

2020-2021 Science Applications Highlights



CPW RESEARCH SUPPORTS MANAGEMENT AND POLICIES

Colorado Parks and Wildlife (CPW) has an in-house science program that has served the agency for over seven decades. CPW research scientists investigate high-priority information needs, and develop and refine many of the tools and practices our agency uses to conserve and manage Colorado's fish, wildlife, and park resources for current and future generations. Below we highlight a few examples of CPW's science activities and their application to management during the past year.

Aquatic Research

Aquatic Toxicology – Work this year spearheaded by CPW's Aquatic Toxicology Lab identified significant increases in benthic algae and macroinvertebrate production where a mine drainage treatment plant was installed. As federal and state entities continue to rank and clean up abandoned mines, CPW could see marked improvement in angler opportunities and fish production as streams once void of life are seeing a return of fish. This work scientifically verified the benefits of such actions.

Fish Passage – Evaluations on the Cache la Poudre River were conducted for nine different species. Passage success of these species were evaluated and hydraulic conditions within the fishway were measured over a range of flows. Results from study contribute to our understanding of nature-like fishway performance to help guide design features of these structures in the future.



Aquatic Invertebrates – CPW Aquatic Research scientists have developed sampling methods to more efficiently calculate the density of *Pteronarcys californica*. These Giant Salmonflies are an important food source for fish, but have been declining in abundance and range in many river systems. Traditional benthic sampling can be labor intensive, expensive, and often fails to identify species that exist in low numbers. Our new technique to count exoskeletons shed by emergent salmonflies can more effectively and accurately estimate abundance of this species, particularly when it occurs in low densities.

Bacterial Kidney Disease – An experiment validated the use of erythromycin injections in brood fish to control Bacterial Kidney Disease. This pathogen is vertically transmitted in eggs from parents to offspring, so is particularly difficult to eliminate. The treatment in this experiment was effective at reducing bacterial loads to below detectable levels in brood fish. While the bacteria were not completely eliminated, the treatment provides a management alternative to control the bacteria in some situations.

Native Species Protection – We evaluated the use of a temporary picket-weir to prevent non-native white and longnose suckers from spawning in Cottonwood Creek, a tributary of Roubideau Creek in the Gunnison River drainage. These are important spawning areas for native flannelmouth and bluehead suckers, where competition and hybridization with non-native suckers threatens their populations. The technique shows promise for reducing spawning success of non-native species.

Avian Research

Gunnison Sage-grouse – Results from CPW research on captive-breeding methods, seasonal habitat selection in different populations, and survival of translocated grouse are being used to inform the U.S. Fish and Wildlife Service’s recovery strategies for this federally Threatened species.

Greater Sage-grouse – CPW researchers developed and published an improved method for attaching transmitters to greater sage-grouse. The method resulted in fewer abrasions and other detrimental impacts, and the method can be easily used in studies where transmitters are used to track sage-grouse.

Raptor Monitoring – CPW maintains a statewide database of raptor nest locations. This information is used for local land use consultations, but managers are interested in assessing raptor populations at a regional or statewide scale. CPW research scientists used the nest database to produce statewide breeding distribution models for high-priority raptor species, conducted preliminary nest survival analyses, and made recommendations on revised nest monitoring protocols to enable more rigorous population monitoring information. Field staff implemented the revised monitoring protocols in 2020, with further refinements in 2021.



Habitat Restoration – In the face of increased fire frequency and invasion by undesirable, competing plant species, managers face substantial challenges in reestablishing native shrubs like bitterbrush that are important for wildlife. Working directly with State Wildlife Area managers, we initiated a study to experimentally evaluate the effectiveness of herbicides and methods to reduce seed loss to predators (ants, rodents) on reestablishing bitterbrush. Results of this study (which will continue through 2024) will help guide future native shrub restoration practices.

Playa Buffers – Buffer strips of vegetation are commonly planted around playa wetlands in agricultural areas to reduce sediment from filling playa basins, but wildlife use of playas with buffer vegetation has not been well-studied. We documented higher bird abundance and habitat diversity on playas with planted buffers than on those without buffers, providing additional evidence of the wildlife value of this wetland management method.

Quail Management – An experimental evaluation of short-duration spring grazing with cattle to remove dense residual vegetation along the South Platte River resulted in minimal benefits for breeding bobwhite quail, and that other management approaches are necessary to improve the quality of quail habitat.

Mammals Research

Moose Management – Data collection to address cost effective approaches for moose management has recently been completed resulting in two publications addressing timing of moose calf births and approaches to estimate calf detection and calving rates. Additional analyses will provide moose condition metrics relative to habitat quality and moose productivity.

Elk Calf Recruitment – Ongoing research is addressing factors influencing declining elk calf recruitment by comparing adult female condition and calf survival from a relatively productive area in the northern part of the state to two lower productivity areas in the southern portion of the state. Data collection is scheduled to continue through 2026.

