Effects of Winter Severity on Hunter Success of White-tailed Deer (*Odocoileus virginianus*) and Mule Deer (*O. hemionus*) in Alberta

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Background

- White-tailed Deer (WTD) and Mule Deer (MD) are present in Southern Canada[1], and in every Wildlife Management Unit (WMU) in Alberta.
- Most popular big game species in Alberta[2].
- WTD and MD have historically gone through population fluctuations[3].
- Lack of a Winter Severity Index (WSI) for Alberta inhibits effective management.
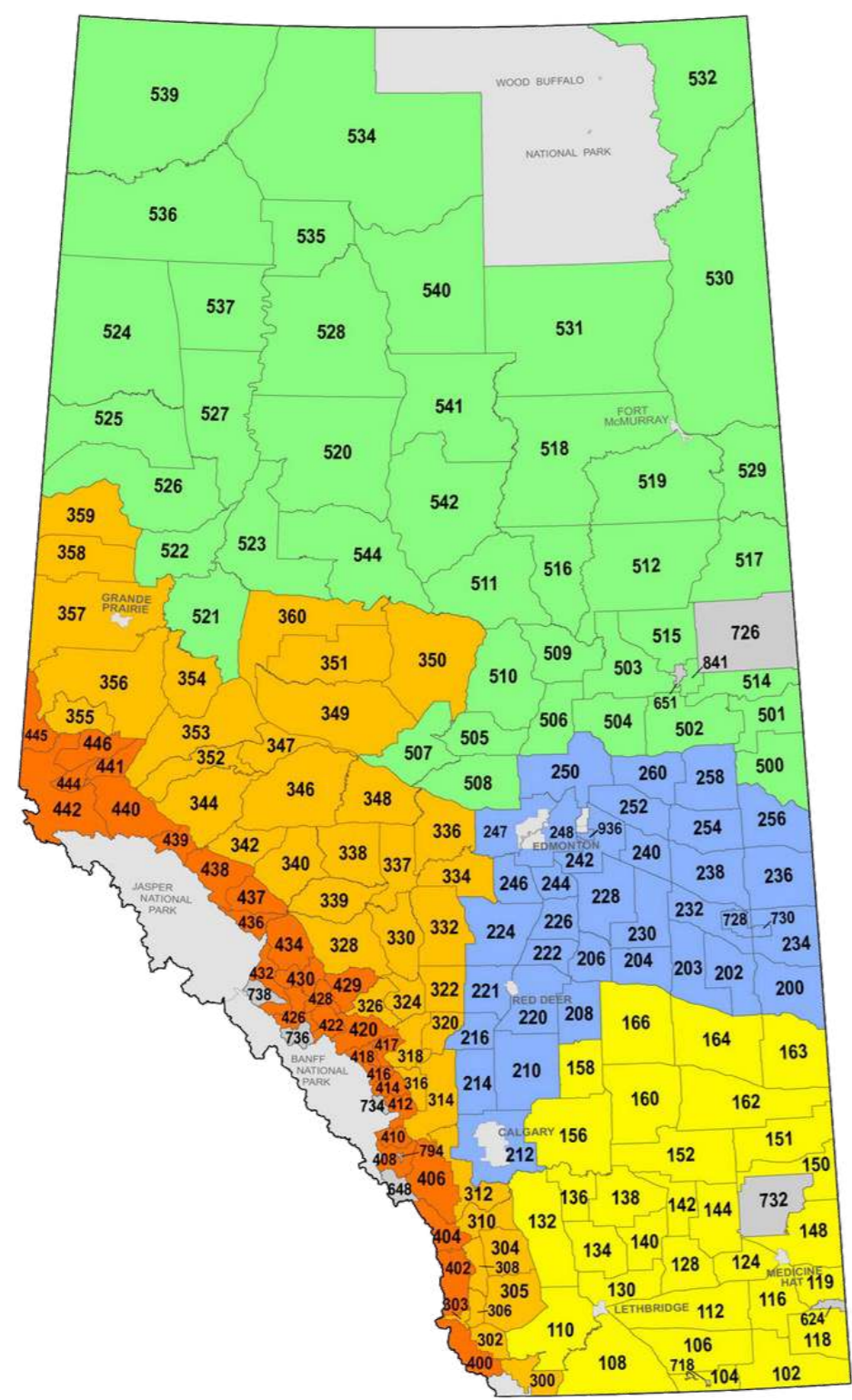- Periods of overabundance and winter mortality could result in the "Hydra Effect,"[4].

