

## How do ungulates learn to migrate? A mechanistic test of the social learning hypothesis.

For migratory ungulates, recent evidence has shown that spatial memory shapes migration, but we do not yet understand the behavioral mechanisms by which migration routes are learned or maintained. It has long been thought that migratory behavior in ungulates is culturally transmitted, with juveniles learning migration patterns from their mothers and then adopting them as adults. Unfortunately, this assumption has never been empirically tested. We tested the social learning hypothesis to advance our understanding of the behavioral mechanisms that underpin the acquisition of knowledge in ungulate migration. Specifically, we addressed the following predictions: 1) juveniles learn migration strategies from their mothers and adopt them as adults, and 2) juveniles learn migration strategies from other animals in their group and adopt them as adults. Analyzing GPS data from mother-offspring pairs of both mule deer and pronghorn, we found that 95% of mule deer ( $n=7$ ), pronghorn ( $n=30$ ) juveniles underwent the same seasonal movements as their mothers in their first year of life. In the spring of 2022, we will have a complete second year of data for juveniles. We will then evaluate the migrations of their second year of life, at which point they are considered adults, migrating independently of their mothers. To identify the mechanisms that underpin how juveniles learn to migrate, we used a step selection function (SSF). At each used and available step we extracted landscape variables (slope, elevation, etc.), phenological gradients (green-up, snow depth), natal route (distance to migration route of mom in the previous year with the fawn), and group dynamics (distance to nearest neighbor's route in the same year). This SSF will allow us to simultaneously evaluate what factors are most important to an ungulate's ability to navigate during migration. Our preliminary findings suggest that female juveniles adopt similar migration strategies as their mothers. This research could have important management implications. If juveniles learn from their mothers, for example, this could place a higher conservation value on maintaining existing migration routes.