Lynx/Snowshoe Hare Research – Research investigations addressing lynx/habitat/prey associations reported (1) stable lynx populations in Colorado, (2) lynx can tolerate moderate levels of winter recreation activity, and (3) hares and lynx were minimally influenced by the bark beetle outbreak. Hare responses to varied forest management practices are pending.

Recreation Impacts – Ongoing research is focused on elk behavioral and demographic responses to human recreational activity to develop and evaluate best management practices that accommodate recreational opportunities while protecting wildlife resources

Energy Development Impacts – Research addressing mule deer/energy development interactions reported that mule deer (1) migrated more rapidly through, but did not avoid developed areas, (2) exhibited behavioral responses associated with level of development activity, but behaviorally mitigated any demographic effects; and (3) pregnancy rates, survival and condition were not influenced by development activity, but birth rates were reduced in developed areas during severe climate conditions. Additional analyses will provide a spatial energy development planning tool and evaluation of winter range habitat treatments as a mitigation option.



Carnivore Management – Recently published research results provide cougar management recommendations and two other projects are addressing predator (bear/cougar)-prey (mule deer) relationships and evaluation of cougar/human incident levels relative to cougar density.

Research Collaborations – Research and management staff are applying research results to update deer and elk DAU plans, estimate cougar and pine marten densities, develop the new oil and gas rules associated with SB 181, assist with recreational trail and Fishers Peak park development, and guide wolverine and lynx management in Colorado and the West.

Wildlife Health

Chronic Wasting Disease (CWD) – Recent CWD research helped identify strategies for its control in affected mule deer populations. These findings are now being incorporated into herd management plan updates.

- *Harvest can limit CWD:* In-state and multi-jurisdiction analyses suggest that increasing male harvest can suppress CWD.
- *Later harvest helps:* Shifting harvest timing closer to the breeding season may provide added control benefits.

Plague – Plague research helped develop tools and techniques to improve its management on the landscape.

- *Vaccination speeds recovery:* Prairie dog colonies vaccinated annually withstand plague outbreaks better and rebound more quickly than colonies not vaccinated.
- *Mechanization speeds vaccine bait production:* Vaccine baits can now be produced >10 times faster thanks to improvements to the manufacturing process.
- *Dose matters:* Recent studies revealed that the original vaccine dose yields insufficient “herd immunity” in prairie dogs to suppress plague at black-footed ferret reintroduction sites. Work is underway to glean more protection from each vaccine dose.



Tools and Techniques – Investigation of new drug combinations, diagnostic tests, and capture tools helps to improve safety of wildlife handling and increase understanding of wildlife diseases.

- *Assays on-demand:* Developing customized in-house lab tests helped meet managers’ needs for information on new diseases of concern like rabbit hemorrhagic disease and echinococcosis.

Colorado Parks and Wildlife Research Publications

(Author names in bold denote CPW research scientists)

2020-2021

Aagaard, K., R. Y. Conrey, and J. H. Gammonley. *In press.* Spatial analysis of the nesting distribution of four priority raptor species in Colorado. *Journal of Raptor Research.*

Americanus, B., **G. J. Schisler**, J. L. Bartholomew, and S. D. Atkinson. 2021. *Myxobolus cerebralis* causes pre-sporogonic mortality in juvenile Mountain Whitefish *Prosopium williamsoni*. *Journal of Aquatic Animal Health.* doi.org/10.1002/aah.10125.

Apa, A. D., K. Aagaard, M. B. Rice, E. Phillips, D. Neubaum, N. Seward, J. R. Stiver, and S. Wait. 2021. Species distribution models for a threatened species: the Gunnison sage-grouse. *Wildlife Research* <https://doi.org/10.1071/WR20006>

Behney, A. C. 2020. The influence of water depth on energy availability for ducks. *Journal of Wildlife Management* 84:436-447.

Behney, A. C. 2020. Ignoring uncertainty in predictor variables leads to false confidence in results: a case study of duck habitat use. *Ecosphere* 11:e03273.

Behney, A. C. 2021. Benefits of playa buffers as bird habitat. *Wilson Journal of Ornithology* 132:749-754.

Behney, A. C. 2021. High intensity short-duration grazing during spring is not an effective habitat management tool for northern bobwhites in Colorado. *Ornithological Applications* 123: DOI: 10.1093/ornithapp/duab015

Behney, A. C. *In press.* Rapid assessment of habitat quality for nonbreeding ducks in Northeast Colorado. *Journal of Fish and Wildlife Management.*

Behney, A. C., J. M. Wolske, T. M. Cucinotta, and C. Tappe. 2020. Factors influencing trapping success of northern bobwhites. *Wildlife Society Bulletin* 44:240-245.

Bergman, E., F. P. Hayes, and K. Aagaard. 2020. Incorporating detection probability to refine Colorado moose parturition dates. *Alces* 56:127-135.