Figure 1. Map of WMUs by land type. Image by Government of Alberta.

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Objectives

1. Develop Winter Severity Indices (WSI) that can be used to predict winter severity effects across the province.
2. Use developed WSIs to determine the mechanisms causing fluctuations in hunter success.
3. Investigate the Hydra Effect by examining the role of differing hunting pressures on fluctuating hunter success.

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Study Site

- 661,848 km^2.
- Alberta contains 166 WMUs, categorized by land type:
  - Prairie, Parkland, Foothills, Mountain, Northern Boreal
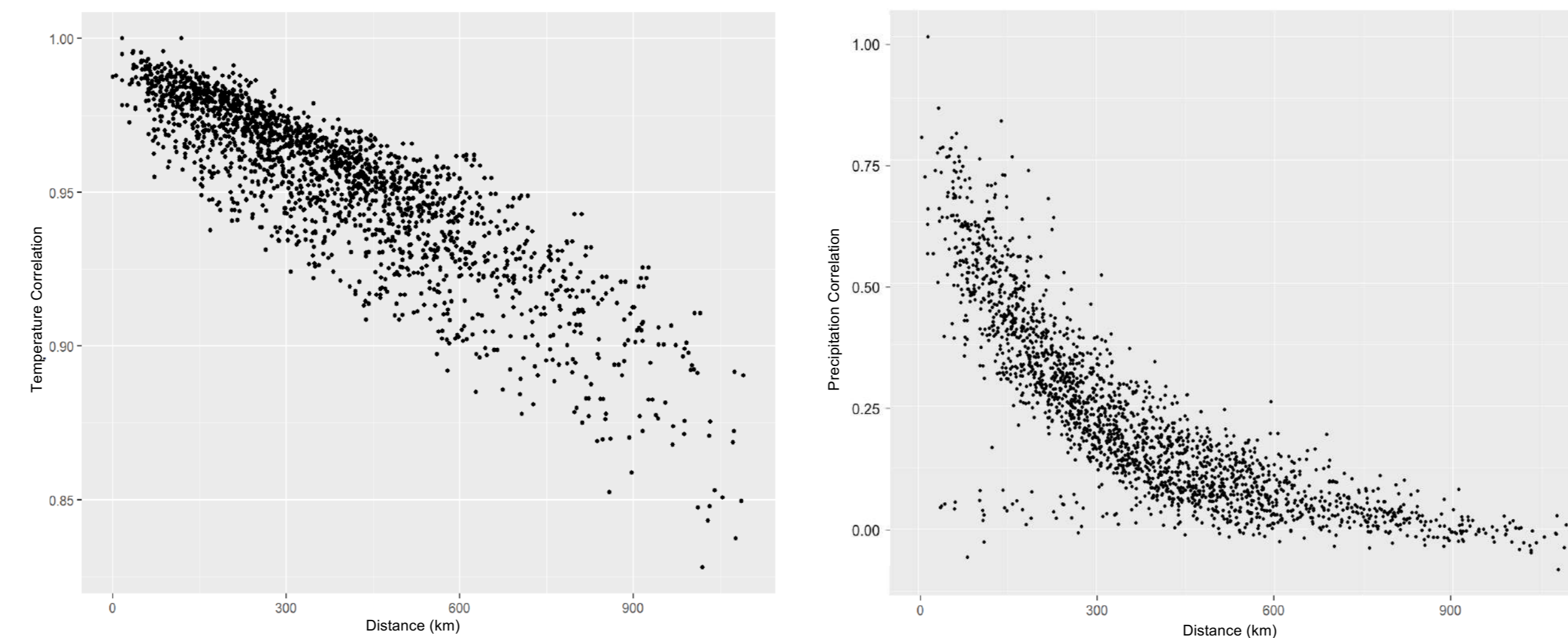- These land regions have been shown to have differing weather patterns[5].

