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INTERSPECIFIC NEST PARASITISM BY CHUKAR ON GREATER SAGE-GROUSE

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Nest parasitism occurs when a female bird lays eggs in the nest of another and the host incubates the eggs and may provide some form of parental care for the offspring (Lyon and Eadie 1991). Precocial birds (e.g., Galliformes and Anseriformes) are typically facultative nest parasites of both their own and other species (Lyon and Eadie 1991). This behavior increases a female's reproductive success when she parasitizes other nests while simultaneously raising her own offspring. Both interspecific and conspecific nest parasitism have been well documented in several families of the order Galliformes, particularly the Phasianidae (Lyon and Eadie 1991, Geffen and Yom-Tov 2001, Krakauer and Kimball 2009). The Chukar (*Alectoris chukar*) has been widely introduced as a game bird to western North America from Eurasia and is now well established within the Great Basin from northeastern California east to Utah and north to Idaho and Oregon (Christensen 1996). Over much of this range the Chukar occurs with other phasianids, including the native Greater Sage-Grouse (*Centrocercus urophasianus*), within sagebrush (*Artemisia* spp.) steppe (Christensen 1996, Schroeder et al. 1999, Connelly et al. 2000). Chukar typically exploit a broader range of habitats than do sage-grouse, but both species use the same species of sagebrush and other shrubs for nesting cover (Christensen 1996, Schroeder et al. 1999). Chukar are known to parasitize nests of other individuals of their own species (Geffen and Yom-Tov 2001), but we are unaware of reported evidence that Chukar may parasitize nests of sage-grouse. Here we describe a case of a Chukar parasitizing a sage-grouse nest in the sagebrush steppe of western Nevada.

We observed this parasitism during a large-scale study aimed at evaluating spatio-temporal variation in the sage-grouse's demographics. The study area is in the Virginia Mountains (40° 3' N, 119° 50' W) approximately 65 km north of Reno, where the sage-grouse population is small and isolated (Coates et al. 2011). Although Chukar occupy the site, their population is scattered and their numbers are relatively small (Coates pers. obs.). The habitat is high-desert sagebrush steppe altered by exurban development, encroachment of conifers and invasive annual grasses, and multiple human land uses, including livestock grazing and recreation. Land ownership is a mix of private and public, the latter administered by the U.S. Bureau of Land Management.

On 5 May 2011, while we were using radio-telemetry (Millsbaugh and Marzluff 2001) to monitor nesting sage-grouse equipped with necklace-style VHF transmitters (Advanced Telemetry Systems, Isanti, MN), we incidentally flushed an incubating sage-grouse and observed two Chukar eggs and eight sage-grouse eggs. We distinguished the remains of the Chukar eggs by their morphology, and David J. Delehanty (Idaho State University) later confirmed our identification. After discovering the parasitized nest, to evaluate the effect of the parasitism we deployed a camouflaged miniature video camera at the nest site (Figure 1a). The device recorded continuously. On 3 June, this nest contained two Chukar eggs and the eggshells of eight hatched sage-grouse eggs (Figure 1b). One of the Chukar eggs was partially hatched, but the chick did not survive; the other egg was fertile and appeared to be in the later stages of incubation, but failed to begin hatching (Figure 1c). We collected the eggs for confirmation of the species.

Although species of the family Phasianidae have been reported to parasitize

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Figure 1. Images recorded by the miniature camera at the Greater Sage-Grouse nest parasitized by the Chukar in the Virginia Mountains, northwestern Nevada. Arrows identify the Chukar eggs: (A) Hen leaving for an incubation recess on 30 May 2011; (B) partially hatched sage-grouse clutch with two Chukar eggs remaining (one is hidden from view under a sage-grouse eggshell); (C) a partially hatched Chukar egg. Images B and C were recorded on 3 June 2011.

nests of others (Lyon and Eadie 1991, Krakauer and Kimball 2009), and the sage-grouse has been documented as a conspecific nest parasite (Bird et al. 2012), our observations represent the first evidence of the Chukar parasitizing sage-grouse nests. Both species construct similar nests by scraping a shallow depression in the ground under vegetation that provides cover (Mackie and Buechner 1963, Connelly et al. 2000). These shared characteristics present opportunities for parasitism by other Galliformes or other ground-nesting precocial birds (Krakauer and Kimball 2009). Furthermore, the Chukar and sage-grouse nest concurrently, usually from early April to early July (Mackie and Buechner 1963, Schroeder et al. 1999), which enhances the opportunity for parasitism.

