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Estimating greater sage-grouse fence collision rates in breeding areas: Preliminary results

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Introduction

Collision mortality is a widespread and relatively common phenomenon among European grouse species (Catt et al. 1994, Bevanger 1995b, Moss et al. 2000). Collision with deer fences is a major source of mortality for capercaillie *Tetrao urogallus* in Scotland (Catt et al. 1994, Baines & Summers 1997), and may be contributing to population declines of that species (Moss 2001). Red grouse *Lagopus lagopus scoticus* and black grouse *Tetrao tetrix* appear to be more common collision victims in Scotland than capercaillie, however, the population consequences for these species are not believed to be as severe (Baines & Summers 1997, Baines & Andrew 2003). Similarly, collisions are a common source of mortality for capercaillie, black grouse, and ptarmigan *Lagopus* spp. in Norway (Bevanger 1990, 1995a, Bevanger & Brøseth 2004), and collision mortality may even approach harvest mortality in some areas (Bevanger 1995b).

Research concerning the relative extent and impacts of collision mortality on North American grouse are limited. Wolfe et al. (2007) studied mortality patterns of lesser prairie-chickens *Tympanuchus pallidicinctus* in Oklahoma and New Mexico, and found 39.8% of all mortality in Oklahoma was caused by collisions with fences. Additionally, Beck et al. (2006) found 33% of the mortality of juvenile greater sage-grouse *Centrocercus urophasianus* on an Idaho study area was caused by collisions with power lines.

Existing research into factors influencing avian collision mortality suggests collision may be influenced by biological, landscape, and habitat features (Bevanger 1994), however, results often vary by species or region (Baines & Summers 1997). For example, Bevanger (1995a) suggested male capercaillie and black grouse have a higher probability of collision than females due to their increased size. In contrast, female lesser prairie chickens were more susceptible to collision mortality due to their increased movement patterns during the breeding season (Wolfe et al. 2007). Other biological factors influencing collision risk include high wing loading and heavy body weight (Bevanger 1998, Janss 2000), as well as factors such as vision (Bevanger 1994), crepuscular or nocturnal activity patterns (Avery et al. 1978), and local or migratory movement patterns (Avery et al. 1978, Malcom 1982). In addition to the possible influences of biological factors, collision mortality in grouse may be influenced by the structure, type, and height of surrounding vegetation (Bevanger 1990, Bevanger & Brøseth 2004), season of year (Catt et al. 1994, Bevanger 1995b), topography (Bevanger 1990), and local bird densities (Baines & Andrew 2003, Bevanger & Brøseth 2004). Furthermore, some authors have found evidence for collision "hot spots" where mortality is concentrated (Bevanger & Brøseth 2000, Baines & Andrew 2003), while others have not found evidence for clumped collision distributions (Baines & Summers 1997).

Recent concerns involving the impacts of elevated infrastructure on greater sage-grouse (hereafter sage-grouse) in Idaho have brought to our attention the lack of empirical data concerning collision frequency of most North American grouse species. The spatial extent of fences and other elevated structures has increased dramatically in shrub-steppe habitats during the last 50 years (Connelly et al. 2000, Connelly et al. 2004), and their potential impact on sage-grouse has not gone unnoticed (Braun



1998, Connelly et al. 2004). Few studies on any grouse species have evaluated factors influencing collision rates across multiple spatial scales, and no studies on sage-grouse have estimated fence collision rates or evaluated factors influencing these rates, further limiting our knowledge of what influences collision risk across the landscape. For these reasons, we pursued this research with the following objectives: 1) estimate collision rates of sage-grouse with fences in sage-grouse breeding habitats, and 2) evaluate the influence of biological, topographical, and fence characteristics on collision rates across multiple spatial scales in sage-grouse breeding habitats.

Study Area

Fence collision surveys in sage-grouse breeding habitats occurred across 4 large geographic regions of southern Idaho (Figure 1). The number and distribution of active leks varied among sampling areas, and the sampling areas were spread across approximately 475 km in southern Idaho. Elevations on sampling areas ranged from 1450-2000 meters. Habitat types on the sampling areas varied from large stands of big *Artemisia tridentata*, low *Artemisia arbuscula* or mixed sagebrush types, to large grasslands, and large heavily grazed pasture and burned areas, and therefore were representative of the variety of habitat conditions on southern Idaho rangelands.