Figure 2. Temperature (left) and precipitation (right) correlation between weather stations as a function of distance. Data obtained from Environment and Climate Change Canada.

Objective 1: WSIs

- Develop WSI(s) for Alberta using daily temperature and precipitation from NASA Daymet V4 satellite.

WSIs to be tested:

- Snow Water Equivalency:[5]
  - $$MELT = (1.88 + 0.007R)(1.8T) + 1.27$$
    $$If\ T < 0: CUMLT = SWE(f) + SUMLT_{Day-1}$$
    $$If\ T \geq 0\ and\ MELT > CUMLT_{Day-1}: CUMLT = 0$$
    $$If\ T \geq 0\ and\ MELT \leq CUMLT_{Day-1}: CUMLT = CUMLT_{Day-1} - MELT$$
- Temperature and snow depth thresholds:
  - $WSI = \#days\ (T \leq -17.7°C + \#days\ (Snow\ Depth > 38cm)$[6]
  - $WSI = \#days\ (T \leq -17.8°C + \#days\ (Snow\ Depth > 45.7cm)$[7]
- Temperature as an aggregating factor of snow depth:[8]
  - $$WSI = \begin{cases} 4 \times (SNOW) & if\ TEMP < -25°C \\ 3 \times (SNOW) & if\ TEMP < -15°C \\ 2 \times (SNOW) & if\ TEMP < -5°C \\ 1 \times (SNOW) & if\ TEMP > 5°C \end{cases}$$
- We are also interested in Spring thaw/freeze events.
- Correlate developed WSIs with hunter success data to determine the most effective WSI.
  - Using information theoretic methods

