

Badger Culling

Culling is the process of removing breeding animals from the population based on certain criteria. In the case of badgers, the culling is typically done in an effort to reduce the number of cows infected by bovine tuberculosis (*Mycobacterium bovis*). Badgers are a vector for this disease and farmers in England want to reduce the costs due to bovine TB since infected cattle are typically destroyed. There is strong opposition to badger culling since there are questions on whether culling is effective and what damage is done to the badger population. In this project, you will build a population model for the badgers and determine under what conditions bovine TB would be endemic to the population as well as predicting the effect of culling on the badger population

Some Model Requirements

- To reduce the complexity, the model will only study the dynamics of the infection in badgers only.
- The badger population is divided into two groups: Susceptible and Infected.
- Badgers do not recover or gain immunity.
- All births in the badger population are susceptible and the birth rate is proportional to the total badger population (susceptible and infected).
- The death rate of susceptible badgers is proportional to the total population and the size of the susceptible population.
- The death rate of infected badgers is proportional to the total population and the size of the infected population. Assume for simplicity the proportionality constant in the death rate is the same for infected and susceptible populations.
- Susceptible members are infected at a rate proportional to the susceptible and infected populations.
- In the absence of culling, the total population behaves logistically.
- The model will include culling. Culling is the removal of members of each population.

Culling Strategies

There are many different culling strategies. Here are two different strategies and you are free to think of others.

- One strategy is to remove a constant number (C) of random members from the total population over a period of time. Each group will have a number of members culled that is proportional to that group's fraction of the total population times C . The sum of culled members from each group should equal C .

- Another strategy is to remove a number of random members from the total population that is proportional to the number of infected individuals. It should be of the form $c(I)$. Again, each group will have a number of members culled that is proportional to the groups fraction of the total population times the number of members to be removed. The sum of the culled members from each group should equal $c(I)$.

Some Questions to Answer

- How does the population behave without the infection or culling?
- How does the population behave with the infection but without culling?
- Does the infection reduce the total population size when there is no culling?
- When is there an outbreak and when is the infection endemic when there is no culling?
- How does the population behave for different culling strategies?
- Can either culling strategy destroy the badger population?
- Can either strategy eradicate an endemic infection? How reduced would the badger population in this case?