Spatio-Temporal Constraints on Moose Habitat and Carrying Capacity in Coastal Alaska: Vegetation Succession and Climate

Author(s): Thomas R. Stephenson, Victor Van Ballenberghe, James M. Peek, and James G. MacCracken
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Spatio-Temporal Constraints on Moose Habitat and Carrying Capacity in Coastal Alaska: Vegetation Succession and Climate

Thomas R. Stephenson,[1] Victor Van Ballenberghe,[2] James M. Peek,[3] and James G. MacCracken[4]

Authors are [1]Associate Wildlife Biologist, Sierra Nevada Bighorn Sheep Recovery Program, California Department of Fish and Game, 407 West Line Street, Bishop, CA 93514; [2]Research Biologist (retired), US Department of Agriculture Forest Service, Pacific Northwest Research Station, 3301 C Street, Suite 200, Anchorage, AK 99503-3954; [3]Professor Emeritus, Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID 83844; and [4]Wildlife Biologist, Timber Department, Longview Fiber Company, PO Box 667, Longview, WA 98632.

Abstract

We used a geographic information system and a Markov chain analysis to model vegetation succession on the Copper River Delta, Alaska, relative to moose (*Alces alces*) habitat availability and nutritional carrying capacity. Between 1959 and 1986 vegetation predominantly shifted from pioneer to later successional communities as a result of glacial retreat and earthquake uplift. Hypothesized vectors of vegetation composition in future decades indicate a trend toward an increase in late-successional communities. A decline in glacier-related disturbance has reduced the level of retrogression that maintains early successional communities in the outwash plain. In addition, landscape heterogeneity increased significantly between 1959 and 1986, particularly in the uplifted marsh. Winter severity was highly variable among years and was correlated with a shift in the location of moose wintering areas. As winter severity increased, there was increased use of the glacial outwash plain landform and its associated plant communities. Successional modeling suggests a decline in the availability of vegetation types important to moose during severe winters with deep snow. Low willow (*Salix* spp.) communities are expanding in the uplifted marsh, a landform used primarily during summer and mild winters. However, tall willow communities that provide winter forage are declining and are being replaced by Sitka spruce (*Picea sitchensis* [Bong] Carr) forest in the glacial outwash plain. Consequently, nutritional carrying capacity of moose on the outwash plain during winter will decline by 42% during 1959–2013.

Resumen

Usamos un sistema de información geográfica y el análisis de la cadena de Markov para modelar la sucesión de la vegetación del "Copper River Delta," Alaska, en relación con la disponibilidad de hábitat y capacidad de carga nutricional para el alce (*Alces alces*). Entre 1959 y 1986 la vegetación fue predominantemente cambiada de comunidades pioneras a comunidades de mayor desarrollo en la sucesión, esto, como resultado de la contracción del glaciares y elevaciones por terremotos. Los vectores hipotéticos de la composición de la vegetación en décadas futuras indican una tendencia hacia un incremento de las comunidades de las etapas finales de la sucesión. Una disminución del disturbio relacionado con el glacial ha reducido el nivel de retrogresión que mantiene las comunidades iniciales de la sucesión en las planicies de material sedimentario. Además, la heterogeneidad del paisaje se incrementó significativamente entre 1959 y 1986, particularmente en las áreas pantanosas emergidas. La severidad del invierno es altamente variable entre años y estuvo correlacionada con el cambio en la localización de las áreas invernales del alce. Conforme la severidad del invierno incrementó, hubo un aumento en el uso de las planicies sedimentarias del glacial y sus comunidades vegetales asociadas. El modelo sucesional sugiere una reducción en la disponibilidad de tipos de vegetación importantes para el alce durante los inviernos severos con nieve profunda. Las comunidades de "Low willow"(*Salix* spp.) se están expandiendo hacia las áreas húmedas emergidas, una topoforma usada principalmente durante el verano e inviernos moderados. Sin embargo, en las planicies sedimentarias del glacial, las comunidades de "Tall willow," que proveen forraje en invierno, están disminuyendo y siendo remplazadas por bosques de "Sitka spruce" (*Picea sitchensis* [Bong] Carr). Consecuentemente, durante el invierno la capacidad de carga nutricional para le alce de las planicies de sedimentarias disminuirá en 42% durante 1959–2013.

Key Words: *Alces alces*, habitat selection, landscape heterogeneity, Markov chain, winter severity

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At the time of the research, the senior author was Graduate Research Assistant, Dept of Fish and Wildlife Resources, University of Idaho, Moscow, ID 83844.

Correspondence: Thomas R. Stephenson, Sierra Nevada Bighorn Sheep Recovery Program, California Dept of Fish and Game, 407 West Line St, Bishop, CA 93514. Email: tstephenson@dfg.ca.gov

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