WESTERN ASSOCIATION OF FISH AND WILDLIFE AGENCIES

PREDATOR CONTROL AS A CONSERVATION MEASURE FOR SAGE-GROUSE

Predator control is a technique that has been applied in research settings and on a limited basis at local scales as a tool to benefit sage-grouse populations. The cause of mortality for most sage-grouse is predation (Bergerud 1988), whether as an egg, chick, juvenile or adult. What is relevant to the long-term sustainability of sage-grouse populations is not how birds die, but rather the rate at which mortality including predation occurs and whether recruitment exceeds mortality.

Sage-grouse are not the primary prey for any predator, but instead predators that typically prey on rodents, rabbits, and hares also take sage-grouse (Schroeder et al. 1999, Hagen 2011). Eggs, chicks, and males on leks are most vulnerable to predation (Hagen 2011). Females have their highest mortality during the breeding season (Davis et al. 2014). Predators of chicks and adult sage-grouse include coyotes, red fox, badgers, bobcats, and several species of raptors, while egg depredation is frequently attributed to weasels, raccoon, common ravens, black-billed magpies, coyotes, badgers, bobcats, and snakes (Baxter et al. 2007, Coates et al. 2008, Coates and Delehanty 2010, Hagen 2011, Lockyer et al. 2013, Orning 2014).

Sage-grouse have co-evolved with the normal complement of predators in sagebrush habitats. However, populations that are isolated due to habitat fragmentation or those in degraded habitats (Baxter et al. 2007) may be more vulnerable to predation. Predation on nests and chicks can be high where habitat is depleted or where predators are over abundant (Gregg et al. 1994, Aldridge and Brigham 2001, Schroeder and Baydack 2001, Coates 2007, Coates et al. 2008, Lockyer et al. 2013). Altered habitats influence distribution and abundance of predator populations in the following ways:

- Predators benefit from human-supplied food and water, such as road-killed carrion, artificial water sources, landfills, livestock carcasses, and cereal crops (Boarman et al. 2006, Baxter et al 2007, Bui et al. 2010, Esque et al. 2010, Newsome et al. 2013, Coates et al. 2016).
- Human structures provide denning, roosting, nesting, and perching sites that did not previously exist for predators in sagebrush landscapes (Coates et al. 2014a;b, Howe et al. 2014).
- Predators achieve greater hunting efficiency in fragmented or degraded landscapes (Vander Haegen et al. 2002, Coates et al. 2014a;b, Howe et al. 2014).
- Human subsidies are linked to increased raven populations which have increased an estimated $\geq$ 4-fold in the western U.S. over the last 40 years (Boarman et al. 2006, Sauer et al. 2011, Howe et al. 2014).
- Increases in red fox and raccoon have also been attributed to human-induced landscape changes and subsidies (Fichter and Williams 1967, Bunnell 2000, Connelly et al. 2000, Baxter et al. 2007).

Predator control activities to benefit sage-grouse have been implemented and evaluated on a limited basis by management agencies, usually in a small-scale research setting or to support a reintroduction or augmentation effort. Some significant sage-grouse predators are protected by Federal law and cannot be (easily) lethally controlled, such as great horned owls, golden eagles, and other raptors. Results of predator control efforts have varied. Coyote removal in Wyoming improved hen survival during the nesting period; however, annual hen survival remained unchanged and nest success was higher in untreated sites (Orning 2014). In another study in southwest Wyoming, there was no measurable effects on nest and chick survival between coyote removal and non-removal areas (Slater 2003). Sage-grouse reproductive success and survival improved during an 8-year study which removed both terrestrial (primarily red fox) and avian (corvid) predators in Strawberry Valley, Utah (Baxter et al. 2007). Several studies have evaluated raven control because of concern over increasing raven populations in sage-grouse habitats. Increased sage-grouse nest success has been documented after raven removal in some studies, but they lacked a comparison to control areas (Batterson and Morse 1948, Coates and Delehanty 2004, Baxter et al. 2007). In Wyoming, sage-grouse nest success was higher in areas of raven removal than in non-treatment areas, but raven numbers rebounded once control efforts ceased (Dinkins et al. 2014). A separate Wyoming study found that

sustained raven removal at high levels increased nest success and may increase sage-grouse populations (Peebles 2015).

Other Considerations. Lethal removal of predators is controversial and likely to engender local and broader opposition. Non-lethal control efforts such as aversive conditioning (Conover and Lyons 2003), hazing, or contraception are likely to have greater public acceptance but we are not aware of any studies that evaluated efficacy of any of these methods in reducing depredation on sage-grouse. Lethal removal of predators in large landscapes is not likely to be practical or cost effective (Willis et al. 1993), and complete removal of the target predator is unlikely. Predator populations are capable of rebounding quickly once removal stops (Gregg et al. 1994, Witmer et al. 1996, Côté and Sutherland 1997, Crooks and Soule 1999, Mezquita et al. 2006, Baxter et al. 2007, Clark 2014, Orning 2014, Dinkins et al. 2014, Dinkins et al. 2016), so control efforts must be sustained if benefits are to persist. Lethal removal may result in unintended consequences such as increases in other, potentially more effective predator species (Mezquida et al. 2006) which may shift predation to other predators or life stages rather than reducing it.

A predator management approach that could achieve long-term conservation goals would include; 1) addressing habitat conditions that ultimately limit sage-grouse production (e.g. hiding cover, food resources) and that provide advantages to predators (e.g. fragmented habitat, non-native vegetation); and 2) eliminating human subsides that artificially support predator populations. Predator removal, in conjunction with habitat improvement and elimination of predator subsidies could be an appropriate short-term management action to address localized and critical population declines or during sage-grouse translocation programs.

Conclusions:

- Large-scale, sustained lethal predator control programs for sage-grouse are likely to engender significant public opposition (Messmer et al. 1999), will be very expensive, and unlikely to be effective unless habitat deficiencies are corrected. In areas where seasonal habitats are in good condition, predator control is not likely to be needed to sustain desirable densities of sage-grouse.
- Predator removal programs can achieve short-term benefits, but their ultimate utility as a long-term conservation tool to increase sage-grouse populations is less well established (Côté and Sutherland 1997, Dinkins et al. 2014, Orning 2014, Conover and Roberts 2017).
- Predator removal may be useful as a short-term management tool to increase nest success and survival when localized sage-grouse populations are declining and have reached a critically low level (Baxter et al. 2007, Conover and Roberts 2017).
- In degraded habitats, sustained predator control and removal of predator subsidies may increase nest success and chick survival to prevent further population declines allowing time for habitat improvement (USFWS 2013).
- Lethal predator control prior to and after releases of sage-grouse may increase survival of translocated sage-grouse in reintroductions or augmentations of local populations. Translocated birds are more vulnerable to predation (Musil et al. 1993, Stephenson et al. 2011).

Literature Cited is available under the Sagebrush Ecosystem Initiative tab at the WAFWA website.

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