

GROUSE PARTNERSHIP NEWS

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MIGRATION AND THE GREATER SAGE-GROUSE

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Migration is a common behavior found in all major taxa from insects to crustaceans to reptiles to mammals and so on. A fifth of the world's species of birds are considered long-distance migrants. There is beauty and wonder associated with natural phenomena such as migration. Migration evokes images of vast herds of wildebeest moving across the Serengeti. It can also be a familiar reminder of the changing of the seasons, like how a harmonious flock of geese pointed south can create a previously unnoticed chill in the air. Greater understanding results in greater appreciation of natural phenomena. Until it was discovered, we could not marvel at the bar-tailed godwit, which flies over open ocean without stopping for 7,000 miles from Alaska to New Zealand; or, the bar-headed goose which climbs 25,000 feet in one flight to ascend the Himalayas. Grouse do not arouse these same images, at least relative to interseasonal movements, because they are not readily observable, nor do they necessarily demonstrate such phenomenal physical feats. However, their behavior still contributes to the diversity of movement found on our planet when animals react to their changing environment.

The oldest acknowledgments to seasonal movements by animals are documented in the Old Testament, with references

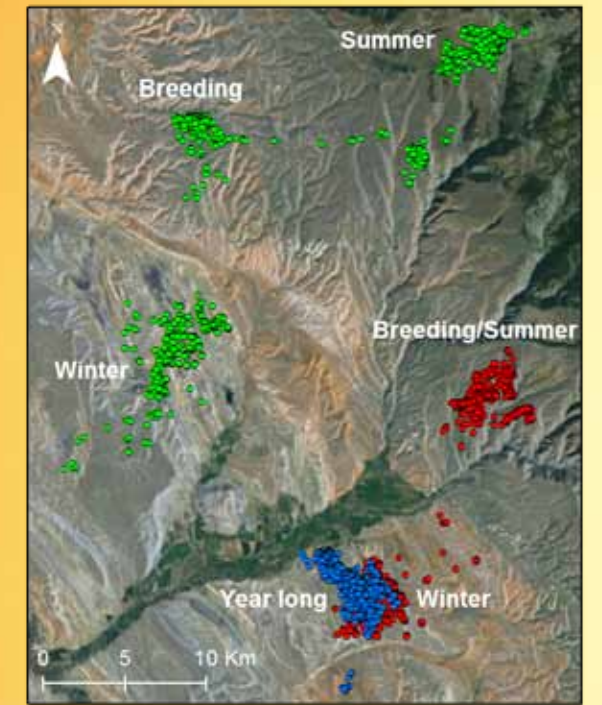
in the books of Job (Job 39:26) and Jeremiah (Jeremiah 8:7; circa 600 BC). The next references were from Aristotle (circa 350 BC) when he recorded the times of departure for species in his area. Much more recently, advances in technology (first via banding, then by the radio-transmitter) assisted in studying movement at the individual level instead of only documenting the redistribution of populations. These first marking techniques showed where animals started and ended but did not provide much detailed information on the routes taken. This information was made more readily available with the advent of satellite and GPS transmitters with high location fix rates. Continued technological advancements have led to individually marking smaller and smaller species with higher and higher performing transmitters resulting in more questions being answered. For example, one can now use data obtained from high fix rates with GPS transmitters to estimate individual movement paths at high resolution allowing for investigations of the factors influencing an animal's decision on when and where to move. This has been the case for the greater sage-grouse.



Locations obtained by GPS transmitters depicting the routes taken by three greater sage-grouse from winter range to breeding range during spring 2019 in southern Wyoming. The green individual traveled between seasonal ranges that were 14 miles apart over 11 days, the blue individual traveled between ranges 33 miles apart over 10 days, and the yellow individual traveled between ranges 23 miles apart over 14 days.

Migration, like many ecological phenomena, is difficult to define. But the pragmatic definition describes an animal as migratory if it demonstrates the use of seasonally dependent non-overlapping ranges. Non-overlapping ranges represent infrequent movements on a greater spatial scale connecting distinct areas of frequent, smaller scale movements termed 'station-keeping' activities. In addition, the use of these ranges corresponds with the periodicity of seasonal habitat use on the annual cycle. In this context, the majority of sage grouse would likely be classified as migratory individuals. We conducted sage grouse studies in the Bighorn Basin of Montana and Wyoming and in central Wyoming where 74% of our GPS-equipped sage grouse were classified as migratory. Using this perhaps more liberal definition, many grouse species would show some form of migratory behavior, if they must consistently travel farther than their normal daily movements between different seasonal habitat requirements. A familiar example is dusky grouse traveling from mountain sagebrush plant communities where they nest to higher elevation conifer forests where they winter. A less familiar example are greater prairie-chickens in the Nebraska Sandhills that travel from grass-dominated rangeland where they nest to areas with more cropland where they winter. We propose sage grouse as an excellent example of how migratory and resident behavior for a species, or population, falls along a continuous gradient. Sage grouse can have two seasonal ranges that are 0, 1, 2, ..., 10, 11, 12, ..., 20, 21, 22, ..., 100, 101, 102, ... miles apart, with any amount of overlap of ranges and any distance along a continuum between ranges. Thus, it would be difficult to derive an objective, crystal-clear cut-off between resident and migratory behavior in sage grouse. It has also been simply described that many grouse have large home ranges. The largest documented grouse migration is about 100 miles connecting sage grouse breeding habitat in Saskatchewan and winter habitat in Montana.

