Annotated Bibliography
Augmenting Greater Sage-Grouse Populations through Captive Breeding
September 2017

Apa, A. D., and L. A. Wiechman. 2015. Captive-rearing of Gunnison sage-grouse from egg collection to adulthood to foster proactive conservation and recovery of a conservation-reliant species. Zoo Biology 34:438-452.

A captive flock of Gunnison sage-grouse was established in 2009 to investigate techniques for egg collection, artificial incubation, hatch, and captive-rearing of chicks, juveniles, sub-adults, and adults. Two-hundred and six eggs were collected from 23 wild and 14 captive females and artificially incubated. Hatchability was 90%, and 148 chicks were produced in captivity and fed a variety of food sources (e.g. invertebrates to commercial chow). Wild-produced eggs were heavier than captive-produced eggs and lost mass similarly during incubation. Bacterial infections were the primary cause of chick mortality, but overall mortality rate was reduced successfully during the course of the study. Authors recommend that conservationists and managers should consider the utility in developing a captive-rearing program or creating a captive population as part of an overall conservation effort for the Gunnison sage-grouse.

Apa, A. D., and L. A. Wiechman. 2016. Captive-breeding of captive and wild-reared Gunnison sage-grouse. Zoo Biology 35:70-75.

Researchers investigated captive-breeding of a captive-flock of Gunnison sage-grouse in 2010. The captive flock was created from individuals reared in captivity from wild-collected eggs that were artificially incubated. The captive flock successfully bred and produced fertile eggs. The timing and duration of male-female breeding interactions was controlled, and a semi-natural mating regime was facilitated. Males established a strutting ground in captivity that females attended for mate selection. Captive females established eight nests and incubated and hatched eggs. Captive females were more successful incubating nests than raising broods. Authors point out that there are many technical, financial, and logistic issues associated with captive-breeding of Gunnison sage-grouse. Authors recommend the development of a captive-flock as part of a comprehensive conservation strategy for Gunnison sage-grouse. They proffer that progeny produced from a captive-rearing program could assist in the recovery of Gunnison sage-grouse if innovative approaches to translocation are developed.

Johnson, G. D., and M. S. Boyce. 1990. Feeding trials with insects in the diet of Sage-Grouse chicks. Journal of Wildlife Management 54:89-91.

One-hundred and forty-two greater sage-grouse eggs were collected from 20 nests in Wyoming in 1985 and 1986. Chicks were hatched in a poultry incubator. An additional 73 chicks ranging in age from 4 to 45 days were captured from the same area. Entire clutches and broods were collected when possible. The effects of eliminating insects from the diet of recently-hatched sage grouse chicks was evaluated with fifty 2-day-old chicks hatched in captivity. The 73 chicks captured in the wild were subjected to the same experimental procedure as the newly-hatched chicks to evaluate relationships between age and effect of insect elimination from the diet. The insect biomass required to keep sage grouse chicks alive and to support normal growth also was evaluated with twenty-five 1-week-old chicks hatched in captivity. All chicks (2-days old) hatched in captivity and not provided insects died between the ages of 4 and 10 days, whereas all chicks given insects survived the initial 10 days. Growth rate of wild chicks <21-days old given insects (9.5 g/day) was significantly higher than growth of chicks provided only vegetation (0.9 g/day). Mean growth rate of wild birds >21-days old given insects and vegetation was 15.4 g per day, whereas, birds given only vegetation gained significantly less weight (9.3 g/day). Chick mortality caused by malnutrition was negatively correlated with quantity of insects provided, while growth rates of surviving chicks were positively correlated with insect rations. Captive sage grouse chicks required insects for survival until they were at least 3-weeks old. Although, sage grouse chicks >3-weeks old survived without insects, their growth rates were lowered significantly, indicating insects were still required for normal growth after 3 weeks of age. As the quantity of insects in the diet increased, survival and growth rates also increased.

Johnson, G. D., and M. S. Boyce. 1991. Survival, growth, and reproduction of captive-reared sage-grouse. Wildlife Society Bulletin 19:88-93.