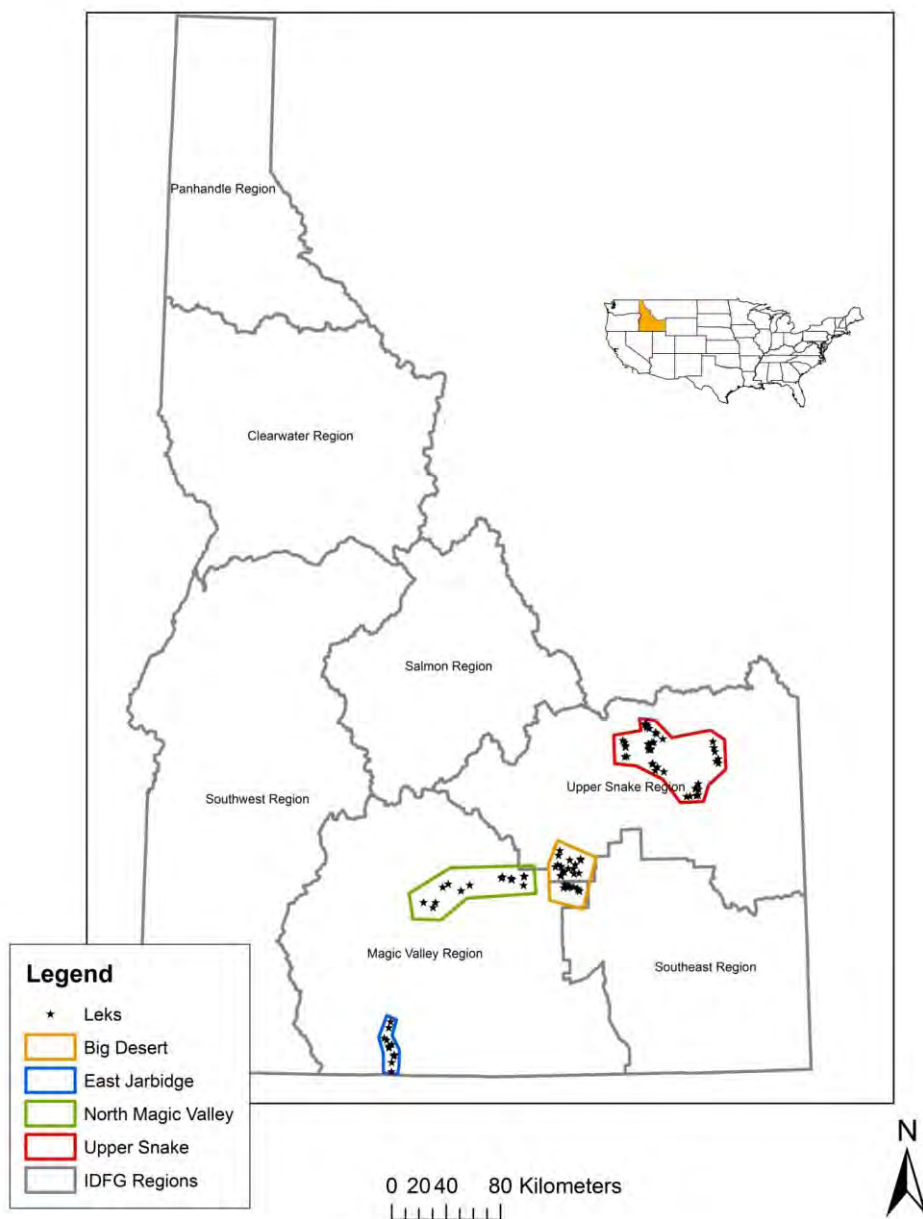


Figure 1. Distribution of sage-grouse lekking areas used in avian fence collision surveys during the 2009 field season.