Objective 2: Hunter Success

- Examine hunter success fluctuations in each WMU and compare developed WSIs.
- Investigate the impact of winter severity on deer populations by examining the change in hunter success after severe winter.
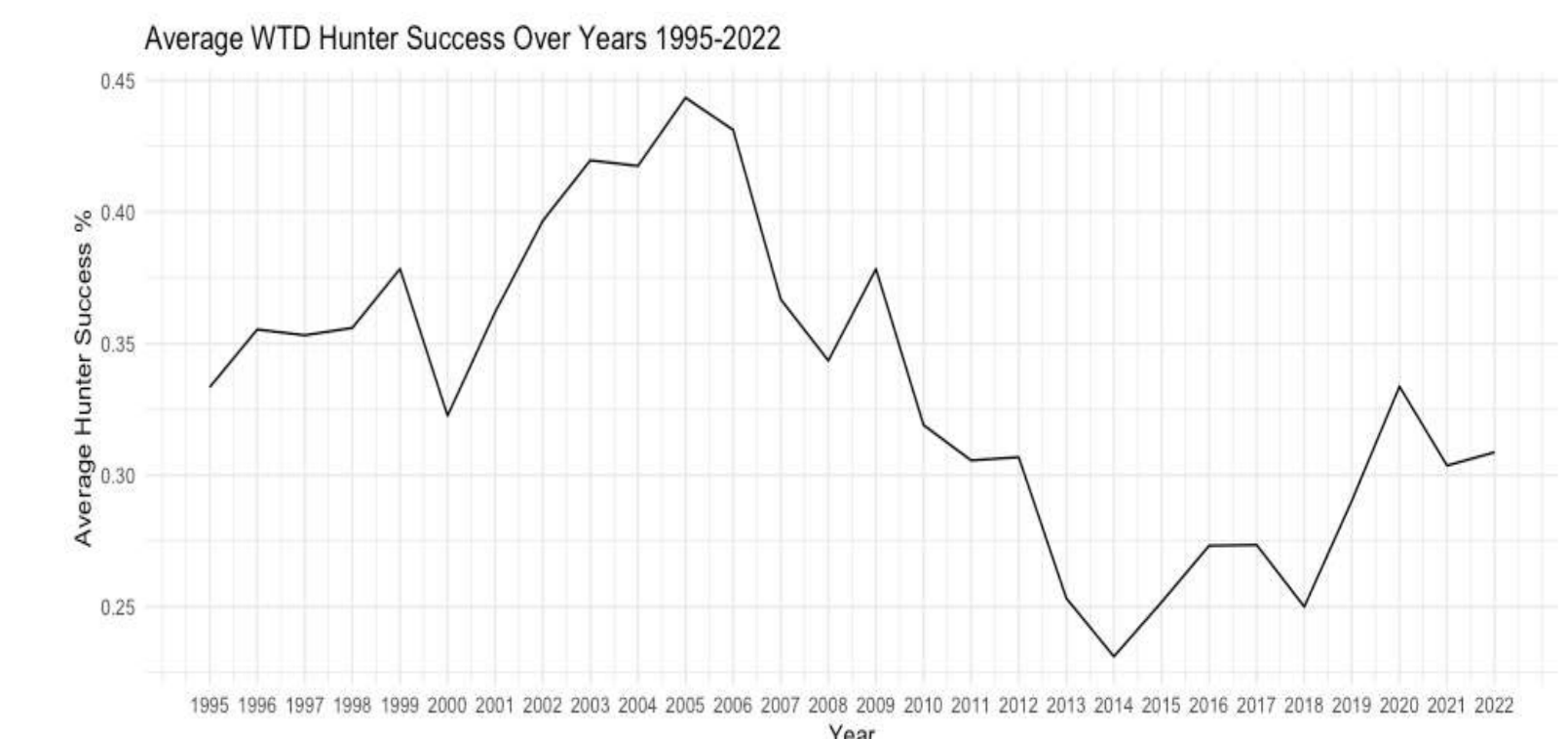

