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## 1.1.0 Introduction

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In this section, we'll explore how dramatic outbreaks in a population can be the result of a bifurcation. John Wesley (Wes) Cain, a bio-mathematician, shows how increasing the carrying capacity of the spruce budworm species can cause a bifurcation which results in an outbreak of the population and serious deforestation.

In this section, you will:

- Build a **differential model of the spruce budworm population** to capture the effect of predation and carrying capacity;
- Use **graphical representations of differential equations** to determine the equilibrium solutions and the long-term behavior of the budworm population for different carrying capacities;
- Determine the **bifurcation** and critical value of the carrying capacity which corresponds to outbreaks of budworms.

**Note:** The model in this section and its analysis are based on the following paper: *Qualitative Analysis of Insect Outbreak Systems: The Spruce Budworm and Forest* by D. Ludwig; D. D. Jones, C. S. Holling in **The Journal of Animal Ecology**, Vol. 47, No. 1. (Feb., 1978), pp. 315-332.



For this section, you'll need to have completed Section 5: Population Dynamics I, and Section 7: Bifurcation I.

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