Partial migration is where some, but not all, individuals in a population are migratory. Partial migration has been argued to be the most widespread form of migration found in all major taxa, including sage grouse. Most people are familiar with annual to-and-fro migrations, where animals travel between a breeding and non-breeding season. Sage grouse can behave like this. However, sage grouse can also demonstrate round-trip migration among three different seasonal ranges. Sage grouse generally have three distinct seasonal habitat requirements (breeding, summer, and winter) with any combination of one to three seasonal ranges for individuals to meet those requirements



Locations over one year for three greater sage-grouse that exemplify different types of migration behavior where grouse use one (blue), two (red), or three (green) unique seasonal ranges to meet breeding, summer, and winter habitat requirements.

It is possible for residents and migrants to share any of the three seasonal ranges. In our sage grouse studies, 26% of grouse were residents with just one annual range meeting all three habitat requirements; 1% of grouse moved between breeding range and a separate area used for both summer and winter; 16% of grouse moved between summer range and a separate area used for both breeding and winter; 18% of grouse moved between winter range and a separate area used for both breeding and summer; and 39% of grouse used three distinct areas to meet their three habitat requirements.

Sage grouse breeding habitat generally includes large areas of sagebrush-dominated plant communities in the vicinity of strutting grounds that also include an herbaceous layer. Summer habitat can include a wide-variety of plant communities within sagebrush-dominated landscapes with a greater source of moisture that keeps plants from desiccating (e.g., riparian, montane sagebrush, wet meadows, and irrigated hayfields or pastures). Winter habitat occurs in mostly sagebrush-dominated plant communities, where sagebrush plants provide food and

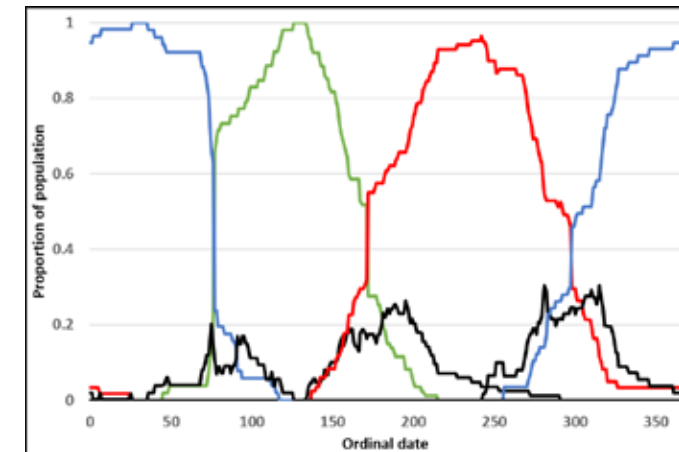


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cover, particularly in areas where tall sagebrush or topography permit sagebrush to extend above snow. Seasonal movements for sage grouse are presumed to be tied to forage quality and availability. Sage grouse appear to depart their breeding range because of decreased forage quality when plants desiccate, depart their summer range because of decreased forage quantity when snow limits availability, and depart their winter range to return to breeding range under favorable conditions (i.e., spring green-up). One can argue that there is also an autumn habitat requirement while transitioning from green forbs on summer range to sagebrush on winter range. However, our observations suggest that in most cases this does not create a fourth seasonal range. Instead grouse start using sagebrush after forbs desiccate while still on summer range, at stopover

locations while migrating between summer and winter range, or they arrive on winter range early well before the arrival of snow. There were a few exceptions when grouse left summer range and went out of their way to spend a little time, usually back on their breeding range, before finally leaving for winter range. Sage grouse use a combination of temperature and precipitation to properly time their movements between seasonal ranges. In general, migratory grouse avoid more rapid plant desiccation in warmer breeding ranges and avoid higher snow accumulation in colder summer ranges with more precipitation than residents in the same population. Our study populations showed that the seasonal transition with the most (75%) individuals exhibiting migratory behavior was between summer habitat and winter habitat, closely followed by individuals (73%) transitioning

between breeding habitat and summer habitat, and the lowest proportion (55%) of the population migrating between winter habitat and breeding habitat. Our observations also revealed that sage grouse spent more time on winter range than any other seasonal range.



Proportion of the GPS-equipped greater sage-grouse population in breeding (green), summer (red), winter (blue), and interseasonal periods (black) in Bighorn Basin, Montana and Wyoming.

Elevational gradients in the western U.S. create conditions conducive for the consistent change of resources needed for migratory behavior to develop. Altitudinal migration is when animals move up and down in elevation. This is common with sage grouse that move up in elevation to access more mesic sagebrush communities during the dry summer and then retreat to the valleys and basins to avoid deep snow during winter. Sage grouse also demonstrate another type of migration behavior that does not neatly fit into the classic forms of altitudinal and latitudinal movements because they are not directly tied to elevational changes or oriented north-south. This is common for sage grouse that do not use mountain summer habitat but instead go to irrigated hayfields and pastures. Irrigation, or natural riparian habitat in some locales, can also provide the added moisture to keep plants green during the dry summer months. Grouse that summer in these areas must leave for winter range during autumn if there is not enough quality sagebrush nearby.

It is important for sage grouse conservation to protect all seasonal habitat requirements including habitat used along migration routes. In our studies we observed that grouse were frequently migrating through breeding habitat, so conservation actions focused on breeding habitat are also partially protecting migration habitat. However, there also appears to be much variation in behavior among populations, such as the proportion of the population that is migratory and the distances of migrations, so better understanding local variation in behavior may be necessary for conservation actions to be successful in protecting all seasonal requirements. Obtaining this detailed basic life history information requires the use of more advanced GPS and radio-tracking technology.

We believe we all have a duty to conserve migratory behavior and migratory populations because of their intrinsic value. We all have more to learn about our beloved grouse and hope you have obtained a little more appreciation for sage grouse now that you have greater understanding. We also hope the next time you experience the changing of the seasons and think about animals changing their behavior to acclimate to the changing environment, you will spend some time pondering migration and the greater sage-grouse.



Ken Miracle