One-hundred and forty-eight greater sage-grouse chicks were acquired by collecting and incubating eggs and by capturing wild chicks. Eggs were incubated in a forced-air incubator at 37.5 C and 50-65% humidity, and were turned every 4 hours. Fifty-one percent of the eggs hatched in 1985, whereas, 80% hatched in 1986. Newly-hatched chicks were left in the incubator for up to 12 hours to dry before being placed in a brooder. Growth chamber were used for a brooder the first year of our study (1985). Temperature in the chamber was set at 35 C for the first 2 weeks, and then reduced slowly to 21 C by the time the chicks were 4- to 5-weeks old. In 1986, chicks were brooded under heat lamps. Chicks were moved to outdoor pens at age 7-9 weeks. Eight chicken wire pens (12.2 x 6.7 x 2.1 m) were constructed for the birds. Plywood 0.4 m in height was installed around the base of each pen to serve as a wind break, and 1 plywood shelter (1.2 x 0.6 x 0.4 m) was placed in each pen. Birds survived long periods of subfreezing temperatures and several weeks of snow-packed conditions without showing any adverse effects. Birds were fed and watered 4-6 times per day while they were held indoors. The first day after hatching, birds were placed in a box and given chopped, boiled eggs, chopped vegetation, and chopped mealworms rubbed on the side of the box at the chicks' eye level to start them feeding. Thereafter, while chicks were held indoors, they were provided insects and finely chopped vegetation. In addition to mealworms; grasshoppers, ants, beetles, crickets, and earthworms were fed to the birds. These insects were chosen because they commonly are eaten by wild greater sage grouse chicks. A minimum of 15 g of insects per day was provided to each bird until it was at least 6 to 7 weeks of age. Eighty-four percent of the chicks survived from hatching or capture until they were moved outdoors, whereas 91% survived after they were moved outdoors. Growth rates of captive chicks (15 g/day) were greater than for wild sage grouse (7 g/day), indicating that captive chicks did as well or even better than wild birds. In December, all birds were placed in 1 pen (12 X 27 m). A display arena was created by clearing all sagebrush from the center of the pen, and arranging it on either side of the arena to provide nesting areas. Strutting activity became common by the middle of March and continued until the middle of May. Nest initiation began the third week of May and continued until the third week of June. Eggs were collected daily and incubated artificially. Eight hens laid 41 eggs. Thirteen eggs (32%) hatched, but 11 of the chicks died within a few days, primarily from peritonitis. Two chicks survived. Providing large quantities of insects and green vegetation is important for maintaining high survival and growth in juvenile birds. Feeding sagebrush may be required to maintain adult birds over winter. Disinfecting housing areas and providing antibiotics should be conducted to maintain relatively disease-free birds.

McEwen, L. C., D. B. Knapp, and E. A. Hilliard. 1969. Propagation of prairie grouse in captivity. Journal of Wildlife Management 33:276-283.

A total of 375 sharp-tailed grouse and greater prairie chickens were reared in pens for use in pesticide toxicity studies. Maintenance techniques were developed to keep parasites and disease at a minimum and encourage breeding. Eggs were incubated and hatched mechanically and chicks were started in indoor brooders, then moved to outdoor pens. Key features of the study are: (1) wire-floored pens to minimize disease hazards, (2) 30 square-feet of floor space or more per adult grouse when kept in common cages, (3) varied diets meeting growth requirements for chicks and seasonal changes in requirements for adults, (4) a fresh water supply, and (5) dusting boxes to control ectoparasites.

Oesterle, P., R. McLean, M. Dunbar, and L. Clark. 2005. Husbandry of wild-caught greater sage-grouse. Wildlife Society Bulletin 33:1055-1061.

Study reports the first successful husbandry and breeding in captivity of wild-caught greater sage-grouse. In October 2003, 21 hatch-year greater sage-grouse were trapped in northwestern Nevada and transported to Fort Collins, Colorado. The birds were held in captivity for 8 months and offered a varied diet, including native food items such as sagebrush and yarrow. Grouse were housed in a large flight pen and allowed free range as a single flock. Mortality rate during the study was 16.7%. Several of the grouse exhibited breeding behavior, and 13 eggs were laid. Techniques used to house and feed wild-caught sage-grouse are described.

Spurrier, M. F., M. S. Boyce, and B. F. J. Manly. 1994. Lek behaviour in captive sage grouse Centrocercus urophasianus. Animal Behaviour 47: 303-310.

Lek display and female choice of males was studied in captive greater sage-grouse. Individual males showed significant repeatability in display frequency between years. Variation in female association with males in artificial arenas was largely attributable to variation in the display frequency of individual males and that of males in adjacent positions in the arena. In addition, males were shown to possess «inherent attractiveness, which was correlated with the length of their keel. Females showed significant consistency in their choice of males, and there was no evidence of copying behavior in their selection of males.

Thompson, T. R., A. D. Apa, K. P. Reese, and K. M. Tadvick. 2015. Captive rearing sage-grouse for augmentation of surrogate wild broods: evidence for success. Journal of Wildlife Management 79:998-1013.

Study developed techniques to rear sage-grouse chicks in captivity, evaluate explanatory variables that could influence hatch and captive-rearing success, and estimate the survival of domestically-hatched chicks to 28 days of age following introduction to a surrogate wild brood. Three-hundred and four 304 eggs were collected from radio-marked female greater sage-grouse during 2004–2007 in 3 study areas in northwestern Colorado. Estimated hatching success of collected eggs was 0.745 and was negatively influenced by the number of days an egg was stored and the percent egg-weight loss that occurred during storage and incubation. One-hundred and seventy-five chicks in captivity were monitored for 1–10 days before introduction and adoption into surrogate wild broods. Model-averaged captive-rearing success was 0.792 across years and was positively influenced by initial chick mass at hatch and daily weight gain in captivity but negatively influenced by the number of days the egg was stored and advancing hatch date. One-hundred-thirty-three chicks adopted into surrogate wild broods were radio-marked and monitored until 28 days of age. Eighty-eight percent of domestically-hatched chicks were successfully adopted within 24 hours. Overall estimate of domestically-hatched chick survival to 28 days (0.423) was comparable to published wild-hatched chick survival. Predation and exposure-related deaths accounted for 26.3% and 25.6% of the known fates, respectively. Authors suggest that captive rearing and release can be a potential management strategy to demographically and genetically reinforce or augment small populations of sage-grouse.