Conner, M. M., **M. E. Wood**, A. Hubbs, J. Binfet, A. Holland, L. R. Meduna, A. Roug, J. P. Runge, T. D. Nordeen, M. J. Pybus, **M. W. Miller.** 2021. The relationship between harvest management and chronic wasting disease prevalence trends in western mule deer herds. *The Journal of Wildlife Diseases.* *In Press.*

Donnelly, J. P., S. L. King, J. Knetter, **J. H. Gammonley**, V. J. Dreitz, B. A. Grisham, M. C. Nowak, and D. P. Collins. *In press*. Migratory efficiency sustains connectivity across agroecological networks supporting sandhill crane migration. *Ecosphere*.

Fetherman, E. R., B. Neuschwanger, T. Davis, C. L. Wells, and A. Kraft. 2020. Efficacy of Erymycin 200 injections for reducing *Renibacterium salmoninarum* and controlling vertical transmission in an inland rainbow trout brood stock. *Pathogens* 2020, 9(7), 547. doi: <https://doi.org/10.3390/pathogens9070547>.

Ferreira, N.C., J. M. Charco, J. Plagenz, C. D. Orru, N. D. Denkers, M. A. Metrick, A. G. Hughson, **K. A. Griffin**, B. Race, E. A. Hoover, J. Castilla, T. A. Nichols, **M. W. Miller**, B. Caughey. 2021. Detection of chronic wasting disease in mule and white-tailed deer by RT-QulC analysis of outer ear. *Scientific Reports* 11(1):1-9.

Fox, K.A., S. M. Muller, T. R. Spraker, **M. E. Wood**, **M. W. Miller**. 2021. Opportunistic surveillance of captive and free-ranging bighorn sheep (*Ovis canadensis*) in Colorado, USA, for transmissible spongiform encephalopathies. *The Journal of Wildlife Diseases* 57(2):338-344. <https://doi.org/10.7589/JWD-D-20-00083>

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Garbowski, M., **D. B. Johnston**, and C. S. Brown. *Accepted*. Cultivars of popular restoration grass developed for drought do not have higher drought resistance and do not differ in drought-related traits from other accessions. *Restoration Ecology*.

Gunn, C., S. E. Hirshman, and **K. Aagaard**. *In press*. Trends in black swift (*Cypseloides niger*) breeding phenology and success in southwest Colorado, 1996 – 2017. *The Wilson Journal of Ornithology*.

Heinold, B. D., **D. A. Kowalski**, and **R. B. Nehring**. 2020. Estimating densities of larval Salmonflies (*Pteronarcys californica*) through multiple pass removal of post-emergent exuvia in Colorado rivers. *PLOS ONE* 15(4). doi: 10.1371/journal.pone.0227088.

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Johnston, D. B., and M. Garbowski. 2020. Responses of native plants and downey brome to a water-conserving soil amendment. *Rangeland Ecology and Management* 73:19-29.

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- Kotalik, C. J., **P. Cadmus**, W. H. Clements. 2021. Before-After Control-Impact field surveys and novel experimental approaches provide valuable insights for characterizing stream recovery from acid mine drainage. *Science of The Total Environment*. 771(145419). doi.org/10.1016/j.scitotenv.2021.145419.
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and R. S. Miller. 2020. Improving the accessibility and transferability of machine learning algorithms for identification of animals in camera trap images: MLWIC2. *Ecology and Evolution* 10:10374-10383.

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❖ Featured article November 2019 issue of Journal of Wildlife Management

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Human Dimensions

Chronic Wasting Disease (CWD) – A CPW survey of resident and nonresident hunters found a disconnect between hunters’ awareness of and concern about CWD and disease prevalence. The study findings were published as part of CPW’s Technical Report series. Another survey is under development to examine landowner attitudes about hunting access and CWD in northeastern Colorado to refine outreach and education messages. CPW personnel also helped develop a three-day workshop with scientists across North America to map the social-ecological system of CWD, in order to allow state agencies to target specific challenges posed by CWD at local, statewide, and regional scales.



State Park Visitor Satisfaction – CPW conducted a pilot study to examine why people visit Colorado’s State Parks, what types of experiences they prefer, and which activities they enjoy. Park managers are using the study results to better understand and plan for the types of outdoor recreation experiences visitors prefer.

College-aged Hunter Recruitment and Retention – In collaboration with researchers from North Carolina State University and the University of Northern Colorado, CPW conducted a workshop with college students who had limited to no hunting experience. The workshop and accompanying research survey resulted in two peer-reviewed publications (one published in the *Journal of Wildlife Management*) to advance hunter recruitment and retention among young adults.

Eagle County Community Survey – To inform land use planning decisions in Eagle County, CPW is collaborating with the Eagle County Community Wildlife Round Table and Colorado State University graduate students to survey county residents about their wildlife values, interests in and concerns about land use changes, outdoor recreation opportunities, and the impact of these decisions on wildlife habitat.