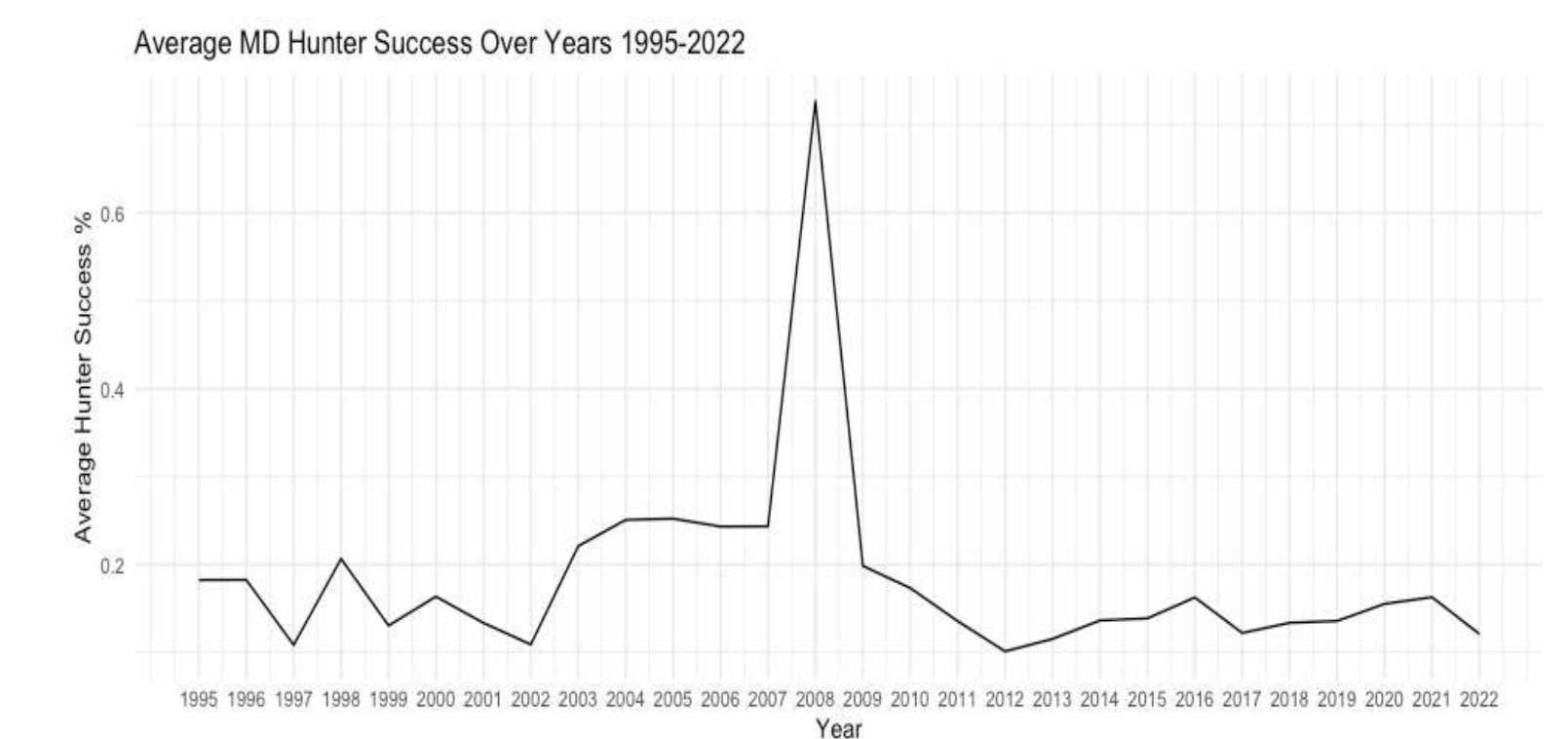Figure 3. Changes in hunter success of WTD from 1995-2022. Data obtained from Government of Alberta.

Figure 4. Changes in hunter success of MD from 1995-2022. Data obtained from Government of Alberta.

Objective 3: Hydra Effect

- Ecological phenomenon where higher mortality results in population stabilization and higher abundance.[4]
  - By keeping populations below carrying capacity
- Suggests that populations with consistent hunting will be less vulnerable to winter events.
- Compare WMUs with differing hunting pressures to determine the effect of hunting on success.
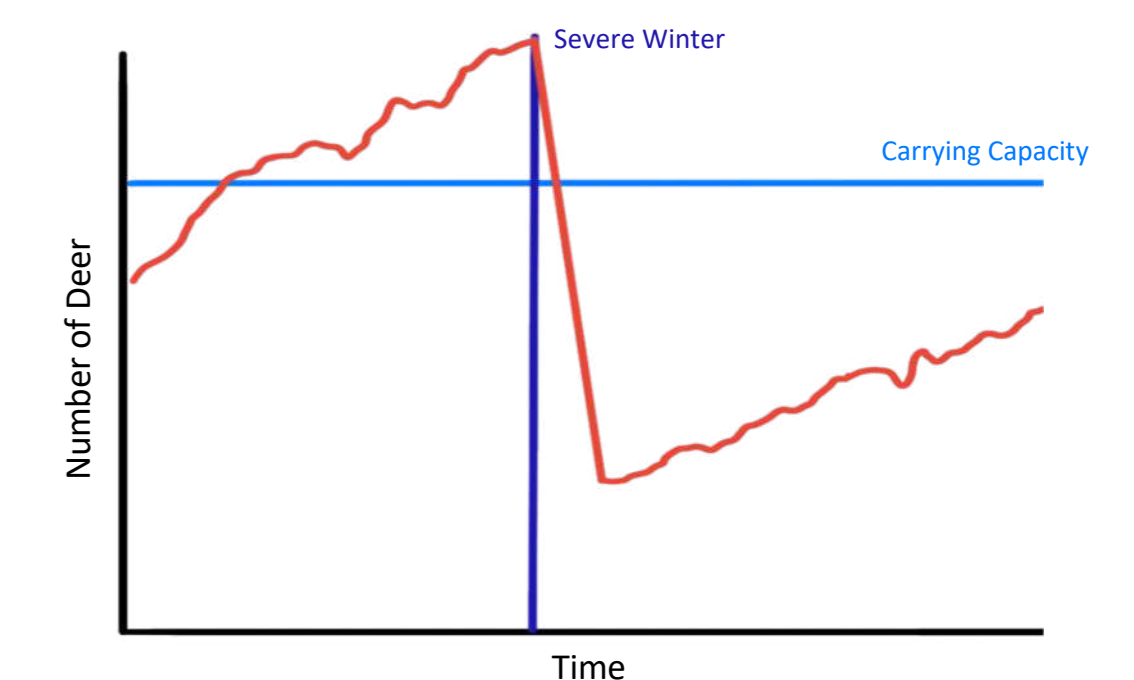

