

# The WEST SIDE STORY

*Elk gangs in Idaho*



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A 1961 movie starring Rita Moreno depicted the lives and interactions between street gang members in the 1950s. At first glance, this may seem to have little to do with elk in Idaho, but there are parallels. The colloquial name for a group of elk is a “gang,” and Idaho lies within and along the western side of the Rocky Mountains. Most importantly, both elk gangs and street gangs are influenced by internal social dynamics as well as the environments in which their life drama plays out.

### **A Look at Elk in Idaho**

Elk are one of the largest members of the deer family. These habitat generalists can be found in sage-dominated deserts as well as cedar-hemlock forests. Typically elk use higher elevations in summer and migrate to lower elevations during winter. They have a polygamous mating system, meaning a single mature bull will mate with several cows. Six subspecies (two of which are now considered extinct) range across North America with the Rocky Mountain elk subspecies (referred to as American elk for B&C records-keeping purposes) having the largest distribution, which includes most of Idaho.

Historically, elk were thought to occur throughout Idaho. The 1860 discovery of gold in



Idaho led to an influx of miners and unregulated year-round hunting. Those declines were reversed by wildfires during 1910-1919 that burned 4.6 million acres in the Northwest, creating abundant elk browse, and by the translocation of about 675-800 elk into Idaho from Yellowstone National Park between 1915 and 1946. Recent aerial surveys estimated the elk population in Idaho at 107,600 statewide. Elk are an economically important species, as illustrated by the harvest of an estimated 20,000 animals in Idaho during 2007.

Current elk management concerns include harvest rates, loss of winter-range habitat, predation, and habitat quality and quantity. High road densities and lack of secure cover increase elk vulnerability to harvest, and increasing human encroachment has resulted in loss of winter ranges. Black bears and cougars, which prey on elk, have been joined recently by wolves in Idaho. This addition of a new predator has changed

the dynamics of the ecosystem. Lastly, because large amounts of high-quality habitat are important to elk populations, managers are continually working to maintain habitat quality and quantity.

Wildlife managers in Idaho are challenged with managing wildlife across the entire state over enormous geographic areas. Elk exemplify these challenges because their seasonal ranges and annual ranges cover entire watersheds and sub-basins, respectively. What new information about elk could point the way to more effective management strategies for elk? This general question is what lured me to Idaho in 2000 to commence graduate studies under Dr. Oz Garton, Professor of Wildlife Resources at the University of Idaho.

### **An Introduction to Metapopulations**

Early in my research, I had the good luck

of attending a workshop on metapopulations led by Dr. Garton. A metapopulation is defined as a “population of populations” or a “set of spatially separate populations, among which there is some movement of individual animals.” Could the challenge of managing elk across an entire state be better addressed by knowledge of how different populations within a metapopulation interact? In other words, could improved understanding of the “connectedness” of individual elk populations be of practical value? I reasoned that such information should enable managers to better anticipate how different populations may respond to management objectives and strategies applied across large geographic areas.

During the workshop, Dr. Garton outlined six steps to delineate populations within a metapopulation: (1) state objectives clearly, (2) determine distribution of individual groups, (3) determine patterns of

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movement and identify geographic barriers to movement, (4) determine levels of genetic similarity and dissimilarity, (5) identify correlations in demographics rates, and (6) integrate all the above information. My research on Idaho elk followed these six steps to examine how Idaho elk populations were connected within a metapopulation. I used different methodological approaches such as genetics, population demography, and environmental factors in examining the connectedness of elk populations.

Typically the metapopulation approach has been applied to isolated or fragmented populations, with an emphasis on the importance of population connectivity. Although elk populations in Idaho are not generally considered isolated or fragmented, their connectivity is influenced by hunting. My basic premise was that assessing elk populations with a metapopulation approach would help discern how and what populations are connected and this information, in turn, could lead to more effective management. For example, suppose that loss of winter range restricts an elk population to a smaller range, thereby increasing its vulnerability to hunting. Understanding the connectivity of this population to other populations becomes important in order to ensure that it survives and is able to sustain future harvests. Furthermore, knowing how populations are connected can improve their overall management by revealing which populations are influenced by neighboring ones.