Methods

We used a cluster sampling approach to estimate collision rates in sage-grouse breeding habitat (Scheaffer et al. 2006). Specifically, 16 lek routes monitored by Idaho Department of Fish and Game were selected for inclusion in the study based on accessibility and known breeding bird use. Once lek routes were selected, global collision rates were estimated using stratified cluster sampling framework (Scheaffer et al. 2006). Specifically, each lek in the route with ≥ 1 displaying male documented the previous year (2008) was buffered by 1.5 km using ArcGIS software. Once each lek on each route was buffered a 1x1 km spatial grid was superimposed over the buffered leks within each route using ArcGIS software, and the grid cells that contained U.S. Bureau of Land Management's (hereafter BLM) pasture boundary layer were used to define the sampling frame. Pasture boundaries were used as our surrogate for fence. Once the sampling frame was defined for each lek route, a stratified cluster sample of 1x1 km grid cells was randomly selected using the Hawth's Tools (Beyer 2004) extension in ArcGIS. We allocated the sample of 60 grid cells to each stratum in proportion to the number of cells in each stratum. Sixty cells were selected as the overall sample size because we assumed this was the maximum number of cells that could be sampled in a month given time and logistical constraints. A month time period was used to facilitate repeat sampling necessary to incorporate temporal variability in lek dynamics. Furthermore, within each strata collision rates were estimated using a 1-stage cluster sampling framework (Scheaffer et al. 2006), and all collision rates were expressed as the number of collision sites per linear kilometer of fence.

Within randomly selected cells all fence sections (sampling elements) were searched for fence collision victims using 1-2 searchers (1 on each side of the fence, or 1 searcher sampling each side in turn). We digitized fence segments located inside our spatial sampling units but not previously identified with the BLM pasture boundary layer using handheld GPS units and ArcGIS software.

We defined a collision as detection of a whole carcass or a feather pile (> 5 feathers) within 15 m of the fence, or detection of feather tufts stuck in the barbed-wire fence. We were cautious when only feather sign was detected, and if an apparent raptor plucking post was present we did not call these collision locations. Given this definition of a fence collision the only victims not accounted for would involve birds flying into fences and leaving no feathers either in the fence or on the ground, and no carcass, or those where evidence was removed prior to sampling by scavengers or weather. Feather tufts and piles were counted as collisions with no knowledge of the fate of the collision victim. Therefore, our estimates are of the number of collision sites present at the time of the survey, and not of collision mortalities, as we had no way to assess the crippling bias caused by individual birds flying into fences and dying at a later time or in a different area (Bevanger 1999). Furthermore, this estimate is likely biased low due to an unknown detection probability for collision evidence in sagebrush-steppe habitats.

Biological, topographical, and fence characteristics were recorded at each collision site. Random points were selected on each study area for site scale analysis of factors influencing collision, to assess the significance of features recorded at collision locations. Specifically, one spatial location for each collision victim found on each study area was randomly generated within the sampling frame using the Hawth's Tools extension (Beyer 2004) of ArcGIS software, and the closest fence segment to this location on the study area was used to measure site-scale variables that will be used in modeling.

Preliminary Results

We sampled fence in sage-grouse breeding habitats from approximately 5 March – 19 May 2009. A total of 66.2 km of fence were sampled in 16 lek routes. However, the 6 lek routes in the Upper Snake sampling area were all sampled twice during the breeding season, and the 2 lek routes in the East Jarbidge sampling area were sampled 3 times as they were the only routes accessible early in the breeding season. All other routes were sampled once each due to logistical and time constraints.

We detected 62 avian collision sites, including 36 known sage-grouse, 24 unknown species, and 2 western meadowlarks *Sturnella neglecta*. Additionally, 24 of the 62 collision locations found during the breeding season were not found in randomly selected sampling units but while walking or driving through the study areas, and therefore were not used in collision rate estimation. Thus, estimates were generated with 27 known sage-grouse and 11 unknown species collision sites. Feather samples from all unknown avian collision victims were sent to the feather identification lab at the Smithsonian Institution in attempt to identify these species. Some of these may be from sage-grouse, which will increase collision rate estimates for that species. Lastly, the composition of evidence types found at avian collision sites was dominated by feather piles; however, a large number of sites also contained feathers lodged in the associated fence (Figure 2).