Parasitic chicks of species with incubation periods shorter than those of the host species are often more successful (Slagsvold 1998), largely because the difference in timing allows parasitic chicks to hatch first and subsequently outcompete the host's chicks. Ground-nesting species may depart from their nests soon after hatching of the first few eggs, and unhatched eggs are often left behind (Westemeier et al. 1998). Among other Galliformes, for example, Greater Prairie-Chicken (*Tympanuchus cupido*) nests parasitized by the non-native Ring-necked Pheasant (*Phasianus colchicus*) are more likely to be abandoned than unparasitized nests because pheasant eggs hatch earlier (Westemeier et al. 1998). Although the incubation period of the Chukar (24 days; Mackie and Buechner 1963, Christensen 1996) is shorter than that of the sage-grouse (28 days; Schroeder et al. 1999, Taylor et al. 2012), at the nest we observed the parasite did not gain this advantage. The Chukar appeared to lay its eggs up to 5 days after the sage-grouse's clutch was complete, as indicated

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by the partially hatched Chukar chick. Therefore, the Chukar eggs may have been incubated insufficiently. Alternatively, the Chukar eggs could have been laid while the sage-grouse was laying but the development of the smaller Chukar eggs was slower than that of the sage-grouse eggs because transfer of heat from hen to egg was reduced. Although this instance of nest parasitism by the Chukar failed to produce viable offspring, if Chukar are able to parasitize sage-grouse nests during laying and hatch before the sage-grouse eggs, the female sage-grouse may abandon her clutch. Bird et al. (2012) reported that in Alberta sage-grouse successfully hatched 42.3% of parasitic eggs deposited by conspecifics.

Our observation should be of interest to wildlife conservationists and managers, as the Chukar is a non-native species whose range overlaps that of the sage-grouse in the Great Basin. Although this observation represents the single clear occurrence of parasitism by the Chukar among 91 sage-grouse nests monitored over 4 years, other occurrences were possible. Furthermore, the parasitism was observed in an area in which Chukar were relatively few. Research into the prevalence of parasitism by the Chukar and its effects on the sage-grouse's nest survival and recruitment rates, particularly in areas where sage-grouse populations overlap areas where the Chukar's population density is moderate to high, might prove beneficial.

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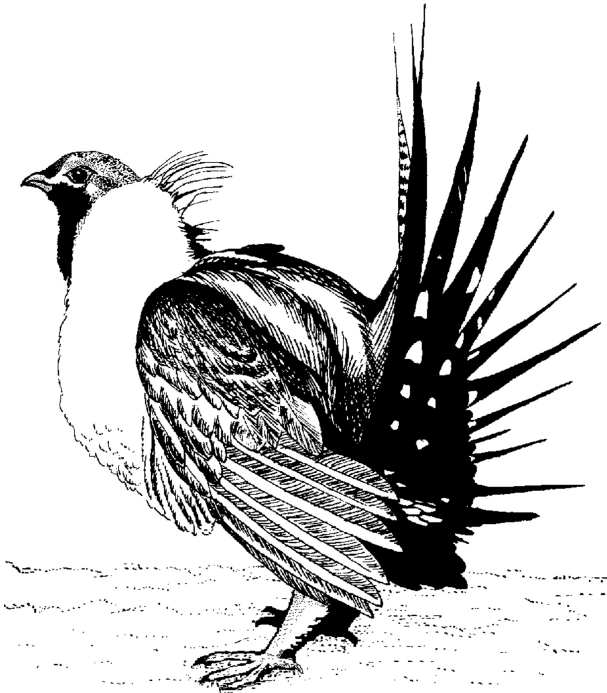
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Greater Sage-Grouse

Sketch by George C. West