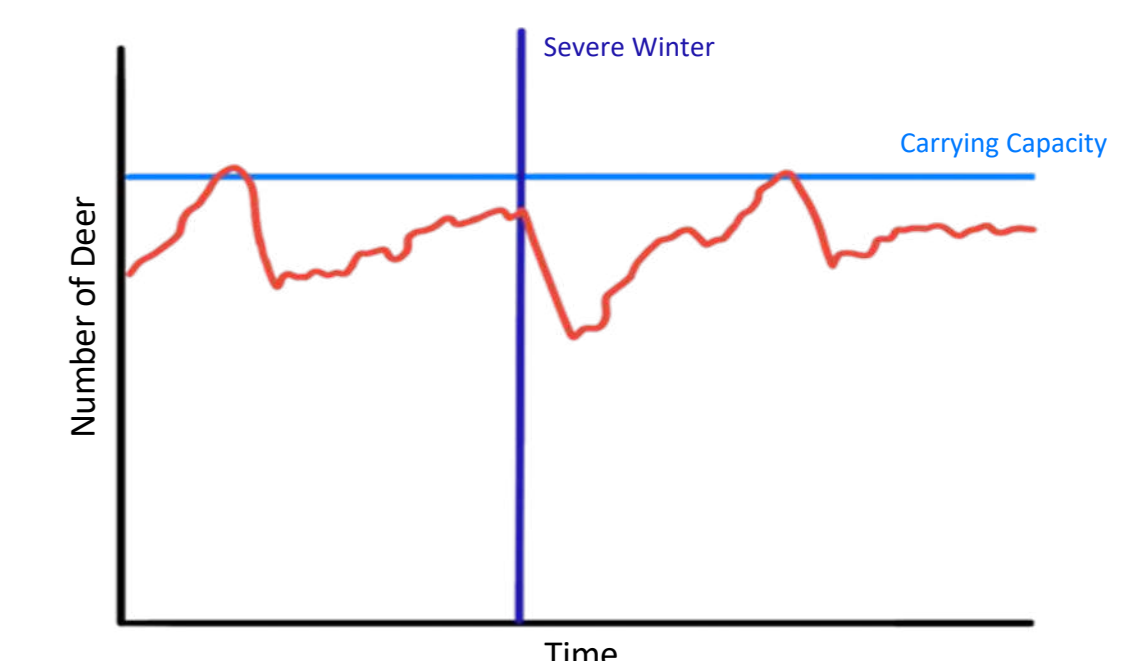Figure 5. Representation of the Hydra Effect on a population in the absence of hunting.

Figure 6. Representation of the Hydra Effect on a population in the presence of hunting.

References

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