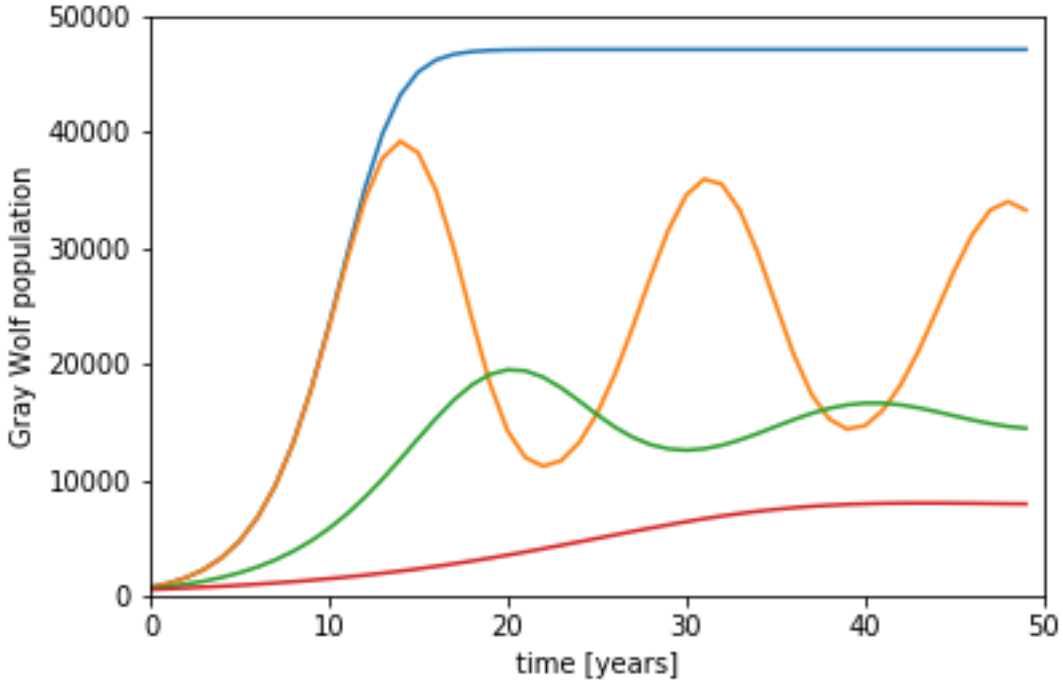

5) Cost Benefit analysis:

Removing the Grey Wolf from the List of Endangered Species would come with it attendant costs and benefits. Depending on the levels of hunting allowed under a change in endangered status, the Grey Wolf could see its population recovery stagnate or even reverse. Furthermore, it has been shown that Wolves are vital for keeping Deer and Elk populations in check, and a reduction in the Wolf population could lead to a surge in the Deer and Elk population, which could potentially lead to overgrazing, increase in diseases amongst deer herds, ect.

However, leaving the Grey Wolf on the List of Endangered Species also has attendant costs and benefits. Though Wolves hardly saturate the landscape, a significant increase in their numbers could lead to negative outcomes for farmers in that sometime Wolves will kill livestock such as cows and sheep. As such, Wolf population growth could lead to more poaching, whereby Wolves are illegally hunted.

So basically, what we have are environmentalists on one side of the issue, and hunters, farmers, and people who are otherwise uneasy with a robust wolf population on the other side. Any change or non-change in policy would have attendant winners and losers, as discussed above.