Remote Sensing to Show Climate Change Impact on Moose

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Introduction

Climate change has been an issue for a long time for wildlife and for different ecosystems. Climate change is due to the energy from the sun not being able to exit our atmosphere due to green house gases and therefore further heating the planet. This has lead to the Earths' temperature increasing in most areas, shorter winters due to the increased temperatures, and snow and ice caps melting at the poles on top of other issues that are occurring due climate change. Normalized Differential Vegetation Index (NDVI) measures the amount of green and the status of the vegetation by looking at the amount of red that is absorbed and the amount of Near Infrared that is reflected (Remote Sensing Phenology Remote Sensing Phenology). An area that is going to be high in vegetation is going to have a higher NDVI value.

Figure 1 Shows how climate change occurs. https://brightfuture.unilever.com/stories/473087/What-is-climate-change--How-can-we-take-action-.aspx

Effects of Climate and Plant Phenology on Recruitment of Moose at the Southern Extent of their Range Case Study:

In the paper they looked at how climate change impacted malnutrition for calves by looking at the plant phenology and climate. They used NDVI from the National Oceanic and Atmospheric Administration weather station to look at a 1 week interval from when vegetation started to appear to the time it was at it's peak. They realized that due to climate change the mothers were having to put more energy into regulating there temperature. They also noticed that due to warmer weather there was less nutrients in the grasses they ate by looking at the rate the NDVI value increased. (Monteith et al., 2015) Figure 2

Figure 2 shows in the grey portions the areas where moose populations are decreasing. https://link.springer.com/article/10.1007/s00442-015-3296-4

Climate Change Impacts Population Dynamics and Distribution Shift of Moose (*Alces alces*) in Heilongjiang Province of China Case Study:

In the paper they observed the impacts of density dependent, NDVI, population dynamics, and temperature on the moose population. They used the NDVI values of the monthly data to measure the amount of vegetation in the area. They concluded with the decrease in the NDVI value over time that deforestation was the main cause of the decline in the moose population. They also realized that climate change has impacted the moose population by pushing them further North. (Dao, Jiang, Stott, and Pao, 2013) Figure 3

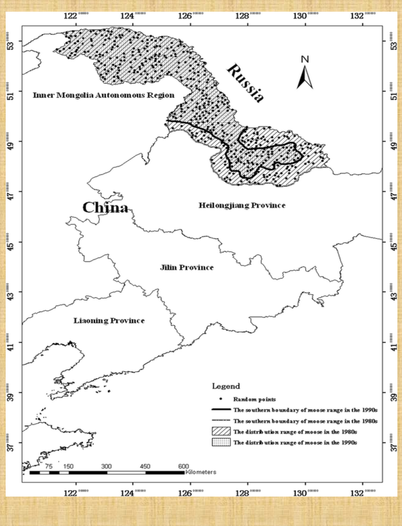

Figure 3 shows the study area and the change in the moose population sites for the China study site. https://link.springer.com/article/10.1007/s11284-013-1054-9

Integration of MODIS-derived Metrics to Assess Interannual Variability in Snowpack, Lake Ice, and NDVI in Southwest Alaska Case Study:

They observed the interannual snow pack duration, snowpack extent, and the vegetation in the area. In their study they used a constrained view angle for their NDVI to reduce cloud cover issues. They also used in their study the NDVI curve to produce points for the start of the growing season, end of the growing season, and other events. They saw that for the NDVI it was not clear when the start of the growing season was, but they did see that there is a relationship between the time when snow melts and the time when grass starts growing which impacts when the animals return. (Reede, Budde, Spencer, and Miller, 2009) Figure 4

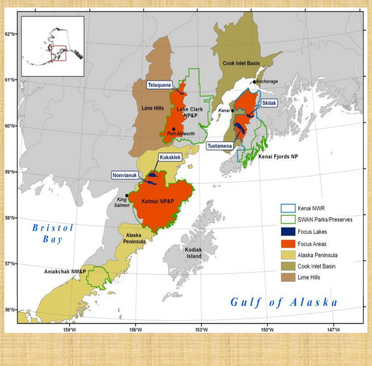

Figure 4 shows the map for the Alaska study site. http://www.sciencedirect.com/science/article/pii/S0034425709000534

Patterns and Causes of Demographic Variation in a Harvested Moose Population: Evidence for the Effects of Climate and Density-Dependent Drivers Case Study: Their objective was to look at how moose population differs in different climates and other factors that impact moose populations for the hunters in the area. Their methods included them using NDVI to judge the vegetation quality. They got to compute the NDVI value from the National Oceanic and Atmospheric Administration satellites. They took the average of the data points that were in the boundaries. They noticed that for different moose population scales different factors impacted them. When the moose population was at a larger scale the main issues that they faced was overgrazing and when they were at a lower scale it was based on climate.
(Brown, 2011) Figure 5

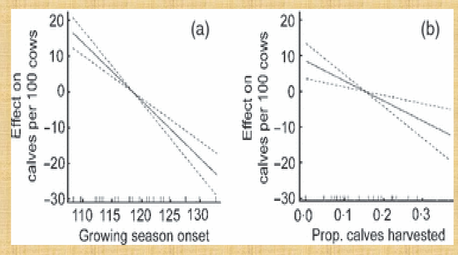

Figure 5 is showing on the right graph the proportion of calves harvested on the x axis and the left is showing the time when vegetation starts growing. This describes how the start of the growing season impacts the amount of calves harvested.
http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2656.2011.01875.x/full

Work Cited

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