

## Depletion Estimates Exercise

1. Catch and effort data from nine removal events of northern pike in Island Lake, New Brunswick can be found in the **PikeIL** data frame in the **FSAdata** package. Load these data into an R object and estimate the initial population size and catchability, with associated 95% confidence intervals. Show only enough results for your calculations to be verified. Interpret your findings.



2. The **leslie.sim()** function can be used to simulate the catch data from a population with known characteristics. This function can be used to examine the effects of different initial population sizes, catchabilities, and removal events on the shape of the Leslie model. In addition, various assumption violations can be modeled. Use this simulation function to answer the questions below. Note: after each question return the simulator to the default values by pressing the “Reset” button. Copy graphs to your report to support your answers. [Note: we strongly urge you to read the “details” portion of the **leslie.sim()** function help topic -- i.e., type **?leslie.sim** in R.]
  - a) Describe what happens to the Leslie model (comment on the shape of the model (i.e., linear, curved, etc.), relative steepness, relative initial CPE, and relative population estimate (i.e., x-intercept)) when the catchability coefficient is increased?
  - b) Describe what happens to the Leslie model when catchability is increased between successive removal events (i.e., increase the “q factor” slider to a value greater than 1).
  - c) Describe what happens to the Leslie model when catchability is decreasing between successive removal events (i.e., decrease the “q factor” slider to a value less than 1).
  - d) From the previous two questions, comment on how a change in catchability between successive removal events may be diagnosed (i.e., identified) from catch and effort data.
  - e) Describe what happens to the Leslie model if there is mortality over the course of the removal events (i.e., decrease the “survival” slider to a value less than 1). In addition, comment on how the estimates of q and N0 would be affected by this assumption violation.
  - f) From the previous question, comment on how mortality over the course of the removal events may be diagnosed from catch and effort data.
  - g) Describe what happens to the Leslie model if there is recruitment to the population between successive removal events (i.e., increase the “recruitment” slider to a value greater than 0). In addition, comment on how the estimates of q and N0 would be affected by this assumption violation.
  - h) From the previous question, comment on how recruitment over the course of the removal events may be diagnosed from catch and effort data.