I began my research by stating my objectives clearly (step 1 from the workshop). My first objective was to delineate elk populations and the associated metapopulation using genetic methods. Objective 2 was to delineate elk populations and the associated metapopulation using demographic data and to measure correlations in demographic rates, such as abundance, between populations. Objective 3 was to investigate the influence of environmental factors such as weather, predation, habitat, and harvest on the delineated elk populations and the associated metapopulation.

### **Delineating Elk Populations Using Genetics**

I used genetics to determine patterns of movement, identify geographic barriers



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to movement, and discern levels of genetic similarity (steps 3 and 4 from the workshop). If two or more individuals are genetically similar, this means they are related by some degree. When an individual elk leaves one population and joins another one to reproduce, its offspring will be genetically similar to the new population. Genetics can be used to indicate populations that are interacting through exchange of individuals, or in other words, which animals have moved between populations and are reproducing within other populations. This is done by identifying each individual's unique genotype and then assessing how similar or dissimilar each individual is from all the others based on genotypes.

I used a variety of different approaches to assess genetic similarity between individual elk, and overall I found that genetic similarity was consistent across multiple populations. My results indicated that elk populations were genetically connected across Idaho. The amount of genetic similarity I found could be attributed to either the translocations of elk from Yellowstone National Park, or to a sufficient number of individuals moving between and reproducing in multiple populations, or both. It is hard to tease these results apart because historical events shaped the genetic similarity observed in my research. However, my results do suggest that elk populations in Idaho are well-connected genetically. In other words, the various Idaho "gangs" are related to one another.

### **Delineating Populations Using Demography**

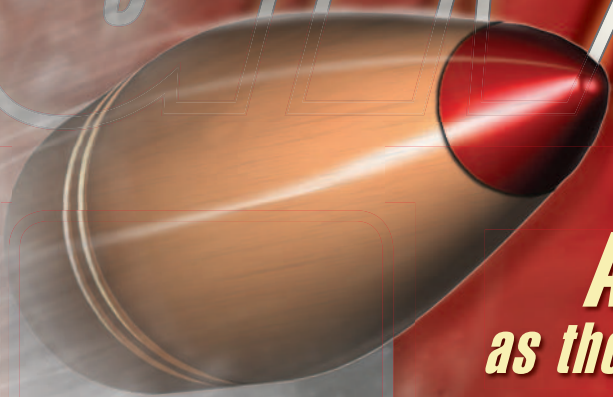
I used demographic data such as abundance to address steps 2 and 5 from the workshop, determining the distribution of individual groups and identifying correlations in demographic rates between different populations. I delineated elk populations using long-term demographic data across Idaho that included the total

number of elk (abundance) and the average number of calves per 100 cows (calf/cow ratio) within a population. A cluster analysis was used to group elk that had similar demographic characteristics. Once elk groups were clustered into demographically similar populations, I looked at the correlation in demographic rates between populations to see if populations were interacting synchronously (responding together) or asynchronously (responding differently). For example, if populations were synchronous, they both would increase or decrease in abundance during the same year, but if populations were asynchronous they would not change together. If environmental factors such as weather influenced several populations, then those populations would change together (synchronously) in response to weather factors (for example, drought).

I obtained population abundance estimates from 20 years of helicopter survey data gathered during 1989-2009. These included data on 1,052 groups of elk, which I was able to cluster into 19 populations. These clustered populations represented groups of elk within which demographic similarity was maximized. Population synchrony was exhibited between the 19 populations, but the degree and magnitude of synchrony varied widely. More distant populations were as likely to be synchronized as those adjacent to each other. Because population synchrony varied widely between populations, it is likely that different factors are influencing these populations. Populations could be responding to external factors such as weather, as well as internal factors such as individual elk moving between populations. I know from my genetic analysis that elk are capable of moving between populations, which means the observed synchrony could be attributed, in part, to this movement. However, factors such as droughts or severe winters could influence populations over large areas. Both internal and

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external factors could be influencing the connectivity between populations. Furthermore, harvest could be considered an external factor that may have influenced population synchrony; however, it is a different kind of external factor because managers can control harvest levels.