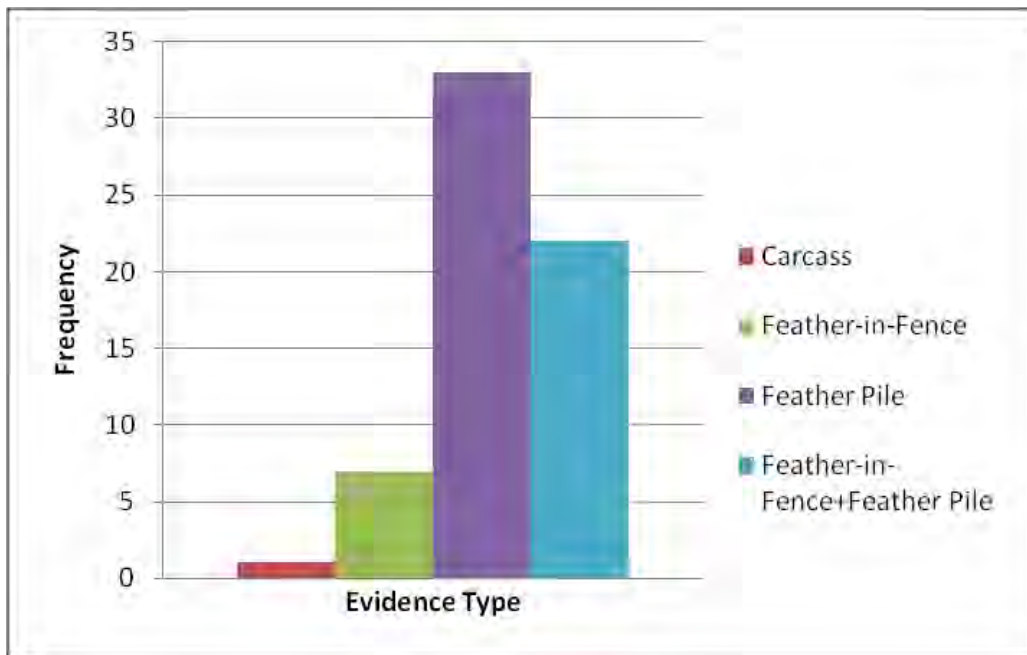


Figure 2. Frequency of each type of collision evidence found at avian fence collision sites in sage-grouse breeding areas in southern Idaho during the 2009 breeding season.

Estimated fence collision rates for individual lek routes were highly variable, ranging from 0-2.94 collisions per linear km of fence. Global collision rate estimates treating lek routes as strata varied by sampling round from 0.062-0.493 per linear km for all species, and 0.062-0.361 per linear km for known sage-grouse (Table 1), and appeared to be less in subsequent sampling rounds.

Table 1. Global estimates for three sampling rounds of breeding season collision rates (per km of fence) for greater sage-grouse in sampling areas in southern Idaho during the 2009 field season.

Sampling Round	Lek Routes Sampled	Collision Rate (All Species)	95 % CI	Collision Rate (Sage-Grouse)	95% CI
Round 1	16	0.493	(-3.511, 4.497)	0.361	(-3.281, 4.002)
Round 2	8	0.124	(-1.539, 1.787)	0.075	(-1.058, 1.209)
Round 3	2	0.062	(-0.990, 1.115)	0.062	(-0.990, 1.115)

Discussion

Fence collision rates in sage-grouse breeding habitat appeared to vary spatially during the 2009 breeding season. However, sample sizes in some areas were relatively small and not all areas were sampled in subsequent sampling rounds, likely adding to the observed variability. Furthermore, we observed collision sites accumulated over an unknown time period in the first sampling round, and this may have inflated the round 1 estimate relative to later sampling rounds.

Our preliminary results suggest uncorrected collision rates in sage-grouse breeding habitats in Idaho may be slightly higher than those reported for European grouse species. Catt et al. (1994) reported collision rates of 0.25 and 0.03 collisions per linear km of fence per month for capercaillie and black grouse in Scotland. Baines & Summers (1997) calculated collision rates for Scottish grouse over a much larger geographic area, and these ranged from 0.4-1.8 collisions per linear km per year. Uncorrected collision rates for tetraonids in Norway ranged from 0.012-0.176 collisions per linear km of fence, and varied by season (Bevanger 1995b). Unfortunately, differences in sampling methodology and intensity may preclude direct comparison of collision rates with these studies.