### **Influence of Environmental Factors on Elk Populations**

My findings showed that demographic characteristics of elk populations respond to both internal and external factors. Furthermore, environmental factors such as density dependence (e.g., negative population growth in response to increasing population density), mortality, weather, and habitat are both spatially and temporally dynamic. Monitoring populations and key environmental factors can yield insights into how elk populations adapt to changing environments.

For this analysis, I used data spanning 1989-2007 and included only three populations that had sufficient data for the years included. I looked at each of the environmental factors mentioned above in relation to population growth rate. In theory, population growth rate should increase until a specific density is reached. At that point, mortality increases to a level that causes the population growth rate to decrease (i.e., density dependence). Elk and other ungulate populations are thought to be influenced by density dependence in the wild. I examined the total number of elk, number of cows, and number of calves, expressed as densities, in relation to population growth rate. For my mortality analysis, I measured the harvest rate (number of elk harvested per year divided by the total estimated number of elk prior to the harvest) and number of wolves per 100 elk. Weather variables in this analysis were precipitation and snow depth. Lastly, I estimated the total amount of available forage biomass during each spring. All of these variables were evaluated to determine how much each one individually, or in combination, influenced the population growth rate of elk.

I found that density dependence influenced the population growth rate of elk more than any other environmental factor. Density dependence had a negative effect on population growth rate, which means that as density increased, the population growth rate decreased. These results suggest that the population level of elk in these three populations was at or near the maximum number that the environment could support. My results also indicated that multiple other factors were influencing elk populations, but



it is difficult to tease apart the influence of each because they have complicated interactions.

An interesting result was that as calf density and total harvest increased, population growth rate also increased. This suggests that harvest may be keeping the population density below the point at which density dependence would depress population growth rate. By harvesting the population, calf survival and density increased, which was reflected as positive population growth rate. I need to emphasize that these are preliminary results and based on only three populations. In the future I intend to expand this analysis to include more populations that have sufficient years of data.

### **Putting Findings to Use in Population Management**

My research suggests that connectivity is high among elk populations within the metapopulation of elk in Idaho. This is supported by the genetic evidence and the findings from demographic analysis. To my knowledge, this is the first time elk populations have been delineated using demographic data—a new approach that could be important in future elk population management.

The demonstrated level of connectivity among elk populations suggests that harvest exerts an influence over a large area. However, from a genetic perspective, elk populations in Idaho are resilient to varying harvest levels over time as long as connectivity between populations is maintained. Current management practices are maintaining sufficient gene flow, but it will be important to monitor trends over time. Genetic monitoring is a way to quantify temporal changes in population genetics and connectivity, and my genetic data can provide the baseline data for this work. Frequent genetic monitoring (e.g., once every five years) will be important for detecting population trends and for evaluating influences of

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sudden events, such as severe winters, on genetic connectivity.

I encourage the continuation of annual helicopter surveys to estimate elk population sizes. However, the current temporal survey design makes estimating elk population growth rates challenging. I believe it will become increasingly important to track elk population growth rates in addition to population abundance estimates using the annual helicopter surveys. Flying specific areas each year or during paired years (i.e., 2009 and 2010) would improve the ability to estimate population growth rates over time. I believe that population growth rate is the best population measure for understanding how populations respond to environmental factors such as density dependence.

In conclusion, the West Side Story for elk brings the popular movie to mind, but I now see some differences more clearly. Unlike the gangs in the movie, elk gangs in Idaho seem to get along with each other. The overall connectivity between elk gangs in Idaho is high and it will be important to maintain that connectivity into the future so that sustainable harvests of gangs can continue. ■

Jocelyn Aycrigg is a Conservation Biologist with the National Gap Analysis Program at the University of Idaho where her current work focuses on continued conservation of all species in the U.S. through development and application of land cover data, protected areas data, and species distribution models. The elk study reported here, completed as part of Dr. Aycrigg's Ph.D. program, was assisted by a grant from the Boone and Crockett Conservation Research Grants Program.