Probability sampling methods used in the initial field season of this study provided a way to assess the variability associated with parameter estimates of interest. Approximate confidence intervals on the estimated collision rates often included negative numbers, which is not biologically realistic. However, these intervals were presented as calculated to demonstrate the variability associated with the sampling methodology. Despite the variability, these methods provide a valid tool for statistical inference to a pre-defined population or sampling-frame. Numerous fence collision studies previously reported have often used convenience sampling methods, which provide no way to rigorously assess precision or determine underlying bias in parameter estimates calculated, and no way to rigorously extrapolate results to a population of interest.

Reported fence collision rate estimates are likely biased low by an unknown detection probability. A carcass detectability and longevity study associated with our search methods has also been completed, and will be used to correct for undetected victims at a later date.

Future fence collision surveys in sage-grouse breeding areas are planned for the 2010 field season. Furthermore, data from the 2009 and 2010 field seasons will be used to model the influence of site and landscape features on collision rates at multiple spatial scales. These models will be developed with the goal of providing a tool for managers to assess collision risk in sage-grouse breeding areas, to aid in prioritizing areas for future management actions which could include recommendations for fence removal, or guidelines for placing new fences in sage-grouse habitats.

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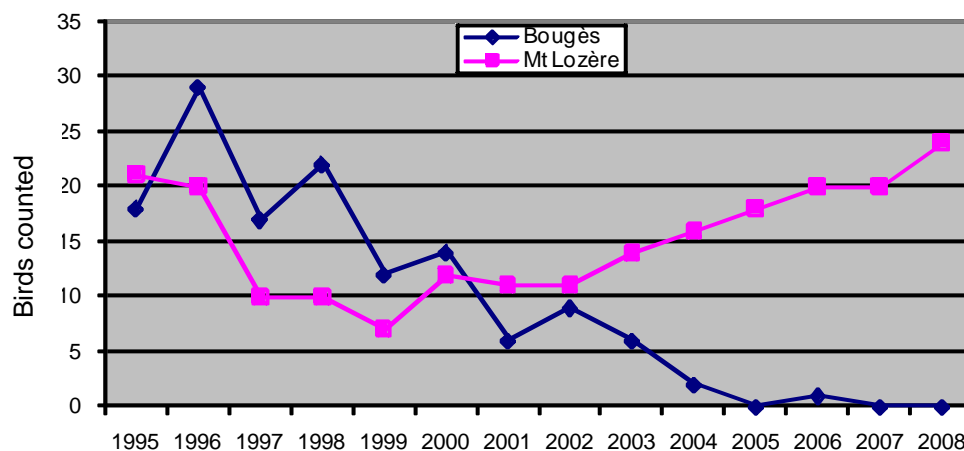
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The reintroduced population of capercaillie in the Parc National des Cévennes is still alive!

Christian Nappée

The capercaillie disappeared from the highlands in the south of The Massif Central about three centuries ago when deforestation destroyed its habitat. Following the immense effort of reforestation undertaken by the Eaux et Forêts authorities from the end of the 19th century onwards, a forest canopy of several thousand hectares has been reformed. The capercaillie habitat reappears here when natural forest restoration is not too greatly affected by commercial forest management practices. In 1976, the Parc National des Cévennes decided to reintroduce this bird into its ecological niche. From 1978 to 1994, 597 young capers produced locally in the Parc's own breeding station, were released in the northern part of its central zone, enabling the establishment of a population of roughly 60 individual birds on the Montagne du Bougès and the Mont Lozère. The demography of this neo-population, estimated yearly by comparing data obtained from counts and occasional sightings, manifestly regressed from the outset until 2002. Releases to reinforce the population, effected between 2002 and 2005 with 43 birds from an Austrian breeding station, may have slightly helped to reduce the genetic drift of the population but were without any real effect on its demography due to the low survival rate of birds bred in captivity (It seems that only three birds, all hens, survived until the next period of reproduction. One of them at least had chicks a year and a half after its release)

Since the extinction of the sub-population on the Mont Bougès, in 2005, the only remaining sub-population is that on the Mont Lozère. It has been progressing from 2002 and has practically doubled according to the annual counts which enable those concerned to establish an estimate called Minimum Summer Numbers.



Evolution between 1995 and 2008 of Minimum Summer Number of the two sub-populations of capercaillie in the central zone of the parc national des Cévennes.

